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Organizational Ambidexterity; Antecedents, Events and Outcome

Balancing exploration and exploitation, the long term sustainability imperative

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Abstract

Could organizational ambidexterity prevent the proverbial red tape from poisoning organizations and render a simultaneous pursuit of exploratory and exploitative activities possible? This thesis examines how one successful production company has balanced the two contradictory activities and what factors have rendered a simultaneous pursuit of exploration and exploitation possible. Two innovation cases and a description of the organization with its resources succinctly cover the most salient factors affecting exploration and exploitation in MPD. Firstly, a hierarchical separation of exploration and exploitation has rendered a simultaneous pursuit possible. Secondly, a supportive organizational context moderates the tension between exploration and exploitation by helping individuals engage in both types of activities. Lastly, environmental dynamics are found to affect both exploration and exploitation.

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Thank you.

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1 Introduction

“And let it be noted that there is no more delicate matter to take in hand, nor more dangerous to conduct, nor more doubtful in its success, than to set up as the leader in the introduction of changes. For he who innovates will have for his enemies all those who are well off under the existing order of things, and only lukewarm supporters in those who might be better off under the new.”Machiavelli, N. (1992:13)

Niccolo Machiavelli’s echoing quote has persevered more than four hundred years of change and innovation yet only a handful of companies make proactive decisions and disrupt the markets with discontinuous change before financial despair. Such an initiative requires a risk prone behavioral leadership style and compromising part of revenue towards product development.

The litmus test of operational leadership is to prove successful in daily operations through alignment of strategy, process management, structure and efficiency while at the same time preparing the organization for the impending disruptive change that face any industry by being flexible, adaptable, organic and innovative. Managers need to proactively deal with the tensions of exploiting current capabilities while at the same time devote time to exploring new possibilities. One solution to resolve this paradox is for the firm to become ambidextrous, i.e. being able to simultaneously pursue exploration and exploitation.

The concept of ambidexterity in the context of an organization has been vastly researched ever since Duncan coined the phrase in 1976, referring to the ability of performing conflicting interests simultaneously. These tradeoffs have since varied from achieving flexibility and efficiency (Adler et al., 1999), alignment and adaptability (Gibson and Birkinshaw, 2004) and incremental and discontinuous innovation (Benner and Tushman, 2003; Smith and Tushman 2005). Still, March’s (1991) notion of exploitation and exploration is the most common conceptualization of these conflicting interests.

In March’s (1991) seminal article the notion of exploration was about search, variation, autonomy and innovation whilst exploitation included refinement, production, efficiency and execution. He argued that firms that were too dedicated to exploration would end up in a suboptimal state with high associated cost and underdeveloped ideas. On the other hand, a company solely focused on exploitation will inevitably face inertia loss and obsolescence. Furthermore March argues that both exploration and exploitation are essential for organizations and as they compete for scarce resources and need to make explicit and

implicit decisions between the two, where explicit decisions are calculated decisions about alternative investments and strategies and implicit decisions are rooted in organizational structure, culture and procedures.

1.1 Scope of the thesis

Organizations are inherently complex full of interdependencies that are hard to detect, with nonlinear behavioral responses. This nonlinearity in organizational context means that if you double the number of workers in a production line, you do not get twice the effect, but rather a lot less. Worst case you are worse off than before you upped the ante. Responses in an organization are not linear and in such environments, causal associations are easily misinterpreted. Qualitative research can describe these idiosyncrasies through observation and in turn generate new theories or conceptualizations.

This thesis will structure around Nammo Raufoss AS, a medium size defense company in Norway comprised of two separate divisional units with individual support functions like marketing, procurement and quality assurance. More specifically the research will largely focus on the development department organized within Missile Products Division (hereinafter referred to as MPD) responsible for development and production of rocket motors for both military and civilian markets. The R&D department is divided into three subgroups; design, engineering and materials. All activities related to R&D are located in Norway. The products are considered niche products and are characterized by low production volumes (generally less than 50) with extreme demand for safety, reliability and performance.

The missile products division struggle with the same scarcity of resources any private company would. However, the division has proven ambidextrous by numerous innovations the last decade while at the same time entertaining production programs. The case presented later in this thesis will entail a more detailed description of these breakthrough developments such as a minimum smoke propellant and application of thrust vector control for agile missile maneuvering, all while delivering stellar performance on serial rocket motor production programs.

This thesis will focus on the tension between exploratory and exploitative activities in the Missile Products Division. Raising awareness of these tensions can hopefully enable management to better deal with the conflicting interests associated with the two activities. A more conscious allocation of resources on the two activities will hopefully be positively associated with more effective project and firm performance.

In order to deal with these tensions it is important to understand how the organization manages these contradictory activities today and identify measures that work and those that don't. With that in mind, this thesis will investigate what factors have rendered a simultaneous pursuit of the contradictory exploratory and exploitative activities possible and consequently achieve organizational ambidexterity.

1.2 Research issue/question

What fascinates with organizational ambidexterity is the multitude of disciplines involved in the construct, such as change management, organizational learning, organizational design and leadership theory. This thesis will build on the seminal work of March (1991) and the rational that exploration and exploitation involve degrees of organizational learning. The purpose of this research is to characterize what factors have positively affected exploration and exploitation and consequently explore how MPD has achieved organizational ambidexterity through structural, contextual and/or leadership-based solutions. The following statements summarize the research questions:

What factors positively affect exploratory and exploitative activities in MPD?

1.3 Thesis structure

After a short introduction in chapter 1 where theoretical perspectives, scope of thesis and research question has been presented, chapter 2 will provide a detailed overview of existing literature and provide the theoretical context for the empirical study. Chapter 3 discusses the research approach and how data has been collected and analyzed as well as arguing for certain limitations of the study before discussing reliability and validity of the performed qualitative research. Chapter 4 presents the empirical research through a case study of the business unit structured on the theoretical framework in chapter 2. Chapter 5 discusses the case study with reference to relevant literature and summarizes the findings from the empirical research. Chapter 6 concludes research in this thesis by revisiting the research question and briefly presenting key findings before suggesting topics for future work.

2 Theory

As with humans, some organizations are born ambidextrous. However, for the vast majority this is not a congenital gift and one need to learn how to become equally adept with both hands at a later stage in life. For mature organizations to achieve ambidexterity, that, is somewhat more complex.

So, what is ambidexterity in the context of an organization and how can it be achieved? Organizational ambidexterity refers to the ability for an organization to simultaneously perform exploration and exploitation, two apparently conflicting activities. Where exploitation refers to the capability of firm efficiency, production and incremental innovations in mature market environments, and exploration consists of autonomy, flexibility and discontinuous innovations to compete in new markets and technologies.

Simsek et al. (2009) argues that the fundamental concept of ambidexterity is poised with ambiguity and disagreement. In an effort to reduce confusion, this literature preface will provide clarity into three major themes in the theoretical nature of the construct; exploration vs. exploitation, orthogonality vs. continuity and ambidexterity vs. equilibrium, a sort of “mise en place” for this thesis on organizational ambidexterity.

Whether exploration and exploitation are distinguished by degree of learning or by the presence or absence of it is a central area of ambiguity. Benner & Tushman (2003) and Holmqvist (2004) align with the theory proposed by March (1991) that both activities to some extent include degrees of learning. Holmqvist (2004) argue that:

“exploitation creates reliability in experience through refinement, routinization, production, and implementation of knowledge. Exploration creates variety in experience through search, discovery, novelty, innovation, and experimentation. Learning competence means that organizations become better at things they do repeatedly and success-fully and that they become less competent at things they do infrequently and unsuccessfully”
Holmqvist, (2004:71)

On the opposite side, Rosenkopf & Nekar (2001), Vassolo, Anand and Folta (2004) and Vermeulen & Barkema (2001) account all incidents of learning to exploration and refer to the use of past knowledge when describing exploitation. In line with March (1991), this thesis will treat organizational learning, not on the individual level but on the organizational level and argue that learning takes place in both exploratory and exploitative activities.

Any activity performed in an organization competes for scarce resources. Hence, the more resources are put into exploration, implies reduced resources for exploitation. Additionally

both activities are self-reinforcing. Exploration is inherently linked to uncertainty and more often than not will lead to failure. This high failure rate creates the need for even more search and innovation and could lure the organization into a failure trap. On the other side of the continuum, exploration is more likely to give short-term success, which in turn reinforces existing belief that more exploitation is needed to increase revenue. March (1991) was quite explicit in his landmark article that both exploration and exploitation are essential for long-term organizational success, but that they are fundamentally incompatible. If resources were infinite it is easy to argue that March (1991) were wrong in his basic assumption and that exploration and exploitation are compatible. Powell, Koput & Smith-Doerr (1996) argue that organizations often have access to resources in their external environment which may help leverage the incompatibility rationale. Mom, van den Bosch and Volberda (2007) found in their research that managers just as well may participate in high levels of exploitation as well as performing exploratory activities. However, there is little empirical research that shows compatibility between the two activities on organizational level. Gupta et al. (2006) argue that answering the question of continuity or orthogonality depends on the level of analysis. Furthermore they argue that it may be easier for a unit or an organization to simultaneously explore and exploit than for an individual to do so. In short there is no straightforward answer and to avoid ambiguity one need to identify whether or not there is scarcity of resources and the level of analysis. If resources are scarce or level analysis is on an individual level, you are more likely to find that exploration and exploitation are mutually exclusive. However, if the level analysis is on business unit or organizational level, there is a higher chance of coexistences.

It is near consensus among scholars that firms need to balance both exploration and exploitation in order to achieve long-term success. (Probst & Raisch, 2005; Tushman & Romanelli, 1985; Dougherty, 1992; Levinthal & March, 1993; March, 1991, 1996, 2006). As March argues: “maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity” (1991:71). The same clarity and consensus cannot be found when investigating what mechanisms organizations can use to excel at both activities. There are two main theories on how organizations can achieve an appropriate balance; ambidexterity and punctuated equilibrium (Benner & Tushman, 2003; Burgelman, 2002; Tushman & Romanelli, 1985; Tushman & O’Reilly, 1996; Meyer & Stensaker, 2006; Probst & Raisch, 2005). The two theories differ in that ambidexterity is defined as the *simultaneous* pursuit of both exploration and exploitation whilst punctuated equilibrium, also

referred to as temporal cycling or sequential ambidexterity, refer to long periods of exploitation only disrupted by short bursts of exploration. The rationale is that firms only realign their strategy and processes when adapting to shifting environments. As noted, details on level of analysis and environmental conditions need to be considered when arguing for one or the other. For organization with scarce resources where exploration and exploitation are considered two ends of a continuum, punctuated equilibrium seem to be the most appropriate mechanism.

2.1 Origin of Organizational Ambidexterity

As noted, Duncan (1976) was the first to use the phrase *organizational ambidexterity* although it was March's (1991) seminal article on organizational learning that sparked a proliferation of interest into the field. This increased attention to both empirical (e.g. Jansen et al., 2005; He & Wong, 2004; Adler et al. 1999), conceptual (Sheremata, 2000) and theoretical (Tushman & O'Reilly, 1996, 1997; Gupta et al., 2006, Smith & Tushman, 2005) work has broadened the understanding of the construct, but also created some confusion and ambiguity as noted in the preface. In its simplest form, organizational ambidexterity is about how firms balance between exploration of new possibilities and the exploitation of old certainties (Schumpeter, 1934). This view has been extended further to encompass how firms adapt to changing environments. Early work by Burns & Stalker (1961) showed how firms in stable environments employed a mechanistic system with clear hierarchical channels, job descriptions and roles. In stark contrast, firms in more turbulent environments had to develop a more organic organization with high degree of autonomy and less formality. The general idea that different organizational structures are subsequently associated with different environments has since been widely accepted (e.g. Tushman & O'Reilly, 2002; Benner & Tushman, 2003; Andersen & Nielsen, 2007).

As mentioned, more prevalent ambidexterity research evolve around exploration and exploitation. Building on that premise; Gibson & Birkinshaw (2004), He & Wong (2004) and Tushman & O'Reilly (1996) all argue that firms are more successful when simultaneously attaining a high level of both exploration and exploitation. Organizational ambidexterity is more than the mere presence of exploration and exploitation, March argues they are both part of what is called organizational learning and cannot easily be separated. Rosenkopf & Nerkar (2001), Vassolo, Anand, & Folta (2004) and Vermeulen & Barkema (2001) all believe organizational learning is concentrated in exploration, and exploitation is simply using existing beliefs and knowledge. While others align with the initial idea of March who

separated exploration and exploitation into what type of learning and to what extent, rather than the presence or absence of organizational learning (Benner & Tushman, 2003; Gupta et al., 2006; He & Wong, 2004).

Over time, as environmental and technological changes occur, companies are forced to align with these changes to succeed. March (1991) argued that: “maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity.” In his view while exploration was about search, variation, risk taking, play and experimentation. Exploitation included such things as refinement, choice, production, efficiency, implementation and execution. Furthermore he argued since both activities compete for scarce resources, as a result: “organizations make explicit and implicit choices between the two.” This argument adheres to the principle idea of Duncan (1976) a few decades earlier, where firms needed to shift between structures to initiate, and in turn execute innovations.

Tushman & O’Reilly (1996) reviewed how firms managed to change over time to succeed and suggested that organizations should simultaneously implement incremental and radical change to be ambidextrous. They looked at the semiconductor industry spanning five decades to understand how organizations evolve; going through long periods of incremental change punctuated by short bursts of radical change. Radical change was almost always driven by organizational performance problems or major shift in the environment. An important lesson learned from their research was that managers periodically needed to destroy what has been created in order to reconstruct into a new organization better suited for the shift to come.

Emphasizing on the contextual importance of system and process role in achieving an appropriate balance between conflicting demands, Gibson & Birkinshaw (2004) developed an alternative conceptual understanding of ambidexterity – contextual ambidexterity, defined as “the behavioral capacity to simultaneously demonstrate alignment and adaptability across an entire business unit“ (2004:209). In their view, alignment refers to all activities working towards the same goal and adaptability is the capacity to reconfigure these activities quickly to meet changing demands in the business environment. Their conceptualization focused on the individual level and argued that ambidexterity is best achieved not through structural separation but when business units encourage individuals to divide their time between alignment and adaptability based on own judgment. Advocating for contextual ambidexterity, Gibson & Birkinshaw (2004) claim their conceptualization could be more sustainable than structural solutions because it encompasses entire business units and not just separated units.

Subsequently in a business unit that exhibit contextual ambidexterity behavior is dynamic and flexible enough to let individuals use own judgment in dividing time between alignment-oriented and adaption-oriented activities. The same logic found in contextual ambidexterity can be found in Adler, Goldoftas & Levine's (1999) analysis of NUMMI, a Toyota subsidiary auto assembly plant in Fremont, California, lately given a renaissance by Tesla Motors. The joint venture was created to give Toyota access to the US market while GM would learn the famed Toyota Quality Management system. Research found that NUMMI used four mechanisms to balance flexibility and efficiency: metaroutines, enrichment, switching and partitioning. Metaroutines were standardized procedures for changing existing routines and for creating new ones that would include workers in standardization processes and induce thrust by subordinates. Enrichment was achieved by adding non-routine tasks to production tasks that in turn created mutual trust and spurred training, job rotation and engineering & management support. Switching meant sequential shifting workers between routine tasks and non-routine tasks which gave workers training and employment security. And lastly, partitioning created temporary subunits that specialized in either routine tasks or non-routine tasks. It is easy to see how research from Adler, et al. (1999) has strongly influenced Gibson & Birkinshaw (2004) in developing the construct of contextual ambidexterity. While the structural definition provide separate structures that specialize in exploration and exploitation as means to achieve ambidexterity, the contextual solution is providing a context where individuals are given the choice between opposing activities and are provided the necessary tools to integrate both activities in their daily chores.

Smith & Tushman (2005) investigated how senior leadership teams dealt with the challenges associated with the strategic contradiction of exploration and exploitation. Their research found that balanced strategic decision-making is rooted in what they called paradoxical cognition – divided into cognitive frames and processes and use Walsh's (1995) definition of cognitive frames as “a mental template that individuals impose on an environment to give it form” (1995:281). The use of paradoxes to describe the contradictions, have according to Smith & Tushman (2005) obscured the managers' role in understanding the tensions and suggest that paradoxical frames refer to “an actor's cognitive juxtaposition of the opposing forces in which actors embrace rather than avoid or deny these tensions” (2005:527).

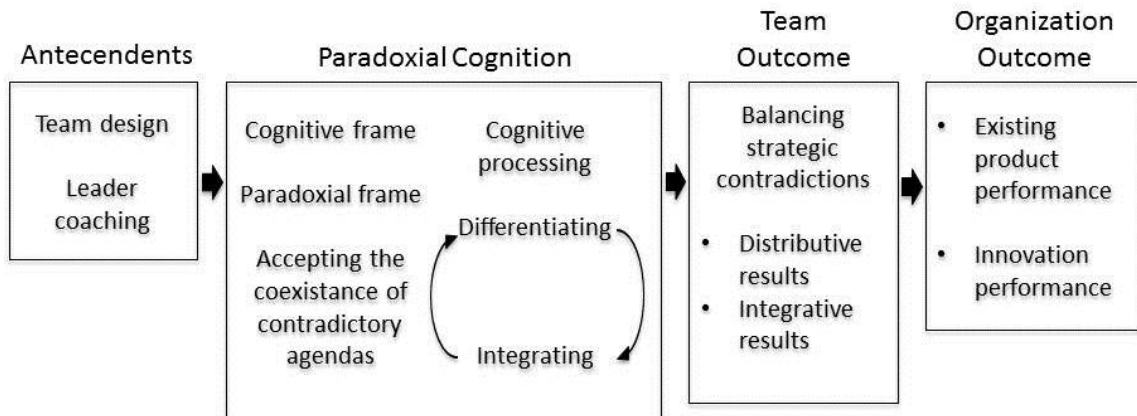


Figure 2-1: Smith & Tushman's (2005) model of managing strategic contradictions

These frames create the foundation for cognitive processes which are associated with managing these contradictions. Figure 2-1 shows an overview of their model of managing these strategic contradictions. In their model differentiating and integrating are two distinct cognitive processes, where differentiating helps overcome inertia by supporting the need for contradictory products and integrating, in contrast, refer to focus on synergies between exploration and exploitation. They conclude that managers should embrace the contradictions, rather than chose between the contradictory styles and structures.

2.2 Related topics to ambidexterity

Organizational ambidexterity can manifest itself in many forms in an organization, on separate sub-units or on individual basis. The contradictory activities, or reconciliations between the two have been researched in a multitude of contexts such as organizational learning, technological innovation, organizational adaptation, strategic management and organizational design. These contexts have been further described in the subsequent sections. Despite the initial difference, they all try to resolve the same paradox of administration.

2.2.1 Organizational learning

-exploration vs. exploitation-

March's (1991) article started a discussion amongst scholars whether both exploration and exploitation were associated to some degree of learning. According to March (1991), exploration is associated with such things as search, risk taking, play, flexibility, discovery and innovation while exploitation is captured by refinement, production, efficiency, selection, implementation and execution. Firms need to constantly manage these tension and build structures or/and management system to help support a health balance between the

contradictory activities. Thompson (1967) observed the challenge of balancing efficiency and flexibility as a “central paradox of administration” (1976:15). Others oppose the original ideas of March (1991) and argue that exploitation is merely reuse of existing knowledge and subsequently associate all degrees of learning to exploration (Rosenkopf and Nerkar, 2001; Vassolo, Anand & Folta, 2004; Vermeulen & Barkema, 2001). Baum, Li & Usher (2000), He & Wong (2004) and Benner and Tushman (2003) are examples of scholars who align with the original idea of March (1991).

As well as associating the two contradictory activities to some extent of learning, March (1991) argues that the two activities are incompatible, or in more general terms, to be on two ends of a continuum. His arguments were that most organizations have scarce resources, thus managers need to carefully divide time between the two activities. Secondly he argued that both activities are self-reinforcing in that return from exploration is inherently uncertain, will more often than not lead to failure which increase the need for even more search. Exploitation on the other hand give immediate return may invoke search along the same lines. The basic idea is that exploitation leads to more exploitation and exploration leads to more exploration. While March (1991) considered the two activities as incompatible, others argue that they are *orthogonal* variables that can be achieved simultaneously (Baum, Li & Usher, 2000; Rosenkopf & Nerkar, 2001; Vassolo, Anand and Folta, 2004). Mom, van den Bosch & Volberda (2007) researched how transfer of knowledge to and from managers affected their engagement in exploratory and exploitative activities. They found that top-down knowledge inflows positively affected managers performing exploitative activities, while there were no correlation between top-down knowledge and exploratory activities. Horizontal- and bottom-up knowledge inflows were positively correlated with exploratory activities. Top-down knowledge inflows refer to unambiguous data, i.e. data that does not need interpretation, and improve a specific area of interest of the manager. Bottom-up knowledge inflows come from lower hierarchical levels than the recipient. In bottom-up inflows they separated between data and knowledge, where data is considered unambiguous and follow strict paths while knowledge appear more random and ad hoc and rather broaden the managers experience. Lastly, horizontal knowledge inflows are knowledge exchange between peers in the organization. With horizontal knowledge inflows managers are more likely to acquire complex and tacit knowledge from different parts of the organization.

Levinthal & March (1993) warn about the myopia of learning when describing how organizations use two mechanisms to facilitate learning in organizations – simplification and

specialization. Simplification aim to simplify experience while specialization will focus attention and narrow competency. Levinthal & March (1991) argues that the two processes are not specific to organizational learning but become “particularly salient to discussions of the design of learning organizations” (1991:97). Prior learning processes leads to the accumulation of knowledge, but future learning is discarded when it does not fit existing knowledge. This cognitive bias was found to endanger long-term survival and is the first of three forms of learning myopia discovered in their research. Secondly, since learning is privileged to the near neighborhood, survival of larger systems may be in jeopardy. The third and final form of myopia is that lessons learned from success often surpass those from failures; as a result risk of failure tends to be underestimated. In other terms, the likelihood of utilizing a routine will increase when associated with success and decrease when associated with failure (Cyert & March, 1963).

Kahneman & Tversky (1979) argued that loss aversion still might lead to a preference of exploitation, even if the expected value of exploration is greater than that of exploitation. The notion of self-reinforcement of exploratory and exploitative activities is also found in organizational learning and does influence the balance between the two activities. Even though organizations cannot be certain of outcomes of their activities, decision makers gain experience and confidence over time. Managers tend to repeat activities with initial success, since increased knowledge make similar activities less risky (Baum et al, 2000; Levitt & March,1988). Levinthal (1997) associated exploration and exploitation by local search activities, such as same demographic, geographic or existing domain (exploitation) and long jumps such as new geographies, different demographic and new domains (exploration).

Argyris & Shön (1976) use the terms single-loop and double-loop learning when trying to resolve the paradoxical activities. Single-loop learning is defined as the encouragement to learn as long as learning does not question the fundamental design, goals and activities of the organization. However, double-loop learning consists of asking to change fundamental aspects of the organization. Based on these definitions it is easy to draw similarities between single-loop learning and exploitation, and double-loop learning and exploration. Although there is disagreement in whether or not exploratory and exploitative activities both involve learning, there seem to be consensus that firms need both activities to sustain long-term performance (Gupta et al., 2006; Levinthal & March, 1993; March, 1991).

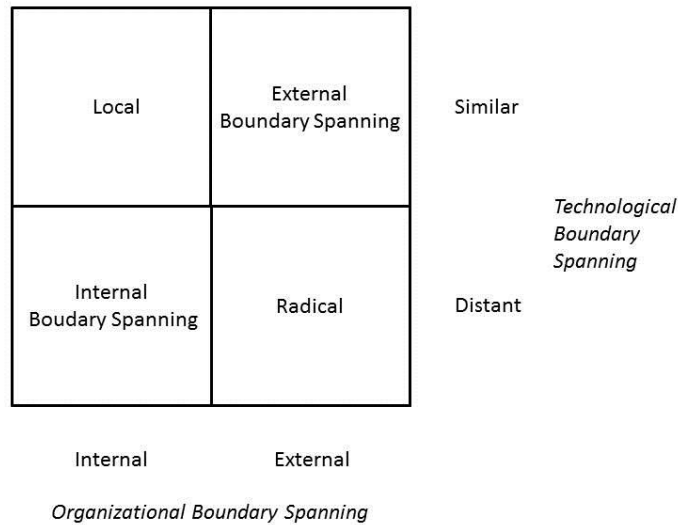


Figure 2-2 Typology of exploration (Rosenkopf & Nerkar, 2001)

Some scholars have further detailed the concept of exploration and exploitation. Rosenkopf & Nerkar (2001) introduced a typology of exploration that recognized local and non-local search through technological and organizational boundaries (Figure 2-2). The four types of exploration are conditioned on whether the knowledge is given externally or internally and from similar or distant technologies; local-, internal boundary spanning-, external boundary spanning- and radical exploration. Local exploration refers to the use of similar technologies internal to the company, i.e. neither technological nor organizational boundary spanning. On the other diagonal, radical exploration, use distant technologies outside of firm boundaries. Internal boundary spanning exploration involves distant technological knowledge within the organization. In contrast, external boundary spanning exploration uses knowledge from other organizations close to its own technological foundation. Rosenkopf & Nerkar (2001) made the distinction between organizational and technological boundary-spanning because they believed the skill set to recombine knowledge from different technological arenas differ from those that require a recombination of knowledge from different organizations. Their empirical research on the optical disk industry showed that the dangers of competence traps, that March (1991) warned about, are real. Managers focusing primarily on exploration that build on technologies developed by other organizations would have a stronger impact. When arriving at the case study of MPD, it will how it used external boundary-spanning exploration in one of its recent innovations.

2.2.2 Technological innovation

-incremental vs. radical innovation-

In technological innovation literature a central theme is the distinction between incremental and radical innovation (e.g. Abernathy & Clark, 1985; Tushman & O'Reilly, 1996; Damanpour, 1996; Dewar & Dutton, 1986). Incremental innovations refer to minor changes or adaptations to existing products or processes. In contrast, radical innovation represents a major change from existing products or processes to completely new ones. Gatignon et al. (2002) suggests a structural approach to prevent ambiguity and confusion when assessing innovation and argue that innovation should be described by distinguishing between; product complexity, the locus of innovation, type of innovation and the innovation characteristics. The structural approach of Gatignon et al. (2002) shows it may be easier to intuit the distinction between incremental and radical innovation than to measure or define them. Along the same lines, Dewar and Dutton (1986) argue that the distinction between the two are on opposite ends of a continuum that range from radical to incremental and an "innovation's placement on this continuum depends upon the perception of those familiar with the degree of departure of the innovation from the state of knowledge prior to its introduction" (1986:1423).

Tushman & O'Reilly (1996) defined ambidexterity as the "ability to simultaneously pursue both incremental and discontinuous innovation" (1996:24) and showed how firms failed to make big changes by not overcoming internal inertia.

2.2.3 Organizational adaptation

-adaptability vs. alignment-

An organization need to balance between continuity and change to achieve long-term success (Levinthal & March, 1993; Tushman & Romanelli, 1985; Brown & Eisenhardt, 1997; Miller & Friesen, 1984). Tushman & Romanelli (1985) developed a model to show how organizations evolved through long periods of equilibrium with short bursts or punctuations of what they called strategic reorientation. Along the same lines, Tushman & O'Reilly (1996) argued that for organizations to succeed, they should not only focus on alignment during evolutionary change, but also pursue radical transformation during revolutionary change. Meyer & Stensaker (2006) looked at an organizations capacity for change on an organizational level where change has to be implemented while maintaining daily operations. They warn of adverse effects of continuous changes on daily operations and advocate organizations to build change capacity through five prescriptions. There is a common belief

that there need to be a balance between change and continuity to prevent organizational chaos or fatigue (Levinthal & March, 1993; Meyer & Stensaker, 2006). Mediating these tensions of continuity and change are left for management for resolve.

2.2.4 Strategic management

-induced vs. autonomous-

In Burgelman's (1991, 2002) intraorganizational ecology perspective an organization is viewed as an ecology of strategic initiatives where strategy emerges from selection and retention of these. His model of strategy making separates between induced strategy processes and autonomous strategy processes. Induced strategy processes help organizations to leverage current learning to exploit opportunities in its near domain, i.e. the use of existing knowledge. Managers find this process attractive since establishing guidelines for participative organizational learning is associated with high costs. Autonomous initiatives emerge outside the current domain and need the use of new knowledge. Furthermore he argues there are two logics behind autonomous initiatives "obligatory logic" and "consequence logic". Within obligatory logic managers engage in autonomous initiatives because it resides with their self-image. With consequence logic managers do not perceive autonomous initiatives as more risky than induced initiatives. In Burgelman's 2002 article he linked autonomous strategy to exploration and induced strategy to exploitation and as leaders compete for scarce resources leaders need to make trade-offs between them. Burgelman suggest that a combination of induced and autonomous processes in strategy making may be the best alternative for sustained performance. He explicitly argues that both are needed simultaneously and that the sequential process of reorientation and convergence of Tushman & Romanelli (1985) is likely to not prove to be sustainable in the long run.

2.2.5 Organizational design

-mechanistic vs. organic-

Burns & Stalker (1961) associated a mechanistic structure to support efficiency while an organic structure supports flexibility through autonomy and decentralization. What organizational structure that is best suited for both efficiency and flexibility have long been discussed in organizational theory. As noted earlier Thompson (1976) described it as the central "paradox of administration".

The notion of a mechanistic organizational structure evolved through scholar's scrutiny of mass production companies during the industrial revolution. As the word suggest, a

mechanistic organization takes the form of a machine, and is designed to be specific and formal with clear job descriptions and detailed processes. Work is strictly supervised with a top-down line of command, i.e. supervisor telling the worker what to do. Since work is defined in such detail through formal rules, procedures and instruction, the organization would have a hard time adapting to changing demands in the market. Thus mechanistic organizations are most commonly found in large organization in stable environments that focus on cost minimization.

On the opposite end, an organic organizational structure is simpler in design where focus is on job autonomy. Employees are not commanded what to do, but rather given the freedom and space to develop their own creativity. This decentralization requires both vertical and horizontal communication, low standardization and few hierarchical levels. An organic organizational form is more likely to be found in smaller firms in high dynamism markets focusing on exploration and learning.

2.3 How to balance the ambidexterity trade-offs

A number of different perspectives on organizational tensions have been presented so far; exploration vs. exploitation, incremental vs. radical innovation, adaptability vs. alignment, induced vs. autonomous strategy and mechanistic vs. organic structures. Simsek et al. (2009) introduced four archetypes to resolve the inherent contradictory activities along two dimensions – temporal and structural. The temporal dimension is used to describe how ambidexterity is pursued over time, either sequential or simultaneous. Essentially temporal ambidexterity capture the distinction between the capabilities required by an organization to allow for a simultaneous pursuit of exploration and exploitation and those needed to switch and adapt between exploration and exploitation, i.e. sequentially. The second dimension capture where in an organizational unit the ambidexterity tradeoff is being realized, independent or interdependent. In the structural dimension the nature of ambidexterity capture the distinction between separating exploration and exploitation in independent units and the tension of having individuals pursue both exploration and exploitation. By juxtaposing the two dimensions into a two-by-two matrix, Simsek et al. (2009) presents a typology with four types of ambidexterity: harmonic, cyclical, partitional and reciprocal as seen in Figure 2-3.

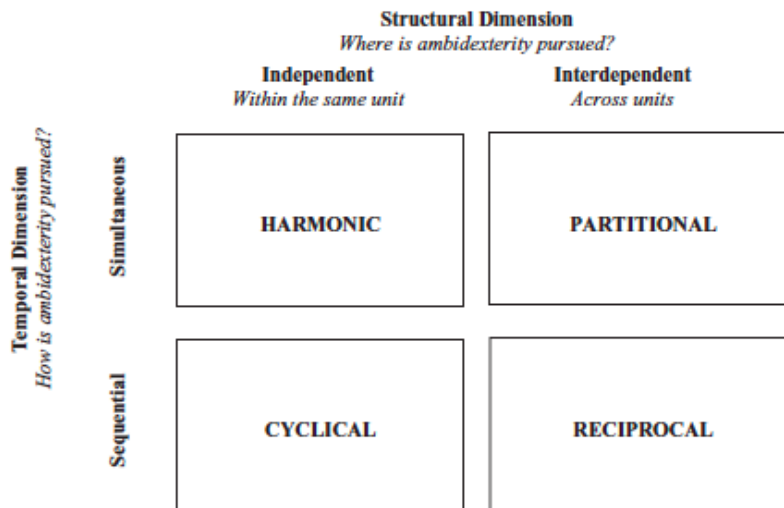


Figure 2-3: Ambidexterity typology (Simsek et al., 2009)

Although the typology of aligning organizational ambidexterity presented by Simsek et al. (2009) provides a logical representation of the nature of the construct; it does not bring new insight into the theoretical framework. So, in order to present the theory in a parsimonious, yet coherent way this thesis will focus on three broad approaches that act as organizational enablers of ambidexterity: structural-, contextual- and leadership-based solutions.

2.3.1 Structural solutions

As the word suggests, structural solutions refer to how organizations can build structural mechanisms to cope with tensions of performing both exploration and exploitation. Most of the theoretical concepts on achieving ambidexterity through structural solutions revolve around two basic concepts: spatial separation and parallel structures, with the first concept being the dominating of the two. This conceptualization bears resemblance to the structural dimension in Simsek's typology and addresses the trade-off by building separate units that is designed for either exploration or exploitation. A spatial separation alleviates the complexity of the organization and makes configuration of each organizational unit to the specific task easier. Benner & Tushman (2003) found that organizational units that focus on exploration tend to be relatively small in size, decentralized with loose process control, conversely units devoted to exploitation are larger in size, have tight process management and are more centralized.

Theory discusses to what extent, if at all, these structurally separate units should be integrated. Some researchers advocate loosely coupled subunits to enhance the ability to adapt and survive over time in changing environments (Levinthal, 1997; Burns & Stalker, 1961;

Burgelman, 1991). Clayton Christensen (1998) does on the other hand suggest that exploratory units need to be completely separated from exploitative units in order to produce disruptive innovations. O'Reilly & Tushman (2004) describes ambidextrous organizations that have multiple tightly coupled subunits, which in turn are loosely coupled with each other. Each unit was physically and culturally separated with individual incentive systems and management teams. Integrating all units with the same strategy required coordination at senior management level.

Earlier studies described an alternative to spatial separation called parallel structures where individuals would allow switching between different structures relevant to the performing tasks. Such a separation could be in the form of a formal structure where routine tasks were performed nurturing efficiency and production. A secondary structure could supplement the shortcomings of the formal structure by supporting tasks not considered routine tasks and innovation. Having these structures in a single business unit would allow for flexibility in the organization and allow exploratory and exploitative activities to coexist. Adler et al. (1999) documented how workers would switch between routine tasks and non-routine tasks at NUMMI production plant and is a great example of how parallel structures can be utilized in an organization. Parallel structures have many similarities to the next conceptualization, contextual solution, in that both solutions would allow for exploration and exploitation to be performed within the same business unit.

2.3.2 Contextual solutions

Advocating for simultaneously balancing the contradictory tensions of exploration and exploitation, Gibson & Birkinshaw (2004) defines contextual ambidexterity as “the capacity to simultaneously achieve alignment and adaptability at a business-unit level” (2004:209). Instead of building multiple structures, contextual solutions refers the system’s ability to shape individual behavior in an organization. Processes and leadership should enable and encourage individuals to use their own judgment on how to divide their time between the varying demand for exploration and exploitation. Gibson & Birkinshaw (2004) refer to previous studies when building support for their contextual solution by referring to job-enrichment schemes (Adler et al., 1999), building a shared vision (Bartlett & Ghoshal, 1989) and flexible managers (Tushman & O'Reilly, 1996), or as they state: “organization context has important similarities to the related concepts of structural context, organizational culture and organization climate” (Gibson & Birkinshaw, 2004:212). Ghoshal & Bartlett (1994) defined organization context with four behavior-framing attributes: discipline, stretch, support

and trust, and argued that they were created and reinforced by actions taken by managers in the business unit. The four attributes were conceptualized as interdependent, meaning an organization needs to encourage discipline and stretch, but the same organization needs support and trust to build a cooperative environment. Ghoshal & Bartlett (1994) did not explicitly say that the four attributes would build capacity for contextual ambidexterity. However, Gibson & Birkinshaw (2004) extended their framework and argued that:

When a supportive organization context is created, individuals engage in both exploitation-oriented actions (geared towards alignment) and exploration-oriented actions (geared towards adaptability), and this results in contextual ambidexterity, which subsequently enhances performance. Gibson & Birkinshaw (2004:213).

2.3.3 Leadership-based solutions

Holding key functions in organizations, senior executives play a crucial role in stimulating ambidexterity. Or as Bernard (1968) frames the function of the executives: "It is precisely the function of the executive to facilitate the synthesis in concrete action of the contradictory forces, to reconcile the concrete forces, instincts, interests, conditions, positions, and ideals" (1968:21). Smith & Tushman (2005) addresses the question of balancing inconsistencies and suggest rather than choosing between contradictory agendas, management should embrace contradictions and effectively manage them. While Gibson & Birkinshaw (2004) emphasize on the "important role played by senior executives in making an organization context effective and developing ambidexterity" (2004:223).

Regardless the foci of scholarly research, top management teams play an important role in balancing performance of daily operations and future adaptability. Strategic decisions divide resources between existing production and innovations. From both structural and contextual antecedents of organizational ambidexterity the inherent importance of leadership is stressed. Some researchers regard leadership processes as separated antecedents of ambidexterity (Lubatkin et al., 2006; Floyd & Lane, 2000), while Volberda et al. (2001) argues that, "top management explicitly manages the balance of exploration and exploitation by bringing in new competencies to some units while utilizing well-developed competencies in others" (2001:165).

2.4 Environmental Factors

There is no doubt that environmental factors help shape organizations and act as influencers on organizational design and strategy and the two most prominent boundary conditions for organizational ambidexterity being competitiveness and level of dynamism. Research into

these boundary conditions can be separated into two distinct approaches: how environmental factors (1) influence organizational ambidexterity and (2) affect the link between ambidexterity and performance.

Several researchers have suggested that environment can affect and influence firms to become ambidextrous (Levinthal & March, 1993; March, 1991; Volberda, 1998). Organizations in environments characterized by rivalry and fierce competition will more frequently deal with the tension between exploration and exploitation. Jansen et al., (2005) studied this relationship empirically and found that firms operating in high dynamism markets characterized by competitiveness are more likely to be ambidextrous.

Several scholars expected environmental dynamisms to affect the link between ambidextrous organizations and performance (Levinthal & March, 1993; Lewin et al., 1999). However, Jansen, van den Bosch and Volberda (2006) were the only ones to find that environments characterized by high level of dynamism exploratory innovation was more effective.

Studies on the environmental effect on the link between organizational antecedents and organizational ambidexterity seem miniscule with the only exemption being Jansen et al. (2005) who found a relationship between contextual ambidexterity and environments of high dynamisms. With this one exemption it makes sense that organizational environment more strongly shape *what* firms choose to do, i.e. simultaneous pursuit or temporal cycling between exploration and exploitation, than *how* they internally resolve the tension.

2.5 Outcomes of organizational ambidexterity

As firms battle the simultaneous pursuit of both exploration and exploitation, do they run the risk of potentially diminishing the sum of the two to a value lower than each of them? March (1991) raised the same question in balancing the two activities – at best firms ran the risk of being mediocre at both. Porter (1980), amongst other scholars, argued that firms needed to make explicit choices between the two. Tushman & O'Reilly (1996) align with March's principal belief of simultaneous pursuit of exploration and exploitation and suggest that firms capable of balancing the tension between the two will in the end achieve superior performance than organizations focusing on one or the other.

After reviewing the literature on organizational ambidexterity there seem to be an apparent mismatch between numbers of conceptual studies and empirical studies. In earlier studies, Adler et al. (1999) discovered how exploration and exploitation coexisted in the GM/Toyota

collaboration on product development and production processes. However, empirical evidence of the positive effect of ambidexterity on firm performance remains sparse.

He & Wong (2004) empirically tested hypotheses related to firm performance based on 206 manufacturing firms and found that (1) the interaction between explorative and exploitative innovation strategies is positively related to sales growth rate [...] and (2) the relative imbalance (absolute difference) between explorative and exploitative innovation strategies is negatively related to sales growth.” (2004:492). Gibson & Birkinshaw (2004) performed a somewhat different empirical study on business-unit level and based on data collected from 4195 individuals in 41 business units, they found that a context characterized by a combination of stretch, discipline, support and trust facilitates ambidexterity and its mediating role on performance. Lubatkin et al. (2006) found that a simultaneous pursuit of both exploration and exploitation positively effects performance after surveying 139 small- and medium sized firms. Venkatraman et al. (2007) however could not find empirical evidence for their ambidexterity hypothesis from a sample of 1005 software firms. Instead, they found that temporal cycling between exploitation and exploration had a positive effect on firm performance. Based on the abovementioned research, one can conclude that research on the performance relationship remain sparse.

2.6 Summary of theoretical framework

From the theoretical framework presented above, organizational ambidexterity should be considered a research field that spans several disciplines such as organization learning, technological innovation, strategic management, leadership theory and organizational design. This cut across of multiple research fields may be a contributing factor of why some find research in this field disparate or ambiguous (Simsek et al., 2009).

Research focused on organizational ambidexterity is related to firms’ ability to simultaneously pursue single-loop and double loop learning, incremental and radical innovation, alignment and adaptability, induced and autonomous strategic processes and efficiency and flexibility in organizational design. In stark contrast, a lot less research has been focusing on how organizations achieve organizational ambidexterity (Adler et al., 1999), however emerging research has focused on how structural-, contextual- or leadership-based solutions promotes ambidexterity (e.g. Gibson & Birkinshaw, 2004; Tushman & O’Reilly 1996; Probst & Raisch, 2005; Burgelman, 1991). The literature review is summarized in Figure 2-4 and includes antecedents, environmental dynamisms and outcome of organizational ambidexterity.

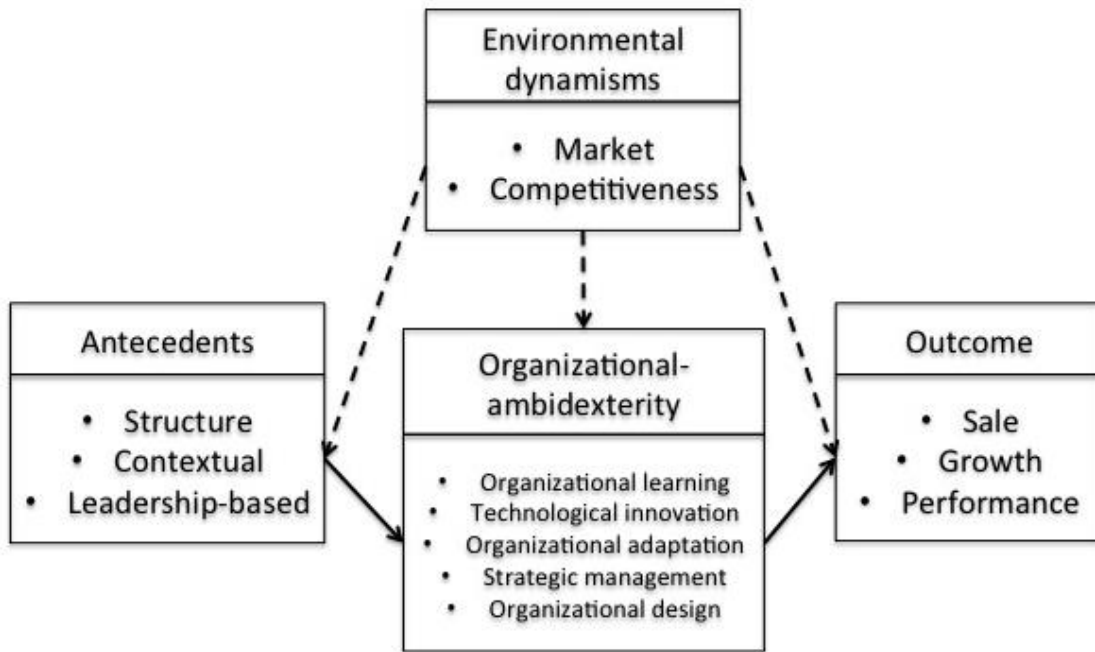


Figure 2-4: Summary of theoretical framework

This section concludes the theoretical framework established from a review of existing literature on the construct of organizational ambidexterity and will help the researcher when approaching the empirical research. Reviewing the theoretical framework several factors are associated with exploratory and exploitative activities. Leaders able to balance between transactional and transformational leadership styles are found to have a positive impact on firm performance, where transactional leadership is best suited for exploitative tasks and transformational leadership is better applied on exploratory activities (Smith & Tushman, 2005; He & Wong, 2004; Tushman & O'Reilly, 1997). In regards to organizational structure, the formality plays a part in affecting the two activities. The more formal or hierarchical the organization is, the more focus will be on exploitation, and on the opposite side informal or horizontal structures support exploration (Burns & Stalker, 1961; Adler et al., 1999; Jansen et al., 2005). Mom, van den Bosch & Volberda (2007) found how knowledge flows in the organization affect exploration and exploitation at manager level. Exploratory activities are associated with horizontal- and bottom-up knowledge (Galbraith, 1973; Burgelman, 1983), while exploitative tasks are associated with top-down knowledge and bottom-up knowledge (Brady & Davies, 2004; Schulz, 2003). Gibson & Birkinshaw (2004) built on Ghoshal & Bartlett's (1994) four behavior-framing attributes: discipline, stretch, support and trust and argued when present, individuals would engage in both exploitation and exploration. A

summary of factors affecting exploration and exploitation identified in the theoretical framework can be seen in Table 2-1.

Table 2-1: Summary of factors affecting exploration and exploitation

Ambidexterity:	Factor:	Indication of:
Organizational structure:	Hierarchical	Exploitation
	Horizontal	Exploration
Leadership:	Transactional	Exploitation
	Transformational	Exploration
Information flow:	Horizontal knowledge	Exploration
	Bottom-up knowledge	Exploration
	Top-down knowledge	Exploitation
	Bottom-up data	Exploitation
Organizational context:	Trust	Exploration and exploitation
	Support	Exploration and exploitation
	Discipline	Exploration and exploitation
	Stretch	Exploration and exploitation

The theoretical framework has given the researcher clues on where to look for different factors when starting data collection in the case company. From the literature review summary in Figure 2-4 and Table 2-1 key elements in the organization and its environment have been identified to affect exploratory and exploitative activities. Based on these findings the empirical research needs to characterize organizational structure, leadership style, information flow, organizational context, environmental dynamisms and organizational antecedents.

By structuring the case study and subsequent discussions based on these building blocks will provide a firm and logical structure for this thesis underpinned with a theoretical justification. An interview guide was developed based these elements in order for the interviewees to contribute to affirming the presence or absence of these factors. The case study is partly built on responses from the interviews and in part by different archival sources. By providing a clear description of the organizational design and explain the different hierarchical levels and their conditional relationships it would be possible to characterize the organizational structure and level of formality. Giving a thorough illustration of how resources are utilized and their

relationship with managers will cover both leadership styles and how information flows in the organization. Through describing how innovation and production processes are managed and executed the presence or absence of the four behavior framing attributes will hopefully be identifiable.

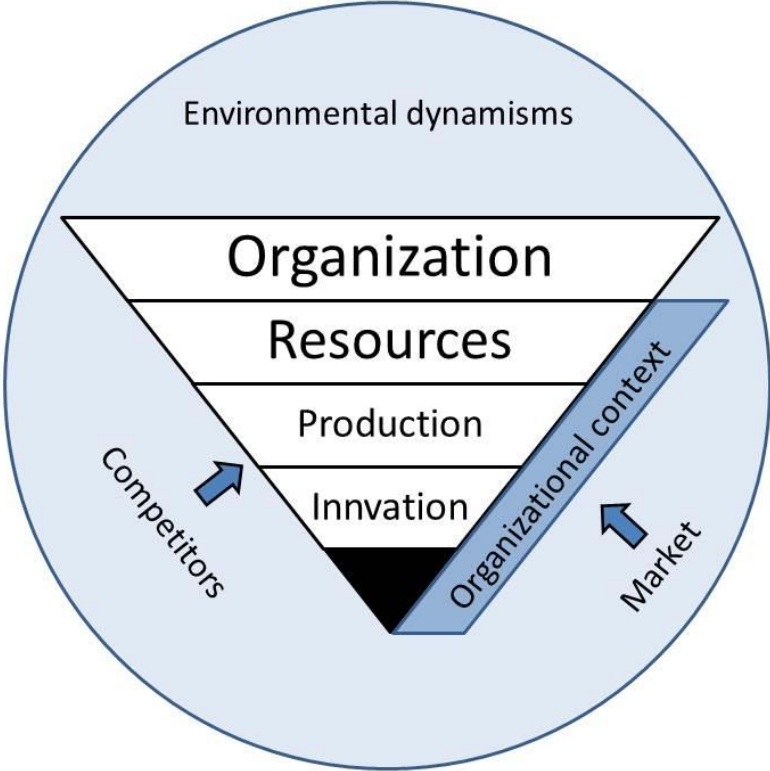


Figure 2-5: Structure for case study based on theoretical framework

3 Research Paradigm

A research paradigm can be understood as a general perspective and a way of breaking down complexity of real world issues. Different research paradigms specify the researchers world view and reflects his or hers knowledge and perspectives (Guba & Lincoln, 1994). Guba (1990) define a paradigm as a “basic set of beliefs that guides action“ (1990:17). Guba & Lincoln (1994) categorized scientific paradigms into four categories: positivism, realism, critical theory and constructivism, each with the three elements ontology, epistemology and methodology. Ontology question what is real in the world, i.e. the “reality” that the researcher is investigating, epistemology is the philosophical branch that investigate the nature of knowledge and the process of acquiring and validating it, i.e. the relationship between the researcher and that reality and methodology is the technique researchers use to investigate that reality.

The underlying paradigm that will be used to understand real world issues presented in this thesis is that of critical realism. Critical realism is best associated with that of postpositivism and describes the world with causal language and can be defined by an eclectic interpretive epistemology (Easton, 2010). Easton (2010) argues that critical realism provide a philosophical validation through ontological and epistemological underpinning and is thus ideally matched to case study research. Critical realists assume that the world exists independently of our knowledge of it and “propose an ontology that assume that there exists a reality “out there” independent of observers” (2010:120). However, the product of the researcher is of course limited by available language when describing observations and their interpretations of them.

A case study approach has been deemed most suitable in the context of this thesis on organizational ambidexterity to narrate what factors have affected exploratory and exploitative activities in MPD. Case studies can be used to provide description, to test theory or to generate theory. The interest of this thesis is within the first aim, to develop a descriptive case study as mean of research strategy to provide a holistic and valid narrative of events evolving particular innovations and production in MPD. Case study research can be based on either qualitative or quantitative data or a combination of the two. Regardless of research data, the case study methodology is the implicit consequence of qualitative research and is well suited to evaluate causality in organizational affairs (Miles, 1979).

3.1 Case Study Approach / Design

The case study approach is probably the most popular research method when researching organizations and relationships. A case study is descriptive, explanatory or exploratory in nature (Yin, 1994). An exploratory case study look for patterns in gathered data in order to build a model that will help to view the data and put it in context. Descriptive case studies are similar to exploratory studies and try to provide evidence of specific features of an event or issue. However, in descriptive studies the researcher use a theoretical foundation to makes sense of collected data and to point in the correct direction. Research questions usually focus on “what”, e.g.: What are the effects of matrix organization on firm performance? Explanatory case studies continue by trying to explain why or how a certain action or event happens. Research questions would ask “how” or “why”, e.g.: Why is job autonomy positively associated with increased efficiency?

There are two distinct approaches on how to use theory when it comes to case study research: deduction and induction. In a deductive research approach the researcher establishes a set of hypotheses based on the existing theory that are validated through empirical research. In contrast, inductive approach starts with empirical studies and ends up with a generalized theory of the observations. When building theory from case studies, Eisenhardt (1989) recommend using grounded theory building (Glaser & Strauss, 1967) that implies a continuous comparison of data with theory, beginning with data collection where one *discover* the theory *in the data*. One common critique of grounded theory is that one cannot set aside theory at the start or assume no theory neutral observation exists. Whatever we do is embedded in some kind of theory or observation. It narrows down to whether the researcher has a realist approach where concepts and categories are believed to lie in the data or a constructive approach where the researcher constructs categories to fit data.

As noted earlier, case studies can be performed by the use of either qualitative or quantitative data and evidence may result from fieldwork, archival information, direct observations or interviews. The case study approach does not imply the use of any particular data collection method and there is a common misconception that case studies are the sole result of ethnography or participant observations (Easton, 2010). Conversely, the use of these methods does not imply production of case studies.

From the above mentioned discussion on research design and approach to empirical data, this thesis will be based on a deductive research approach where qualitative data are gathered through empirical research. Based on the research question, a descriptive single case study of

MPD has been deemed most suitable with critical realism as the underlying research paradigm. Existing theory relevant to the field of organizational ambidexterity will provide a theoretical framework that support empirical data gathered through interviews and archival information to explore what factors affect exploratory and exploitative activities in MPD.

3.2 Data collection

To cover all aspects of activities and variables associated with organizational ambidexterity found in the theoretical framework, semi-structured interviews were conducted with engineers, middle managers, directors and project managers in MPD. A semi-structured interview style was chosen to allow a natural flow in the conversation between interviewer and interviewee. Each interview was limited to one hour. This provided time for the interviewee to answer in detail regarding specific questions, but did also allow for digressions where appropriate. Another idea of the one hour limitation was to give a sense of urgency that would influence both participants to stay factual throughout the interview. The intention of the interview method was to gain insight into the individuals experience and perspective on themes described in the theoretical framework related to the research question. In the end seven MPD employees were interviewed to provide data to support the research in this thesis: two lower level engineers, two middle-managers, one project leader and one director.

Semi-structured interviews are advantageous in term of its flexibility. Not forcing the conversation in one particular direction and showing interest in the individual interviewee may induce more thrust and thus lead to a potential discovery of a more in-depth reflection of his or hers experience and perspectives. An interview guide (Appendix A) was developed in advance of the interviews and served to cover most facets of organizational ambidexterity as presented in the theoretical framework.

By selecting interview candidates from different levels of the organization (triangulation) one reduces the risk of misinterpretation and representativeness. Stake (2005) argued that this triangulation is considered a process where multiple perceptions will clarify the meaning of a construct and verify repeatability of an observation. Performing interviews on several hierarchical levels in the organization further enhance the insights, and increase the chance of forming a holistic frame of reference. If a homogenous relationship is identified across interviews, the described factor or attribute can be aggregated to an organizational level.

3.3 Data analysis

In this thesis empirical data is mainly gathered from two sources: archival information and interviews. In addition, observations and experiences from the researchers own 9 years of employment cannot be disregarded and has both directly and indirectly influenced interpretation of acquired data and research approach. Archival information is more or less directly used in presenting the company and has not been interpreted by the researcher. Interviews on the other hand have been transcribed and further structured. Structuring means attaching catchword to segments of the text to make it easier to identify and compare different topics from the interviews. One could further categorize these structured catchwords in order to collect qualitative data. Young (1981) calls this method “optimal scaling” defined as a: “data analysis technique which assigns numerical values to observation categories in a way which maximizes the relation between the observations and the data analysis model while respecting the measurement character of the data” (1981:358).

As stated in section 1.2, this thesis will investigate and seek to answer what factors has rendered a pursuit of both exploration and exploitation possible within MPD. Although the question relates to organizational ambidexterity, whatever evidence found from the empirical research is by no mean limited to the specific theoretical construct.

As mentioned, the case being presented in section 4 has been generated from data provided by multiple different sources. Section 4.1 present a historical perspective on the beginning of the industrial cluster in Raufoss and how rocket motor development started, and as a whole gathered from archival sources, e.g. Eger (2009). Descriptions of Nammo Raufoss AS and Missile Products Division in the subsequent sections are also gathered from internal archival information, i.e. intranet, organizational charts, etc. Both the historical introduction and the description of the company provide a holistic frame for the reader as a mean to put in context the detailed information presented later in the case. The objective of the next sections is to give the reader an understanding of how the organization is designed with different functions and responsibilities, briefly describe the products, resources, technologies and the environment in which the business unit operates. The two innovation processes was chosen based on feedback from the interviewees combined with the personal experience of the researcher as the best suited examples of how innovational processes are handled internally and affected by the environment.

All case information is then discussed in chapter 0 with regards to the research question aided by the theoretical framework. And as mentioned earlier, the discoveries are not limited by theory, but rather validated by referring to research with similar arguments and/or findings.

3.4 Reliability and validity

The question of reliability and validity is one of importance and should be considered independent of research method. Reliability and validity provide indication of repeatability of the research and to what extent the evidence is generalizable. Yin (1994) argues that the goal of reliability is to minimize biases and errors in a study. In the subsequent research the method of triangulation has been chosen and the interviews were audiotaped by the permission of the interviewees and then transcribed.

The focal point of this thesis on organizational ambidexterity has been a single case study on the business unit level of one company operating in the international defense market. While the descriptive case study is suggestive, there are a number of caveats which concern limitations of this study. First and foremost results are based on the case study of a single firm. By that rationale, findings in this thesis should only be considered suggestive.

There is a chance results from this thesis are idiosyncratic to the specific nature of the defense market with its close link to government entities. Subsequently, research could benefit from a larger sample of companies spanning several business environments. A multiple case study including other Norwegian defense companies could increase level of generalizability of the results.

Since the researcher is employed by the case company, his biases may have had limitation on the study. In addition to representativeness, the researchers relationship to the interviewees may have affected the responses. Eisenhardt (1989) recommended having multiple research teams conducting the research covering only parts of the case to reduce the shear work load and maintain objectivity to evidence. However, since this thesis is the sole result of one researchers work, employing additional researchers to conduct parts of the research has not been deemed possible.

Validity of quantitative research has traditionally been judged on four criteria: internal validity, external validity, reliability and objectivity. These criteria are however not practical when judging validity of qualitative research. In qualitative research, objectivity, reliability and validity can be understood as trustworthiness understood as credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985). This thesis will use the alternative

criteria for judging qualitative research proposed by Lincoln & Gube (1985) when determining the validity of research performed. In the context of this thesis on organizational ambidexterity, credibility is understood as the objectivity of how believable the researcher is.

Credibility is maintained throughout this thesis by consistently referring to sources and material used, but eventually it boils down to the participative researcher to legitimately judge his or hers credibility of the results.

Transferability determines whether or not the results are generalizable. By providing a detailed case description and present the underlying assumption used in the research, transferability can be enhanced. However, burden of responsibility to judge how sensible such a transfer is, is borne by the person transferring the results.

Dependability refers to the need for the researcher to account for the ever changing context of the research. By thoroughly accounting for environmental factors that may have affected how the researcher has approached the problem.

Confirmability asks if the results can be confirmed by others. To increase confirmability the researcher has, to the best of his knowledge, explained his biases towards the research, company and interviewees. Also by documenting the procedures for checking the data that has led to the case description will enhance confirmability. A summary of the criteria for judging validity can be found in Table 3-1.

Table 3-1: Criteria for judging validity in qualitative research

Criteria:	Researcher to ask:
Credibility	Are the results believable?
Transferability	Can results be transferred to other companies or other environments?
Dependability	Are there contextual changes as research progresses?
Confirmability	Given the same data, could another researcher confirm the results?

4 Case Study

4.1 Organizational antecedents

When Rødfos Fyrstikfabrik went bankrupt in 1879 and the associated land and production facilities were sold to the department of defense in 1894 the company was named Rødfos Patronfabrik. The birth of what would later become Nammo Raufoss was a fact. A proposition handed in to the Norwegian government on June 14, 1897 suggested production of nitroglycerin gunpowder and the production line producing 6.5mm ammunition for Krag-Jørgensen rifles was started June 9, 1900.

Fast forward half a century and Rødfos Patronfabrik has become Raufoss Ammunisjonsfabrikker (hereinafter referred to as RA) and with the aid of Marshall Help and NATO related programs the rocket motor activity was intensified in the late 1950's. Terne and Penguin were the first national programs where rocket motor propellant was developed and produced at RA. Soon after followed Sidewinder-9B, the first NATO coordinated program where RA was the rocket motor design agent. M72 LAW (Light Antitank Weapon) was also started in the early 1960's and can only be described as an unconditional success with well over 50 years of strong presence in the market and millions of sold systems worldwide. (Eger, 2008)

A further refinement of Sidewinder-9B rocket motor concepts led to an expansion of production facilities at RA and rendered production of new composite propellant possible. Engineering capacity was increased to cope with the new production capacity and RA continued to participate in an increasing number of international development programs. At the end of the 1980's RA took a big step towards establishing itself as a European rocket motor manufacturer by being awarded contract for development of the acceleration motors and separation booster motors for the ARIANE 5 space program.

RA split in three companies in 1995; Raufoss Automotive AS, Raufoss Service AS and Raufoss Technology AS (hereinafter referred to as RATEC) – the civilian and military oriented business of former RA. Three years later Nammo Raufoss AS was founded based on a merger of three major Nordic defense companies: Celsius AB, Patria Industries Oyj and RATEC. Nammo Raufoss AS were structured into three separate divisions targeting three different market segments, Small- and Medium Caliber Division, Large Caliber Division and Missile Products Division (hereinafter referred to as MPD). Small caliber ammunition production was quite early moved to sister companies in Sweden and Germany and

consequently the two ammunition division merged into one at Raufoss and became what is now called, Medium- and Large Caliber Division (hereinafter referred to as MLCD).

4.2 Nammo Raufoss AS

This section provides a description of Missile Products Division and aim to give the reader a holistic perspective of the organization. The case study will subsequently be discussed in the next chapter before concluding this thesis with a summary of key findings. All quotes used in chapter 4 are excerpts from interviews and have been translated by the researcher.

4.2.1 Missile Products Division

Missile Products Division is organized under Nammo Raufoss AS which in turn is part of the corporate structure of Nammo AS together with four other divisions: Small Caliber Division, MLCD, Demil and Nammo Talley. The legal structure constitutes some 30 subsidiaries in 9 countries on three continents in total.

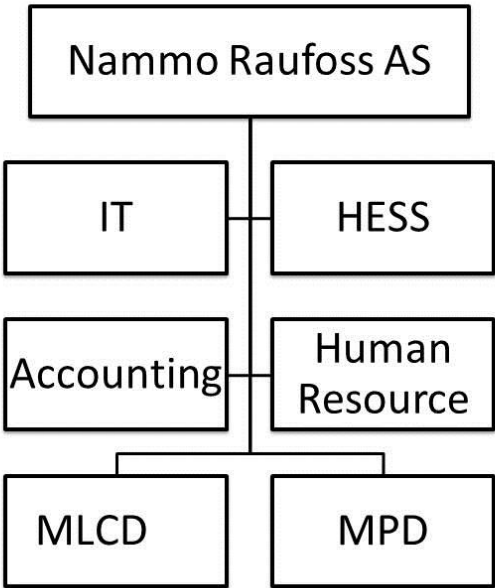


Figure 4-1: Organizational structure of Nammo Raufoss AS

Administration at Nammo Raufoss AS hold key functions like accounting, human resource, HESS (Health, Environment, Safety and Sustainability) and IT while MPD and MLCD are individual business units with its own marketing-, logistic-, procurement, quality-assurance, engineering- and project groups.

MPD develop and produce advanced rocket motors for military and civilian segments like air-to-air, ground-to-air and space applications, including high-performance thrust vector control

and warheads. The site is located in Raufoss Industry Park, an industry cluster encompassing more than 40 businesses, most of them with linkage to RA. Development and production at MPD is split in two separate locations on the 3000 acres land and a test center (organized under MLCD) is located close to the production facilities where rocket motors are tested. Figure 4-2 provides an overview of the organizational structure of the Missile Products Division.

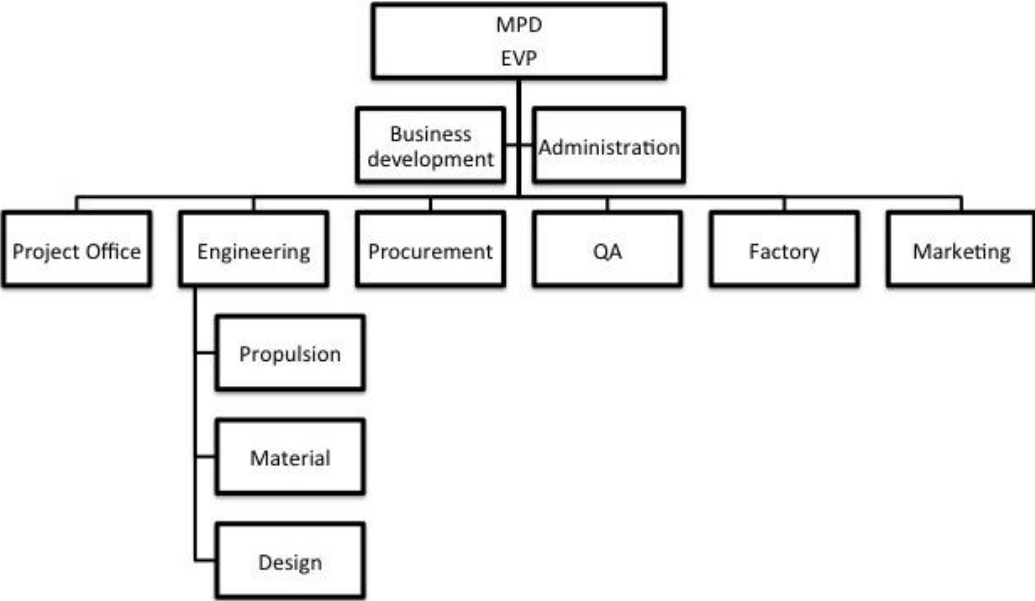


Figure 4-2: Organizational structure of MPD

The rocket motor factory is physically separated from the rest of the organization together with the quality assurance group. All production and process related employees are organized within the factory. Process engineers are assigned responsibility for specific components in the production line. Their main tasks are to develop and maintain production processes but the engineering group also utilizes their expertise in development of new rocket motors and asks for advice related to their specific production knowledge.

The engineering department provides technical support to programs from conceptualization through development and industrialization into full rate production. Each program is run through separate project offices, where each project manager acts as lateral communication channels into the R&D department. Alongside both quality assurance group and project planners, these project managers create lateral communication channels, and together with the

traditional hierarchical structure of the R&D department they make up what can be described as a matrix organization. Here is one manager commenting communication channel in MPD:

Sometimes it baffles me how little information is flown from marketing meetings and down into the organization. For some reason it is not communicated down into the matrix. Information in general flows bottom-up.

The design group is responsible for product design, i.e. 3D models, stage drawings and process drawings. Additional group activities are tooling design, tolerance analyses and project management for both development and production programs. As a consequence of the inherent complexity of the products and the high demand for safety, reliability and performance the design group has a high level of interdependence with the engineering group during development. Engineering group responsibilities are concentrated around structural-, ballistic-, thermal-, CFD analyses and systems engineering, whilst the material group cover chemical analyses and responsibility for adhesives, insulation and propellant. Interdependence is also high between the material group and the engineering group. Each of the R&D subgroup managers have technical responsibility alongside their managerial duties and need to battle the tradeoff between managing subordinates and supporting production and innovation projects.

Both production- and development programs are led by project managers in the project office group. However senior engineering staff typically runs technology programs, directed towards new technologies or new applications of old technology. Here is how one manager of one of the engineering groups explains how they balance between exploration and exploitation:

As an organization, we are structured to perform both exploratory and exploitative activities simultaneously. For us, working on the technology programs, it is basically down to our own judgment to divide time between the two. However, time planned for exploratory activities is more often than not spent on more imminent exploitative tasks.

The balance between exploration and exploitation on the individual level is not well defined and depends on the workload from project offices rather than strategic decisions from top management.

4.2.1.1 Products

MPD is a supplier of rocket motors for military and civilian application to NATO countries and their allied partners. All products are developed, produced and tested at Raufoss in Norway. Each rocket motor design is customized and developed based on customer requirements and specifications. The customer plays an active role during development and

participates on milestone reviews. The products does not typically need in service support during its lifetime, however special events may trigger the need for spare parts. After a development program is fully qualified rocket motors are built to order, so MPD does not keep stock of rocket motors for potential future sales. A typical development program takes between 24 to 36 months and the subsequent production program can run for as much as 20-30 years dependent on market demand. Below is a list of current and former rocket motor development and production programs:

- AMRAAM (Advanced Medium Range Air to Air Missile)
- ESSM (Evolved Sea Sparrow Missile)
- IRIS-T (Air to Air Missile with TVC)
- IRIS-T SL (Surface Launch IRIS-T with TVC)
- EXOCET MM40 B3 Booster (Anti-Ship Missile with TVC)
- Sidewinder AIM-9L (Air to Air Missile)
- Penguin MK2 Boost & Sustain Motor
- NSM Booster (Naval Strike Missile)
- IDAS (Interactive Defence & Attack for Submarines)
- ARIANE 5 (Separation & Acceleration Boosters)
- Hybrid Rocket Motors & Monopropellant Thrusters for Space

4.2.1.2 Market and customers

The Nordic countries (Norway, Sweden and Finland) are defined as the home market for the Nammo group and make up 25% of net sales, USA/Canada 40%, Europe 20% and the rest of the world 15%. MPD contribute to Nammo group net sales through export to Europe and the US.

MPD pays a lot of attention to their customers both in terms of service and through the quality of their products. Given the delicate nature of the products, safety and reliability are invariable focus areas both internally and to their customers. Several customers have recognized the supplier quality provided by MPD and the numerous awards serve as recognition of its production excellence.

The market for rocket motors in Europe and US can best be described as an oligopoly, where a low number of customers compete for the same market segment. The same oligopoly can be found amongst MPD's competitors both in Europe and in the US. Over the past decade

consolidation in the industry has reduce number of competitors in the US and European market to less than five.

4.2.2 Resources

With the exception of a small research team at NRE and a handful of long term consultants, MPD does not employ external resources in its development activities. This have to do with the fact that the knowledge required to be part of a development team needs to be highly specialized. Each employee in the development department will eventually by responsible for a specific field and his or hers knowledge will be used on multiple projects and programs. Knowledge will, as far as possible, overlap between employees. However, given the sizes of the organization, that is not always feasible. Employees are only dedicated full time on exploratory activities for shorter periods.

Occasionally MPD will hire PhD candidates who work part time while working on their thesis. MPD also cooperates with universities and other educational institutions with regards to instruction of master students and summer intern. This enables the organization to further develop internal competency in fields where knowledge is scarce.

The project offices allocate resources in the engineering group in accordance with demand. Generally engineers work on anything from one to five projects at any given time, on both production and development activities – exploratory and exploitative. Middle managers are heavily involved in both exploratory and exploitative activities; however above that level managers only support exploratory activity alongside their managerial duties. Since engineering competence to accommodate the rocket motor production and development is highly specific, the organization does not follow cyclical fluctuations in the market closely. As a consequence ongoing production and development activities largely dictate resource availability and stretch in the organization. Here is how one manager explains exploratory activities in MPD:

We (MPD) are quite sensitive to size, thus we cannot hire researchers and devote them towards exploratory activities. [...] The few activities we do have, that is more or less solely exploratory, would equate to no more than 3 full-time equivalents and is less than critical mass to be able to function. That is why exploratory activities are being tied towards development activities that are destined to become exploitations.

Employees frequently share knowledge between each other and management stresses the importance of “making each other better” through sharing of experience and knowledge. Management also emphasizes the importance of transparency in way of working as a crucial

factor of success in development programs. Small team rooms have been established where communication boards lists actions for all team members on each development program. One group manager talks about how knowledge is shared in the organization:

Our group has collectively established a shared folder with lessons learned from previous development activity failures so that we do not make the same mistake twice. I strongly believe in working in a transparent environment where everyone can see what each other are working on and what we have accomplished. There are so many synergies that emerge from working in such an environment.

The organizational structure is considered flat, with few levels between lower level engineers and top executives. The EVP has mentioned several times that: “his door is always open, for everyone”. When failures do happen, there is no internal blame-game, but rather a collective effort to mitigate the problem at hand. All employees have individual office space, but there is a supportive atmosphere with an “open door” policy. Sharing of knowledge is highly encouraged and there is no fear of engineers “stealing” intellectual property from one another. Middle managers lead by example and willingly share knowledge when solicited for their views.

MPD does not reward its engineers for the development of new ideas, improvements or patents. It is communicated that those kinds of activities are part of job description of the engineers and thus should not be rewarded. However, all employees are now part of the new reward structure that is based on group performance according to specific key performance indicators.

4.2.3 Leadership

All companies within the Nammo group share the same vision and values. Nammo’s vision is “securing the future” by delivering high quality products, having a strong financial development, seeking long term sustainable business and maintain a secure and safe work environment. The three values are dedication, precision and care. The company argues that these values are important for nurturing trust between individuals and linking the organization together. Corporate human resource in Nammo has developed a leadership program called “talent factory”. The one-year program has educated current and emerging leaders and managers to develop a common leadership platform in the organization with the intention to create a common set of beliefs that help shape the leadership style.

Managers in MPD all have exploratory and exploitative tasks in addition to their managerial duties. There is high degree of individual autonomy and as a consequence managerial tasks do

not have the same priority as other activities in the task environment. Here is how one manager answers the question whether leadership can be characterized as transactional or transformational:

I believe it is best characterized with a third option – situational leadership. We are not purely transactional; we are transactional when there are no external impulses. It might seem like a funny mixture, but I believe having the tension between the two is advantageous. However, this situational leadership requires an organization open to change and adaptation.

4.2.4 Production

On the production floor there are clear job descriptions and work processes are highly detailed on each operation and specific the each type of component produced. Operators sign off on shop travelers when each process step is performed documenting measurements or quantities and controllers supervise vital operations. Operators and process engineers are frequently consulted by the engineering group in early stages of rocket motor development to include new knowledge of operations and mitigate previous errors. Operators are also encouraged to bring improvement ideas forward. These improvement suggestions used to be individually rewarded with a fixed percentage of initial production savings. However, in recent time the reward structure has changed from individual to group level based on a set of key performance indicator.

Being both ISO 9001 and 14001 certified is a strong visual statement of the commitment to process management and HESS. Both in production and engineering there is a strong focus on process management and implementation of total quality management (TQM) and six sigma principles. These principles are manifested in all activities in the organization and there are several lean-coordinators supervising six sigma projects throughout the organization. All employees attend an introductory six sigma course and there are several certified “green belt” and “black belt” employees.

4.2.5 Innovation processes

A senior management team leads innovational processes at MPD, through what internally is called “technology programs”. Themes on future research topics are discussed at internal strategy meetings where top executives, senior management, senior engineers, marketing and business development are present. Although technology programs are developed and led by senior management and senior engineers, they include the entire organization in the execution of related tasks. These technology programs run for four years and are financed partly with internal funds and partly by the Norwegian Research Establishment (hereinafter referred to as

NRE), a government research institute. Here is how one manager stresses the importance of innovation in MPD:

It is important that we (MPD) continuously develop our knowledge base and consequently create new possibilities for the company. If we would merely continue along the same path as before with minor modifications to our products, new markets or contracts would soon be out of reach. I guess it is because we have proven adaptable and risk prone and had the gut to gamble on new technologies (e.g. jet vane and min smoke propellant) that we have been so successful the last decade. However, none of this would have been possible without the proven track record of a robust production history.

4.2.5.1 *Min Smoke Propellant*

Although Alfred Nobel made the first smokeless gun propellant in 1888 by combining nitro-cellulose and nitro-glycerin, it would take several decades before it was first found applicable as rocket motor propellant. However, quickly after the US and Germany had discovered its capabilities as rocket motor propellant other leading nations would adopt the technology for use in rocket motor applications.

Fast-forward 80 years and doublebase propellant is still a commonly used rocket motor propellant favored for its smoke less signature. However, the European regulation on Registration, Evaluation, Authorization and restrictions of Chemicals (REACH) has banned the use of certain additives in the doublebase composition, rendering the propellant illegal for use in the near future. This soon-to-be ban created an industry need for a new, REACH-compliant, smoke less propellant.

A declining demand for RA's doublebase propelled rocket motors forced a shutdown of the nitro-cellulose facilities at Raufoss in the mid 90's. This marked the end of an era in terms of gunpowder and doublebase propellant production at Raufoss. In the late 90's a portion of the strategy developed for MPD's future technologies would include a min smoke propellant to replace the doublebase propellant currently deployed in the market. Work with a new propellant formulation with smokeless characteristics would remain more or less dormant for over a decade. As the REACH effort started to gain momentum in European industry, focus increased in MPD to research chemical compositions that would work for min smoke applications. Management opinion was that it would have been a clear strategic advantage for MPD to have a developed min smoke propellant before a ban was enforced.

Supporting production programs would consume most of the available engineering capacity and there were no infrastructure in MPD's production facilities that could support a min

smoke development. Min smoke propellant is classified as a 1.1 explosive, which reduced production, handling and storage capabilities at Raufoss to a minimum. All this was about to change when a customer approached MPD with the inquiry to develop a rocket motor with min smoke propellant. Just a year prior to the above-mentioned inquiry, funds were made accessible for MPD to invest in a brand new 1.1 propellant production line including a new chemical laboratory resulting in dual propellant mixing capabilities.

With the contract in place with the new customer and the 1.1 production line completion date fixed, work on rocket motor development and min smoke propellant gained momentum. With a clear deadline for when MPD needed a new min smoke propellant, the material group had a clear goal to work towards. In close cooperation with NRE, the material group eventually accomplished to develop the min smoke propellant in time. Here is one manager explaining what enable min smoke development activities in MPD:

We owe it to our customer of the new rocket motor development contract where min smoke propellant was required. We did not have the necessary understanding of propellant composition and the development contract enabled us set clear goals and deadlines together with NRE.

4.2.5.2 Thrust Vector Control

After the fall of the Berlin wall in 1989 and the German reunification in 1990, Germany had large stocks of old Russian AA-11 Archer missiles. After evaluating these assets they discovered that its capabilities had been largely underestimated and especially the maneuverability was far superior to its European counterpart – the AIM-9 Sidewinder. In 1995 Germany, Italy, Greece, Sweden, Norway and Canada announced collaboration of the IRIS-T development program to re-gain the superiority in the European airspace.

Back in Norway, Raufoss Ammunisjonsfabrikker had just split in two. However, for RaTech business went on as usual. During the 80's and 90's RA had increased its technical knowhow as a rocket motor manufacturer further enhancing insulation and propellant capabilities through ASRAAM and other joint programs. The contract for developing the IRIS-T rocket motor brought with it a requirement of thrust vector control components (hereinafter referred to as jet vanes) to outmaneuver the Russian AA-11 Archer.

Development of the rocket motor entailed full design authority on the jet vanes, a rather new technology for MPD. The organization had employed several engineers with computational fluid dynamics background a couple of years prior to the IRIS-T rocket motor development which would later prove crucial for the success of the rocket motor development program.

In early years after qualification of the rocket motor, a strategic decision to invest in jet vane production capabilities forced itself onto management. It was decided that such a capability could prove strategically important and it was decided to move forward with the investment plans – in hindsight nothing short of a bold commitment by MPD executives.

Implementation of the jet vane production line proved difficult at times, but in the end persevering attitudes from the engineers and management made MPD prevail in the end and qualify the jet vane production line. Around the same time MPD won the contract for developing a new rocket motor booster for the French Exocet missile. The concept included a pioneering nozzle design with jet vanes building on experience from the IRIS-T development.

Without the early investments in production facilities and the efforts to develop jet vanes for IRIS-T, MPD would not have been in the position to produce jet vanes for the Exocet booster rocket motor program or IRIS-T SL. What MPD's future would have looked like without the material and technological innovations surrounding the jet vane production line are mere speculations, but at best MPD would not have had the competitive advantage on thrust vector production capabilities.

5 Discussion

Throughout time firms have battled the tension between exploration and exploitation, where the two activities were considered mutually exclusive (March, 1991). Research into existing literature has illustrated what factors have affected exploration and exploitation and the outcome of organizational ambidexterity (Floyd & Lane, 2000; Benner & Tushman, 2003; Tushman & Romanelli, 1985; Tushman & O'Reilly, 1996; Probst & Raisch, 2005; Levinthal & March, 1993; March, 1991, 1996). Instead of building on existing theoretical or conceptual work, this thesis has focused empirical research into one business unit to investigate what factors have affected exploration and exploitation.

5.1 Exploration and exploitation

A central theme throughout this thesis has been the tension between exploration and exploitation. According to March (1991), exploration is associated with such things as search, risk taking, play, flexibility, discovery and innovation while exploitation is captured by refinement, production, efficiency, selection, implementation and execution. However, recent studies have shown that exploration and exploitation in not mutually exclusive on business unit or firm level (Gibson & Birkinshaw, 2004; He & Wong, 2004). This thesis argues that MPD has proven ambidextrous for over a decade performing both exploratory and exploitative activities simultaneously. First and foremost discussion will focus on how the two activities are performed in the organization.

March's definition of exploration and exploitation fits well within the context of MPD. However, in an effort to further detail the meaning of these activities in the context of MPD, *exploration* has been considered technological innovations that will give MPD a competitive edge in the market, process innovations that dramatically changes speed of manufacturing or have a significant impact on cost of rocket motor production. *Exploitation* is tied to routine tasks relevant for rocket motor production and development. Here, routine tasks are defined as the rules, procedures, conventions, strategies and technologies in which the organization in constructed (Levitt & March, 1988). Management emphasizes that even routine tasks include degrees of learning by focusing on total quality management and 6-sigma principles, which suggest that by repetition and incremental improvements one acquire new knowledge that will increase efficiency and proficiency. Although there are some degrees of learning related to these routine tasks they cannot be associated with exploratory activities.

Some scholars relate exploitation and exploration to different hierarchical levels in the organization (e.g., Floyd & Lane, 2000). The same hierarchical separation of activities can also be found in MPD where exploratory activities are developed and led by a senior management team through technology programs and exploitative activities are led by program managers. Although tasks related to innovation activities are executed by lower level engineers, ownership is still with the senior management team. It is clear from the case study that most employees in the engineering department are involved in both exploratory and exploitative activities and need to use their own judgment when deciding on what activity to spend their time, i.e. they are not told what to do or when to do it. Gibson & Birkinshaw (2004) argued in order for individuals to be engaged in both exploitation-oriented actions and exploration-oriented actions, trust, discipline, support and stretch was needed. Since the case information clearly shows that engineers are engaged in both types of activities, a natural continuation is to look for these four behavior-framing attributes in the organization.

There are strong elements of support across departments and the fact that employees are not blamed for their mistakes reinforces trust in the organization. Individual autonomy is also considered an indication of thrust and seems to have a strong presence in the engineering department. For this autonomy to work, discipline is of unconditional importance. Without discipline, the individual autonomy could quickly turn into a smoke and mirror show. Both the jet vane and min smoke case study provides evidence of stretch in the organization. They both show how the organization adapted to changing demands for resources. Engineers were relieved from their daily routine tasks to be able to focus on exploratory activities for shorter or longer periods of time. This stretch in the organization in allocating resources was crucial in both cases in order to support the ongoing exploratory activities. It also shows how the organization adapts to changing demand to meet customer expectations.

Top management plays an important role in defining the content of exploratory activities, but there is little evidence for leadership at MPD to explicitly manage the balance between exploratory and exploitative activities. Both lower level engineers and middle managers need to balance between exploratory and exploitative, but the research cannot find The balance is managed through the project office in their demand for resources to support exploitative activities.

There is a strong focus on process management and implementation of total quality management (TQM) and six sigma principles. Even though this focus is a condition for success in any production environment, one should also consider the side effects of such an

approach. As Benner & Tushman (2003) found in their research, process management activities are positively associated with organizational effectiveness only under periods of stability and incremental change. In turbulent environments and with new customer segments they argue process management activities build resistance to change and in the end inhibit organizational variability and adaptability. Process management is mostly used as a problem-solving tool for production and process related activities in the factory at MPD, i.e. exclusively used on exploitative activities. Although some six sigma projects emphasize on the development department, these projects focus on activities related to support of rocket motor production in the factory. Given the case description and above-mentioned information it seems that process management does coexist and does not inhibit exploratory activities. This may partly be explained by the hierarchical separation of exploratory and exploitative activities.

Accompanying the internal resources at MPD, NRE plays a crucial role in executing exploratory activities for parts of the organization. Using the theoretical framework to describe the relationship between MPD and NRE, the government research facility should be considered an external resource that is loosely coupled with MPD as they employ several fulltime researchers that work on tasks related to the technology programs. The exploratory example of min smoke development clearly shows how important NRE's coupling with MPD is in support of their exploratory activities. The loose coupling and physical separation was important factors for NRE to be able to focus resources to resolve principal research on particular chemicals for the new propellant. Both the loose coupling and physical separation prevents more imminent exploitative activities to cloud the researchers focus. Having only exploratory tasks alleviates management at NRE from dealing with the tensions between exploration and exploitation and is probably the most important factor for why several scholars so strongly advocate for it (Tushman & O'Reilly, 1997; Gupta et al., 2006). For lower level engineers participating in exploratory activities in MPD, individual autonomy is an important factor in balancing between exploratory and exploitative activities.

5.2 Balancing the tradeoff between exploration and exploitation

Galbraith (1973) and Pfeffer (1981) both suggest there should be a rough equivalence of power between the lateral and hierarchical dimensions in a matrix organization. This holds true in the R&D department as well, although responsibility and authority in the lateral dimension varies. Being a rather small department, R&D managers tend to be more operational and lack managerial experience to effectively manage changing environments. As

a consequence lateral channels are by far the most frequent axis of communication. Since all exploitative activities are managed by the project office and the fact that middle manager are more operational the horizontal knowledge flow is a logical consequence.

From the description of the organization in the previous chapter it is evident that exploratory activities are led by senior management team and exploitative activities are led by project managers in the project office. It seems the tradeoff between these two activities is managed indirectly through the demand for resources for exploitative activities. As most technology programs have a life expectancy of four years or more, imminent pressure is always on production related activities. With ongoing production and technology programs always in need of support from the same resources, both exploratory and exploitative activities occur simultaneously in the organization, although emphasis is always on the latter. Additionally, as both the jet vane and min smoke propellant case study exemplifies, external situations may affect the level of resources necessary to perform the two activities.

Revisiting the theoretical framework, three broad approaches that act as organizational enablers of ambidexterity has been presented: structural-, contextual- and leadership-based solutions. There are parallels from several approaches that can be drawn to how MPD balance the tradeoff between exploration and exploitation. In terms of structural approach, NRE can be seen as a structural separate unit focusing on exploratory activities. However, NRE does most of its research related to chemical composition of propellant formulations and thus only alleviates exploratory activities from MPD related to propellant development. So, spatial separation can only explain how a fraction of exploratory activities are handled at MPD. In addition to NRE working on the min smoke development, the material group responsible for propellant development at MPD was able to devote several engineers as well as the section manager. This stretch in the organization rendered a balance of pursuing min smoke development while at the same time supporting production programs possible.

As stated earlier in this section, exploratory and exploitative activities are also related to different hierarchical levels of the organization. However, after reviewing literature on organizational ambidexterity it does not seem to be support for a hierarchical separation as an approach to ambidexterity. This discovery does not imply that there is no coherence; it merely shows the need for further research on the topic.

Ghoshal & Bartlett (1994) defined organization context with four behavior-framing attributes: discipline, stretch, support and trust, and Gibson & Birkinshaw (2004) used the same four attributes and argued that they gave support for individuals to engage in both exploitation-

oriented actions (geared towards alignment) and exploration-oriented actions (geared towards adaptability).

5.3 Environmental factors

As mentioned in the theoretical framework several scholars argue that environmental factors influence both how firms approach ambidexterity and the link between ambidexterity and performance. Jansen et al., (2005) found support for firms operating in high dynamism markets characterized by competitiveness are more likely to be ambidextrous. This section will examine how environmental factors in a moderate to low dynamism defense marked have affected MPD's approach to ambidexterity.

The defense marked is considered a mature market, with stable competitors and customers. Customers of MPD do not expect radical new technologies when they request information regarding proposals. More often than not customers in fact request that known technologies are implemented in the development of new rocket motors. This conservatism especially affects those in MPD closest to the customer, marketing and project managers, and subsequently reinforces demand for exploitative activities in MPD.

Traditionally defense contracts have been awarded to national companies, based on political decisions. However, last couple of years, level of competitiveness has increased in the defense marked because of a shift in both Europe and the US national policies to put defense contracts out on tender across nations. This has also affected MPD where top management and marketing has seen a need for increased focus on exploratory activities to be able to compete in an international defense market.

In case of the min smoke propellant both environmental factors came more or less simultaneously and requested the need for a new technology. MPD had early on identified the need for a new generation min smoke propellant and provided early funding through technology programs. And when the customer requested a proposal for a rocket motor with a min smoke propellant, focus on the technology program was further augmented. In the case of the min smoke propellant development it is obvious that the two environmental factors complimented each other in affecting MPD's exploratory activities.

6 Conclusions

Looking back at the last six months of research, it is apparent that the study has culminated in several insights on factors positively affecting exploratory and exploitative activities in MPD. The findings have several limitations that have culminated in a number of recommended topics for future research. This research has dealt with the caveats concerning ambiguity in organizational ambidexterity research by explicitly mentioning that (1) organizational learning exists in both exploration and exploitation, (2) level of analysis is on business unit and (3) exploration and exploitation are not considered mutually exclusive based on level of analysis.

Exploration and exploitation are found not to be mutually exclusive on business unit level in MPD. Through hierarchical separation a simultaneous pursuit of both exploration and exploitation was rendered possible within the organization. The research also finds how NRE's coupling with MPD has positively affected exploratory activities related to propellant development.

This thesis finds support for all four attributes of organizational context defined by Ghoshal & Bartlett (1994). Individuals in middle manager level, and lower, engage in both exploitation-oriented actions and exploration-oriented actions. This evidence reaffirms findings made by Gibson & Birkinshaw (2004) where a supportive organizational context helps individuals engage in both exploration-oriented and exploitation-oriented actions. Balance between exploratory and exploitative activities was found to be arbitrary and indirectly managed through the project office in the matrix organization.

The environment surrounding the organization was characterized by stability and incremental change but was found to affect MPD in two distinct ways. (1) MPD's customers were positively associated with an internal focus on exploitative activities and (2), level of competitiveness and rivalry was positively associated with exploratory activities. Tushman & O'Reilly (1996) found that radical change was either driven by performance problems or shift in environment: Both min smoke and JV activities were initiated based on environmental stimuli and support the observations made by Tushman & O'Reilly (1996).

6.1 Future research

The research presented in this thesis is by no mean complete. Natural limitations in time on project and number of researchers working on this thesis limits the accomplished scope and there is an obvious need for future research on what factors are affecting exploratory and exploitative activities in the organization.

One interesting addition to this research would be to include the other business unit at Nammo in Raufoss, namely MLCD. Performing more or less the same research on MLCD would be a great possibility to subsequently investigate how environmental dynamisms affect exploratory and exploitative activities. The two business units share the same vision and values, have more or less the same organizational structure and share historical underpinnings. They only differ on environmental dynamism were the environment of MLCD is characterized by fierce rivalry with a large number of competitors and customers while MPD's environment, as mentioned earlier, has a moderate level of competitiveness with few competitors and customers.

Jick (1979) suggest that triangulation can improve confidence in the research. Triangulation is broadly defined by Denzin (1978) as "the combination of methodologies in the study of the same phenomenon" (1978: p291). In case future research will build on the research covered in this thesis, a comparative study using both qualitative and quantitative research methods could enhance credibility of the results.

Level of analysis in this thesis has focused on business unit. Most ambidexterity research has focused on corporate (e.g. He & Wong, 2004), or sub-organizational units (e.g., Tushman & O'Reilly, 1996; Adler et al., 1999). Future research on how to resolve the tension between exploration and exploitation could investigate further the presence of the four attributes determined by Gibson & Birkinshaw (2004) and how they affect the two activities on an individual level.

7 References

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<http://nammo.com/>

<http://www.airforce-technology.com/projects/iris-t-air-air-guided-missile-germany/>

APPENDIX A: INTERVIEW GUIDE

Explain the constructs:

Transformational relationship – Innovative, recognizing own capabilities, inspiring

Transactional relationship – enforces rules, intervene in problems, maintain status quo

Exploitation - search, risk taking, play, flexibility, discovery and innovation

Exploration - refinement, production, efficiency, selection, implementation and execution

Innovation:

- Could you explain the importance of innovation in the organization
- How does management communicate the importance of innovation?
- Are all hierarchical levels included in innovation processes?
- Could you describe how one technical innovation of your choice was conceived and developed in the organization
- To what extent are external resources used for exploratory and exploitative activities
- To what extent are employees encouraged to use own judgment when balancing exploration and exploitation

Market:

- How does the market influence internal activities
- To what extent are sub tier suppliers involved in exploratory activities

Organization:

- In your words, what characterizes the organizational structures
- How are activities balanced between exploration and exploitation in the organization
- Are there organizational structures in place to support exploratory and exploitative activities?
- Are exploration and exploitation performed in parallel or sequentially?
- Are employees encouraged to bring new ideas and are there any kind of reward structure
- Would you consider MPD as a formal or informal organization

Communication:

- How would you characterise knowledge flow in the organization?
 - Top-down
 - Bottom-up
 - Data and knowledge
 - Horizontal

Trade-off

- How does the organization balance between exploration and exploitation

Leadership

- What characterises leadership at Nammo
 - Transaction or transformational?