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The Ambidextrous Organization Antecedents of Exploration and Exploitation

Examining Nokia's Growth to Market Leadership and Failure at Renewal

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Acknowledgements

Writing this thesis has been a long process. It started with a desire to explain anomalies I had experienced while working at Nokia from the year 2000 to 2009. I could not quite understand why things worked the way they did, and events at the company after I left their service made me even more confused. This was not necessarily the best possible starting point for a thesis, I lacked a clear focus as there were many different aspects that interested me. On the other hand, curiosity is a good driver for research. Now, many years later, I think I have answers to some of my questions.

First of all, thank you Prof. Anssi Öörni for your help with the thesis. Your insightful comments have improved the text tremendously. There are generic comments and then there are comments where you realize the person has waded through a sometimes muddy logic to find the flaws you are unable to see yourself. You have provided the latter.

I wish to thank Professors Hannu Salmela and Risto Rajala for acting as examiners, and Prof. Risto Rajala for agreeing to act as my opponent. There are also many colleagues at Åbo Akademi who I have had the pleasure to work with over the years, thank you all. I have been fortunate to get to know many fantastic people. Here, I especially wish to thank Piia Hirkman for the fun and engaging discussions, as well as the work we did on joint papers. Thank you Kaj-Mikael Björk and Xiaolu Wang for the many late-night discussions on both academia as well as everything else, and generally for making life more fun.

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Henrik Nyman

Abstract

A persistent question in strategic management is how organizations learn new things while also making use of current competences. In this thesis, I will examine how Nokia grew to become a leader in telecommunications, and how this leadership position was eroded when new competitors entered the market. I will examine the turn of events at Nokia through a lens of exploration and exploitation, defined as the capacity to develop new competences and seek new venues of business, and the ability to benefit from existing competences. The ability to do both at the same time has also been denoted as ambidexterity. Studies indicate that ambidexterity can support the long-term competitiveness of companies, especially those operating in more dynamic environments such as high-tech.

However, the exact mechanisms for supporting ambidexterity remain unclear. We still do not fully understand how external factors influence the propensity for exploitation and exploration, nor is it clear how internal strategic choices, structures, and cultures influence ambidexterity. In many cases, companies pursue simultaneous exploration and exploitation by separating focus between different units. In practice, this can involve units that focus on research and development, that is, exploring, while core business activities are taken care of by operative units that exploit existing business opportunities. At the same time, there are other ways of balancing between exploration and exploitation, and many organizations struggle with reconciling a disparate focus in different units.

In this thesis, I will examine Nokia's ability to explore and exploit from the start of the nineties until the mobile phone division was divested in 2013. The findings are based on a combination of interviews for the included articles and secondary sources in this thesis summary. My findings indicate that the starting point for successful exploration is a clear definition of strategic intent. This becomes particularly important if the organization is faced with exogenous shocks such as disruptive innovations, like Nokia did when new competitors entered the market from 2007 onwards. Conditions like these might also require a re-definition of strategic intent. Further, ambidexterity relies on structures and cultures that are maintained through a balance of formal and informal control. In practice, this means that focus and ways of working is governed not only by clearly specified processes, rules, and incentives, but also with the help of unwritten mechanisms such as group norms, organizational culture, and values. This balance between different modes of control was skewed at Nokia, both in the nineties and from roughly 2007 onwards. Lastly, ambidexterity relies on multiple forms of balancing between exploration and exploitation. Separate units that focus on exploration might be a necessary but not sufficient precondition for ambidexterity. From 2007 onwards, Nokia relied extensively on separate organizations for exploration, both internal units and external partners.

Abstrakt

En återkommande fråga inom strategisk ledning är hur organisationer lär sig nya saker samtidigt som de utnyttjar befintliga kompetenser. I den här avhandlingen kommer jag att undersöka hur Nokia växte till en marknadsledare inom telekommunikation och hur denna ledande position urholkades när nya konkurrenter kom in på marknaden. Jag kommer att undersöka händelseutvecklingen på Nokia med hjälp av teorin om utforskning (exploration) och utnyttjande (exploitation). Exploration är förmågan att utveckla nya kompetenser och söka nya affärsområden medan exploitation beskrivs som förmågan att utnyttja befintliga kompetenser. En samtidig kapacitet för båda har också betecknats som organisatorisk ambidextri. Tidigare forskning påvisar att ambidextri stöder företagets långsiktiga konkurrenskraft, särskilt i mer dynamiska miljöer.

De exakta mekanismerna som möjliggör ambidextri är dock fortfarande oklara. Vi förstår inte fullt ut hur externa faktorer påverkar benägenheten att utforska nya kompetenser och det är inte fastställt hur interna strategiska val, strukturer och kulturer påverkar ambidextri. Företag har också ofta ett separat fokus på forskning och utveckling i skilda enheter medan den operativa verksamheten utnyttjar befintliga kompetenser. Tidigare forskning lyfter emellertid fram svårigheterna med att utnyttja nya kompetenser utvecklade i olika enheter. Samtidigt finns det också andra sätt att skapa en balans mellan utforskning av nya kompetenser och utnyttjande av befintliga kompetenser.

I denna avhandling kommer jag att koncentrera mig på en period som sträcker sig från början av nittiotalet fram till avyttringen av Nokias mobiltelefondivision år 2013. Mina resultat baserar sig på intervjuer samt sekundära källor. Resultaten lyfter fram vikten av ett tydligt definierat strategiskt fokus för att möjliggöra utforskning av nya kompetenser. Detta är särskilt viktigt om marknaden förändras radikalt, precis som fallet var för Nokia när nya konkurrenter kom in på marknaden år 2007 och 2008. Dylika förändringar kan också kräva att det strategiska fokuset omdefinieras. Ambidextri kräver också strukturer och kulturer som upprätthålls genom en balans mellan formell och informell kontroll. I praktiken innebär det att fokus och arbetssätt inte enbart styrs av tydligt specificerade processer, regler och incitament, utan också med hjälp av underförstådda mekanismer som gruppnormer, en organisationskultur och värderingar. Denna balans mellan olika former av kontroll fanns inte på Nokia under nittiotalet och från år 2007 framåt. Därtill kräver ambidextri flera olika former av balansering mellan utforskning av nya kompetenser och utnyttjande av befintliga kompetenser. Separata enheter som enbart fokuserar på utforskning av nya kompetenser kan vara nödvändiga men det krävs också andra sätt att stöda utforskning och utnyttjande. Från år 2007 framåt förlitade sig Nokia i stor utsträckning på separata organisationer och enheter för byggandet av nya kompetenser. Dessa representerades av både externa företag och olika interna enheter.

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1. Introduction

An enduring question in strategic management is how companies make use of existing competences for efficiency, while developing new competences in response to changing market conditions (Levinthal and March, 1993). In this thesis, I will examine turn of events at Nokia through a lens of exploration and exploitation (March, 1991), defined as the capacity to develop new competences and seek new venues of business (i.e., explore) and the ability to profit on existing competences (i.e., exploit). The capacity for simultaneous exploration and exploitation has also been conceptualized as ambidexterity (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2013). Studies show that ambidexterity can have a positive impact on firm performance, particularly for larger companies operating in high-tech (Uotila et al., 2009; Junni et al., 2013; O'Reilly and Tushman, 2013).

I have a personal interest in Nokia, as I worked there for a fairly long period of time. However, it is also a tale of a company on the brink of bankruptcy that in less than ten years became a market leader in an entirely new industry: mobile phones and telecommunications equipment. This is not perhaps a unique story, but what makes it even more fascinating is how quickly the tide would turn. In 2013, Nokia sold its mobile phone business to Microsoft, a previous partner in the development of smartphone operating systems. This was the culmination of a series of events that started with the introduction of Apple's iPhone in 2007. In mere six years, the undisputed market leader was faced with a situation where a large part of its business would be divested, later to be shut down completely.

In 2007, Nokia produced and sold roughly 13 mobile phones per second while reporting very good financial results (Nokia, 2008). As such, Nokia had an ability to exploit. It can also be argued that the rapid growth to market leadership required exploration and new competences, while the turning tides after 2007 could be attributed to a lack of said ability. As such, both exploration and exploitation contributed to Nokia's success, whereas a lack of exploration could have impeded Nokia's performance from 2008 onwards (cf. March, 1991; Tushman and O'Reilly, 1996; Uotila et al., 2009; O'Reilly and Tushman, 2013; Junni et al., 2013). Given this, exploration and exploitation are suitable constructs to examine the turn of events at Nokia.

Nokia's rise to fame and decline to obscurity in mobile phones has garnered the interest of both popular press and academics (see, e.g., Cord, 2014; Vuori and Huy, 2016; Doz and Wilson, 2018; Lamberg et al., 2019). However, the analysis of success and failure in business is fraught with challenges. Laamanen et al. (2016) note that success and failure are often depicted in black-and-white terms with no middle ground. They focus specifically on Nokia and note the same phenomenon, either the company did "everything right" or it was a complete failure. Rosenzweig (2014) discusses this phenomenon at length and posits that firm performance as a dependent variable in a study is problematic. Briefly put, people tend to attribute positive characteristics to companies that

perform well and vice versa, describe poor performance with negative connotations. Correlation and causality are effectively treated the same; some studies assume that attributes associated with positive or negative performance can be applied universally (March and Sutton, 1997). However, Rosenzweig (2014) posits that it is more likely that performance leads to a particular characterization of an organization rather than these characteristics themselves leading to either good or bad performance. In other words, organizational performance impacts how the organization is depicted, and reliable information about what activities lead to either good or bad performance is thereby difficult to assess.

The basic premise of this case study is to document Nokia's rise to fame and subsequent failure. At the same time, firm performance is not the dependent variable. Instead, I will use exploration and exploitation as dependent variables, and look at the antecedents and consequences of these constructs. In other words, what enables or impedes ambidexterity, and what are the consequences of ambidexterity or a lack thereof? Rather than only looking at the challenges Nokia faced from 2008 onwards, I will examine Nokia's development over a longer time (cf. Vuori and Huy, 2016; Lamberg et al., 2019). In practice, I will examine Nokia's actions and ability to explore and exploit from the start of the nineties until the mobile phone division was divested in 2013.[1] In my analysis, I will use a combination of first-hand accounts, that is, interviews done for the articles included in this thesis, as well as secondary sources to present new ways to support ambidexterity in an organization. To avoid a biased explanation, I will also compare Nokia to other companies that experienced similar changes to their operating environment. Further, I will also return to alternative explanations to Nokia's troubles in the conclusion of this thesis summary.

The following section details the theoretical underpinnings of the thesis, that is, the concepts and theories I have used in my analysis. This is followed by a more detailed account of the research gap and theoretical contribution of the thesis.

1.1. Theoretical Underpinnings

Figure 1 contains the concepts and theories I have used in this thesis to conceptualize ambidexterity and the antecedents of exploration and exploitation. The concepts indicated in bold were used in the publications included in the thesis. As Nokia experienced severe market turbulence, I have also used the theory of sustaining and disruptive innovations to complement my analysis in this thesis summary.

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[1] The decision to sell the mobile phones business unit was made in 2013, the deal was eventually closed in 2014.

In his seminal paper, March (1991, p. 71) talks about maintaining a balance of *exploration and exploitation* defined as follows:

> "Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution."

Subsequently, exploration has been limited to developing new knowledge and competences, whereas exploitation denotes an ability to utilize existing competences (Levinthal and March, 1993). March further argues that exploration or exploitation at the expense of the other leads to suboptimal firm performance. As such, maintaining a balance between exploration and exploitation has been an object of substantial academic debate. *Organizational ambidexterity* has been defined as the ability of the firm to host multiple contradictory resource set-ups (Tushman and O'Reilly, 1996). Essentially, this implies at a capacity to both explore and exploit, to compete in both mature and new markets (O'Reilly and Tushman, 2013). In other words, ambidexterity is a way to secure both the short-term and long-term performance of the company.
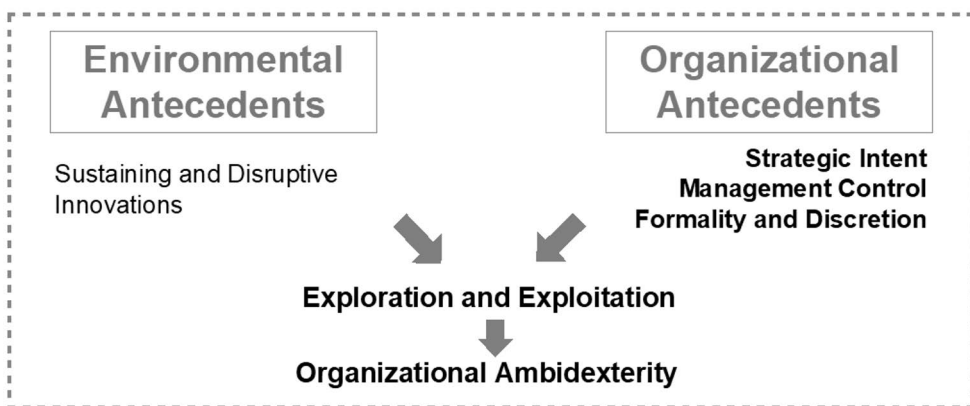
Figure 1 Theoretical underpinnings

The concrete mechanisms for achieving ambidexterity remain somewhat ambiguous, and more research on the topic has been called for (O'Reilly and Tushman, 2013). In their seminal article, Tushman and O'Reilly (1996) note that ambidexterity requires an alignment of *strategic intent*[2], structure, and

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[2] Originally, Tushman and O'Reilly defined this as 'strategy'. Strategy can be seen as a very multi-faceted concept (see, e.g., Mintzberg et al., 2009). In later works, they also define strategy as 'strategic intent' (O'Reilly and Tushman, 2008; O'Reilly and Tushman, 2013).

culture.[3] O'Shannassy (2016) defines three common elements in definitions of strategic intent: 1) a vision for the direction of the organization, 2) principles for resource allocation to support that direction, and 3) a sense of foresight that permeates the organization. For this thesis, strategic intent is defined as the intentionality and cognition of senior management in defining an overarching set of goals that guide activities and resource allocation. This effectively also creates a shared view of what the organization stands for. In this thesis, I will look at the effect of a clear strategic intent (or lack thereof) on the propensity for ambidexterity. Structures, in turn, refer to the way the firm executes its operations, including the ways power, resources, activities, and responsibilities are distributed (Lavie et al., 2010). Culture pertains to the norms and values that members in an organization use to guide their work (Lavie et al., 2010). While there is a notion that structures support exploitation and culture supports exploration, there is little or no empirical evidence pertaining to how a combination of structure and culture leads to ambidexterity (Lavie et al., 2010; Burton and O'Reilly, 2021). This is a key focus of this thesis.

To provide a more detailed account of the structures and culture that support ambidexterity, both are conceptualized in the thesis through *management control* (Ouchi, 1979; Ouchi, 1980). In practice, Ouchi's model for management control details the mechanisms that govern and steer the organization. These control mechanisms can be categorized as bureaucratic control or as clan control. The former is based on explicit rules, processes, incentives, and ways of working, while the latter relies on informal rituals and ceremonies in the organization. Clan control is characterized by implicit ways of working that are not documented; in Ouchi's words, "it's just there" (Ouchi, 1979, p. 840). However, this does not mean it cannot be influenced, nor that the impact of clan control would be insignificant. As such, a key focus of the thesis is to empirically validate how bureaucratic and clan control enable ambidexterity (cf. Tushman and O'Reilly, 1996; Burton and O'Reilly, 2021). Management control as outlined by Ouchi is typically analysed in the context of the line organization. However, I will also examine temporary project organizations and their impact on ambidexterity. Projects are typically reliant on explicit ways of working defined in a project management methodology (Joslin and Müller, 2016). These methodologies have also been characterized as the antithesis of what exploration in projects requires (Lenfle, 2008). While projects at Nokia were typically reliant on a methodology, several new innovations and competences were developed in a project mode of working

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[3] Tushman and O'Reilly also included a fourth dimension to be aligned: people, referring to specific skills in the organization. It could, however, be argued that the notion of exploration and exploitation already captures this aspect as the focus is on the utilization of existing competences and acquisition of new competences. For this thesis, I will assume that Nokia had the means to hire, develop, and retain necessary people.

(Laukkanen, 2012). This would assume that some projects exhibited less reliance on explicit ways of working. To understand this phenomenon, I have used the notion of *formality and discretion* to understand project work (Naveh, 2007). These constructs that look at how projects are governed and work therein organized. Discretion can be seen as autonomy in the project team to adapt practices to changing conditions, whereas formality assumes the project work is governed by pre-defined rules, processes, and structures (Tatikonda and Rosenthal, 2000).

Discontinuous change (e.g., big technology transitions) as opposed to incremental change typically requires a reorientation of strategic intent, structure, and culture, that is, a renewed alignment of the organization (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2021). Arguably, Nokia experienced such a discontinuous change with the introduction of new competitors from 2007 onwards. Incremental and discontinuous change has also been conceptualized as *sustaining and disruptive innovations* (Christensen, 1997).[4] Essentially, sustaining innovations improve the performance of existing products, while disruptive innovations introduce a new value proposition. According to Christensen, these disruptive innovations tend to underperform compared to established products, only to later surpass mature products in terms of performance. This was also the case with the new competition Nokia faced, something I will examine further in Chapter 7 of the thesis. O'Reilly and Tushman (2008; 2021) have also argued that ambidexterity is a key capability to cope with disruption. In essence, they argue that exploration is paramount in crafting a response to market disruption.

1.2. Research Gap and Theoretical Contribution

My intention with this thesis summary is to expand on the publications included in the thesis and examine a series of events to analyse antecedents of organizational ambidexterity and practical ways to balance between exploration and exploitation. Three of the publications included in the thesis are studies focusing on Nokia. This thesis summary expands on these studies with an in-depth review based on secondary sources.

Expanding on the concepts and theories outlined in Figure 1, Lavie et al. (2010) present a framework to analyse the antecedents, trade-offs, modes of balancing, and performance implications of ambidexterity. In introducing their framework, Lavie et al. (2010) stress that they wish to critically review prior research and review concerns regarding exploration and exploitation as constructs, raising several questions around antecedents of ambidexterity that require further research. Subsequent scholars have raised similar concerns (e.g., O'Reilly and Tushman, 2013; Wilden 2018; Burton and O'Reilly, 2021).

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[4] Originally, Christensen used the term disruptive 'technologies', and only later changed the wording to 'innovations'. Both work in the context of this thesis, but the word 'innovation' is useful in a larger context to illustrate the broader implications for Nokia.

These open questions can broadly be divided to four categories: 1) the role of discontinuous change in the form of *exogenous shocks*, 2) the role of organizational *structures and culture* 3) the role of senior management in defining a *strategic intent* for the company and through that, managing a balance between exploration and exploitation, and 4) what *mode of balancing* between exploration and exploitation works best?

Scholars have also called for a return to a view of ambidexterity as a capability to resolve tensions on different levels in the organization (Nosella et al., 2012; O'Reilly and Tushman, 2013). This notion has two consequences: 1) we need to understand how tensions are resolved in different contexts, such as the larger organization, units within it, in temporary projects, and by individuals, and 2) we need to account for what a resolved tension means in practice. In assessing the latter, I believe we need to distinguish between exploration as an activity and as a capability. In this view, exploration as an activity implies at specific efforts guided towards renewal, such as research and development. Most larger companies do this. However, exploration as a capability means that tensions are resolved, and that these exploratory efforts produce results that lead to increased firm performance. In effect, exploration creates opportunities that are exploited for effect (Lavie et al., 2010). As such, successful balancing between exploration and exploitation implies at a capability to explore combined with exploitation of both existing and new competences.

Lavie et al. (2010) note that it is unclear how major market changes in the form of *exogenous shocks* affect the propensity for exploration and exploitation. Despite a need for exploration in the face of change (cf. O'Reilly and Tushman, 2008; 2021), some organizations might "salvage their past investments" rather than engage in exploration (Lavie et al., 2010, p. 120). A similar call for research on the environmental antecedents of exploration and exploitation is put forward by Wilden et al. (2018). They note that particular attention should be given to environmental context, and how exploration and exploitation evolve over time. In this thesis, exogenous shocks are conceptualized with the help of Christensen's (1997) notion of disruptive innovations. Further, the exact *structures and culture* that support ambidexterity remain somewhat unclear, despite the long history of research in the field (Lavie et al., 2010; O'Reilly and Tushman, 2013; Burton and O'Reilly, 2021). I will examine structures and culture at Nokia with the help of Ouchi's (1979) notion of management control, which provides a clear framework to identify the mechanisms pertaining to structures or culture, respectively. This will help in understanding the exact role of organizational structures and culture in promoting ambidexterity. The role of senior management is also outlined as a venue for future research, particularly relating to how the inherent contradictions between exploration and exploitation are managed (Lavie et al., 2010; O'Reilly and Tushman, 2013). The *strategic intent* of the company is an essential way for senior management to manage these contradictions, as it guides resources and activities towards exploration or exploitation (O'Reilly and Tushman, 2008). Organizational

evolution and market discontinuities might, however, require a redefinition of strategic intent. This can create a paradox between the old and the new (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2013). More research on how this paradox can be managed has been called for (O'Reilly and Tushman, 2013).

Lavie et al. (2010) also outline specific mechanisms, such as structurally separate units focusing on exploration that enable a balance between exploration and exploitation. At the same time, they raise the question of what the best *mode of balancing* between exploration and exploitation is. There are also indications that ambidexterity is dependent on the use of multiple modes of balancing, suggesting that ambidexterity requires a combination of structural means and an organizational context that enables individuals to divide their time between exploration and exploitation (Ossenbrink et al., 2019; Foss and Kirkegaard, 2020). In contrast, some scholars propose that organizational separation is a necessary precondition for exploration, that is, separate units such as R&D labs are always needed for exploration (Kauppila, 2010; O'Reilly and Tushman, 2013). There is, however, conflicting evidence regarding this, suggesting that individuals can engage in exploration irrespective of whether the unit is tasked with exploration or not, indicating that more research on the topic is needed (Ossenbrink et al., 2019; Foss and Kirkegaard, 2020).

Table 1 summarizes the research gaps and specific research questions I will address through an in-depth case study of Nokia. In addition to the research gaps in Table 1, Lavie et al. (2010) posit that there are other antecedents where the implications on exploration and exploitation are clearer. A high degree of competitive intensity and absorptive capacity promote exploration. Competitive intensity increases with the number of competitors in the market whereas absorptive capacity refers to the capability to assess the value of external knowledge and utilize it internally. These aspects from Lavie et al.'s framework are included in the analysis to broaden the perspective and get a holistic view of Nokia's ambidextrous capabilities.

Table 1 Questions regarding exploration and exploitation as constructs

Topic	Question	References
Exogenous shocks	*Research gap:* Under what conditions do organizations respond to exogenous shocks with exploration versus exploitation? In this thesis, the theory of disruptive innovation is used to conceptualize exogenous shocks. *Research question (specific for this thesis):* Did Nokia explore when faced with market disruption?	Lavie et al. (2010) Wilden et al. (2018) Christensen (1997)

Topic	Question	References
Organizational structure and culture	*Research gap:* What is the role of organizational structures and culture in promoting ambidexterity? In this thesis, management control is used to conceptualize structure and culture. Formality and discretion are used to conceptualize the role of pre-defined processes and structures in projects. *Research question:* How did various forms of management control support ambidexterity at Nokia?	Lavie et al. (2010) O'Reilly and Tushman (2013) Burton and O'Reilly (2021) Ouchi (1979) Naveh (2007)
Senior management and strategic intent	*Research gap:* How can senior management reconcile and synchronize efforts at exploration and exploitation and how important is strategic intent in supporting ambidexterity? *Research question:* How did Nokia's senior management reconcile efforts at exploration and exploitation, and what role did strategic intent play in this?	Lavie et al. (2010) O'Reilly and Tushman (2013)
Balancing between exploration and exploitation	*Research gap:* What is the best mode of balancing between exploration and exploitation? *Research question:* What modes of balancing between exploration and exploitation were successful at Nokia?	Lavie et al. (2010) Kauppila (2010) O'Reilly and Tushman (2013) Ossenbrink et al. (2019) Foss and Kirkegaard (2020)

1.3. Approach

This summary part of the thesis is built upon findings in the included publications, which are expanded upon with a more extensive review of secondary data. Using the theoretical foundation outlined in Chapters 2 and 3, secondary sources are used to examine a series of events at Nokia (cf. Lamberg et al., 2019). In practice, I have analysed these events considering their antecedents and outcome in terms of exploration or exploitation. I have also looked at what form of balancing was practiced. The analysis of these events will then be used to answer the questions outlined in Table 1. The data analysis approach is discussed in more detail in Section 4.3.

1.3.1 The Unit of Analysis

Previous research has looked at ambidexterity on different levels: from the individual's perspective, on a project level, at a firm level, and as partnerships between firms (Li et al., 2008; Nosella et al., 2012). According to Li et al. (2008) this has created some confusion as the unit of analysis is different. In this thesis, I will try to encompass all the above levels, while being cautious to separate and indicate the unit of analysis clearly. As earlier noted, many different perspectives are likely needed for successful ambidexterity (Ossenbrink et al., 2019). In other words, individual judgement, organizational traits, projects, and partnerships between firms can all contribute to ambidexterity. Further, Chandrasekaran et al. (2012) note that the effects of exploration typically materialise over time. Given this, I will examine Nokia's ambidextrous capabilities over a longer time. The turn of events at Nokia are categorized chronologically into three different time periods: 1992-1998, a period of rapid market expansion is examined in Chapter 5, market dominance from 1999 to 2007 is examined in Chapter 6, and new competition entering the market in 2008-2013 is examined in Chapter 7.

Laukkanen (2012) has studied Nokia, specifically through various product innovations. The products and services examined were developed in a project mode of working, further warranting the need to understand how projects balance between efficiency and renewal. A project has been described as a temporary form of organization, typically formed for a pre-defined period to undertake a unique endeavour (Williams, 2005). Projects have become an integral part of the modern firm: new product development, the implementation of information systems, or the establishment of new ways of working are just a few examples of the activities that are co-ordinated in a project mode of working. If, for example, new product development is done in a project mode of working, the temporary organization becomes fundamental for operations. This was the case at Nokia. Given the prevalence and importance of projects for the modern firm, it is of essence to also understand this form of organization in relation to the objectives set out in this thesis. The temporary nature of the project also implies at different dynamics compared to the line organization; the intention is to look at what this means in practice for ambidexterity.

The temporary project organization can be used to complement capabilities in the line organization. Similarly, firms are typically reliant on external partners to achieve their goals. Complementing internal capabilities, external partnerships can be used to foster ambidexterity (Kauppila, 2010). In addition to exploratory capabilities, partners can also be used to enhance capabilities for exploitation. This typically involves the use of contract manufacturers and suppliers for efficiency (Kauppila, 2010). Supply Chain Management (SCM) is a practice and field of research that has its origins in companies that started seeing suppliers as partners, rather than entities working independent from the main business (Sherer, 2005). In practice, this entails "integrated behaviour" between partners, sharing of information, risks and rewards, as

well as joint processes and strategies for serving customers. In other words, with a supply chain focus the boundaries of the traditional firm become blurry. In addition to partnerships centred around exploratory capabilities, this thesis will look at how Nokia managed its supply chain for efficiency. In 1995 and 1996, Nokia experienced severe difficulties with its supply chain. The so called "logistics crisis" had a big impact on operations and Nokia's ability to serve its customers. Nokia's response was as expected, supply chain management capabilities had to be developed. These developments are also examined in more detail in the thesis.

1.3.2. A Note on Generalizability

In their paper on Nokia's troubles, Lamberg et al. (2019) criticize causal analysis in case studies. They note that their focus was on "choices instead of attributes" (p. 2), and that this is a sufficient and only way to explain why Nokia failed in meeting the needs of changing consumer preferences. In other words, they see theory building or testing from case studies as "tentative" as access to data is limited. I do not fully subscribe to their way of thinking. Their approach precludes generalizability, and I believe this is where the merits of this work should lie. At the same time, context is of paramount importance, and to a degree, it obstructs generalizability. Further, I do recognize the challenges with causal inference as not all alternative explanations can be accounted for. In a way, the approach in this thesis summary subscribes to Lamberg et al.'s (2019) notion of focusing on choices. I will examine a series of events to analyse their impact on exploration and exploitation. At the same time, my intention is to apply a theoretical framework to the analysis, and through that enrich our understanding of why things unfolded the way they did.

The topics outlined in Section 1.2 and Table 1 represent gaps in our current understanding of ambidexterity. While the analysis in this thesis will shed some light on these open questions, it is clear that a single case study cannot provide comprehensive answers to the outlined research gaps. However, I hope the developments analysed in this thesis are useful also in other contexts than the one studied here.

1.4. Included Publications

Table 2 contains a list of the original publications included in the thesis. The empirical data in the thesis is in the form of interviews in two case studies focusing on Nokia. Two other included publications are literature studies. Section 1.5 cross-references the publications with the chapters in this summary.

Table 2 Included publications and their organizational focus

#	Title	Method	Data	Org. Focus
1	Nyman, H.J. (2012), "An Exploratory Study of Supply Chain Management IT Solutions", *Proceedings of the 45th Hawaii International Conference on System Sciences*, 4-7 January, 2012, Maui, USA.	Analytical conceptual research	Structured literature review Personal experience	Supply chain capabilities at Nokia
2	Nyman, H.J. and Hirkman, P. (2012), "On the Nature of Supply Chain Management Projects and How to Manage Them", *European Conference on Information Systems 2012 Proceedings,* 10-13 June, 2012, Barcelona, Spain.	Analytical conceptual research	Structured literature review	Project management for SCM projects
3	Nyman, H.J. and Öörni, A. (2023), "Successful Projects or Success in Project Management - Are Projects Dependent on a Methodology?", *International Journal of Information Systems and Project Management*, Vol. 11, No. 4, 5-25.	Case study	Interviews	Temporary project organizations at Nokia
4	Nyman, H.J. (2023), "Management Control and Ambidexterity: How Nokia's Ambidextrous Capabilities Were Lost", *Academy of Management Annual Meeting Proceedings,* 4-8 August, 2023, Boston, USA.	Case study	Interviews Secondary sources	Management control in Nokia's line organization

Table 2 also outlines the organizational focus of the included publications. Publication #4 looks at Nokia from the perspective of the line organization. It examines Nokia's ambidextrous capabilities over a roughly 20-year time period. In addition to the line organization, publication #3 looks at how Nokia used the temporary project organization for ambidexterity whereas publications #1 and #2 have a supply chain capability focus. Publication #1 outlines specific information systems Nokia implemented to develop new SCM capabilities. Publication #2 looks at project management for the development

of SCM capabilities and asks the question whether a more emergent project management methodology is needed.

1.5. Overview of the Thesis

Chapter 2 (The Ambidextrous Organization) examines the ambidextrous organization: what does a balance of exploration and exploitation entail and what are the established ways of achieving it? I will also examine performance implications of ambidexterity in more detail. Further, this chapter examines ambidexterity in a project and a supply chain context.

Chapter 3 (Antecedents of Ambidexterity) details previous research on environmental and organizational antecedents of ambidexterity. This includes a review of sustaining and disruptive innovations (Section 3.1) and management control (Section 3.4) that I have used to further conceptualize antecedents of exploration and exploitation.

Chapter 4 (Methodology) contains a discussion of the drivers for my research. With a background in industry, my intention and goal has been to present practically relevant results with a high degree of scientific rigour. The first part of the chapter discusses practical challenges in balancing between relevance and rigour. In Section 4.2 (Epistemology), I provide a brief review of the philosophical underpinnings for my research, also in the context of alternative views of the world. Section 4.3 (Research Methods) presents the research methods used in the thesis, while Section 4.4 (Quality in Qualitative Research) presents thoughts on what constitutes successful qualitative research. Section 4.5 details the events in Nokia's history that will be examined in more detail in Chapters 5 through 7.

Chapter 5 (A Rising Star and Growth Pains) looks at Nokia from the year 1992 to 1998. During this time, Nokia experienced the so called "logistics crisis" in 1995 and 1996. Events leading up to the logistics crisis are examined through a lens of organizational ambidexterity and management control. Further, Nokia's response to the logistics crisis is examined; *publication #1* details the information systems that were put in place to ensure supply chain management (SCM) excellence at Nokia. *Publication #4* looks at the management control mechanisms that were in place during this time, and how these resulted in a high reliance on exploration.

Chapter 6 (An Expanding Business) examines turn of events at Nokia from 1999 to 2007. Nokia had gained market leadership for mobile phones in 1998, and the business continued to grow. The organization produced a host of innovations that are still ubiquitous in mobile devices. At the same time, there was a gradual shift towards efficiency at the expense of a forward-looking stance. *Publication #4* looks at how Nokia balanced between exploration and exploitation during this time, and how management control mechanisms evolved. *Publication #3* looks at the temporary organization, and how projects were steered at Nokia. Projects were perceived as important mechanisms for renewal, both in terms of product development and information systems.

Publication #2 compares traditional project management to agile project management, specifically for supply chain management projects. In building the SCM capabilities outlined in Chapter 5, Nokia largely relied on traditional project management. The included publication argues that some of these projects could have benefited from a more emergent project management style.

Chapter 7 (New Competition and Decline) looks at how changing consumer preferences created turmoil at Nokia. Following results presented in *publication #4*, this chapter also examines Nokia's difficulties in responding to new competitors and suggests that these difficulties were partly due to a misalignment of management control, leading to an overemphasis on exploitation at the expense of exploration.

Chapter 8 (Discussion) analyses the findings from Chapters 5-7 in light of the research gaps outlined in this chapter.

Chapter 9 (Conclusion) provides a summary and concluding remarks.

2. The Ambidextrous Organization

Ambidexterity as a term refers to a person's ability to use both of her hands with equal proficiency. In strategic management, it has come to represent firms that have an ability to engage in both exploration and exploitation. In essence, the ambidextrous organization can compete in both mature markets where efficiency and incremental improvement is important, as well as in new markets where flexibility and experimentation lie at the core of performance (Duncan, 1976; Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2013). Supporting the notion of competing in new versus mature markets, exploration has been conceptualized as the pursuit of new competences, while exploitation capitalizes on the firm's existing knowledge base (Levinthal and March, 1993; Li et al., 2008).

In Chapter 2, I will discuss various facets of ambidexterity, as well as different ways to balance between exploration and exploitation. Section 2.1 will examine ambidexterity and firm performance, that is, the consequences of exploration and exploitation in the short-term and the long-term. March (1991) noted that exploration and exploitation compete for the same resources and, as such, seeking the new happens at the expense of efficiency in the present. At the same time, more recent studies point at the complementary effects of exploration and exploitation. In short, exploration creates abilities that can be exploited, and exploitation creates revenue that can be invested in exploration (Lavie et al., 2010). This interdependency will be examined further in Section 2.2. A balance between exploration and exploitation can be achieved through different modes of balancing; the structural and contextual foundations of ambidexterity are examined in Section 2.3. I will also take a cross-boundary perspective, looking at ambidexterity in projects in Section 2.4, as well as in the supply chain in Section 2.5.

2.1. Ambidexterity and Firm Performance

Ambidextrous firms are characterised by an ability to compete in mature markets (exploitation), where for instance cost efficiency, customer service, and distribution are essential, while at the same time being able to compete in new markets (exploration), where for instance speed, flexibility, and the novel are crucial (Tushman and O'Reilly, 1996). As such, the firm can generate cash flow from established businesses through efficiency and structure, while at the same time being flexible and entrepreneurial. Exploitation has been seen as conducive to short-term performance, whereas exploration ensures longer-term performance (Levinthal and March, 1993).

March (1991) posits that performance stems from a balance of exploration and exploitation. There are also reports to the contrary, indicating that under certain conditions, financial performance might suffer from exploration (Van Looy et al., 2005). This is particularly true for firms operating in mature markets. Yet, empirical evidence suggests that in uncertain markets, more turbulent environments, or in conjunction with rapidly developing technology,

the positive effect of ambidexterity is pronounced (Uotila et al., 2009; Simsek, 2009; O'Reilly and Tushman, 2013; Junni et al., 2013). In other words, the industry the firm is operating in does matter, and the case company in this thesis would fall into the category where ambidexterity has an impact on firm performance. In practice, rapid technological development can change what customers perceive as the 'right product', forcing companies to adapt.

2.1.1. Successful Exploration and Exploitation

While ambidexterity correlates positively with firm performance in dynamic environments, there has been less academic attention to what constitutes successful exploration or exploitation on their own. This is perhaps more relevant in terms of exploration. Successful exploitation can easily be defined based on the outcome; a focused execution of current capabilities typically leads to measurable results. But what about exploration, the seeking of new competences, risk-taking, and innovation? If an organization takes a risk, that risk might realize, and the outcome might not be what was desired. In fact, it is hard to imagine a long strait of failed exploratory efforts positively contributing to firm performance. As such, an exploratory effort needs to be succeeded by exploitation, new competences need to be utilized. Lavie et al. (2010) note that exploration creates opportunities that *can* be exploited, or in other words "exploration evolves into exploitation" (p. 114). In effect, exploration is not only about the possibility to exploit opportunities; increased performance relies on the *actual* exploitation of said opportunities. In other words, too much exploration without exploitation can lead to a "failure trap" (Levinthal and March, 1993; Chandrasekaran et al., 2012, p. 134). Exploration can also be seen as a capability, whereby resulting performance gains materialize over time (Chandrasekaran et al., 2012). Given this, exploration is not only an activity, but rather a capability to first develop new competences and then "reap the fruits" of these competences. Put differently, when viewed on organizational level as opposed to sub-unit level, exploration and exploitation is not about a discrete choice between the two but rather a continuous process where the organization explores opportunities that subsequently are exploited, which in turn can lead to more exploration (Lavie et al., 2010). These viewpoints are necessary when examining the turn of events at Nokia and validates the need to understand the interdependency between exploration and exploitation.

2.2. Trade-offs and Interdependence

Many scholars, starting with the seminal papers by March (1991) and Tushman and O'Reilly (1996), imply that firms must reconcile between stability and change, the present and the future, and reliability and innovation. In practice, these studies emphasise the contradictory elements of exploitation and exploration and see them as inherently inconsistent. In other words, there is a trade-off between the two. In practice, decisions on resource allocation need to consider whether short-term productivity should be emphasized at the expense of long-term renewal. This of course assumes that resources are constrained, as they typically are. Leveraging existing knowledge also creates

a degree of reliability and predictability, whereas the search for new knowledge is essentially risk-taking: can new knowledge be capitalized to a sufficient degree? What level of exploitation is needed to hedge for investment in the future? As such, the outcome of exploration is always more distant compared to exploitation that focuses on productivity right now.

At the same time, the argumentation that exploitation and exploration are fundamentally interdependent is also supported in literature. Looking at exploitation and exploration from the perspective of stability and change, Farjoun (2010) argues that stability can be a precondition for change, and that change enables stability. He argues that many highly innovative firms rely on a high degree of structure, discipline, and rigidity in steering their innovation practices. Bureaucracy is used to its best, avoiding the negative aspects associated with too much structure (cf. Brown and Eisenhardt, 1997; Brown and Eisenhardt, 1998). In practice, this can take on the form of routines for job rotation and knowledge management that can give raise to new innovative paths by combining knowledge in new ways (Farjoun, 2010). Toyota can be seen as one example of this. Adler et al. (1999) have looked at how Toyota enabled simultaneous efficiency and flexibility, something they refer to as the "paradox of administration" (p. 43). For example, metaroutines and job enrichment are central to Toyota's standard operating procedures. Workers participate in standardisation processes, thus having an impact on how new routines or changes to old ones are carried through, sometimes leading to new and innovative paths. In addition, non-routine tasks are systematically added to routine work, creating a richer environment to support new ways of working.

The role of financial performance of the firm should also be examined in the context of efficiency supporting innovation. While high performing firms run the risk of becoming complacent, superior financial performance is still instrumental in creating slack. In practice, there is more room for risk taking when there is a financial surplus (Lavie et al., 2010). Furthermore, as earlier noted, the capability to exploit an innovation is central, otherwise the innovation will remain as a good idea that was never implemented. All in all, stability and structure (exploitation) can be a powerful foundation for change and innovation (exploration), that in turn will require exploitation for effect.

As exploration and exploitation are mutually interdependent, this brings to question how this interdependence manifests itself in practice. Gupta et al. (2006) argue that this is dependent on the unit of analysis and available resources. Within a smaller subunit, such as an individual or a small team, exploration and exploitation are typically mutually exclusive. However, looking at a larger organization, both can coexist provided that sufficient resources are available (cf. March, 1991). This view is consistent with much of the literature on the ambidextrous organization. Yet if exploration and exploitation are mutually interdependent, this begs the question whether both should take place in every unit or domain, irrespective of their primary focus. In the following section, I will discuss practical means for enabling ambidexterity.

2.3. Modes of Balancing

In an extensive review of literature, Lavie et al. (2010) define four alternative modes of balancing between exploration and exploitation for organizational ambidexterity. *Organizational separation* implies at separate units dedicated to either exploration or exploitation. This type of ambidexterity highlights the role of management in ensuring coordination at a corporate level (O'Reilly and Tushman, 2013). In practice, this entails separate units that focus on, for instance, research and development (R&D), having separate competences, systems, processes, cultures, and incentives to drive exploration, whereas the operative organization focuses on current operations, that is, exploitation. Put together, these form an ambidextrous organization. O'Reilly and Tushman (2013) define this form of ambidexterity as structural. The structural form of ambidexterity also includes *domain separation.* This mode of balancing assumes simultaneous exploration and exploitation in different domains through partnerships and alliances (Kauppila, 2010; Lavie et al., 2010). This can entail upstream or downstream alliances in the supply chain, either as changing (i.e., new) partnerships or by utilising the competences of existing partners. This aspect of organizational ambidexterity will be further examined in Section 2.5.

In contrast to simultaneous ambidexterity through structural means, *temporal separation* entails sequential steps between exploration or exploitation over time (Duncan, 1976; Lavie et al., 2010; O'Reilly and Tushman, 2013). Temporal separation works with underlying assumptions from the so-called punctuated equilibrium model (Tushman and Romanelli, 1985), suggesting that firms evolve through punctuated, sequential changes to adapt to changing external circumstances (O'Reilly and Tushman, 2013). Given the focus on changes over long periods of time, it has been suggested that temporal separation is more suitable in stable, slowly moving environments (O'Reilly and Tushman, 2013). However, "exploration projects" can also be a way to enable ambidexterity through temporal separation (Brown and Eisenhardt, 1997; Lavie et al., 2010; Chandrasekaran et al., 2012). This is a more pertinent proposition in the context of this thesis (see Section 2.4).

A fourth category, *contextual ambidexterity,* was originally proposed by Gibson and Birkinshaw (2004). Contextual ambidexterity works with an assumption that simultaneous ambidexterity is possible within the same unit. Rather than focusing on organizational structures or processes, as is the case with organizational, temporal, or domain separation, contextual ambidexterity is centred around the individual's ability, willingness, and practical possibilities to independently decide how to allocate time to either exploratory or exploitative activities (Gibson and Birkinshaw, 2004). Gibson and Birkinshaw (2004, p. 211) call for a "supportive organizational context" that relies on "stretch, discipline, support, and trust" (p. 214) to enable contextual ambidexterity. Wang and Rafiq (2014) discuss the need for a shared vision and organizational diversity for contextual ambidexterity. A shared vision embodies values and norms that individuals in the organization share that help

in reaching commonly agreed organizational goals. Organizational diversity is a common view that encourages and tolerates differences in viewpoints, skills, and knowledge. On a similar note, Andriopoulos and Lewis (2009) call for behavioural and social means for contextual ambidexterity.

Table 3 Modes of balancing, the unit of analysis, and form of ambidexterity

Mode of Balancing	Unit of Analysis	Form of Ambidexterity
Organizational separation	Internal line organization	Structural
Domain separation	Partnerships and alliances in the supply chain	
Temporal separation	Projects (Internal line organization)	Sequential
Contextual Ambidexterity	Individual	Contextual

Table 3 summarizes the different modes of balancing between exploration and exploitation, along with the unit of analysis and resulting "form" of ambidexterity. While temporal separation can focus on how the organization changes structures and processes over time, the focus in this thesis will be on how a temporary form of organization, that is, projects can enable exploration, exploitation, or both. Next, I will examine some of the criticism that has been put forward regarding the various forms of balancing between exploration and exploitation.

2.3.1. Choosing a Balance: Challenges and Interdependency

The practical ways of achieving organizational ambidexterity are elusive. Gupta et al. (2006, p. 697) conclude that "although near consensus exists on the need for balance [between exploration and exploitation], there is considerably less clarity on how this balance can be achieved".

Organizational and domain separation, that is, structural ambidexterity represents a classical notion of how ambidexterity can be achieved. After all, many companies employ separate entities tasked with looking to the future, either internally or externally. However, as noted by Smith and Tushman (2005) as well as O'Reilly and Tushman (2013), this creates a very practical leadership challenge: how is a separate structural focus aligned? This requires a common strategic intent, and practical mechanisms to later utilize new competences in the operative, "receiving" organization. As Lavie et al. (2010) note, this is not trivial. Senior management needs to manage the tensions arising from partly conflicting goals, and align efforts on an operational level in both the exploiting and exploring organizations (cf. March, 1991). As discussed in Section 2.1.1, senior management needs to ensure that exploration evolves into exploitation.

O'Reilly and Tushman (2013) posit that contextual ambidexterity is not the answer to how the firm should adjust to change. They argue that change, in

particular disruptive change, calls for senior management decisions regarding the strategic re-orientation of the firm, entailing for instance acquisition of new competences and other resources. At the same time, previous research raises the notion that contextual ambidexterity requires strong management support; management is responsible for building an organizational context that supports ambidexterity, legitimizing a focus on both exploration and exploitation (Martin et al., 2019; Maclean et al., 2021). The interdependent nature of exploration and exploitation also supports a notion that a balance of exploration and exploitation should be present everywhere, rather than separated over time or space when looking at the whole organization.

Increasingly, there is also evidence that organizations do not employ a single form of balancing, but rather that multiple forms of separation are used concurrently (Kauppila, 2010; Ossenbrink et al., 2019). Birkinshaw and Gibson (2004, p. 49) note that "contextual ambidexterity differs from structural ambidexterity in many important ways [...], but the two approaches are best viewed as complementary". Similarly, Adler et al.'s (1999) study of Toyota[5] as well as Foss and Kirkegaard's (2020) study of William Demant Holding showed that these companies employed both structural and contextual means for ambidexterity. This presents us with a dilemma and begs the question whether all forms of separation are intertwined. While this might be the case, this thesis will focus on investigating the organizational design, partnerships, and project setup that can support ambidexterity. In addition, I will look at means to ensure that individuals in these contexts can both explore and exploit. Next, we will examine ambidexterity through a temporary organization form, projects, and after that through partnerships in the supply chain.

2.4. Temporal Separation through Projects

Projects are often used as a temporary organization form for renewal. Projects have been characterized as an organization within the organization, specifically tasked with a unique endeavour (Williams, 2005; Sailer, 2019). While striving for something new, projects tend to rely on previous experience and adhere to predefined ways of working for efficiency. Thus, the tension between exploration and exploitation is also present in projects.

Predefined ways of working in projects, including rules, processes, and structures are typically defined in a project management methodology (Joslin and Müller, 2016). This is true for both stage-gate, "traditional" project methods, as well as for so-called agile projects. The primary difference between these two is the nature of planning. Traditional project management relies on a high degree of planning at the start of the project, whereas agile project management relies on iterative planning. The difference is not in the amount of planning, but in the timing of planning (Serrador and Pinto, 2015); is planning

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[5] Adler and colleagues did not specifically talk about ambidexterity, but their description of conditions at Toyota fit well to the notion of ambidexterity.

done ahead of the project or during the project? In essence, traditional projects rely on a sequential plan-build-deploy model, whereas activities in an agile project are adapted iteratively based on customer feedback (Fernandez and Fernandez, 2008). Both methods for running projects have their proponents, but the reasoning behind a standardized way of working, irrespective of method, is efficiency. In other words, predefined ways of working are supposed to lead to a desired outcome (Wysocki, 2009; PMI, 2017). Often, this means adhering to the triple constraints of scope, time, and budget (although agile projects might emphasize time to a lesser degree). In contrast to a uniform application of pre-defined practices for project success, a contingent view of project management assumes that project management is adapted to context (Hanisch and Wald, 2012).

Predefined practices defined in a project management methodology focus on decreasing variance and increasing efficiency. In other words, exploitation is emphasized. Temporal separation through projects would, however, assume that the project also focuses on exploration[6]. Previous research advocates a move away from the traditional plan-build-deploy model for projects when exploration is desired (Lenfle, 2008). Agile project management has been found more suitable for exploration projects (Sailer, 2019), along with studies advocating a contingent view of projects when exploration is desired (McGrath, 2001; Shenhar et al., 2016). Essentially this implies at the project adapting work practices to the external environment, and a move away from strictly defined practices, that is, a methodology. This practice of allowing the project team to deviate from pre-defined practices has been denoted as discretion, whereas a reliance on a methodology has been defined as formality in projects (Naveh, 2007). Formality is akin to bureaucratic control whereas discretion can rely on a combination of both bureaucratic and clan control, the key difference being whether the project team follows a pre-defined practice or develop their own way of working. In this thesis, I will examine how formality and discretion support or preclude exploration and exploitation in projects.

2.5. Domain Separation and the Supply Chain

In addition to the internal line organization and temporary project organization, firms also build ambidextrous capabilities through partnerships and alliances. Conceptualized as domain separation (Lavie et al., 2010), firms tend to balance internal capabilities with that of partners. Over time, this enhances either exploitation, exploration, or both (Lavie and Rosenkopf, 2006). On a similar note, Kauppila (2010) discusses exploitation partnerships and exploration partnerships. In a case study of Vaisala, a Finnish high-tech company in the field of environmental measurement, he describes how

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[6] The project could also focus on complementing exploratory capability in the line organization with exploitation. However, given that the line organization typically has a focus on exploitation, the opposite is the more likely scenario.

exploration was promoted through R&D partnerships with research institutes, and exploitation was promoted through contract manufacturing. Simsek (2009) concludes that the diversity of alliance partners contributes to organizational ambidexterity. In more practical terms, Dittrich et al. (2007) describe how IBM moved to a highly exploratory strategy through alliances, whereas Benner and Tripsas (2012) describe how the threshold for the introduction of digital cameras was significantly lowered by a highly developed supply chain of contract manufacturers. As such, firms can leverage strengths and compensate for weaknesses through partnerships in their supply chain.

3. Antecedents of Ambidexterity

Chapter 2 reviewed the performance implications, trade-offs, interdependence, and practical means of enabling a balance between exploration and exploitation. This chapter examines the antecedents of ambidexterity in more detail, more specifically the environmental, organizational, and managerial contexts that aid or preclude ambidexterity.

Starting with environmental antecedents as outlined by Lavie et al. (2010), *competitive intensity* and *exogenous shocks* constitute key environmental antecedents to ambidexterity. Competitive intensity is the extent to which competitors maintain a zero-sum relation to each other. In other words, an increase in competitive intensity typically means that competitors are not content with status quo, or that new competitors enter the market with the intent to capture market share. Exogenous shocks are essentially the extreme version of a dynamic market environment, characterized by an unexpected event or technology that redefines the market. An increase in competitive intensity typically drives exploration, whereas the effect of exogenous shocks on the propensity to explore and exploit is unclear (Lavie et al., 2010). In this thesis, I will examine competitive intensity and exogenous shocks through a lens of *sustaining and disruptive innovations* (Christensen, 1997). Essentially, I will argue that disruptive innovations create an exogeneous shock, whereas sustaining innovations lead to increased competitive intensity (cf. Lavie et al., 2010). According to O'Reilly and Tushman (2008; 2013; 2021), ambidexterity is a key capability when an organization is faced with disruption. This thesis will investigate whether this is the case. I will discuss sustaining and disruptive innovations in Sections 3.1 to 3.3, first in general terms and then specifically for the mobile phone industry.

Various organizational antecedents such as *absorptive capacity* and *organizational structures and culture* affect the propensity to explore and exploit. Absorptive capacity is the ability to assess the value of external knowledge and apply it to internal operations (Lavie et al., 2010). In practice, the ability to scan for external knowledge and apply it internally supports exploration. The exact organizational structures and culture needed for ambidexterity will be examined further in this thesis. These are conceptualized through management control, referring to how the organization executes its operations either through explicit or implicit mechanisms (Ouchi, 1979). I will examine these topics further in Section 3.4

Senior management plays a big role in managing contradictions between the new and the old, exploration and exploitation. Alignment between structure, culture, and *strategic intent* is necessary for ambidexterity (Tushman and O'Reilly, 1996; Lavie et al., 2010; O'Reilly and Tushman, 2013). I will examine the role of senior management in more detail in Section 3.5.

3.1. Sustaining and Disruptive Innovations

March (1991) characterized exploration as, among other things, innovation. The key dimension distinguishing innovations from business as usual is the novel element and a notion of change (Slappendel, 1996). As such, it is a forward-looking stance that enables the company to be re-oriented to serve customers in a new way (Mone et al., 1998). There are, however, different views on what innovation entails, also in relation to exploration and exploitation. Li et al. (2008) discuss incremental and radical innovations in the context of exploration and exploitation. They note that incremental innovation is typically based on the exploitation of the firm's existing knowledge base, whereas radical innovation requires exploration of new capabilities. Benner and Tushman (2002) define this as exploitative innovations based on the current technological direction, and exploratory innovations that shift towards a new technological trajectory. Christensen (1997) discusses technological progress in the form of sustaining and disruptive innovations.[7] Mature markets are typically characterised by sustaining innovations, whereas new markets are typically the result of disruptive innovation (Tushman and O'Reilly, 1996; Christensen, 1997). Sustaining innovations are typically incremental steps in the development of a technology, product, or service, whereas disruptive innovations are defined by their ability to completely displace established technologies and ways of working. In his view, the key difference between sustaining and disruptive innovations lies in whether existing products are updated, or new ones created. Disruptive products generally cater for a smaller customer base, a niche market, and these products frequently underperform the more mature, established products. Yet, they are often cheaper, simpler, or easier to use. In the long-run, product performance tends to increase and often, disruptive products displace older technologies. Incumbents tend to overlook these disruptive innovations, mainly due to the niche market, but also due to the investments made in their older technology. A key characteristic of disruptive innovations is that they have lower performance from the viewpoint of the mainstream market, whereas they can have higher performance in certain areas valued by an emergent market segment. This emergent market segment is typically willing to overlook the shortcomings in performance valued by mainstream consumers. However, as the performance increases, it starts to cater also for the needs of the mainstream market. In practice, this typically means that new features are introduced that change the basis of competition (Danneels, 2004).

In popular press and among the general public, photography is often used to illustrate how a disruptive innovation completely redefined business

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[7] As earlier noted, Christensen changed the wording from sustaining and disruptive 'technology' to 'innovation'. It could also be argued that 'business model' is a suitable word to be used (Christensen, 2006; Christensen et al., 2015).

models. A prominent example is Kodak, one of the most successful photographic film companies that eventually ended up bankrupt as digital photography gained ground. Looking at digital photography, the first digital cameras had poor quality in comparison with photographic film. However, they had features that were ground-breaking. While the cost of the camera was high, the cost of an individual picture was next to nothing. This completely changed the business model in terms of selling and developing film. Another ground-breaking feature was the almost immediate access to the photo as, again, film did not have to be developed. Over time, digital photography gained parity with film photography in terms of quality, eventually also surpassing it. Christensen (1997) includes diverse examples of this phenomenon in his book, such as the hard drive industry and steel mills. A crucial aspect to consider in these examples is that these companies were not unaware of the new technology that would come to have a profound impact on their business (Christensen, 1997). In fact, it was an engineer at Kodak who invented the first digital camera (Kreiser, 2012). As such, an overly emphasis on competing in mature markets took precedence over competing in new markets (Christensen, 1997; Christensen et al., 2015).

Disruptive technologies such as digital photography, have radical effects on the strategic intent, structure, and culture of the firm. This brings about a painful, but necessary, transition when a firm needs to capitalize on an innovation or develop a response to a competing disruptive innovation (O'Reilly and Tushman, 2021). At the same time, competing in mature markets requires incremental improvements in the form of cheaper or more powerful technology, typically having a big impact on costs and features. In other words, the same product can be offered at more competitive prices or with better features. As such, sustaining innovations are important to ensure efficiency in operations, potentially bringing about significant competitive advantage in the short-term. However, markets are not static; customer requirements change, and technology is in a constant state of flux, bringing about more competition. To this end, previous literature supports a notion that discontinuities happen frequently and continuously (Eisenhardt and Tabrizi, 1995; Tushman and O'Reilly, 1996; Brown and Eisenhardt, 1997).

In summary, many companies work in an environment of continuous change:

i)   in order to offer largely the same product as others but using sustaining innovations to lower cost or build products with better features. This increases competitive intensity.

ii)   in anticipation of changing customer requirements (the firm pushing for disruptive change), or

iii)   in response to fundamental changes to the competitive landscape (the firm reacting to an exogenous shock in the form of disruptive innovation).

Of these, the last category is perhaps the most difficult to cope with. It implies at a radical change to consumer expectations that can require dramatic changes to the firm's operations. At the same time, incremental or radical innovations that focus on competitiveness in an existing technological trajectory are also likely to contribute to high competitive intensity (cf. Lavie et al., 2010).
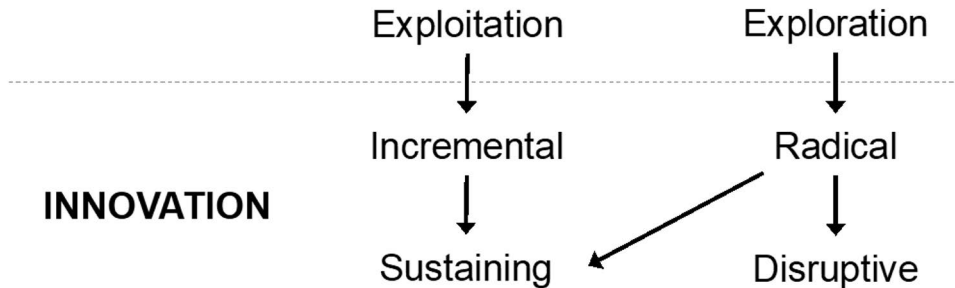
Figure 2 Exploitation and exploration and various forms of innovation

According to Lavie et al. (2010), competitive intensity and exogenous shocks act as antecedents to the propensity to explore or exploit. For the purposes of this thesis, I have examined these through a lens of incremental, radical, sustaining, and disruptive innovations. Figure 2 summarizes the relationship between these constructs and exploration versus exploitation. In essence, exploitation supports incremental innovation while exploration supports radical innovation (Benner and Tushman, 2002; Li et al., 2008). However, the relationship between incremental and radical innovation on the one hand and sustaining and disruptive innovation on the other is less straight-forward. According to Christensen (1997), radical innovation can also support sustaining trajectories. One such example would be the jet engine, which was a radical innovation compared to propeller-based aircraft. However, it largely served the same customers and did not significantly alter the product itself, the characteristics of an aircraft remained the same. As such, it was a sustaining innovation. Govindarajan and Kopalle (2006) maintain that the "radicalness" of an innovation is a matter of technology, while "disruptiveness" is a question of the market that is created. Or, as Christensen (2006, p. 48) puts it: "It [disruptiveness] is a business model problem, not a technology problem". Next, I will examine these concepts in the context of this thesis.

3.2. Disruption in the Mobile Phone Industry

One challenge in discussing the turn of events at Nokia is post rationalization, especially from 2008 onwards. This is evident also when discussing disruptive innovations, and what should have been done to counter the effects of new competitors entering the market. In fact, Christensen's theory of disruption was widely discussed and studied at Nokia, and Christensen himself did not initially deem Apple's iPhone as disruptive (Cord, 2014; Lindén, 2015). In practice, he deemed that Apple was "leaping ahead on the sustaining

trajectory" and building a better phone (Mcgregor, 2007, quote from interview). He changed his mind later. According to Christensen, he initially did not understand what was being disrupted: a mobile phone or a laptop (Bennett, 2014). According to him, it was the latter. A new user interface and the ability to easily install value-adding applications would indeed embody the promise of a true smartphone.[8] For many, this would become their primary computing device, often replacing a laptop or desktop computer. This is a very important point, as one could argue that the main feature of a modern smartphone is not to be a phone, but rather to provide access to applications and the Internet. The phone itself is an added bonus. Given this, I tend to disagree with Christensen, as a connected computing device in your pocket that also contains a phone in fact disrupted the traditional mobile phone, including what constituted a smartphone prior to the iPhone. As such, it was not a better phone on a sustaining trajectory, it was a new device that replaced earlier mobile phones. While smartphones prior to the iPhone (where Nokia commanded a respectable market share) did have similar features, application development was hard and access to applications was poor (see, e.g., Siilasmaa and Fredman, 2019 or Doz and Wilson, 2018). Further, access to the Internet was cumbersome, primarily because of the small screen but also because navigation was difficult as it required a physical keypad.

Apple was first in introducing a completely new approach to mobile application development reliant on an ecosystem of developers to promote the attractiveness of the product.[9] In line with Christensen (2006), this also had an impact on the business model. Further, the iPhone provided hardware reliant on capacitive touch screens for a new way of interacting with the device. Many of the technologies that Apple employed were in fact not new. Previous attempts at touchscreen user interfaces as well as developer communities had been tried, primarily by Nokia (I will examine this further in Chapter 6). Yet, the capacitive touchscreen was far more responsive than previously used resistive touchscreens.[10] As noted, application development was also seen as easy. At the same time, some deemed the technological features of the iPhone as inferior compared to established products. For example, the lack of a physical keypad was criticized, consumers could not change the battery, and the need for a "all-in-one" device was questioned (see, e.g., Cord, 2014; Buck, 2017). To a degree, this perception was also prevalent inside Nokia, something

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[8] A key feature in a smartphone is the operating system (OS) that allows for expansion and modification of the functionality through additional applications (Siilasmaa & Fredman, 2019).

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[9] Apple's App Store was opened in 2008, one year after the release of the first iPhone.

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[10] For a more in-depth explanation of the differences between capacitive and resistive touchscreens, see Dube (2018).

I will examine further in Chapter 6. As such, Apple's iPhone fit many of the traits Christensen (1997) outline for disruptive innovations: it catered for specific features that were valued by a niche market, but in some respects, it was technologically inferior to its counterparts.[11] However, as performance grew, Apple's iPhone and mobile platform set about a paradigm shift in consumer expectations. This was also later acknowledged by Nokia's CEO Stephen Elop in his (in)famous 'burning platform memo', where he concluded that "a battle of devices has now become a war of ecosystems" (Ziegler, 2011).

3.3. Responding to Disruption through Ambidexterity

As earlier noted, disruption can entail a company responding to disruptive change or itself being the disruptor. The context of this thesis pertains to the former, and the analysis is done after the fact. Criticism regarding the theory of disruptive innovation has been directed at its lack of predictive power (Danneels, 2004). Companies and senior management would need to predict disruption ex-ante, rather than after the event. The fact that Christensen himself stumbled regarding the disruptiveness of Apple's iPhone illustrates the problem. However, Govindarajan and Kopalle (2006) note that it is valuable to do an ex-post analysis of disruption, arguing it helps in understanding the characteristics of disruption, which in turn can help with the aforementioned problem. They also argue it helps in understanding the characteristics of companies with the power to disrupt. As such, by analysing a response to disruption, we can potentially learn what characteristics are needed for disruption. An additional factor to consider is that some incumbents prevail in the face of disruption. As noted by Danneels (2004), while some companies indeed fail in the face of disruptive innovation, this is not always the case (see, e.g., McKendrick et al., 2000; Komori, 2015). This begs the question why some fail at handling the effects of disruption while others succeed.

Facing disruptive change, O'Reilly and Tushman (2008; 2013; 2021) argue that the company needs to redefine its strategic intent, that is, the central goals that define activities and guide resource allocation. Following this, a realignment of structure and culture is necessary (Tushman and O'Reilly, 1996). Next, I will look at what this means in practice, namely how management control acts as an organizational antecedent of ambidexterity. I will return to strategic intent and the role of senior management in Section 3.5.

3.4. Management Control

Lavie et al. (2010) define organizational structure and culture as antecedents to exploration and exploitation. In terms of structures, Lavie and colleagues put forward that there are indications of formal structures constraining

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[11] Christensen also posits that disruptive innovations enter the low-end of the market (i.e., they are typically cheaper). This wasn't the case with the iPhone. Yet, Android would later occupy that part of the market.

exploration, but that results are inconclusive. Similar conclusions are brought forward regarding culture; a strong culture can both promote and discourage exploration depending on how the development of new knowledge is commonly viewed in the company. Similarly, Burton and O'Reilly (2021) note that despite an assumption that formal structures drive exploitation and culture drives exploration, there is little empirical evidence to support this notion. In my research, I have conceptualized structures and culture with the help of management control. I will also examine how organizational age and size influences the way control is typically applied in an organization.

Management control has been defined as the means with which the organization is managed to reach it objectives (Ouchi, 1979; Cardinal et al., 2004; Malmi and Brown, 2008). In practice, this implies that resources are obtained and allocated so that the organization's goals can be achieved (Lebas and Weigenstein, 1986). A notion of control is essential for any organization; control ensures a coordinated and cooperative effort to achieve organizational goals. Of note is that control is not necessarily an explicit process or code of conduct. It takes place in a social system and can as such also assume tacit and subtler forms, such as unwritten rules or codes of conduct (Lebas and Weigenstein, 1986). The context of the firm is for the most part characterised by some form of hierarchy. This implies a structure of controllers, typically managers, exercising authority through various mechanisms to ensure a regulation of behaviour of controlees, the subordinates. In practice, control mechanisms are devices that when implemented result in the regulation of behaviour (Kirsch, 1997). These could include processes and rules, but also, for example, stories that enact certain values and organizational culture. Control is applied in the line organization as well as in the temporary project organization. The supply chain is more complex, but the need for control for a cooperative effort remains.

Ouchi (1979) divides control into three categories: market, bureaucratic, and clan control. An important point in this categorization lies in the role of information in establishing control. In a market control set-up, prices convey information and enable easy comparison, and can thus act to regulate behaviour in an effective way. This can be compared to the influential work by Coase (1937) and Williamson (1981), concerned with where the boundaries of a firm should lie based on a notion of transaction cost economics. Oftentimes, it is easier to work towards a common goal in an organizational set-up whereby an authority exercises control. In this case, rules are needed. These are established through a bureaucratic mode of control. This is, perhaps, the "traditional" notion of control in many people's mind. There are guidelines, processes, work descriptions, and goals to abide to, and a supervisor is responsible for ensuring that this takes place. In the absence of or as a complement to rules, traditions can act to steer behaviour. This is the case with clan control, where social mechanisms act to regulate behaviour. This form of control is enacted through social interaction. In effect, it conveys what is "proper behaviour" (Ouchi, 1979). An example of clan control is the

socialization in certain professions. For example, nurses and doctors are indoctrinated with certain values. However, this same socialization process occurs in nearly every organization. To better illustrate this, we could consider an example where no bureaucratic control is exercised. In practice, this would mean that only those with a strong internal commitment to the organization's goal are hired and retained, and they are trusted to do their best (Ouchi, 1979). In practice, this means that empowerment and trust are key components of clan control.

In looking at the rule based, bureaucratic mode of control, we can also distinguish between how rules are enforced: are the activities of individual actors monitored, or is the outcome of these activities measured? We can thus divide the bureaucratic mode of control to two categories, behaviour control and outcome control (Ouchi, 1979; Kirsch, 1996; Kirsch, 1997). A similar refinement of clan control has been proposed, implying that it can be viewed on individual or group level (Kirsch, 1996; Kirsch, 1997). Further, we can consider whether there are explicit or implicit codes of conduct. This is captured by the concept of formal and informal modes of control (Kirsch, 1996; Kirsch, 1997). In other words, formal control implies at mechanisms that are documented, while informal control are the unwritten rules, values, and shared norms within an organization. Behaviour and outcome control constitute examples of formal control, while self and clan control are typically based on implicit mechanisms and can thus be described as informal control.

Figure 3 presents a taxonomy of control modes to synthesize and summarize the discussion on control. Prices drive market control, while rules and traditions are the basis of control in the line organization. This form of control is essentially based on authority, either explicit or implicit (Ouchi, 1979). Explicit authority manifests itself as formal control, either regulating behaviour or outcome. Typical examples of such mechanisms include guidelines, incentives, processes, or performance criteria (metrics), and performance measurement. Implicit authority manifests itself as informal control, either on an individual level (self-control) or group level (clan control). Mechanisms that regulate behaviour through informal means include individual goals and work ethic, as well as rituals, stories, and ceremonies that convey values, culture, and beliefs. For the purposes of this thesis, the most important distinction lies in explicit and implicit mechanisms of control. In other words, in Chapters 5 to 7, the focus will primarily be on distinguishing between authority based informal and formal control at Nokia.

Markets and authority can be seen as alternatives regarding how to organize the allocation of resources (Coase, 1937; Williamson, 1981). At the same time, there is also an awareness of both existing at the same time (Ouchi, 1979; Bradach and Eccles, 1989). For example, many firms employ internal transfer pricing. The franchising movement and complex supply chain networks creating value are other examples of this phenomenon. Setting aside the degree to which markets and authority are used, the notion of both guiding activities within the firm is evident. Any modern corporation is reliant on external

partners for help in delivering value to customers. As such, some degree of market control is always present. For the purposes of this thesis, the focus will be on control mechanisms pertaining to authority. However, behaviour can also be effectively steered through mechanisms such as business cases, market share targets, profit and loss statements, and product profitability calculations. In effect, these mechanisms often use price as a proxy to steer behaviour, albeit in a different way than in market control. They sanction or forbid the pursuit of the proposed actions. As such, I have viewed these as one form of formal bureaucratic behaviour control.
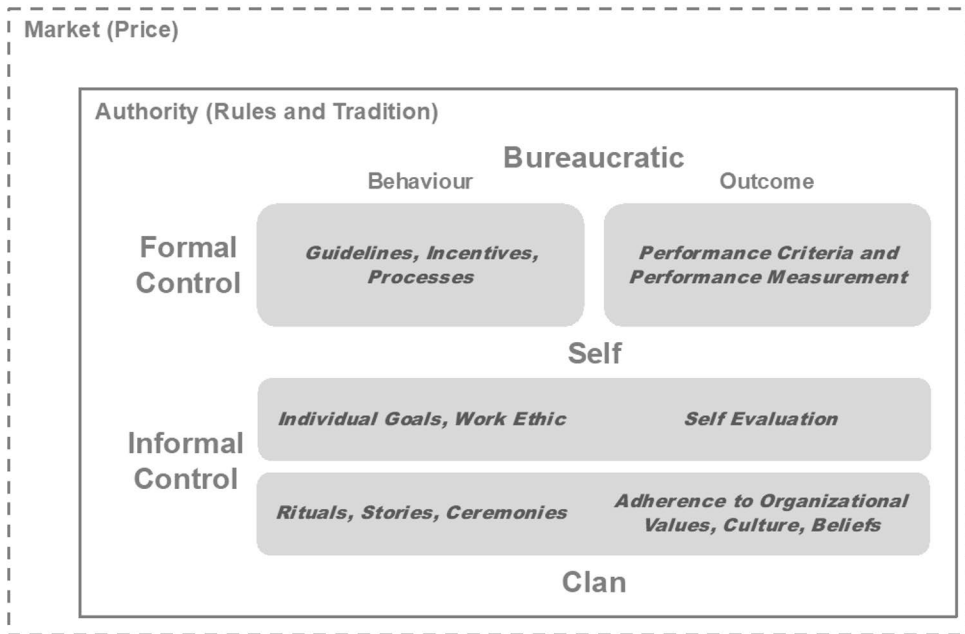
Figure 3 A taxonomy of organizational control

The size and age of the organization also affects how control is applied. Greiner (1998) notes that as organizations grow, autonomy (informal control) is gradually replaced with formal control. In other words, start-ups are typically more reliant on informal control, whereas more mature companies rely on formal control. However, having had challenges with an overly emphasis on formal control, successful organizations eventually tend to re-introduce "social control and self-discipline" (p. 7). As such, successful and mature organizations in fact rely on a balance of informal and formal control. A balance of control in this context can be seen as the "harmonious use of multiple forms of control" (Cardinal et al., 2004, p. 412).

Christensen and Overdorf (2000) note that a firm's capability to respond to competition lies in resources, processes, values, and culture. In essence, the first two are typically controlled through the bureaucratic control mechanisms outlined in this section. Values and culture, on the other hand, are defined as the decisions that employees make themselves in prioritizing their work. These

decisions are influenced through informal control. Through these capabilities, firms are typically adept at responding to sustaining technologies, while disruptive technologies pose a different challenge (Christensen and Overdorf, 2000). Capabilities also define what a firm *cannot* do, and they can turn into disabilities and rigidities (Christensen and Overdorf, 2000; Lucas and Goh, 2009). Lucas and Goh (2009) describe how such core rigidities prohibited Kodak to fully embrace digital photography. These rigidities are defined as the employee skills, technical systems that embed knowledge, management control systems, and values that prohibit a response to a disruption (Leonard-Barton, 1992). Kodak made several forays into digital imaging, especially from the late nineties onwards: a separate unit, Digital and Applied Imaging, was set up in 1997 and a digital transformation strategy was devised in 2003. However, significant infighting between the traditional business and the digital imaging unit ensued (Lucas and Goh, 2009; Shih, 2016). Simply put, the values and culture of the organization was not aligned with a new focus on digital imaging. Later, the same issue plagued the implementation of the new digital transformation strategy. Ho and Chen (2018, p. 365) note that the execution of the strategy was hampered as "the challenges the company faced were managerial and organizational rather than technical".
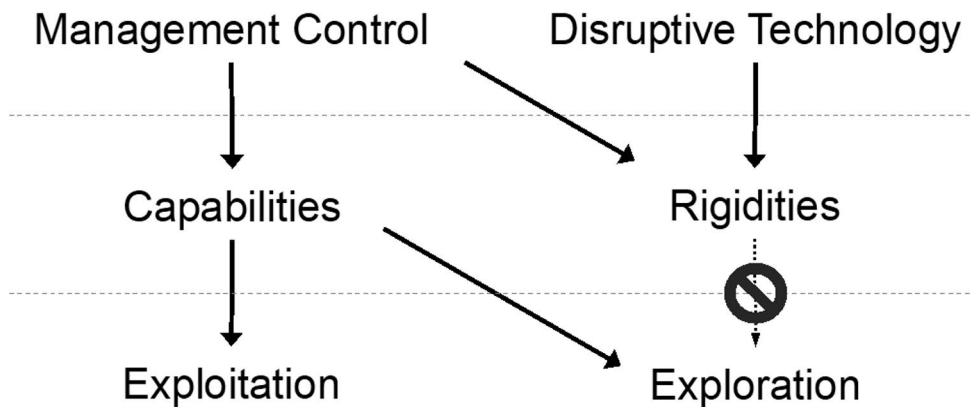
Figure 4 Management control as a foundation for capabilities and rigidities

As such, highly rooted capabilities that were appropriate in a given situation were inappropriate when faced with disruptive change (Lucas and Goh, 2009). On a similar note, O'Reilly and Tushman (1996) describe how companies develop structural and cultural inertia over time, rooted in structures, processes, and implicit norms and values, preventing a response to disruptive change. In other words, capabilities are used by the firm to compete, both in the face of sustaining and disruptive technologies, whereas rigidities prohibit change, especially in the face of disruptive technologies. Given this, capabilities can also be framed as the ability to explore and exploit, whereas rigidities effectively prohibit exploration (Lucas and Goh, 2009). As such, management control influences and builds the capabilities that drive exploitation and

exploration in the firm. At the same time, management control can also act to build rigidities. These principles are summarized in Figure 4.

In practice, rigidities are rooted in the processes, values, and culture of the firm (Christensen and Overdorf, 2000). So, what are examples of rigidities that prohibit exploration in the face of disruptive innovation? Lucas and Goh (2009) provide practical examples from Kodak and Digital Equipment Corporation that include a "nightmarish bureaucracy" (p. 54), misguided incentive and rewards systems, and a focus on high gross margins and overall profitability. In practice, these examples pertain to formal control.

In summary, I have conceptualized structure and culture as management control that creates capabilities for exploration and exploitation. Capabilities can also turn into rigidities in the face of disruptive technologies, which begs the question how capabilities should be managed to ensure the capacity for exploration.

3.4.1. Overcoming Rigidities

In his seminal book, Christensen (1997) argues that organizational separation is the most natural way to manage the effects of disruptive innovation. Later, Christensen and Overdorf (2000) posit that new capabilities and the removal of rigidities relies on three alternatives:

i)   a new independent organization that focuses on new processes and technologies,
ii)   the acquisition of a different organization that can solve the problem, and
iii) the development of new structures within the existing organization.

Alternatives (i) and (ii) closely resemble organizational and domain separation. Adding to this, O'Reilly and Tushman (2021, p. 13) note that "more sophisticated separation" is needed, including strong senior management support and an overarching view of vision and goals that spans across units. Alternative (iii), new structures, is described by Christensen and Overdorf as a new organization within the existing organization. This can be accomplished through new teams, or through a temporary project organization. As such, temporal separation is an alternative, whereas contextual ambidexterity can also provide suitable conditions for renewal within teams.

3.4.2. Formality and Discretion in Projects

Project work often adheres to a set of rules defined in a project management methodology. According to Joslin and Müller (2016), the methodology outlines processes, tools, techniques, methods, capability profiles, and knowledge areas as the building blocks of a project methodology. In other words, the methodology is a comprehensive toolkit that governs many, if not most, aspects of project work. In practice, this means that projects typically exhibit a high degree of formal control through the work practices outlined in a methodology (Joslin and Müller, 2016). Burton and O'Reilly (2021) have studied temporary

project organizations and find that project performance in exploration projects is dependent on informal control. This would imply that methodology can hamper exploration in projects.

At the same time, projects can be used for exploration, provided there is a leeway for the project team to develop work practices (Lenfle, 2008). This autonomy in the project team has been denoted as discretion, as opposed to formality that assumes pre-defined rules, processes, and structures for the project (Tatikonda and Rosenthal, 2000; Naveh, 2007). In practice, discretion enables a contingent view of the project, adapting it to its context (Hanisch and Wald, 2012). McGrath (2001) and Shenhar et al. (2016) note that a contingency view of projects acts as an enabler for exploration in projects. While formality is reminiscent of formal control, discretion implies at autonomy for the project team. In other words, they key difference to formality is that work practices are developed "on the fly" as opposed to defined in a methodology; project management is emergent rather than predefined. While this could mean that discretion relies on both formal and informal control, it is likely that emergent project management relies less on documented practices. In other words, discretion is likely to rely on informal management control to a greater degree than formality. In practice, discretion empowers the project team and the individuals in it to define practices in the project. Following Burton and O'Reilly's (2021) findings, this would mean that a high degree of discretion supports exploration projects.

3.5. The Role of Senior Management

Lavie et al. (2010) posit that top management's previous experience and propensity for either exploration or exploitation affect the organization as a whole. Path dependency based on experience is typically strong, and this can have far reaching implications for the whole organization. Perhaps due to this, there are numerous studies that report an organizational bias towards exploitation (March, 1991; Benner and Tushman, 2002; Benner and Tushman, 2003; Uotila et al., 2009; Lavie et al., 2010; Garud et al., 2011). The hunt for quick profits is likely the culprit, combined with a difficulty in predicting costs and benefits of innovation (Mone et al., 1998). However, provided there is a drive for exploration, a key leadership task for senior management is to manage the inherent contradictions between exploration and exploitation (O'Reilly and Tushman, 2013). This involves the allocation of resources between the old and the new, and management of any conflicts that arise. Strategic intent is a key part of this process, ensuring that activities are aligned around a common goal (O'Reilly and Tushman, 2008; 2013; 2021). This can be seen on two different levels, employees understand how exploratory efforts link to the overall target of the organization, while senior management can identify exploratory efforts that require exploitation.

3.5.1. Strategic Intent at Kodak, Polaroid, and Fujifilm

Earlier, I outlined digital photography as a disruptive innovation similar to the capacitive touchscreen and application ecosystem Nokia faced. Three

incumbents in the field of analogue photography were faced with difficult decisions regarding their future: Polaroid, Kodak, and Fujifilm. Moving forward, actions by senior management greatly influenced how these companies defined their strategic intent, that is, the central goals for the organization (O'Reilly and Tushman, 2013).

Tripsas and Giovanni (2000) have studied Polaroid, a company with its origins in analogue photography where the cameras supported instant printing of an image. They conclude that the capability and desire for exploration was high throughout the organization, and that technological capabilities in terms of digital photography were world class.

> "Polaroid did not experience major difficulties searching in a radically new technological trajectory and developing new technological competencies, largely due to the consistency of this purely exploratory behaviour with the belief in the primacy of technology." (Tripsas and Giovanni, 2000, p. 1158)

Yet Polaroid found itself outpaced when digital photography gained ground and filed for bankruptcy in 2001. This begs the question what happened. Tripsas and Giovanni paint a picture of large conflicts between senior management and middle management at the division in charge of digital photography. While exploration was indeed promoted as it lied at the core of Polaroid's strategy and culture, there was a strong belief among senior management that digital imaging should still support "instant photography", that is, printing of the image from the device. In other words, despite changes in technology, the strategic intent was not redefined. Basically, customer value would still rely on instant photography (Tripsas and Giovanni, 2000). Senior management's view hindered the exploitation of innovations related to digital imaging. Ultimately, consumers and the market had a different viewpoint.

There is a widespread assumption that Kodak failed to invest in digital photography and that this was the cause of their subsequent demise (Shih, 2016). However, there is more to the story. Kodak put together a timeline for the company's transition to digital photography as early as 1979 (Hill, 2012a; The Economist 2012a; Hill, 2012b).[12] In 1991, Kodak developed a digital strategy and released their first professional digital camera, to be followed by a consumer version a few years later (Hill, 2012a; Ho and Chen, 2018). In 1999, after having consulted with Clayton Christensen, Kodak understood the potentially disruptive effect on their business and further increased their focus on digital photography (Christensen, 2006; Ho and Chen, 2018). Heeding the advice of Christensen, Kodak grew their market share in digital cameras (Christensen, 2006). In 2003, Kodak developed a "digital transformation strategy" with four objectives: 1) managing the film business for efficiency, 2) lead in output distribution, 3) grow in digital photography capturing, and 4)

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[12] In this timeline, consumer uptake of digital photography was estimated to occur in 2010 (Hill, 2012a). In effect, the transition was much faster as analogue film sales peaked already in the year 2000.

expand in digital imaging services (Ho and Chen, 2018). All-in-all, the strategic intent outlined by senior management was clear. However, as described in Section 3.4, there were challenges with the structure and culture to support the strategic intent. At the same time, the strategic intent did not fundamentally change; Kodak was to remain focused on photography. This was in stark contrast to their largest competitor, Fujifilm.

Fujifilm defined their first digital strategy in 1997 that emphasized 1) the development of digital technology, that is, image sensors, 2) extending the life of film, in practice through improving quality to stay ahead of digital sensors, and 3) developing entirely new businesses (The Economist, 2012b; Komori, 2015; Ho and Chen, 2018). However, the top management team decided the forego investments in new businesses, as film was a profitable and expanding business (Komori, 2015). In 2004, this would change. Fujifilm announced their "Vision 75" strategy honouring their 75th anniversary. The intent was no less than to save Fujifilm and grow sales (Komori, 2015). In practice, the goal was to use old competences for new business and developed entirely new competences for new business areas. Diversification lay at the core of the new strategy (Tripsas, 2013; O'Reilly and Tushman, 2021). In practice, Fujifilm diversified into many different industries such as, cosmetics (based on chemistry know-how of anti-oxidation), polarizing film for LCDs and mobile phones, and medical equipment (The Economist, 2012b; Komori, 2015; Ho and Chen, 2018). As planned, the diversification eventually compensated for the radical slump in film sales.[13]

To summarize, senior management has a big influence on the definition of an organization's strategic intent. Faced with disruptive change, an oftentimes painful reorientation of this strategic intent is necessary (O'Reilly and Tushman, 2008; 2021).

3.6. Combined Learnings

Figure 5 summarizes what we have reviewed regarding the antecedents and modes of balancing for ambidexterity. In terms of the balance between exploration and exploitation, there is evidence that organizational and domain separation should be complemented with contextual means (Adler et al., 1999; Birkinshaw and Gibson, 2004; Kauppila, 2010; Ossenbrink et al., 2019; Foss and Kirkegaard, 2020). In this thesis, temporal separation has been exemplified through projects. This temporary form of organization is often reliant on formality to manage the project (Naveh, 2007; Joslin and Müller, 2016). Burton and O'Reilly (2021) have studied projects, and they posit that enabling exploration in projects require organic structures. This can also be conceptualized through discretion that enables autonomy for the project team to adapt the project to its context (Naveh, 2007).

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[13] Fujifilm was also successful in aligning structures and culture with the new strategic intent (Tripsas, 2013; O'Reilly and Tushman, 2021).

Mode of Balancing (Lavie et al., 2010)	Antecedents			Reference
	Sustaining Innovations	**Disruptive Innovations**		Christensen, 1997
	Environmental			
	Competitive Intensity	**Exogenous Shocks**		Lavie et al., 2010
	Absorptive Capacity			Lavie et al., 2010
Temporal separation	**Formality**	**Discretion**		Naveh, 2007
	Strategic Intent (Managerial)	Structure	Culture	Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2021
Organizational Separation		Resources & Processes	Values & Culture	Christensen and Overdorf, 2000
Domain Separation		Management Control Systems	Values	Lucas and Goh, 2009
Contextual Ambidexterity		Organizational Structure (Organizational)	Culture	Lavie et al., 2010
		Formal Control	**Informal Control**	Ouchi, 1979; Kirsch, 1996
Ambidexterity (Exploration and Exploitation)				Tushman and O'Reilly, 1996; March, 1991
Incremental & Exploitative Innovation – Radical & Exploratory Innovation				Benner and Tushman, 2002; Li et al., 2008

Figure 5 A summary of antecedents of ambidexterity and modes of balancing

This thesis will examine various environmental, managerial, and organizational antecedents of ambidexterity. Ambidexterity has been portrayed as a response to sustaining and disruptive innovations (Christensen, 1997; O'Reilly and Tushman, 2021). Here also conceptualized as competitive intensity and exogenous shocks (Lavie et al., 2010), these require alignment of the firm's strategic intent, structure, and culture (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2021). The definition of a firm's strategic intent is a key task for senior management (O'Reilly and Tushman, 2008). In literature on disruptive innovation, structures and culture have also been conceptualized as resources, processes, and management control systems as well as values embedded in culture (Christensen and Overdorf, 2000; Lucas and Goh, 2009). Lavie et al. (2010) refer to these as organizational structure and culture, whereas I have used Ouchi's (1979) and Kirsch' (1996) notion of formal and informal control to further conceptualize these constructs. In addition to these, this thesis will also examine absorptive capacity as an organizational antecedent of ambidexterity (Lavie et al., 2010).

An ambidextrous organization has the capability to utilize existing competences for incremental innovation while also developing new competences for radical innovation (Benner and Tushman, 2002; Li et al., 2008). This, in turn, increases competitive intensity and might lay the groundwork for further disruption. Moving forward, the concepts in bold in Figure 5 will be the focus of this thesis. Next, we will look at the methods and data analysis of the thesis, and how these constructs have been examined.

4. Methodology

4.1. Rigour and Relevance in Research

An enduring challenge for researchers in business is the balancing between rigour and relevance. The level of emphasis on either or depends on the field of study, but also when examined separately, there are likely to be differences in terms of what different academic traditions perceive as rigorous or relevant research. A simple, straightforward definition of relevance and rigour is similar to how the words effective and efficient are distinguished: doing the right thing, that is, relevant and effective, and doing the thing right, that is, rigorous and efficient (Remenyi, 2010). When talking about *relevance,* it is of course crucial to ask the question relevant to whom? As the focus of this thesis is on business administration and the corporate context, the obvious answer to that question is that the findings need to be relevant to businesses. In practice, there is a need to be able to translate the findings to guidelines or clear practices that can be applied in the corporate context. At the same time, there is a need for a clear theoretical contribution, which sets the basis for *rigour* in research. There are two important dimensions to rigorous research: the research should be conducted in accordance with the scientific standards of the research paradigm in question, and there is a clear contribution to the body of theoretical knowledge (adapted from Myers, 2013). Scientific research is also subject to peer-review, and one could argue that publication in an academic journal constitutes a measure of rigour (Myers, 2013). However, the peer-review process has also been criticised for an overly emphasis on rigour (Sarker, 2007). Business schools favouring rigour over relevance has been discussed at length by Bennis and O'Toole (2005) when they assess the ability of business schools to conduct practically relevant research. They argue that research in business administration suffers from "physics envy" (p. 98), whereby the focus is on scholarly advancement rather than practical implications. Ultimately, they share a view that the quality of research in business is determined by its ability to balance relevance and rigour (a view promoted also in Myers, 2013). So, if a balance of rigour and relevance is needed in business research, what does this entail in practice?

Research, whether basic or applied, contains a novel element. It solves problem that have not already been solved. I believe this creates a particular challenge for business research. Given the breadth of data available to companies and their inherent pursuit of efficiency, it can be assumed that many practical problems are continuously being solved. At first glance, one could assume this creates a rather narrow focus for business academics who wish to solve practical problems. However, I believe there still are a lot of topics that business research should focus on. In my opinion, these can broadly be categorised to three groups:

1) Problems that firms are unaware of.

Building upon previous research, scholars are in a unique position to identify phenomena that firms do not recognise as problems. This goes back to the predictive and prescriptive nature of theory, and when applied in a new context this can generate unique insights that are difficult or impossible for the firm to single out as the focus is on practical, rather than theoretical knowledge. One such problem could be the antecedents and consequences of ambidexterity.

2) Complex problems that are outside the core business of a firm, yet relevant for operations.

Firms tend to focus on problems that fit into what they define as their core business. In practice, this means that phenomena that support business, but are not characterised as a core competence are rarely at the focus of attention and further development. An example of such a phenomenon could be project management. Many firms rely on projects as means of organising work. Yet, few companies would indicate project management as their core business (although some do). As such, the development of ways of working and methods in project management is left to others. Project management, along with many other organizational theories, is conceptually complex, it involves many different contexts, actors, and ultimate goals. In other words, project management is highly relevant for the firm, yet theoretically complex and rarely at the focus of development activities within the firm.

3) Documentation of existing firm practices.

The third category has to do with gaining a better understanding of how things work. I do not believe a thorough documentation of what happens in an organization is possible without putting oneself in the reality that the organization lives in. This means that a practical dimension is always present, rather than an explicit focus only on theorising. Yet, theory is still in an important role and makes the difference between, for example, documenting business processes (the focus of the firm) and understanding organizational behaviour (the focus of academia).

This brings to question whether the quality of this thesis should be judged based on how it fits to any or all of the suggested categories. Somewhat surprisingly, my answer to that question would be 'no'. There is an abundance of success criteria and rules for what constitutes good research. The three categories above should be thought of as an attitude to be embraced rather than rules to be followed. Scientists are often rewarded and hired based on publications that have passed the muster of peer-review. This ensures rigour. The three categories above can be seen as a "litmus test" for relevance, can you as a scientist present your research to a business leader and (1) frame it as a

problem he or she is unaware of, (2) frame it as a problem affecting operations but currently not being solved within the company, or (3) detail how the firm works beyond already existing documentation?

4.2. Epistemology

My research is qualitative in nature. A straightforward distinction between qualitative and quantitative research is that qualitative research focuses on data in the form of text based on, for example, interviews whereas quantitative research focuses on data in the form of numbers (Myers, 2013). The purpose with the qualitative inquiry is to gain an understanding of social phenomena (something that can also be the focus of quantitative research). In this vein, some argue that qualitative research is inherently *interpretive* in nature. This view of the world and assumption of knowledge, also referred to as epistemology, assumes that reality is a social construction. Along these lines, some define the purpose of qualitative research as explaining social phenomena and understand how people construct their reality (Merriam, 2002; Gibbs, 2007). At the same time, there is increased awareness that qualitative research need not necessarily be interpretive in nature (Klein and Myers, 1999; Myers and Newman, 2007). One can assume a *positivist* stance to the world also in qualitative research, and assume that there is an objective reality, independent of our construction of it (Myers, 2013). This also works the other way around, quantitative data is a valid input for an interpretive study (Walsham, 2006). As such, I am inclined to subscribe to Myers' (2013) view of the distinction between qualitative and quantitative research as a focus on text or numerical data and keep epistemological views as a separate topic.

There are many epistemological views among researchers. The perhaps most dominant ones in business research are interpretivism and positivism. In this section, I will examine basic definitions of interpretivism and positivism, the role and assumptions of the researcher, and position my research as interpretive.

An interpretive researcher assumes that our understanding of reality is a social construction, based on language, consciousness, shared meanings, documents, tools, and other artefacts (Klein and Myers, 1999; Walsham, 2006). In contrast, the positivist researcher assumes that there is an objective reality independent of social construction, and that this reality has measurable properties (Walsham, 1995; Myers, 2013). This means that the assumptions and the role of the researcher is different. The interpretive researcher collects data that not only describes the objective and observable that can be measured (the focus of the positivist researcher), but also data on the subjective meaning of behaviour (Lee, 1991). Related to this, the interpretive stance sees values and facts as intertwined, and views all observation as value-laden (Leitch et al., 2013). In other words, objectivity is an elusive target as any observation is likely to be affected by the observer. A positivist stance sees values and facts as separate, and science only concerned with the latter (Walsham, 1995). In my view, this also highlights the role of context in positivist and interpretive

studies. In a positivist study, context is described to ascertain that it has not introduced bias or to describe the limitations of the study, whereas in an interpretive study, context is assumed to *always* affect results since reality is constructed by the people involved in a phenomenon. This includes both the subjects under study and the researcher. Furthermore, context is also paramount when understanding the meaning of data in an interpretive study. The phrase "keeping my head over water" can have an entirely different meaning depending on the context, for instance when discussing safety when swimming or my work with this chapter of the thesis. Iterating between the meaning of parts and the whole that they form is also referred to as hermeneutics, and this can be seen as forming the basis for the interpretive research philosophy (Klein and Myers, 1999). All of the above calls for a rich description of the surrounding conditions of an interpretive study. So, should this thesis be positioned as interpretive or positivist? I find an "objective truth" very difficult to ascertain in social research. I also believe context in social research is far too influential to be reduced to a quality check criterion. In this vein, my work should be viewed as interpretive.

Given the importance of context, I have designed the analysis in this thesis summary around specific events in Nokia's history that had a big impact on the propensity to explore or exploit. In the following section, I will first review the methodological approach in the included publications, followed by a description of the analysis done for this thesis summary.

4.3. Research Method

My intent with this section is to briefly review the research methods used in the included publications and discuss the analysis done for the summary part of the thesis. Included publications #1 and #2 in the thesis can be categorised as analytical conceptual research. This involves a broad range of research on the same topic that is summarised and analysed for common elements, combined, and then extended (Meredith, 1993). New insights to previous problems are developed through logical connections between the identified common elements (Wacker, 1998). Essentially, this research relies on previously published material to infer an understanding of the phenomenon under study.

Publications #3 and #4 can be seen as inductive case studies. Inductive research implies that conclusions are drawn from many particular but similar instances. This contrasts with deduction, where conclusions are drawn from general statements (Gibbs, 2007). The difference between the two can also be describes as "bottom-up" or "top-down" reasoning, inductive studies start from empirical data whereas deductive studies typically start with theory that is tested, the former is exploratory while the latter explanatory (Myers, 2013). Case studies gather empirical data from one or more companies in a real-life, contemporary setting to discover relevant features, factors, or issues that might apply in similar settings (Myers, 2013). A defining feature of case studies is that they seek to answer 'how' and 'why' questions, that is, how and why

certain courses of actions were decided upon (Yin, 2014). Eisenhardt (1989) presents a process for conducting inductive case studies that we have largely followed in our research. Eisenhardt's process starts with determining the focus of the case study. At the onset of the interviews conducted for this study (included publications #3 and #4), it was clear that project management, leadership, and renewal would be the focus. Once the focus is determined and the case(s) selected, data is gathered and analysed, and compared to previous literature.

While publications #3 and #4 are inductive in nature, this summary part of the thesis follows a different logic. The starting point has been the research gaps and concepts outlined in Sections 1.1 and 1.2. In that vein, the summary part of the thesis uses deductive reasoning. The data analysis in the thesis summary is based on secondary sources.

4.3.1. Included Publications

Data for publications #3 and #4 was gathered from a total of 36 interviews with managers and executives at Nokia (see appendixes of publications #3 and #4, respectively, some interviews were included in only one of the publications). The interviews were inductively analysed. Coding of the interviews followed many of the principles outlined as grounded theory by Glaser and Strauss (1967). Grounded theory seeks to "develop new concepts and theories of business-related phenomena, where these concepts and theories are firmly grounded in qualitative data" (Myers, 2013, p. 107). Since 1967, grounded theory has subsequently been refined in many steps. This has also been the subject of debate, first and foremost between the two originators of the methodology, but also among a wider audience. Part of the debate relates to the coding process, and whether it encourages emergence of theory as opposed to forced conceptualisation. The coding process proposed by Glaser (1992) consists of three steps: (i) open coding, going through the data and highlighting parts of interest without any preconceived notion, (ii) selective coding, grouping of codes into categories of interest, and (iii) theoretical coding, where a new theory is proposed. This is largely the steps we have followed in both publications #3 and #4 included in the thesis. In addition, the findings in publication #3 were verified with qualitative comparative analysis (Ragin, 2014). Differences in standpoints regarding the coding process have lessened in later years and focus instead lies on adhering to the basic principles of grounded theory: theory building, theoretical sensitivity, and constant comparison (Seidel and Urquhart, 2013). Theoretical sensitivity refers to awareness of the underlying meaning of data, based on for instance professional or personal experience, whereas constant comparison implies that each finding is compared with previous findings (Glaser and Strauss, 1967). It is also important to note that while grounded theory seeks to build theory, it does not imply that previous research is not considered. The role of (previous) theory is important in evaluating results, and a theoretical lens can also be applied in later stages of the data analysis (Urquhart and Fernandez,

2013). The role of theory was big both in evaluating the results and as a lens through which we built the final coding categories.

4.3.2. Thesis Summary

The key data source for the analysis in this thesis summary is secondary data in the form of articles and books on Nokia in both academic and popular press. Myers (2013) notes that documents, including books, can be an important source of data for case studies. He also outlines specific criteria for the quality of the evidence: Is the evidence free from distortion and genuine? Is it clear and comprehensible? Similarly, Yin (2014) notes that documentation in previous studies and literature is a suitable source of data for case studies. The strength of this approach lies in the specific and broad account of events. On the other hand, a particular weakness of documentation is bias, both in terms of incompleteness and reporting bias (Yin, 2014). In this thesis summary, I have striven to include a magnitude of events, often referenced by multiple sources to avoid a biased analysis. In other words, much of the information is referenced by several authors. Some of the articles and books used as secondary data provide alternative explanations to Nokia's troubles, using different theoretical frameworks. However, my focus has been on the specific events, the context, and the decisions made, not the explanations in the secondary data. I have analysed events with the help of the theoretical framework laid out in Chapters 2 and 3. As such, alternative explanations and the theoretical frameworks used in previous studies have not been considered. However, a large part of the previous literature is not academic in nature, but narrative accounts that describe the turn of events at Nokia over time. In other words, the focus has been on understanding what happened, and (re-)analyse that with a new theoretical lens. However, I will return to the alternative explanations in previous literature in the conclusion part of the thesis. The secondary sources, consisting of books and academic articles on Nokia are summarized in Table 4.

Table 4 Secondary sources (books and articles on Nokia)

Title	Author(s)	Year/Publisher or Journal
Making Sense of Ambidexterity: A Process View of the Renewing Effects of Innovation Activities in a Multinational Enterprise[14]	Laukkanen, S.	2012/Hanken School of Economics
Operation Elop The Final Years of Nokia's Mobile Phones	Nykänen, P. and Salminen, M.	2014/Teos (English translation)

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[14] Doctoral thesis defended at the Hanken School of Economics, Helsinki.

Title	Author(s)	Year/Publisher or Journal
The Decline and Fall of Nokia	Cord, D. J.	2014/Schilds & Söderströms
Nokia och Finland Rapport från de galna åren ("Nokia and Finland: An account of the crazy years")	Lindén, C-G.	2015/Schildts & Söderströms
Distributed attention and shared emotions in the innovation process: How Nokia lost the smartphone battle	Vuori, T. and Huy, Q.	2016/Administrative Science Quarterly
Against All Odds Leading Nokia from Near Catastrophe to Global Success[15]	Ollila, J. and Saukkomaa, H.	2016/Maven House
Ringtone Exploring the Rise and Fall of Nokia in Mobile Phones	Doz, Y. L. and Wilson, K.	2018/Oxford University Press
Transforming NOKIA The Power of Paranoid Optimism to Lead Through Colossal Change	Siilasmaa, R. and Fredman, C.	2019/McGraw Hill Professional
The curse of agility: The Nokia Corporation and the loss of market dominance in mobile phones, 2003–2013	Lamberg, J., Lubinaitė, S., Ojala, J. and Tikkanen, H.	2019/Business History

In line with Lamberg et al. (2019), Myers (2013) notes that examining a series of events is useful in qualitative studies to understand relationships between the constructs under investigation. As earlier noted by Chandrasekaran et al. (2012), results from exploration can materialize over a long period of time. As we look at a series of events and decisions, we can also look at exploration as a capability rather than as a specific activity.

Next, I will explain in more detail how the data in the secondary sources was analysed: how were the events selected and analysed? In practice, I followed principles outlined for structured literature reviews for the analysis. Kraus et al. (2020, p. 1026) define a systematic literature review (SLR) as follows:

> "An SLR is a review of an existing body of literature that follows a transparent and reproducible methodology in searching, assessing its quality and synthesizing it, with a high level of objectivity."

Of note is that this is not an SLR in the traditional sense, the intention is not to examine literature on a particular theoretical construct. Instead, the focus is on events that are examined through a particular theoretical lens. However, the intent is to follow a transparent and reproducible logic in finding, assessing, and synthesizing the findings. Central to this notion is the review protocol,

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[15] Originally published in Finnish in 2013.

outlining criteria for inclusion, extraction, and synthesis (Kraus et al., 2020). In practice, this refers to a) which sources are included, b) how data is identified in said sources, and c) how data is combined to create concepts.

Regarding a) which data sources were included in the analysis, the search for literature started with finding books and academic articles written about Nokia. As the interest was in building an account of events, any source that did not contain empirical data or a narrative account was excluded. In the next stage b), a timeline of events was created. The timeline included events that fell into the following categories:

- Service and software development
- Hardware development
- Important products related to the above
- Key organizational changes
- External opportunities and threats

In essence, the focus was on activities pertaining to exploration, or attempts thereat. In addition, I looked for external events that had far-reaching consequences for Nokia. In the last step c), I picked the most relevant events that were further analysed with the help of the concepts outlined in Chapters 2 and 3. This led to, for example, organizational changes to be removed as the concepts in Chapters 2 and 3 are not designed to examine and analyse organizational structures. Webster and Watson (2002) outline a practical approach for documenting the concepts found in previous literature. Inspired by this, the events in the timeline were plotted in a concept matrix, as illustrated in Table 5. Key concepts pertaining to exploration and exploitation formed headers, and each event was plotted under the appropriate header.

The results of the analysis are presented in Chapters 5-7, where the events are also described in more detail along with the outcome in terms of exploration or exploitation. In addition to the formal analysis based on the literature in Table 4, the results are complemented with select articles from popular press, referenced in text.

Table 5 Concept matrix

Event #	Antecedents			Mode of Balancing/ Type of Separation				Outcome: Exploration or Exploitation
	Environmental	Organizational	Managerial	Organizational	Domain	Temporal	Contextual	
Event 1	Disruptive innovations Exogenous shocks Sustaining innovations Competitive intensity	Absorptive capacity Management control Formality Discretion	Strategic intent	…	…	…	…	⋮
Event 2								
…								

4.4. Quality in Qualitative Research

> "Interpretive researchers are not saying to the reader that they are reporting facts; instead, they are reporting their interpretations of other people's interpretations."

> - Walsham, 1995

Although the above holds, there is a need to establish clear criteria for what constitutes a credible interpretive and qualitative analysis of phenomena. "Traditional" quality criteria in empirical research consist of three elements: reliability, validity, and objectivity (Flick, 2009). Here, I will discuss these in light of interpretive qualitative studies. In essence, *reliability* refers to a notion that reported findings are more than a coincidence. The research has been conducted with diligence. An underlying assumption regarding reliability is also that the study is repeatable; another researcher can follow the same steps and come to the same conclusion. In practice, I find this criterion difficult in a qualitative and interpretive setting due to the influence of context and the underlying assumption that the researcher is a part of the result, rather than a "passive" observer. In discussing a systematic audit trail of the steps in a qualitative study, Sinkovics and Afoldi (2012) conclude that the intention with an audit trail is not to ensure replicability but explain the context and idiosyncrasies that preclude replicability. In other words, because of context and the role of the researcher, the same study cannot be replicated. That being

said, there are specific guidelines regarding how to conduct interviews that we have striven to follow in our research (see, e.g., Myers and Newman, 2007). Furthermore, transcripts of interview recordings have been meticulously done to ensure reliability. *Validity* can be summarised "as a question of whether the researchers see what they think they see" (Flick, 2009, p. 387). In practice, this refers to whether an established scientific research method has been used to obtain the findings. Van Maanen (cited in Walsham, 1995) talks about first-order data when referring to the actual interview material (and the perception of the interviewee) and second-order concepts when referring to the researcher's constructions. Second-order concepts require good theory and insightful analysis that relies on a sufficient understanding of context (Walsham, 1995). *Objectivity* is seldom considered as a criterion for interpretive qualitative studies for the reasons previously outlined (Flick, 2009).

Alternative criteria, perhaps better suited for qualitative studies have also been proposed. Golden-Biddle and Locke (1993) propose authenticity, plausibility, and criticality as quality criteria. These can be compared to the previously reviewed criteria: reliability, validity, and objectivity. *Authenticity* is about showing that the researcher has understood the context of the study and her own role. This can be done for instance by indicating personal bias and through a rich description of conditions in the field. *Plausibility* is understood as the ability of the reported findings to convince the reader. In practice, this means the text in the research report must connect to the reader's personal and professional experience (Walsham, 2006). In the scientific community, this typically involves the use of theory to abstract, generalize, and explain phenomena (Klein and Myers, 1999). *Criticality* refers to how the research report engages the reader to probe her taken-for-granted beliefs. In my opinion, this could also be seen as the researchers' ability to critically review their own work. Klein and Myers (1999) refer to the principles of multiple interpretations and suspicion. This assumes that different interpretations are reported and accounted for, and that the researchers are sensitive to systematic distortions in the data. In my view, authenticity, plausibility, and criticality form a good basis for assessing the quality of interpretive studies. I will return to these criteria in the conclusion chapter of the thesis.

4.5. Case Nokia: A Timeline of Events

In the "expanded" case study in this thesis summary, I will use secondary sources to examine specific events in the history of Nokia to determine antecedents and consequences of ambidexterity. A timeline of the events that are analysed in more detail is presented in Table 6. Nokia is a product company; as such, many specific products and related services are examined. The products and services are listed according to the year they were announced; of note is that the development of these products and services started earlier. Also, the actual product launch might have been later, often at different times depending on the market. The story of Nokia over a period of roughly 20 years

is complex and multi-faceted, and the purpose of this thesis is not to build a historical account of events in the company. The events examined in this case study were chosen because they had far reaching consequences, or simply because they are good examples of the thinking prevalent in the organization at the time. Also of note is that my intention is to analyse specific events, and how these contributed to exploration or exploitation. Nokia's "overarching focus" on either exploration, exploitation, or both is detailed in publication #4.

Table 6 A timeline of events

Year	Event	Description
1992	A decision to focus on telecommunications	Jorma Ollila is made CEO of Nokia, and a decision to divest all businesses outside telecommunications is made.
1995	Logistics crisis	Supply chain capabilities fail, and Nokia issues a profit warning
1995	New Ventures Board and Nokia Ventures Organization (NVO)	The New Ventures Board (NVB) is founded to seek growth opportunities. NVB is restructured and strengthened as Nokia Ventures Organization (NVO) in 1998.
1996	The Communicator	A personal digital assistant is announced that, in addition to the phone, contains a web browser, fax, email, and a calendar.
1997	Club Nokia	Club Nokia is founded as a customer website for additional content like games and ringtones, as well as support and special offers.
1998	Symbian OS and S60	A joint venture between Nokia, Ericsson, and Motorola is founded to develop an operating system (OS) for mobile devices. Later, Nokia develops a user interface on top of Symbian called S60.
1998	Market leadership	Nokia overtakes Motorola as the largest manufacturer of mobile phones in the world.
2000	Digital Convergence Unit	A team responsible for the development of so-called converged devices is founded. Converged devices combine multiple functionalities (such as a camera, email, web browsing) with a traditional mobile phone.
2001	Nokia 7650	Nokia's first camera phone is announced, also the first device to run the Symbian OS with the S60 user interface.
2004	NVO and Club Nokia shut down	NVO is shut down because of unsatisfactory results. Club Nokia is shut down due to pressure from Nokia's largest operator customers.

Year	Event	Description
2005	Open Source Software Operations (OSSO) and Maemo	A team focusing on the development of a Linux based OS for mobile devices is founded. Later, this OS is to be named Maemo. In 2010, the OS evolves into MeeGo.
2006	Nokia N95	Nokia announces the first phone with a built in GPS receiver, along with a 5-megapixel camera, dedicated music keys, and a large display.
2006	Download!	Nokia's first application store is launched.
2007	Apple iPhone	Apple's iPhone is brought to market. One year later in 2008, Apple opens their app store.
2007	Open Handset Alliance (Android)	Google announces the formation of the Open Handset Alliance, a consortium of 34 companies committed to develop the Android OS for mobile devices.
2008	Trolltech and Qt	The Norwegian firm Trolltech is acquired for their Qt application framework, allowing for the development of applications on the framework and running of the apps on any underlying OS.
2008	Nokia 5800 XpressMusic	The 5800 XpressMusic, a touchscreen phone, is announced.
2008	Nokia N97	Nokia announces the N97 in December 2008, a device running Symbian S60 with a touchscreen and a slide-out qwerty keyboard.
2009	OVI Store	Nokia's second application store is launched.
2009	Nokia N900	Nokia announces the N900, the first mobile phone running the Maemo OS (earlier Maemo devices did not contain a radio, i.e., they did not contain a phone).
2010	MeeGo	Nokia announces a joint venture with Intel to develop a new Linux based OS for mobile devices. Maemo is combined with Intel's Moblin to form MeeGo.
2010	Nokia N8	Nokia announces the N8, a flagship device running a revamped version of the Symbian OS.
2011	Windows Phone	Nokia announces a completely revamped smartphone strategy reliant on Micrsoft's Windows Phone.
2013	Nokia Mobile Phones divested	Nokia sells its mobile phones unit to Microsoft and continues as a company focusing on mobile network infrastructure equipment.

Next, I will examine the turn of events in Table 6 with the help of the framework outlined in the thesis so far. Chapters 5-7 start with an overview of the key events during the time period examined, followed by an analysis of environmental, organizational, and managerial antecedents to ambidexterity, as well as the mode of balancing used (if any). At the end of chapter, a summary is presented that outlines each event, its impact on exploration and exploitation, as well as antecedents and modes of balancing. This summary is based on the concept matrix outlined in Table 5.

5. A Rising Star and Growth Pains (1992-1998)

Although Nokia is an old company founded in 1865 as a pulp mill, the company Jorma Ollila took over in 1992 was to become a very different firm. As the CEO himself points out, his appointment would "mark the end of one era in the firm's history, and the start of a new one" (Ollila and Saukkomaa, 2016, p. xviii). Ollila had overseen the mobile phone division for two years prior to being appointed CEO of the whole corporation. He was a strong believer in the potential of mobile phones and mobile communication; in 1992, a decision was made to divest all businesses other than telecommunications. In other words, Nokia was to become fully focused on mobile phones and networks. This ushered in a period of strong growth, as illustrated by the financial performance in Appendix B in publication #4. Sales of mobile phones increased from 1,6 million units in 1992 to 40,8 million units in 1998 (Ollila and Saukkomaa, 2016).

This growth came to a temporary but rather abrupt halt in late 1995, and a profit warning was issued in December of that year (Ollila and Saukkomaa, 2016). Supply chain capabilities had failed; component availability for mobile phones became an issue, and at the same time, wrong products were manufactured as no proper forecasting methods were in place. Purchasing, manufacturing, and sales processes were not integrated, and IT solutions for visibility were lacking in capability (Ollila and Saukkomaa, 2016; Doz and Wilson, 2018). To fix these problems, new information systems were to be developed. This meant that new processes, ways of working, and IT solutions were needed. The first thing to implement was a new Enterprise Resource Planning (ERP) system. German SAP was selected, and the ERP system was functional only six months after the implementation had started (Doz and Wilson, 2018).[16] The real-time visibility to Nokia's global logistics that the system provided was an effective management tool, providing Nokia with a competitive advantage compared to its peers (Doz and Wilson, 2018). However, the development of supply chain capabilities did not end with a new ERP system, something I will discuss further in Section 5.3.

Partly because of the logistics crisis, Nokia's top management decided that new growth and a "third leg" would be needed in addition to mobile phones and network equipment (Ollila and Saukkomaa, 2016; Doz and Wilson, 2018). In 1998, This led to the formation of an independent organization called Nokia Ventures Organization (NVO), tasked with finding and financing start-ups to work with. However, this did not result in Nokia expanding beyond telecommunications, and NVO was shut down in 2004. I will examine this decision in more detail in Chapter 6.

In 1996, Nokia launched a new product called the Communicator. In some ways, it was a precursor to the smartphone; it combined voice capability with

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[16] The ERP implementation project is also discussed in included publication #3.

an Internet browser, email, and a calendar (Cord, 2014). The development of the Communicator was led by one man, who according to several accounts was given leeway and the resources to pursue a product that would come to stretch existing capabilities (Ollila and Saukkomaa, 2016; Doz and Wilson, 2018). While not a big commercial success, it has nevertheless been described as a triumph in terms of mindshare and marketing, giving Nokia a differentiated edge over its competitors (Ollila and Saukkomaa, 2016).[17]

The Communicator built competences around UI development, application software, and operating systems, along with an understanding of the wider ecosystem involved in the development of all these technologies. As a result, Nokia early on realized the value of augmenting the phone with additional content. Club Nokia was introduced in 1997 as a content aggregation site to build customer loyalty, offering ringtones, applications, and games along with support, offers, and information on products (Ollila and Saukkomaa, 2016; Doz and Wilson, 2018; Lamberg et al., 2019). However, for reasons I will cover in the next chapter, Club Nokia was shut down in 2004.

Along with the Communicator and Club Nokia, top management's view of competition also diversified. Microsoft was seen as a big threat if they were to take control of the smartphone OS (Cord, 2014; Doz and Wilson, 2018). For personal computers, Microsoft had grabbed a big part of the value chain. This fear led to the formation of a joint venture with rivals Ericsson and Motorola to acquire the British firm Psion to develop a smartphone OS called Symbian. This was to be an open OS available to anyone who joined the consortium, unlike proprietary solutions like Palm's or licensed solutions like Microsoft's. However, differentiation was possible through proprietary user interfaces (UIs). This led to the development of the Series 60 (S60) UI on top of Symbian, which was later licensed to competitors to halt Microsoft's progress (Doz and Wilson, 2018). In effect, Symbian became the "Windows for mobile computers" attaining a smartphone market share of more than 60% (Lindén, 2015). The end of the time period examined in this chapter marked a milestone for Nokia; in 1998, Nokia overtook Motorola as the world's largest manufacturer of mobile phones and became the market leader. In the following sections, I will look at the events outlined above with the help of the theoretical framework outlined in Chapters 2 and 3.

5.1. Antecedents of Exploration and Exploitation

5.1.1. Environmental Antecedents

In the early nineties, Motorola was the undisputed world leader in mobile communication (Ollila and Saukkomaa, 2016). However, there was no intention on the part of Nokia to be content with status quo. This led to an

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[17] For example, Val Kilmer used the Communicator as his mobile computer in The Saint, a blockbuster movie in 1997.

increase in *competitive intensity*. During the nineties, Nokia strived for competitive advantage through a series of *sustaining innovations*. First, Nokia's approach relied on a digital standard for mobile communication, the Global Standard for Mobile communication (GSM). In contrast to Motorola, the emphasis was on digital communication standards as opposed to analogue. GSM becoming a global standard also facilitated Nokia becoming a global company (Ollila and Saukkomaa, 2016). The second technological development that became prevalent in the wake of the logistics crisis was a focus on converged devices, that is, augmenting the mobile phone with other functionality. The Communicator started this development, and it was later followed-up with more devices (see Chapter 6). Fear of commoditization drove the development of the Symbian OS. In practice, Nokia wanted to control the value chain for the whole product, as opposed to the set-up in the PC industry where hardware and software were controlled by different companies (Cord, 2014; Doz and Wilson, 2018). To complement a focus on convergence, Club Nokia was an attempt to tie consumers closer to the Nokia brand and thereby bypassing operators (Doz and Wilson, 2018). Competitive intensity also drove a desire to seek growth from of new ventures, leading to the formation of Nokia Ventures Organization (NVO). All-in-all, competitive intensity and sustaining innovations drove exploration at Nokia.

5.1.2. Organizational Antecedents and Management Control

During the nineties, the propensity for exploration through *absorptive capacity* was high. External knowledge was acquired and applied internally through benchmarking, increasing exploration. Of particular interest was the technological prowess of Motorola, and their products were scrutinized in detail (Ollila and Saukkomaa, 2016). This went beyond technology, which is evident in CEO Ollila's biography. Motorola is given plenty of space as the company Nokia had set its sight on. When Ollila discusses the key strategic focus during the nineties, the quote "We would beat Motorola" sums it up nicely (Ollila and Saukkomaa, 2016, p. 128).

Although Nokia is an old company, the new management team and refocus on telecommunications meant that many teams and ways of working were new and reliant on informal control (cf. Greiner, 1998). There were relatively few formal structures in place, and work was characterized by a strong culture. Nokia's top management wanted to emphasize a "flat, decentralized organization" (from the 1992 annual report, cited in Cord, 2014). One executive also concluded that "you cannot have phenomenal growth in a company with a strong culture of central control. We gave trust under responsibility. It was extremely important, this culture and governance on values" (Cord, 2014, p. 64). The "Nokia Way" was established early on to describe Nokia's core values: customer orientation, respect for the individual, achievement, and continuous learning (Ollila and Saukkomaa, 2016). Employee headcount grew rapidly during these years, and the values were used as an important tool for onboarding new employees. There was an emphasis on *informal control*, as one executive recalls: "You need company values, without these, energy and risk-

taking won't be there and there won't be innovation. To deal with uncertainty and ambiguity you need a culture of sharing and trust with the right support incentives" (Doz and Wilson, 2018, p. 43). Although the logistics crisis introduced a great deal of formal control mechanisms to cope with the situation, Ollila describes how people were still "endowed with boldness, curiosity, and the right degree of responsibility", still epitomizing informal control to a high degree (Ollila and Saukkomaa, 2016, p. 223). At the end of the time period examined in this chapter, common support platforms for IT, HR, and finance were rolled out in an effort to increase formal control (Cord, 2014; Doz and Wilson, 2018). Further, there was an increased sense of things changing when Nokia was no longer the runner up for market leadership. To ensure alertness, senior management also introduced outcome control in the form of market share targets. As one executive put it: "market share targets [were introduced], so we would not rest on our laurels" (Doz and Wilson, 2018, p. 63).

A key event that occurred during this time was the logistics crisis. The logistics crisis was the result of missing formal control mechanisms, such as processes and systematic ways of working. As the CEO Ollila notes: "We had stealthily grown into a global company, but we lacked a global company's logistics and efficiency" (Ollila and Saukkomaa, 2016, p. 213). This prompted a shift of focus to explore capabilities that could avoid similar problems in the future (Ollila and Saukkomaa, 2016; Doz and Wilson, 2018). New information systems, processes, and new ways of working were put in place, these capabilities are examined further in Section 5.3. This focus on processes and formalized control would later be expanded also beyond supply chain management, as noted in publication #4 and Chapter 6.

Included publication #4 contains an in-depth analysis of how organizational control manifested itself during this time period, and how that came to influence exploration and exploitation at Nokia. A key premise of the included publication is that informal management control supports exploration, whereas formal management control leads to exploitation. A balance of both formal and informal control is needed for ambidexterity. During the nineties, the interviews reveal a focus on mechanisms typical for clan control and a relative absence of rules, processes, and regulations. Table 1 in publication #4 summarizes the results; there was an emphasis on informal control, which led organization to emphasize exploration.

5.1.3. Senior Management and Strategic Intent

A new management team formed in 1992 to support the implementation of Nokia's new *strategic intent:* a focus on telecommunication. This would set the scene for alignment and a growing business, enabling exploration of new competences. While the strategic intent was centred around mobile phones, a development towards converged devices started already in the nineties, whereby the phone offers more functionalities for its user. This development started with The Communicator and was followed-up with the focus on a new smartphone OS, Symbian (see Chapter 6).

5.2. Modes of Balancing

The logistics crisis required a fast response from the organization, requiring a complete overhaul of supply chain management. New competences and information systems were predominantly developed in a project mode of working (see Sections 5.3 and 6.3). These "exploration projects" to build new competences signify *temporal separation* for ambidexterity. Ultimately, the organizational focus shifted to exploiting these new competences (see Section 2.1.1). This had far reaching consequences, and the logistics crisis would come to affect the turn of events many years ahead.

Nokia Ventures Organization (NVO) was set up in 1998 tasked with seeking new growth opportunities. It was coupled with a growth fund with a mandate to finance start-ups developing disruptive technologies (Doz and Wilson, 2018). As such, NVO was a separate organization within Nokia aiming to explore new avenues of business through *organizational separation*. At the same time, NVO can be seen as a form of *domain separation*, as the modus operandi was to explore with the help of partners and alliances. Another example of domain separation is the joint venture between Nokia, Motorola, and Ericsson to acquire the British firm Psion for the development of the Symbian OS. The development of Symbian through a joint venture proved to be challenging, which led to Nokia assuming full ownership of the platform in 2008 (Siilasmaa and Fredman, 2019).

The Communicator required entirely new competences around software development on different levels. The driving force behind the Communicator was essentially one person, who was given the leeway and resources to pursue a ground-breaking product (Ollila and Saukkomaa, 2016), signifying *contextual ambidexterity*.[18]

5.3. New Supply Chain Management Capabilities at Nokia

Included publication #1 details some of the development initiatives that were started in the aftermath of the logistics crisis. These developments can be categorized into four categories: (i) data management, (ii) data exchange, (iii) data tracking, and (iv) process models. The improvements outlined in publication #1 represented significant development of new competences at Nokia. As such, the response to the logistics crisis required exploration.

The capabilities and competences outlined in publication #1 were specifically aimed at increased efficiency. In other words, the new competences gained would later be exploited to handle the rapidly increasing demand for mobile phones. Internal efficiency was a big part of the focus, but the new supply chain management capabilities also built a foundation for Nokia to leverage its supply chain for exploitation (Cord, 2014; Doz and Wilson, 2018).

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[18] There is no information on whether the Communicator was developed in a project mode working or not. However, the practices for project management examined in this thesis were introduced later in response to the logistics crisis (see Section 6.3).

5.4. Summary

Table 7 summarizes the key events from 1992 to 1998, and how these influenced the antecedents and modes of balancing for exploration and exploitation. In Section 2.1.1, I discussed what constitutes successful exploration. A key factor is whether the attained new competences are exploited and thereby contributing to firm performance. As such, a positive impact on performance is reliant on exploration and subsequent exploitation, or in other words, new competences being used for effect. In Table 7, I distinguish between exploration that created opportunities that were later exploited ('exploration as a capability', see Sections 1.2 and 2.1.1) and attempts at exploration that did not materialize ('exploration as an activity'). A dash in the table indicates that the mode of balancing is impossible to ascertain based on the data examined.

Table 7 A summary of antecedents and modes of balancing 1992-1998

Year	Event	Antecedent	Mode(s) of Balancing	Exploration/ Exploitation
1992	A decision to focus on tele-communications	Competitive intensity driving sustaining innovation Strategic intent (new focus) Informal management control Absorptive capacity	N/A	Exploration as a capability
	Competitive intensity and strategic intent: Nokia strived for and gained increased market share through a focus on digital standards for mobile communication (GSM). The main competitor relied on analogue standards. Informal management control: A flat, decentralized organization enabled growing the organization and a focus on new competences needed to support growth in telecommunications. Absorptive capacity: Especially Motorola was benchmarked.			

Year	Event	Antecedent	Mode(s) of Balancing	Exploration/ Exploitation
1995	Logistics crisis	Informal management control (a lack of formal management control)	Temporal separation	Exploration as a capability
	Informal management control: Growth came to an abrupt halt due to failing supply chain capabilities, new competences were developed in various SCM projects.			
1996	The Communicator	Competitive intensity driving sustaining innovation	Contextual ambidexterity	Exploration as a capability
	Competitive intensity: The Communicator branded Nokia as a technology leader.			
1997	Club Nokia	Competitive intensity driving sustaining innovation	-	Exploration as an activity
	Competitive intensity: Club Nokia was an attempt to gain market share through applications and services. It was shut down in 2004.			
1998	Nokia Ventures Organization (NVO)	Competitive intensity (and the logistics crisis)	Organizational separation Domain separation	Exploration as an activity
	Competitive intensity: In response to the logistics crisis, NVO was set up to build a "third leg" through partnerships with start-ups. Ultimately, no new businesses were built and NVO was shut down in 2004.			
1998	Symbian OS and S60	Competitive intensity driving sustaining innovation	Domain separation	Exploration as a capability
	Competitive intensity: Fear of "commoditization" akin to the PC industry led to the Symbian consortium that developed a new OS.			
1998	Market leadership	N/A	N/A	N/A

6. An Expanding Business (1999-2007)

At the start of the millennia, Nokia had finetuned its logistics and efficiency to ensure that the events of 1995 and -96 would not be repeated. In the year 2000, Nokia was the undisputed market leader for mobile phones with a market share of 32% (Ollila and Saukkomaa, 2016). Motorola was now a distant second. Market leadership continued throughout the period examined in this chapter, from 1999 to 2007. In 2007, Nokia sold around 13 mobile phones per second, reaching a market share of 40% (Nokia, 2008).

At the same time, an entrepreneurial spirit within Nokia lasted. The Digital Convergence Unit (DCU) was founded in 2000 with a mandate to explore mobile data driven business models and products (Doz and Wilson, 2018). The DCU would focus on what later was to become smartphones. In 2003, DCU was renamed 'multimedia', gaining a bigger role in Nokia's business (Cord, 2014). Initially, the DCU would focus on the Nokia 7650 camera phone announced in 2001. This was to become a big undertaking, involving more than 500 people all over the world and multiple technology partners (Doz and Wilson, 2018). The 7650 was also the first mobile phone to feature the new Symbian S60 OS. In effect, it was the first smartphone; in addition to rich multimedia capabilities, additional applications could also be installed. The phone was a success, both commercially and in terms of mindshare (Doz and Wilson, 2018). In 2002, the front cover or the Economist featured the 7650 and declared it "Computing's new shape" (Lindén, 2015). Essentially, the notion of converged devices meant that Nokia was aiming for a device that could cover a wide range of functionalities for its user. This was a key part of Nokia's new strategic intent and implied at competing with entirely new players such as camera manufacturers (Cord, 2014).[19]

The year 2004 would become eventful. The Nokia Ventures Organization (NVO) had not been able to generate the "third leg" envisioned in the nineties, and it was shut down. Another important event was the fate of Club Nokia. To understand the reasoning behind this, we need to look to Nokia's customers. In effect, Nokia was perceived as owning a too big part of the value chain. Nokia declined to manufacture "white label" phones that could be rebranded according to the operator, and Nokia was making inroads to services with Club Nokia. This was in direct competition with some operators such as Vodafone with their "Vodafone Live" concept (Lindén, 2015; Doz and Wilson, 2018). This was open war, and operators reduced purchases from Nokia (Ollila and Saukkomaa, 2016). Nokia caved, and Club Nokia was shut down as it was seen as secondary to the main business.

According to accounts in Cord (2014), soon after the turn of the millennia some people in senior management felt that Nokia would need a successor to

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[19] Nokia surpassed Canon and Nikon as the world's largest manufacturer of digital cameras in 2006 (Cord, 2014).

Symbian. This materialized in the development of a Linux-based mobile operating system (OS), later to be named Maemo. A fairly small team called Open Source Software Operations (OSSO) was formed in 2005 to lead the development of a new OS, resulting in the first Linux-powered mobile device: the Nokia 770 Internet Tablet. Of note is that this device did not contain a radio, that is, a phone. The plan was to develop Maemo in parallel with Symbian, and eventually replace it. However, internal resistance and fear of cannibalization between competing devices with different operating systems proved to be a big obstacle (Cord, 2014; Doz and Wilson, 2018; Lamberg et al., 2019). The first Maemo device with a mobile phone was the N900 model launched in 2009. By that time, OSSO had been merged with the Symbian development team, ultimately loosing much of its development autonomy (Doz and Wilson, 2018).

In 2006, the Nokia N95 smartphone was announced. It featured a wide variety of features, notably a GPS receiver with maps, a high-quality 5-megapixel camera, a FM radio tuner, a music player with dedicated music keys, and a big screen (although not a touch screen). Although the N95 was not the first mobile phone equipped with GPS, it was the first phone that could provide a true turn-by-turn navigation experience. In addition to capturing significant mindshare, the N95 was also a big commercial success; it was the most profitable Nokia phone ever, contributing to record profits in 2007 and 2008 (Laukkanen, 2012; Vuori and Huy, 2016; Ollila and Saukkomaa, 2016). The same year, Olli-Pekka Kallasvuo took over as the CEO, replacing long-time CEO Jorma Ollila who continued as chairman of the board. Further, Nokia introduced the Download! service in 2006, which was an application store for Symbian. However, the response from consumers was underwhelming due to relatively few applications, poor recognition, poor developer support, and poor technical implementation (Cord, 2014).

The year 2007 was an eventful year with the introduction of two new competitors that would later become significant: Apple and Google. Apple's iPhone received an enthusiastic consumer response, especially in the US. However, numerous comparisons in popular press favoured the N95, notable examples include Fortune and Popular Science (Cord, 2014; Siilasmaa and Fredman, 2019). The iPhone featured an entirely new user interface, a capacitive touchscreen.[20] At the time, this was the differentiating feature, the popular application ecosystem for the iPhone was to be introduced one year later in 2008. Nokia had earlier experimented with capacitive touchscreens, but had faced numerous problems (Lindén, 2015). In practice, all of Nokia's touch enabled devices, that is, Maemo based Internet tablets were built with resistive touchscreens. Although a capacitive screen represents a hardware innovation, this was a software problem for Nokia: Symbian could not work with capacitive touchscreens (Cord, 2014). All-in-all, the shift towards application stores and capacitive touch implied a new value proposition for

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[20] Capacitive touchscreens are described in more detail in Dube (2018).

consumers. Vuori and Huy (2016) note that, for the first time, differentiation relied on software, not hardware technology. Google followed suit. They had earlier acquired a start-up developing a mobile device OS called Android. The development work was quickly geared towards making Android compatible with capacitive touchscreens[21], and an application store was launched the same year as Apple.

6.1. Antecedents of Exploration and Exploitation

6.1.1. Environmental Antecedents

In practice, the decision to pursue converged devices meant that Nokia had to cater for a wider variety of customer needs. This led to an increase in *competitive intensity,* which promoted exploration. As a result, the Digital Convergence Unit (DCU) was tasked with differentiation through several exploratory products and projects, such as the 7650 camera phone. This led to competition with, for example, camera manufacturers. From the perspective of competitive intensity and *sustaining innovations*, the N95 smartphone is interesting. It was developed as a high-end smartphone between 2004 and 2006 and would go on to capture significant market share and mind share in the industry (Ollila and Saukkomaa, 2016). Indeed, one driver for the development of the N95 was to re-establish Nokia as the intellectual industry leader, driven by competitive pressure (Laukkanen, 2012). As such, the N95 represented the pinnacle of Nokia's strategic intent to pursue converged devices that had started with the Digital Convergence Unit and the 7650 camera phone. As a big commercial success, it validated the exploratory efforts undertaken to strengthen market leadership, both in commercial and technological terms (Doz and Wilson, 2018).

As I argued in Chapter 3, new competition from Apple (and Google) represented *disruptive innovations*, that constituted an *exogenous shock*. The advent of the iPhone changed the market, at least for some consumers. As one executive at Nokia laments: "In 2007-2008 all of a sudden the radio [phone functionality] was not important at all ... Until then the important aspects were power consumption, radio quality, size, base band, things like that. This changed overnight." (Cord, 2014, p. 90-91). Despite its shortcomings, the iPhone eventually redefined what a smartphone should be. Initially, this did not lead to significant exploration at Nokia. The key feature in the original iPhone was the touchscreen. However, 18 months after the introduction of the iPhone Nokia had only one touchscreen device on the market (see Chapter 7), and due to issues with the OS, the touchscreen was of the resistive kind. In practice, all of Nokia's key devices still relied on physical keyboards (Siilasmaa and

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[21] For an overview of the early development of Android, see
https://arstechnica.com/gadgets/2016/10/building-android-a-40000-word-history-of-googles-mobile-os/ (accessed 12th of August, 2020).

Fredman, 2019). A similar pattern can be observed with application ecosystems, something I will examine further in Chapter 7.

6.1.2. Organizational Antecedents and Management Control

Nokia's search for new market opportunities and technologies continued, albeit to a lesser degree than in the nineties. As such, Nokia's *absorptive capacity* decreased, but not to the degree that there was no desire to seek out new market opportunities. For example, the success of Nintendo's GameBoy and Apple's iPod were eyed with interest (Cord, 2014). Handheld gaming and portable music players were deemed as interesting markets.[22] In line with Nokia's strategy for converged devices, this led the formation of the Digital Convergence unit and the development of the 7650 camera phone. At the same time, there are examples to the contrary, that is, low absorptive capacity. A lack of ability to apply external knowledge for exploration is exemplified by the failed efforts at domain separation through the Nokia Ventures Organization (NVO). In section 6.1.3, I will examine how NVO succumbed to thinking prevalent in the mainstream organization. This way of looking at external knowledge permeated the whole organization more and more, leading to difficulties with absorptive capacity. Nokia had been the market leader in mobile phones since 1998 and the N95 smartphone had solidified this position, despite the announcement of Apple's iPhone in 2007. Down the road, this would create challenges. The exploratory effort to build a flagship device in line with a strategic focus on convergence was clearly successful. However, the success with N95 shifted focus to build more of the same. For the time being, focus moved towards exploitation. Several incremental variants of the N95 were released in the following years. By that time, consumer preferences had already changed (Cord, 2014). Ollila and Saukkomaa (2016, p. 351) conclude that the N95 had created a "deceptive sense of security", shifting the focus away from emerging competition and the future. This might be one reason for the decrease in Nokia's absorptive capacity that hampered the response to Apple's iPhone and Google's Android. Vuori and Huy (2016) report that, contrary to common belief, executives at Nokia had a good perception of key features in the iPhone up to a year before it was announced. They also understood that Nokia lacked a response. However, rather than exploring new competences in the form of capacitive touchscreen technology and a "new" OS to support it (i.e., Maemo), a decision to adapt Symbian for resistive touchscreens was made. The result was the 5800 XpressMusic and later the N97, neither of which provided a user experience on par with the iPhone (see Chapter 7). These products were essentially extending existing capabilities, namely the Symbian S60 platform with all its limitations, including a lack of support for capacitive touchscreens (Cord, 2014). In other words, the iPhone and Android did not initially prompt

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[22] Nokia later made inroads to these markets as well, with products that are not analysed in this thesis.

benchmarking and the exploration of new capabilities in the form of an OS that could support capacitive touch.

Included publication #4 examines turn of events at Nokia during 1999-2007 from the perspective of organizational structure and culture. Table 1 in publication #4 summarizes the results; the organization had matured, and many *formal control mechanisms* had been introduced to complement *informal mechanisms* (cf. Greiner, 1998). To a degree, the mechanisms typical for clan control remained; there was a focus on a flat organization, trust was high, and there was room for passion and intuition to steer one's work. At the same time, control also became reliant on the mechanisms put in place as a response to the logistics crisis. Behaviour and outcome control were emphasized to a much higher degree than in the nineties. Publication #4 puts forward that this balance of management control acted to support ambidexterity.

The shutting down of NVO exemplifies an emphasis on formal control; although tasked with exploring new ventures, NVO had succumbed to the dominant culture of Nokia's core operations. Speed, and the rejection of everything that might take a long time to develop had become important, and this notion was explicitly enforced in NVO (Doz and Wilson, 2018). This resulted in new ventures not being given enough time to mature and in some rather strange decisions; Cord (2014) describes how a media streaming company partly owned by NVO was sidestepped in favour of a competitor, with seemingly poorer technology. However, this competitor was much larger and ready to go to market. In other words, short-term gains outweighed that of long-term opportunities.

Despite this, a degree of entrepreneurial spirit remained. There were several exploratory ventures, yet from the perspective of management control these were somewhat different:

– The 7650 camera phone

At this time, Nokia had developed a formalized project management methodology to run any project, including product development projects (see publication #3 and Section 6.3). On this note, Doz and Wilson (2018, p. 76) quote the 7650 development project manager: "If we had tried to establish that program in the main phone development process, I doubt we would ever have completed it." In effect, this epitomises discretion in the project. At the same time, the sheer size of the product development project was substantial in terms of the number of people, partners, and geographic locations involved. As such, it is likely that a degree of formal control was needed to coordinate and facilitate operations.

– Open Source Software Operations (OSSO)

OSSO was formed to build a new mobile operating system, Maemo, which was first used in the 770 Internet Tablet. Described as a "skunk works" project, the team had a high degree of autonomy and agile operations (Cord, 2014; Doz and

Wilson, 2018). Product development in OSSO has been described "as a playground" by employees (Kurri, 2012). As such, it is likely that the team could operate without many of the formal control mechanisms that defined hardware development projects at the time. Instead, informal mechanisms of control defined the ways of working.

– The N95 smartphone

The development of the N95 has been described as an instance where various functions came together to create a winning concept (Cord, 2014). The N95 smartphone represented the pinnacle of Nokia's strategic intent to offer converged devices. The development of an "all-in-one" device required unprecedented cooperation between different units in charge of different technology modules. The N95 also required significant new competences, particularly relating to the integration of GPS functionality and maps (Laukkanen, 2012). From a management control perspective, the development of N95 is multi-faceted. Laukkanen (2012) describes how, on the one hand, the N95 conformed to the established product development practices in Nokia that were reliant on a high degree of formal control. This was particularly evident in terms of product portfolio management, a process designed to manage sales of existing products in relation to future technology and product needs. Also, a milestone-based project management process was in place. On the other hand, Laukkanen describes how cooperation was characterized by a relatively self-organized community developing their own norms. Individuals in the project team were empowered to do their best. When describing work practices in the project, he quotes the VP of imaging saying that "nobody was explicitly in charge" (Laukkanen, 2012, p. 70). As such, the N95 project exhibited both formality and discretion and through that, a degree of emergent project management. From a management control perspective, the N95 was developed with formal and informal control mechanisms working in tandem.

An interesting comparison can be made between the products the OSSO team developed and the N95. It would seem the Maemo products were never truly prioritized in the influential product portfolio management process that had given credence to the N95. Indeed, Cord (2014) reports on a top executive outright dismissing Maemo products as having little importance. Applying the formal control mechanisms that were in place to manage the product portfolio could have alleviated the infighting and the fear of cannibalization that led to Maemo devices never being prioritized.

– The Download! Service

Nokia's 'Download!' service has not received much attention in popular press, nor scholarly attention, perhaps because it failed to gain significant market traction. Yet this was an attempt at an application store before app stores became mainstream. Cord (2014) describes how one interviewee recalls that the team was encouraged to try new things and learn, and how sufficient

resources were available for this purpose. In other words, this was positioned as an exploratory effort. At the same time, it becomes evident how formal control mechanisms crippled the effort. Cord (2014) describes how profitability was one driver, Nokia initially demanded more than half of the application revenue, eventually settling for a 50% share. Also, there was a reliance on scale and size. The development partners were large multinational companies, and no smaller developers were invited to distribute their applications through 'Download!'. In 2009, there was a revamped interest in application stores. However, by that time, Nokia had lost its first mover advantage. All-in-all, there is a similarity between 'Download!' and how Nokia Ventures Organization (NVO) succumbed to Nokia's mainstream culture that emphasized scale and profitability from the get-go.

6.1.3. Senior Management and Strategic Intent

At the turn of the millennia, Nokia redefined its *strategic intent*.[23] Convergence, that is, the device catering for several functionalities for its user lay at the core of the new strategic intent (Doz and Wilson, 2018). The first step in realizing the new strategic intent was the formation of DCU, and the first Symbian powered camera phone, the 7650. These efforts culminated with the N95 in 2006. The strategic intent enabled resource allocation for exploration while partly "shielding" these exploratory efforts from core operations and ways of working (cf. O'Reilly and Tushman, 2013; 2021). There were also exploratory activities that were hampered by a lack of strategic intent. Nokia had a long history of application stores, starting with Club Nokia in 1997. However, this did not lie at the core of Nokia's operations. As one executive noted: "Earlier, we saw developers as an opportunity, but not a killer opportunity … we understood the need for a good app store too late" (Cord, 2014, p. 127). Club Nokia was shut down already in 2004. In hindsight, this was probably a bad decision. When discussing the new competition and the ecosystems that emerged in 2008, Ollila recalls: "Club Nokia had perhaps been a gesture in the right direction, but that was as far as we had gone" (Ollila and Saukkomaa, 2016, p. 337). A similar lack of strategic intent plagued the 'Download!' application store. The focus was solely on hardware sales, not on growing an ecosystem (Cord, 2014). Similarly, it can be argued that Open Source Software Operations and Maemo suffered from a lack of strategic intent. While there were individuals in top management concerned with the performance of Symbian, a broader view of how Maemo would fit to Nokia's core operations was lacking (Cord, 2014). All in all, Club Nokia, the Download! app store, and Maemo represented attempts at exploration that never materialized through exploitation.

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[23] A more correct wording might be that Nokia expanded its strategic intent. Along with a focus on convergence, there was also a focus on affordable "traditional" mobile phones. However, for the purposes of this thesis and the events examined, the focus shifted towards competing with an entirely new device category.

6.2. Modes of Balancing

Both the team behind the 'Download!' application store and the Digital Convergence Unit (DCU) was set-up with a mandate to explore (Cord, 2014; Doz and Wilson, 2018), epitomizing *organizational separation*. Doz and Wilson (2018) note that the DCU was established to epitomize the "can-do spirit" of Nokia in the nineties, explicitly designed to shield entrepreneurial activities from other "core" operations. DCU's first major development project was the 7650 camera phone, involving several key technology partners in the development of the camera module. As such, *domain separation* was also used to leverage upstream supply chain partners' competence for exploration (cf. Kauppila, 2010).

Of note is that DCU grew from a small unit with an exploratory mandate to one of the key business units within Nokia, responsible for the development of, for example, the N95 smartphone a few years later. That being said, the leeway organizational separation offered was no longer available once the DCU had grown into the Multimedia unit. Laukkanen (2012, p. 105) notes that in Multimedia "there were more formal structures and more business analytical rigor than in the Digital Convergence Unit." Looking at how work was organized within the unit, product development projects in Multimedia used *temporal separation* to oscillate between purely exploitative projects (and products) to ones that involved exploration, such as the N95 (cf. Chandrasekaran et al., 2012, also see included publication #3).

Included publication #4 notes that the balance of control modes during the time examined in this chapter acted to support *contextual ambidexterity*. Moving from individuals in the larger organization to one specific project, the N95 development project also exhibited a balance of formal and informal control, that is likely to have supported contextual ambidexterity in the project. In practice, individuals in the project were not hampered by formal control mechanisms and could engage in exploration.

Experiences gained from the DCU were in all likelihood influencing how the Open Source Software Operations (OSSO) team was set-up. Organizational separation provided the OSSO team significant freedom to pursue new competences to develop an entirely new mobile operating system: Maemo. The OSSO team retained this freedom for a long period of time, as opposed to the rapid growth of DCU that quickly introduced more formalized operations. Unhampered by strict guidelines, such as those that had been in place for Nokia Ventures Organization (NVO), OSSO produced fast results. In 2005, the 770 Internet Tablet that used an entirely new operating system reached the first consumers. This was the same year OSSO was founded. However, the results – in practice the new operating system – was difficult to integrate with core operations. Significant infighting ensued. Organizational separation requires strong coordination on senior management level. This was lacking as the internal conflicts were allowed to continue. Also, there was no coherent plan for how Maemo would replace or complement the Symbian S60 offer. These

plans would only develop significantly later, upon realization that a more solid response to the iPhone and Android was needed.

6.3. Temporal Separation: Project Management at Nokia

The development of a harmonized project management methodology at Nokia dates back to the implementation of the SAP ERP system (see Section 5.3.). This was a very successful project. Like the proponents for the efficacy of project management methodologies, many within Nokia deemed the successful ERP implementation as sufficient proof that the same method would work in all projects. This led to the development of NOCOP (NOkia COnnecting Projects) which was a milestone based, so called waterfall approach for projects (Nokia, 2005). This became ubiquitous for the development of information systems, new processes, and new products. In practice, this created a very formalized view of how projects should be run (cf. Naveh, 2007). However, Nokia's strict emphasis on a corporate project management methodology might have been misplaced.

As noted in included publication #3, project success is dependent on a project methodology which is adapted to context. This context can be assessed based on the role of exploration. However, a key finding in publication #3 was that Nokia partly assumed a "one-size fits all" approach to project management. In practice, formality was misplaced in some projects where discretion and exploration would have been needed, and vice versa. This can be exemplified with the help of ERP systems and APS systems (See Section 5.3 and publications #2 and #3). The ERP system is a pre-defined, well-structured information system that assumes a certain structure is in place: process models, organization, and the associated data (Kumar and van Hillegersberg, 2000). As such, the ERP system developer has defined a structure for which the information system is built. These kinds of projects do not benefit from exploration, and a high degree of formality is suitable to manage the project.

Publication #2 looks at project management for supply chain management projects. Using APS systems as one example, the publication notes that these can benefit from agile project management as opposed to waterfall project management. APS systems require a great deal of customization to create value (Hvolby and Steger-Jensen, 2010). Although APS systems are standardized information systems, the functionality is explicitly designed to cope with the unique set-up for each supply chain, requiring a deep understanding of the technology itself. As such, these projects often require new competences, exploration, that the project management methodology needs to accommodate. As outlined in publication #3, agile project management is a methodology that effectively combines structure (i.e., formality) with a degree of freedom (i.e., discretion), the latter being imperative for exploration.

At the same time, projects that require a very high degree of exploration can benefit from discarding pre-defined practices in a methodology altogether (see publication #3). In practice, discretion enables empowerment of individuals to seek new ways of working, supporting exploration in the project. The examples

in this section pertain to SCM projects, but the principles outlined in publication #3 apply for a range of different development efforts in the company. However, at Nokia traditional waterfall methods were used in most officially sanctioned projects, including product development projects. Although some projects such as the 7650 and N95 smartphones implemented mechanisms to support emergent project management, this was rare. In practice, Nokia could have benefitted from a less strict focus on methodology to drive projects, with the principles outlined in publication #3 as a guide.

6.4. Summary

Table 8 outlines the key events during this time, along with the antecedents, mode of balancing, and resulting implications for exploration and exploitation. Continuing the practice in Chapter 5, I also distinguish between exploration as a capability and as an activity.

Table 8 A summary of antecedents and modes of balancing 1999-2007

Year	Event	Antecedent	Mode(s) of Balancing	Exploration/ Exploitation
2000	Digital Convergence Unit (DCU)	Competitive intensity driving sustaining innovation Strategic intent (convergence)	Organizational separation	Exploration as a capability
	Competitive intensity and strategic intent: DCU was tasked with applying new technology to capture market share and to support Nokia's focus on converged devices.			
2001	Nokia 7650	Formality and discretion → A balance of formal and informal management control Absorptive capacity Strategic intent (convergence)	Temporal separation Domain separation	Exploration as a capability
	A balance of management control in a project mode of working: The 7650 development was "shielded" from core operations, which would imply at autonomy, yet the scale of operations also demanded a high degree of formal control. Absorptive capacity: The 7650 successfully used technology partners to develop the camera module. Strategic intent: The 7650 was the first of many converged devices.			

Year	Event	Antecedent	Mode(s) of Balancing	Exploration/ Exploitation
2004	NVO shut down	Lack of absorptive capacity Formal management control	N/A	Exploitation
	Lack of absorptive capacity: Challenges with integrating results from NVO meant that it was shut down. Formal management control: Despite a mandate to explore, NVO was expected to follow rules for efficiency in the "core" organization.			
2004	Club Nokia shut down	Lack of strategic intent (and the operator revolt)	N/A	Exploitation
	Lack of strategic intent: Club Nokia was shut down as it was not seen as a crucial part of Nokia's business, triggered by the "operator revolt".			
2005	Open Source Software Operations (OSSO) and Maemo	Informal management control Lack of strategic intent	Organizational separation	Exploration as an activity
	Informal management control: OSSO produced fast results, but the products were hampered by a lack of support from the core organization. Lack of strategic intent: There was no universal agreement among senior management on how Maemo would be integrated to Nokia's core operations.			
2006	Nokia N95	Competitive intensity driving sustaining innovation Formality and discretion → A balance of formal and informal management control Strategic intent (convergence)	Temporal separation Contextual ambidexterity	Exploration as a capability
	Competitive intensity and strategic intent: The N95 (re)established Nokia's technology leadership and went on to become Nokia's best-selling product ever. The product was also the culmination of the focus on converged devices. A balance of management control in a project mode of working: A "self-organized" community was built in the project that also relied on key formal management processes, such as product portfolio management.			

Year	Event	Antecedent	Mode(s) of Balancing	Exploration/ Exploitation
2006	Download!	Formal management control Lack of strategic intent	Organizational separation	Exploration as an activity
	Formal management control: Positioned as an exploratory effort, the team still had to abide to rules for efficiency in the "core" organization, similar to NVO. Lack of strategic intent: Application ecosystems were not seen as a "killer opportunity".			
2007	Apple iPhone	Exogenous shock (iPhone touchscreen UI as a disruptive innovation) Lack of absorptive capacity	N/A	Exploitation
	Exogenous shock/disruptive innovation: The iPhone capacitive touchscreen represented a new UI paradigm, enabling easy Internet browsing. Lack of absorptive capacity: Nokia did not investigate the use of the key technology in the iPhone, i.e., *capacitive* touchscreens.			
2007	Open Handset Alliance (Android)	Exogenous shock (Android touchscreen UI as a disruptive innovation) Lack of absorptive capacity	N/A	Exploitation
	Exogenous shock/disruptive innovation: Android was also adapted to work with capacitive touchscreens. Lack of absorptive capacity: Nokia did not investigate the use of the key technology in Android phones, i.e., *capacitive* touchscreens.			

7. New Competition and Decline (2008-2013)

Nokia's first response to new competition from Apple and Google was the 5800 XpressMusic phone. The Nokia 5800 was announced in late 2008, more than a year after Apple had launched their iPhone. The press called it an "iPhone killer", although it was clear within Nokia that it would not be able to compete head-on with the iPhone (Siilasmaa and Fredman, 2019). The touchscreen was of the resistive type and consequently, the user experience was inferior to the fluent operation of a capacitive screen. This was a software problem, the 5800 ran the Symbian S60 operating system that was not designed to operate with touchscreens. Consequently, it had been a big and difficult undertaking to adapt the OS for touchscreens and as a result, software issues delayed the launch (Vuori and Huy, 2016). A capacitive, as opposed to resistive, touchscreen would have represented an even more difficult proposition (Cord, 2014). Although the phone was a commercial success, the "iPhone killer" epithet was not accurate, and customers would come to realize this as well (Siilasmaa and Fredman, 2019).

Apple opened its application store for the iPhone in 2008 and Google quickly followed suit; Google's app store, the Android market – later Google Play – opened later that year (Cord, 2014). In 2009, Nokia was finally supposed to provide devices and services to compete with the burgeoning Apple and Android ecosystems. Nokia's application store, the OVI store, was launched in May. It immediately faced technical problems, but perhaps worse, the usability of the app store had not improved much from the issues that had plagued the 'Download!' app store. Apps were hard to find, and the user interface was perceived as poor (Cord, 2014). This time around, Nokia provided more favourable terms for developers, but there was still the issue of development work for Symbian being difficult. At the time, Nokia had 57 (!) different versions of Symbian in use, causing significant fragmentation of the platform (Doz and Wilson, 2018). In late 2010, the OVI store had around 28 000 apps whereas Apple's app store boasted around 300 000 apps and Android had 150 000 apps (Siilasmaa and Fredman, 2019). The only metric where the OVI store had a clear edge was market reach, it was available in 190 countries.

The N97 smartphone was announced in December of 2008, and it reached the market mid-2009. Whereas the N95 a few years earlier had been universally praised, the N97 received mostly negative reviews. Still running Symbian, the N97 used a resistive touchscreen and it was plagued with significant shortcomings in terms of software quality (Cord, 2014). Nokia executives later described the phone as a "customer experience let-down" (Ollila and Saukkomaa, 2016). Others went even further and described it as a "total fiasco" in terms of quality (Vuori and Huy, 2016, p. 37).

In 2008, the Maemo development team was merged with the significantly larger Symbian development team. At this time, Maemo started garnering considerably more interest, and the team reached an important milestone in 2009. The N900 smartphone was the first Maemo device that was "allowed" to

ship with a radio, that is, it was the first Maemo smartphone. While there were shortcomings, it generated a positive buzz in the industry and among developers (Cord, 2014; Siilasmaa and Fredman, 2019). The next step is a curious one; in February 2010 Nokia announced that Maemo was to be merged with Intel's open source Moblin OS to create a new operating system called MeeGo. The new operating system with two tech giants backing was supposed to garner more interest among developers (Siilasmaa and Fredman, 2019). In practice, combining development teams and technical architectures was difficult, causing significant delays (Doz and Wilson, 2018).

In 2008, Nokia made a decision that could drastically ease application development, acquiring the Norwegian firm Trolltech and their application development framework Qt. This enabled development of an application on the Qt application layer while running the app on any underlying OS (Nykänen and Salminen, 2014; Cord, 2014; Doz and Wilson, 2018). In practice, this was to become the bridge between Maemo and Symbian. However, infighting between the Symbian and Maemo fractions was allowed to continue, and they built separate and incompatible Qt UI tools for developers (Doz and Wilson, 2018).

The N8 smartphone reached the market towards the end of 2010. It had a capacitive touchscreen and a completely revamped version of Symbian. Nokia had acquired all rights to Symbian to ensure that the fragmented development work with many partners could be alleviated (Lamberg et al., 2019). Despite this, the software development for N8 had been delayed several times (Siilasmaa and Fredman, 2019). The initial response to the N8 was positive. Pre-order quantities were assuring, and the hardware received praise. However, when the phone was released the reactions to the revamped Symbian OS were mostly negative. The return rate stabilized around 25%, that is, every fourth device was returned by consumers (Cord, 2014; Vuori and Huy, 2016; Siilasmaa and Fredman, 2019). This was an issue with the device software, the ecosystem, and the applications available for the phone.

The problems with executing a revamped strategic intent had been evident for some time when Olli-Pekka Kallasvuo was replaced as CEO in September 2010. Stephen Elop, a former Microsoft executive, was brought in to bring a new perspective on both software and hardware development. He promptly started "Project Sea Eagle" to review capabilities, competitiveness, and alternative strategic directions (Siilasmaa and Fredman, 2019). With this review concluded, Nokia announced a strategic partnership with Microsoft in February 2011. The intention was to transition all Nokia smartphones to Microsoft's Windows Phone OS. It was now clear that new Symbian versions had not fixed the development debt with the OS, massive amounts of work would still be needed to bring Symbian to par with Android and Apple's iPhone (Siilasmaa and Fredman, 2019).

Ultimately, Windows Phone failed to reach a significant foothold on the market. The task of building a viable third ecosystem proved to be a too big obstacle, even with one of the largest software firms in the world backing the effort. In a dire financial situation, Nokia sold the mobile phone division to

Microsoft for 5,44 Billion Euros in 2013 (Nykänen and Salminen, 2014; Cord, 2014; Siilasmaa and Fredman, 2019). The "new Nokia" was to focus on mobile networks through its subsidiary Nokia Solutions and Networks.

7.1. Antecedents of Exploration and Exploitation

7.1.1. Environmental Antecedents

Deciphering Nokia's top management's reaction to the advent of new competition in 2007 and 2008 is complex. In hindsight, the combination of a large touchscreen with an application ecosystem was *disruptive*, constituting an *exogenous shock*. Not one, but two competitors entered the market to cover many different price points. Initially, this did not foster exploration. As noted in Section 6.1.2, Nokia did not demonstrate a sense of urgency in terms of touchscreens. Most devices still relied on physical keyboards, and the 5800 and N97 models were developed with resistive touchscreens. In effect, this represented development on an incremental and sustaining technology trajectory, with a focus on exploiting existing competences. As for application ecosystems, there was a growing realization that this would become a game changer. With the introduction of the iPhone and Android, the notion of value in the eyes of consumers had shifted from just the device to the availability of applications to augment it. In other words, the iPhone and Android were not two devices and operating systems, but two ecosystems. This, in turn, meant that the value chain no longer consisted of only a device manufacturer's supply chain, but also application developers. This created a conundrum for Nokia. However, the acquisition of Qt meant that there was an opportunity to build a harmonized application platform to stretch across the two underlying operating systems, Symbian and Maemo. This could have created momentum for developers and the OVI store. However, the opportunity was floundered as both OS teams created separate Qt frameworks. In addition, rather than focusing efforts on a comprehensive understanding of the shortcomings with the 'Download!' service and the strengths of Apple's and Google's offerings, the OVI store was launched in mid 2009 with many earlier mistakes repeated (Cord, 2014).

New competition entering the market with new value proposals meant that *competitive intensity* was high. Moreover, Nokia was threatened from many directions. Apple had clearly gained mindshare with a differentiating offer for high-end phones, whereas Google was pushing Android as the low(er) cost alternative for iPhone. As a result of increased competitive intensity, Nokia eventually increased its efforts to compete with the iPhone and Android. The Maemo team saw a significant increase in assigned resources; now was the time Maemo to evolve into a full-fledged smartphone OS. The culmination of this work was the release of the N900 smartphone in late 2009. Described as a "shining ray of hope", it was to be the beginning of something new that could finally challenge the competition (Siilasmaa and Fredman, 2019, p. 60). In addition, the push to make Symbian competitive continued. The N8 smartphone that reached markets in 2010 was supposed to be culmination of

this work. In some respects, it was. It ditched a qwerty keyboard and now used a capacitive touchscreen. For Nokia, both the N900 and N8 were radical innovations, albeit on a sustaining trajectory. However, Symbian was the N8's Achilles heel, exploitation of the aging OS was simply not competitive, whereas the development of Maemo (and support for the N900) was hampered by the new partnership with Intel (Siilasmaa and Fredman, 2019).

7.1.2. Organizational Antecedents and Management Control

Nokia demonstrated low *absorptive capacity* during the period examined in this chapter. The new user experience brought about with capacitive touchscreens was completely ignored in favour of resistive touchscreens and physical keyboards for a long period of time (Siilasmaa and Fredman, 2019). Low absorptive capacity also thwarted Nokia's focus on application ecosystems. Earlier, Nokia had flirted with application development through the 'Download!' application store, yet it was still perceived as a lower priority. Lamberg et al. (2019) note that target setting was fully focused on hardware sales, that is, number of new devices as well as their financial performance. Fostering an ecosystem was a target in name only. In other words, while there was market enthusiasm around (capacitive) touchscreens and application ecosystems, Nokia did not initially embrace these opportunities. When the OVI store went live in Q2 2009 it repeated earlier mistakes with the Download! service, rather than focusing on what made Apple's app store and the Android market work, both in terms of application development and the store experience (Cord, 2014). In sum, absorptive capacity was low which led to exploitation rather than exploration in key areas, such as products (the 5800 and N97) and the revamped OVI app store.

Included publication #4 examines changes in organizational structure and culture at Nokia over a period of 20 years. Publication #4 describes how Nokia gradually moved from a high reliance on *informal control* in the nineties, to a balance of control modes during the time period examined in Chapter 6, to almost solely relying on *formal control* mechanisms from 2008 onwards. Section 3.4 introduced the notion of rigidities. Based on the secondary sources examined for this thesis summary, the following rigidities can be observed.

– Cord (2014) paints a picture of frustration and people being unable to do their job because of top-down steering, such as meetings with mandatory attendance. This top-down steering also directed work in a way that obscured visibility to actual customer needs and market trends. There was a continued focus on product roadmaps and timetables, sometimes at the expense of quality (Vuori and Huy, 2016). Further, technology decisions and strategy had become fully top-down driven, critical voices, questions, or even new business opportunities "from the field" were met with scepticism (Cord, 2014; Vuori and Huy, 2016; Lamberg et al., 2019). The balance of control modes that had earlier supported an entrepreneurial and agile approach to problem solving in projects such as the N95 smartphone was no longer present.

- Practical day-to-day work at Nokia was steered with the help of incentives in the form of monetary bonuses. This form of bureaucratic outcome control created some rather bizarre duplication of work. For example, two different incompatible ways to store contacts were built, one stand-alone contacts program and one part of the mail program (Cord, 2014). This was because bonuses dictated the focus, and two teams were incentivised to build an address book. Constant re-organization also wreaked havoc among development projects that did not fit with the new team's incentive scheme (Nykänen and Salminen, 2014). In other words, even projects that fit to the prevailing focus on quantifiable business benefit were terminated because they did not fit to an incentive scheme that favoured different activities. Common sense and alignment between peers were replaced with top-down steering. Further, bonuses could be nullified due to overall company performance. As such, an individual's or team's good work did not matter if the overall financial performance of the company was poor. This served to further demotivate people and look for ways to optimize their own work, not necessarily based on what was good for the company, but according to what could maximize their personal bonus (Nykänen and Salminen, 2014).

- The attention of top management was focused on product margins and profitability, rather than capabilities and features in products. Vuori and Huy (2016, p. 35) describe how goal setting by management was business case driven, quoting a manager who notes that "Nokia is business-case driven. We make everything into a business case and use figures to prove what's good". One hundred million in increased sales was set as the limit, this was perceived as the cost of R&D, operations, and marketing of a new product (Lindén, 2015). Unless conclusively proven to increase sales, product innovations were simply killed. At the time, Nokia employed a large department of hundreds of people at the Nokia headquarters that were focusing on strategy development (Lamberg et al., 2019). Yet rather than mandated with concrete opportunities to influence the strategic direction of the company, this team was largely deployed to please shareholders and handling investor relationships, epitomizing a focus on financials (Cord, 2014; Nykänen and Salminen, 2014; Lamberg et al., 2019). The other side of the coin, cost, was equally emphasized (pun intended). Siilasmaa and Fredman (2019) describe how relentless cost cutting became the norm. With growing challenges and diminishing sales, management responded with deeper cuts. Again, this led to somewhat bizarre decisions. Costs trumped quality and user experience; Nykänen and Salminen (2014) report on frustration among engineers with the fact that slightly more expensive components could not be used, despite having a major positive impact on user experience.

In practice, the rigidities observed above are rooted in various forms of bureaucratic control. Findings in the included publication #4 along with the secondary sources examined for the thesis summary support a notion that formal control permeated the organization and influenced the events examined in this chapter, but also the organization as a whole. However, the secondary sources do not give a detailed account of how key projects, such as the Nokia 5800 Xpress Music, N97, and N8 were managed, and whether there was sufficient leeway (i.e., discretion) to enable exploration.

7.1.3. Senior Management and Strategic Intent

Decision making by Nokia's senior management was likely affected by the very strong market position and profitability Nokia had enjoyed. As described in the beginning of this chapter, profitability and market share remained high during 2008. Previous ways of working had clearly worked. This created a propensity for exploitation in key areas: the reliance on Symbian for the 5800, N97, N8 models, and the lack of focus on application development and an ecosystem. Symbian had been extremely successful, not perhaps because of technical capability, but out of sheer ubiquity. However, the competitive landscape changing from 2008 onwards prompted a renewed *strategic intent*. In practice, this entailed a focus on capacitive touch and an application ecosystem; the N8 was the first flagship device to feature capacitive touch. Further, Nokia built a renewed application store, the OVI store. The role of Maemo in this new set-up remained unclear, and a clear strategic intent was missing. It would seem parts of senior management still favoured Symbian, despite clear signs of a development debt that meant huge improvements were needed for Symbian to be competitive (Cord, 2014; Siilasmaa and Fredman, 2019). The acquisition of Trolltech and the Qt framework was supposed to unify the platforms. However, the infighting between Maemo/MeeGo meant that the potential of the Qt framework was never utilized. Similarly, the N900, which was based on Maemo, never really saw follow-up. Instead, a joint venture was created with Intel to co-develop Maemo as a new OS called MeeGo. In the end, it was recognized that the performance of both Symbian and MeeGo was not satisfactory, which led to the partnership with Microsoft for a new smartphone OS (Nykänen and Salminen, 2014; Siilasmaa and Fredman, 2019).

7.2. Modes of Balancing

From 2008 onwards, *organizational separation* was no longer viewed as a viable strategy to drive exploratory efforts. This created unease in, for example, the OSSO team that was merged with the substantially larger Symbian development team (Doz and Wilson, 2008). However, the move to integrate Maemo with Symbian development was logical, as organizational separation had created practical problems with aligning focus and creating a coherent product strategy. Unfortunately, a clear strategic intent was still missing, and the reorganization did little to alleviate infighting between the two factions of OS developers (Cord, 2014; Doz and Wilson, 2018; Lamberg et al., 2019).

In terms of product development, Nokia continued to rely on a project mode of working. In other words, there was a continued reliance on *temporal separation* to tackle changing market conditions and develop new, innovative products. The project mode of working was typically highly formalized, as noted in included publication #3. Although there is little information about work practices in the key projects outlined in this chapter, such as the N97, N900, or N8, included publication #4 outlines an increased reliance on formal control mechanisms in the organization as a whole. Further, publication #4 posits that *contextual ambidexterity* is largely reliant on a balance of management control. In effect, this mode of balancing was not present as the organization had moved to a strong reliance on formal control only.

Domain separation was used extensively during the time period examined in this chapter, including application developers for the OVI store, Intel for MeeGo, and the partnership with Microsoft for a new mobile OS.

7.3. Summary

Table 9 details the key events from 2008 to 2013, their antecedents, modes of balancing and resulting exploitation or exploration.

Table 9 A summary of antecedents and modes of balancing 2008-2013

Year	Event	Antecedent	Mode of Balancing	Exploration/ Exploitation
2008	Nokia 5800 XpressMusic	Exogenous shock (iPhone and Android touchscreen UI as a disruptive innovation) Lack of absorptive capacity Strategic intent (convergence)	Temporal separation	Exploitation
	Exogenous shock: The 5800 model was Nokia's first response to consumers favouring touchscreen phones. Lack of absorptive capacity: Instead of exploring and enabling capacitive touch, resistive touchscreens were favoured as these were easier to adopt for an OS meant for physical controls: Symbian. Strategic intent: Symbian had been extremely successful and lay at the core of the focus on convergence.			

Year	Event	Antecedent	Mode of Balancing	Exploration/ Exploitation
2008	Acquisition of Trolltech and the Qt application framework	Exogenous shock (iPhone and Android ecosystem as a disruptive innovation) Lack of strategic intent	N/A	Exploration as an activity
	Exogenous shocks (application ecosystems): Qt could have alleviated challenges with development for both Symbian and Maemo but this opportunity was floundered. Lack of strategic intent: The role of Maemo remained unclear.			
2009	OVI Store	Exogenous shock (iPhone and Android ecosystem as a disruptive innovation) Lack of absorptive capacity Strategic intent (touch UI and ecosystems)	Domain separation (building an ecosystem of developers)	Exploitation
	Exogenous shock: Nokia was faced with ecosystem-based competition, and the OVI store was in response to this. Lack of absorptive capacity: Rather than exploring what made competing application stores work, Nokia repeated mistakes from earlier iterations. Strategic intent: Nokia gradually realized the importance of an application ecosystem and changed the strategic intent to incorporate this aspect.			

Year	Event	Antecedent	Mode of Balancing	Exploration/ Exploitation
2009	Nokia N97	Exogenous shock (iPhone and Android touchscreen UI as a disruptive innovation) Lack of absorptive capacity Strategic intent (convergence)	Temporal separation	Exploitation
	Exogenous shock: The N97 was Nokia's second response to consumers favouring touchscreen phones. Lack of absorptive capacity: Instead of exploring and enabling capacitive touch, resistive touchscreens were favoured as these were easier to adopt for an OS meant for physical controls: Symbian. Strategic intent: Symbian had been extremely successful and lay at the core of the focus on convergence.			
2009	Nokia N900	Competitive intensity driving sustaining innovation Lack of strategic intent	Temporal separation	Exploration as an activity
	Competitive intensity: Maemo had gotten more attention in response to new competition on the market. Lack of strategic intent: Despite positive reviews for the N900, Nokia still seemed to favour the development of Symbian.			
2010	MeeGo	Lack of strategic intent	Domain separation	Exploration as an activity
	Lack of strategic intent: The role of Maemo remained unclear, and the partnership with Intel further slowed down development.			
2010	Nokia N8	Competitive intensity driving sustaining innovation Strategic intent (touch UI and ecosystems)	Temporal separation	Exploration as an activity
	Competitive intensity and (a new) strategic intent: Nokia incorporated a capacitive touchscreen in the N8, requiring a significant revamp of Symbian.			

Year	Event	Antecedent	Mode of Balancing	Exploration/ Exploitation
2011	Microsoft Windows Phone	Competitive intensity	Domain separation	Exploration as an activity
	Competitive intensity: Development of Symbian and MeeGo was no longer seen as a viable option.			
2013	Nokia Mobile Phones divested	N/A	N/A	N/A

8. Discussion

8.1. Research Gap and Findings

In this section, I will review the research gaps outlined in Chapter 1 from the perspective of environmental, organizational, and managerial antecedents, as well as various forms of balancing between exploration and exploitation. Looking at the events analysed in Chapters 5-7, some attempts at exploration were more successful than others. In this line of thought, scholars highlight the interdependency between exploration and exploitation, and that exploration should be viewed as a capability rather than an activity (Lavie et al., 2010; Farjoun, 2010; Chandrasekaran et al., 2012). In other words, merely initiating activities to seek new competences is insufficient. New competences need to be put in use; exploration needs to evolve into exploitation. The summary tables in Chapters 5-7 and the instances of "exploration as an activity" indicate that this is an area where Nokia faced difficulties, particularly from 2008 onwards. In practice, this means that the capability to explore was largely lost from 2008 onwards, despite activities pertaining to exploration. With this in mind, the next sections will cover antecedents of exploration and different ways of balancing between exploration and exploitation. This is followed by a summary that outlines four key propositions based on the analysis in this thesis. While I will review each antecedent separately, it is notable that many events exhibit a combination of many factors that either supported or prohibited successful exploration.

8.1.1. Environmental Antecedents

In line with previous research, a highly dynamic environment and *competitive intensity* drove exploration at Nokia (Uotila et al., 2009; Lavie et al., 2010; Junni et al., 2013). Many radical innovations were brought to market as a result of competitive intensity, such as The Communicator, Symbian, the 7650 camera phone, and the N95 all-in-one device. Common for all of these were that they were sanctioned by top management and anchored in a common strategic intent. The projects that developed the 7650 and N95 also relied on a high degree of discretion (see Section 8.1.2).

While competitive intensity promoted exploration at Nokia the effects of *exogenous shocks* is less clear (cf. Lavie et al., 2010; Wilden et al., 2018). Nokia experienced an exogenous shock with the introduction of the iPhone and the Android OS in 2007. A new UI approach and two ecosystems of application developers constituted a disruptive innovation (Christensen, 1997). This typically requires a change in the strategic intent, structures, and culture of the company (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2021). However, initially this did not lead to changes in Nokia's strategic intent. Capacitive touchscreens and an application ecosystem were sidestepped. At first, Nokia saw touchscreens as a novelty; the bulk of the product portfolio relied on physical keyboards while application development was still not in focus (Cord, 2014; Siilasmaa and Fredman, 2019). In practice, this meant that

important devices such as the Nokia 5800 and the N97 relied on resistive touchscreens. This would gradually change. A focus on application developers started with the acquisition of Qt in 2008 and was followed up with the OVI store in 2009. With competitive intensity increasing, Nokia also embraced capacitive touchscreens in the N8, while also trying alternative operating systems to better cope with competitive pressure. The N900 was a Maemo based device, while Nokia moved to Windows Phone in all their products from 2011 onwards. However, the structures and culture of the company were not modified to accommodate a new strategic intent, something we will examine in the next section.

8.1.2. Organizational Antecedents

Included publication #4 notes that Nokia moved from an emphasis on informal control in the nineties, to a balance of both *informal and formal control* around the turn of the millennia, and further to an emphasis on formal control from around 2007 onwards. This in line with Greiner's (1998) notion of organizational evolution, describing how organizational age and size affects the predisposition for control. While an emphasis on informal control in the nineties contributed to the logistics crisis, it also enabled exploration to support rapid growth. Another factor that supported exploration during the nineties was the propensity for *absorptive capacity* (cf. Lavie et al., 2010). Nokia's biggest competitor, Motorola, was scrutinized in detail and learnings were applied internally.

At the turn of the millennia, the response to the logistics crisis had introduced a host of formal controls. Included publication #4 outlines how this resulted in a more mature company reliant on a balance of control modes that supported ambidextrous capabilities. Two of the events examined in Chapter 6 were very successful product development projects, the 7650 and the N95. Publication #3 outline how Nokia often applied a "one-size-fits-all" approach to project management, which during this time relied on a so-called stage-gate waterfall approach (Fernandez and Fernandez, 2008). There were, however, notable exceptions. The Nokia 7650 and N95 product projects exhibited both formality and discretion (Naveh, 2007). This enabled a degree of freedom in the project teams to adapt the project to its context, thereby also enabling exploration (McGrath, 2001; Shenhar et al., 2016). The Nokia 7650 also relied on absorptive capacity; many technology partners were involved in, for example, the development of the camera module. While the Nokia 7650 and N95 relied on a combination of formal and informal control, there were instances where this balance was not present. Both the Nokia Ventures Organization and 'Download!' application store succumbed to formal control mechanisms present in the core organization. In practice, this meant that organizational separation was not coupled with separate structures and cultures in the units tasked with exploration (cf. O'Reilly and Tushman, 2013). In contrast, the Open Source Software Operations team relied heavily on informal control. Results were fast, the team produced an entirely new device with a new operating system the same year they were founded. However, the

integration of these results to core operations was difficult due to a lack of strategic intent (see Section 8.1.3).

Looking at the period from 2008 onwards, Nokia exhibited a host of rigidities (Lucas and Goh, 2009). As outlined in Section 7.1.2, a strong reliance on formal control fostered rather bizarre decision-making. In practice, it would seem the empowerment and trust were replaced with processes, rules, and incentive schemes (cf. Ouchi, 1979). Rather than individuals and teams building a sense of where to focus, the organization started to "hide" behind formal control mechanisms, inhibiting the ability to explore. As noted in Section 3.4, organizations tend to evolve by introducing formal control mechanisms, just like Nokia had done. However, Greiner (1998) notes that many successful organizations revert from an overly focus on formal control by re-introducing informal control mechanisms as they mature. In his words, a last phase of organizational evolution is characterized by flexible management and social control rather than formal control. Management's task is to consult, not direct. It would seem Nokia never reached this phase in its organizational evolution. This likely impeded Nokia's response to disruptive market changes. In addition to an overly focus on formal control, absorptive capacity decreased. The response to the iPhone and Android OS lacked an understanding of key features in these products, a well-functioning (capacitive) touchscreen and an application ecosystem. There were attempts at both touchscreen phones and an application ecosystem, but these were based on resistive touchscreens (and an OS not designed for touch) while application development for Symbian remained difficult. The Qt framework could have alleviated these problems, but it never got the necessary attention. The issues with a lack of absorptive capacity coincided with a lack of strategic intent, something we will examine in the next section.

8.1.3. Managerial Antecedents

O'Reilly and Tushman (2013) posit that a key leadership task is to direct resources towards exploration and exploitation and manage any conflicts that arise in this process. A key to successfully balance exploration and exploitation is a common *strategic intent*, that is, a clear definition of the overarching goals of the organization. Without a clear strategic intent that is understood and widely accepted, inherent conflicts between exploratory and exploitative efforts become difficult to handle (March, 1991). During the nineties, Nokia operated with a clear notion of focusing on growing demand in telecommunications; the strategic intent was well-defined.

At the turn of the millennia, Nokia's new strategic intent centred around a focus on converged devices with the Symbian S60 OS at its core. This led to the formation of the Digital Convergence Unit, later Multimedia, with a clear mandate to explore, resulting in products such as the Nokia 7650 and N95. At the same time, the Open Source Software Operations (OSSO) team developing the Maemo OS suffered from a lack of strategic intent. Although tasked with exploration, there was no coherent plan for how the results would be integrated to the mainstream business. Infighting ensued. Similar challenges

were faced by Club Nokia and the 'Download!' service. While these were exploratory efforts, there was no overarching goal to ensure that application development and an ecosystem would be an integral part of the mainstream product offer. In these cases, exploration never evolved into exploitation.

Looking at the period from 2008 onwards, Nokia was slow in changing its strategic intent, despite the disruption taking place. This is most evident in terms of the high reliance on the Symbian OS, which lay at the core of the focus on convergence. Previously very successful, there was an inherent belief that the OS would sustain Nokia's performance also in the future (Doz and Wilson, 2018). As a result, key products such as the Nokia 5800, N97, and N8 were built upon Symbian. This also meant that efforts around Maemo (later MeeGo), and the Qt framework's role in building a bridge between different operating systems wavered. There was a lack of a clear strategic intent in terms of developing an alternative OS to Symbian (Siilasmaa and Fredman, 2019). Despite a favourable response, this also meant that the N900 with the Maemo OS was not followed-up with further devices. Instead, Nokia partnered with Intel for the development of the OS. However, the strategic intent of the company gradually shifted to embrace application development and capacitive touchscreens. These efforts were still centred around Symbian, which had accumulated a significant development debt. Further, the rigidities outlined in Section 7.1.2 and in publication #4 could have impacted the ability to effectively transform Symbian to an OS supporting capacitive touch and easy application development.

In summary, senior management's previous experience favoured the development of Symbian, while a lack of a clear strategic intent for an alternative OS, Maemo, hampered these efforts. This highlights a conundrum companies are faced with when responding to disruptive change: previous experience can hinder a necessary reorientation of strategic intent (Tushman and O'Reilly, 1996: Lavie et al., 2010; O'Reilly and Tushman, 2021). Three other companies featured in this thesis faced the same problem. Kodak and Polaroid were largely stuck in their past, reliant on photography and instant printing of images (Tripsas and Giovanni, 2000; Ho and Chen, 2018). They saw disruption only as a technology change. This is in stark contrast to a large competitor of theirs. After some initial wavering, Fujifilm completely redefined its strategic intent to focus on entirely new product lines (Komori, 2015).

8.1.4. Modes of Balancing

Previous research notes that organizations do not necessary employ a single form of balancing in their attempts at ambidexterity (Birkinshaw and Gibson, 2004; Kauppila, 2010; Ossenbrink et al., 2019; Foss and Kirkegaard, 2020). Instead, different forms of ambidexterity are used interchangeably and sometimes simultaneously. Included publication #4 and this thesis summary supports this notion.

During the first two time periods examined in this thesis, Nokia successfully employed multiple forms of balancing between exploration and exploitation, including contextual ambidexterity. In the last time period from 2008 onwards,

Nokia no longer used organizational separation. One reason for this might be the difficulties with, for example, NVO and OSSO. Further, as publication #4 notes, the predisposition for formal control effectively prohibited contextual ambidexterity. In effect, this lowered performance in terms of exploration, further supporting a notion that multiple forms of balancing are needed.

8.1.5. Summary

In Chapter 1, I outlined questions that represent gaps in our current understanding of ambidexterity. Table 10 lists these research gaps as well as research questions specific for this study, along with a summary of findings and propositions to highlight key results.

Table 10 Research gaps and findings

Research Gap	Findings in the Included Publications	Research Question, Key Events, and Propositions
Under what conditions do organizations respond to exogenous shocks with exploration versus exploitation? In this thesis, the theory of disruptive innovation is used to conceptualize exogenous shocks.	The included publications only focus on organizational antecedents of ambidexterity, whereas this thesis summary also includes an analysis of environmental antecedents.	Did Nokia explore when faced with market disruption?
		1999-2007 - Apple iPhone (exogenous shock/disruptive innovation) - Android (exogenous shock/disruptive innovation)
		2008-2013 - Nokia 5800 (exploitation in response to touchscreen UIs) - Qt (exploration as an activity in response to competition from ecosystems) - OVI store (exploitation in response to competition from ecosystems) - N97 (exploitation in response to touchscreen UIs) - N900 (exploration as an activity in response to touchscreen UIs) - MeeGo (exploration as an activity in response to competition from ecosystems) - N8 (exploration as an activity in response to touchscreen UIs)
		Initially, Nokia did not explore but instead relied on existing competences. A renewed strategic intent triggered exploration, but this was unsuccessful due to missing absorptive capacity, as well as an imbalance of management control modes. **Proposition 1** Based on disruptive market changes, a reorientation of strategic intent is necessary to trigger exploration.

Research Gap	Findings in the Included Publications	Research Question, Key Events, and Propositions
What is the role of organizational structures and culture in promoting ambidexterity? In this thesis, management control is used to conceptualize structure and culture. Formality and discretion are used to conceptualize the role of pre-defined processes and structures in projects.	Publication #4: A balance of control was needed to support ambidexterity at Nokia. Publication #3: Discretion was needed to support exploration in projects at Nokia. Agile project management effectively combines formality and discretion and can thus support exploration. A project mode of working that completely discards methodology can also support exploration. Publication #2 Agile project management is needed in SCM projects that are structurally complex, uncertain, and with strong interdependence between elements in the project. Traditional project management is less suited for these projects.	How did various forms of management control support ambidexterity at Nokia?
		1992-1998 - A decision to focus on telecommunications (informal control)
		1999-2007 - Nokia 7650 (formality and discretion) - Nokia Ventures Organization (formal control) - Open Source Software Operations and Maemo OS (informal control) - N95 (formality and discretion) - Download! app store (formal control)
		Nokia faced difficulties with an imbalance of control modes during the nineties, as well as from 2008 onwards. This effectively hampered Nokia's ambidextrous capabilities. A high reliance on informal control resulted in a lack of structures to support growing demand. A high reliance on formal control led to difficulties with exploration, as personal judgement and adaptability was replaced with rules, processes, and incentives. **Proposition 2** A balance of formal and informal control (or formality and discretion in projects) is needed to support ambidexterity.

Research Gap	Findings in the Included Publications	Research Question, Key Events, and Propositions
How can senior management reconcile and synchronize efforts at exploration and exploitation and how important is strategic intent in supporting ambidexterity?	Publication #4: Aligning a disparate focus on exploration and exploitation in different units was difficult at Nokia, in particular without a clear strategic intent.	How did Nokia's senior management reconcile efforts at exploration and exploitation, and what role did strategic intent play in this?
		1992-1998 - A decision to focus on telecommunications (clear strategic intent)
		1999-2007 - Digital Convergence Unit (clear strategic intent) - Nokia 7650 (clear strategic intent) - N95 (clear strategic intent) - Download! Store (lack of strategic intent) - Open Source Software Operations and Maemo OS (lack of strategic intent)
		2008-2013 - Qt (lack of strategic intent) - OVI store (clear strategic intent) - N900 (lack of strategic intent) - MeeGo (lack of strategic intent) - N8 (clear strategic intent) - Windows Phone (clear strategic intent)
		Strategic intent was central for reconciling efforts at exploration and exploitation at Nokia, whereas a lack of strategic intent hampered many exploratory activities. **Proposition 3** Reconciliation of exploration and exploitation and successful ambidexterity requires a clear definition and communication of strategic intent by senior management.

Research Gap	Findings in the Included Publications	Research Question, Key Events, and Propositions
What is the best mode of balancing between exploration and exploitation?	Publication #4: Contextual ambidexterity played a key role for Nokia's ambidextrous capabilities. Publication #1: New SCM competences and solutions were crucial for Nokia to improve efficiency (in response to the logistics crisis).[24] These new competences also lay the foundation for exploitation in the supply chain (effectively supporting domain separation).	What modes of balancing between exploration and exploitation were successful at Nokia?
		1992-1998 - Organizational, domain, and temporal separation as well as contextual ambidexterity
		1999-2007 - Organizational, domain, and temporal separation as well as contextual ambidexterity
		2008-2013 - Domain and temporal separation
		Successful exploration at Nokia relied on a combination of many modes of balancing between exploration and exploitation. In the last phase examined in this thesis, Nokia relied on partners and projects for exploration, and the capability to explore was lost (despite exploratory activities). **Proposition 4** Multiple modes of balancing combined with contextual ambidexterity are needed to support organizational ambidexterity.

A key finding based on the propositions in Table 10 is that ambidexterity is not a result of one specific antecedent or form of balancing. Key antecedents to ambidexterity include a clear strategic intent, a balance of formal and informal control (cf. Tushman and O'Reilly, 1996; Lavie et al., 2010), coupled with multiple forms of balancing, including contextual ambidexterity (cf. Ossenbrink et al., 2019; Foss and Kirkegaard, 2020). Strategic intent seems to be a key factor in aligning a disparate focus on exploration and exploitation. It allows for senior management to shield exploratory activities while later integrating them to the core organization, as exemplified by the DCU, the 7650, and the N95. A clear strategic intent also characterized later activities that Nokia crafted in response to market disruptions by Apple and Google, such as the N8 and the OVI store. However, other factors likely inhibited successful exploration in these cases. Contextual ambidexterity that had contributed to the success of, for example, the N95 was no longer a viable option due to an

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[24] The logistics crisis and capabilities for domain separation were not specifically discussed in publication #1.

imbalance of management control. Further, absorptive capacity was low, and Nokia did not copy the characteristics of competing app stores and UI technologies.

This raises a key question: what could have been done differently? One could argue that the strategic intent should have "embraced" capacitive touch and an ecosystem earlier. However, similar examples from Polaroid, Kodak, and Fujifilm demonstrate that this reorientation is difficult. Further, Nokia eventually changed its strategic intent but failed to execute on it. This was largely due to an imbalance of control. Structures and culture are needed to support ambidexterity (Tushman and O'Reilly, 1996; Lavie et al., 2010), and Ouchi's (1979) notion of management control gives us a more granular description of these constructs. In practice, it allows scholars and managers to "check" the presence of both formal and informal control through the mechanisms outlined in Section 3.4 and in the included publication #4. This is something senior management at Nokia could have done to subsequently initiate efforts to reduce the presence of various forms of formal bureaucratic control.

8.2. Alternative Explanations

The quality criteria for qualitative research outlined in Section 4.4 include criticality as one aspect, involving a need to account for different interpretations. Some of secondary sources I have used present alternative explanations to what happened at Nokia. In the interest of a comprehensive account, I feel that these should also be reported as a part of this thesis.

Many books about Nokia are narrative accounts that cover events in a "neutral" way, based on interviews done by the author(s). While very interesting and useful for a researcher, these books do not seek to build theory, nor do they use a theoretical framework to frame decision making or specific events. In contrast, the studies in Table 11 are theory building and they provide alternative explanations to the analysis in this thesis. I have chosen to include Risto Siilasmaa's biography in this group despite it not being an academic study. The reason for this is that it corroborates some of the findings in an earlier academic study.

Table 11 Previous academic literature on Nokia's decline along with key findings

Book or Journal Article	Year Author(s)	Type	Key Findings/Reasons for Nokia's Decline
Distributed attention and shared emotions in the innovation process: How Nokia lost the smartphone battle *Administrative Science Quarterly*	2016 Vuori and Huy	Interview study	The central premise of Vuori's and Huy's article is that middle- and top management experienced fear. Top management feared external parties such as shareholders and investors as well as competitors, whereas middle management feared the reaction of top management. This led to a situation where information passed up the ladder was skewed; problems and negative news did not reach top management. At the same time, top management did not communicate a sense of urgency to middle management regarding external threats, e.g., the capabilities of new entrants to the market.
Ringtone Exploring the Rise and Fall of Nokia in Mobile Phones *Oxford University Press*	2018 Doz, Y. L. and Wilson, K.	Narrative/ interview study	The starting point for Doz' and Wilson's book is to look at Nokia's decline from three perspectives: 1) As an instance of Schumpeterian creative destruction, 2) As an instance of failed organizational evolution, or 3) As a failure of management volition. In the end, the authors conclude that Nokia's decline had started already prior to new competition from Apple and Google. They emphasize a matrix re-organization in 2004 as a failure and outline several decisions by management that led to the decline. In particular, they stress top management's propensity to rely on past experience in guiding decision making. This led to a chain of events that ultimately caused the decline.

Book or Journal Article	Year Author(s)	Type	Key Findings/Reasons for Nokia's Decline
Transforming NOKIA The Power of Paranoid Optimism to Lead Through Colossal Change *McGraw Hill Professional*	2019/2018 in Finnish Siilasmaa, R. and Fredman, C.	Biography	Siilasmaa provides numerous accounts of bad news and development problems, in particular relating to Symbian, not reaching top management. Further, he paints of picture of former CEO and Chairman Jorma Ollila enticing fear in subordinates. In effect, parts of his account mirrors Vuori's and Huy's (2016) findings.
The curse of agility: The Nokia Corporation and the loss of market dominance in mobile phones, 2003–2013 *Business History*	2019 Lamberg et al.	Narrative/ interview study	Lamberg et al. examine a chain of events and decisions that led to Nokia's decline. They claim that causal inference is only possible by examining choices rather than other organizational attributes, as full access to company archives is not available.

There are two central themes in the studies in Table 11. On the one hand, studies stress 'fear' and how this led to distorted information reaching top management and vice versa, how top management failed to articulate outside threats. On the other hand, studies indicate there was a long series of events and decisions that led up to the difficulties Nokia faced when Apple and Google disrupted the market. It is clear also from the perspective of this thesis that a chain of events, both successes and failures, influenced decision making to a high degree. Similarly, a distorted flow of information might be the reason for the lack of absorptive capacity.

8.3. Quality Criteria Examined

In Chapter 4 of the thesis, I outlined the quality criteria I have striven to follow in my research. In terms of *authenticity*, I hope that the analysis broken down as a timeline serves to create a rich description of conditions. Rather than portraying Nokia in black and white terms, either as a failure or as a success (cf. Laamanen et al., 2016), I have striven to create a balanced narrative looking at what made Nokia the success it was and what led to the decline of their business. While my personal experience with the company could have created bias, the empirical data in included publication #3 has been analysed with the help of a co-author. Further, my personal experience served to raise more questions than preconceived notions of why things worked the way they did. In the end, I feel that I have found answers to many of my questions.

Theory lies at the core of establishing *plausibility* in an academic study. The framework outlined in Chapters 2 and 3 provide a suitable frame of reference to understand how exploration and exploitation manifested itself at Nokia. A key focus of the thesis was to study the research gaps outlined in previous research and presented in Chapter 1.

Criticality assumes multiple interpretations and suspicion is present in the research, and that also the reader's beliefs are challenged. This is by no means an exhaustive analysis of what happened. I have reviewed several other studies regarding alternative explanations, and this study is based on both empirical data and secondary sources. It is one piece of the puzzle. I am hoping that it serves to raise new insights to what could have been done differently at Nokia and how these learnings can be applied in similar contexts. While the environment examined here is distinct, I do believe companies can use these results to work out how to better balance exploration and exploitation also under less dynamic conditions. If a company faces a similar disruption to their core market as Nokia did, this thesis is a survival guide.

9. Conclusion

This thesis summarizes the included publications and examines a series of events to determine the antecedents, modes of balancing, and implications of ambidexterity based on these events. This approach allows for the examination of ambidexterity over time, in effect enabling us to see exploration as a capability rather than a discrete choice or activity (Lavie et al., 2010; Nosella et al., 2012). We have examined environmental antecedents that trigger the need for exploration, while also looking at managerial and organizational antecedents that enable ambidexterity. This corresponds to a notion that ambidexterity requires an alignment of strategy, structure, and culture (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2021).

A response to exogenous shocks in the form of disruptive innovations is reliant on exploration that in turn requires a realignment of strategic intent, structures, and the culture of the company. Senior management plays an important role in defining the strategic intent of the company. This ensures an overarching goal that provides the organization with a clear direction (O'Reilly and Tushman, 2013; 2021). This helps individuals to understand the role of exploratory efforts, but it also helps management in identifying exploratory efforts to be exploited. A response to disruptive innovation often starts with a redefinition of strategic intent, followed by alignment of structures and culture. This thesis puts forward that a balance of formal and informal control is needed to enable ambidexterity, effectively supporting existing structures and culture, or enabling the change of these. An imbalance of control can lead to either "failure traps" as the organization lacks the means to exploit (Levinthal and March, 1993; Chandrasekaran et al., 2012), or an inability to support exploration as individual autonomy is replaced with various forms of behaviour and outcome control (Ouchi, 1979). These principles apply irrespective of whether contextual ambidexterity is pursued or whether different modes of balancing are used. In effect, a combination of various modes of balancing with contextual ambidexterity is likely to produce the best results (Birkinshaw and Gibson, 2004; Kauppila, 2010; Ossenbrink et al., 2019; Foss and Kirkegaard, 2020).

This brings us to two key challenges not explicitly addressed in this thesis. How does one know that the company's strategic intent is suitable for the market, and how are structures and culture built? Knowing upfront whether a strategic intent is the best possible is impossible, it requires testing. Therein lies perhaps the core strength of ambidexterity, it allows for both testing of an existing strategic intent and a reorientation of the company in response to environmental shocks or competitive intensity. In terms of building the necessary structures and cultures, this thesis puts forward that formal and informal control mechanisms are used (Ouchi, 1979; Kirsch, 1996). The key contribution of the thesis is not in how to apply these. Instead, I wish to direct attention at how senior management needs to maintain a balance between the two. Just like there is a propensity for exploitation in organizations (March,

1991; Benner and Tushman, 2002; Benner and Tushman, 2003; Uotila et al., 2009; Garud et al., 2011), it would seem organizations easily revert to formal control as they mature (Greiner, 1998). This was also the case with Nokia. In effect, this thesis provides empirical evidence that a balance of control is needed for ambidexterity (cf. Burton and O'Reilly, 2021) while also providing senior management with a means to identify whether a balance is present; is there room for stories, rituals, and ceremonies that build a culture, or is everything guided by processes, rules, and incentives?

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Appendix: Original Publications

Nyman, H.J. (2012), "An Exploratory Study of Supply Chain Management IT Solutions", *Proceedings of the Forty-Fifth Annual Hawaii International Conference on System Sciences*, **4-7 January 2012, Maui, USA.**

This is the author's accepted manuscript, edited after peer review.

Nyman, H.J. and Hirkman, P. (2012), "On the Nature of Supply Chain Management Projects and How to Manage Them", *European Conference on Information Systems 2012 Proceedings,* **10-13 June 2012, Barcelona, Spain.**

Nyman, H.J. and Öörni, A. (2023), "Successful Projects or Success in Project Management - Are Projects Dependent on a Methodology?" *International Journal of Information Systems and Project Management*, **Vol. 11, No. 4, pp. 5-25.**

Nyman, H.J. (2023), "Management Control and Ambidexterity: How Nokia's Ambidextrous Capabilities Were Lost", *Academy of Management Annual Meeting Proceedings,* **4-8 August 2023, Boston, USA.**

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1

An Exploratory Study of Supply Chain Management IT Solutions

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Abstract

This paper explores the evolution of supply chain management IT solutions and looks at how these relate to each other and the overall performance of supply chain operations. A number of different technologies that help companies master their supply chain are looked at, and major benefits and drawbacks with these are presented. The IT solutions are categorized in three areas: data management, data exchange, and data tracking. In addition, some related process models like vendor managed inventory (VMI) and collaborative planning, forecasting and replenishment (CPFR) are studied.

1. Introduction

Supply chain management (SCM) is highly dependent on information and communication technology (ICT). In today's world, nearly all companies use some form of ICT solution to help them orchestrate logistics and communicate with their partners. This can range from simple solutions in a spreadsheet, printed out and faxed to a supplier, to highly sophisticated enterprise resource planning (ERP) systems combined with automated system-to-system (S2S) solutions. Laudon, cited in [26], defines supply chain IT solutions as "information systems that automate the flow of information between a firm and its suppliers to optimize the planning, sourcing, manufacturing, and delivery of products and services". If we look at SCM as a discipline, many definitions stress the need to integrate business processes across company boundaries to generate value for all parties involved [25,8,30]. As such, two things become important, the need to manage business processes and data as well as the need for integration with supply chain partners.

I have worked in different roles related to supply chain management for over nine years. As a project-, and program manager as well as team leader, I have experienced various facets of SCM IT implementation. In a Fortune Global 500 company, I have had the opportunity to engage with numerous suppliers, outsourcing partners, logistics service providers, and SCM/ERP software providers. I have personally participated in, led or overseen the implementation of advanced planning and scheduling (APS) systems, radio-frequency identification (RFID) technology, enhancements to enterprise resource planning (ERP) systems, and VMI implementations with new suppliers (including the automation of data communication between the parties involved). I have been the chief designer of a collaborative planning solution, rolled out to over 150 suppliers, that utilizes all of the above technologies. The combined purchase volume through this solution is more than USD 10 billion annually. With this paper, one key intention is to review relevant academic research against personal experience (my own reflections and personal experience is written in italics) or in essence; to have a "dialogue" between personal experience and academic research in order to see whether these mirror each other or not.

In addition, this paper will provide an overview of the evolution of selected SCM IT solutions in the past fifty years. This is more than a history lesson, as many companies still use technology that was developed a fairly long time ago. In fact, doing a quick assessment of how a company utilizes SCM IT solutions could give us an understanding of the overall maturity of the company's SCM activities. The suggestion here is not that this would be an absolute, unambiguous evaluation of maturity. There are however several elements tying the choice of IT solutions to how advanced operations are. For example, many scholars stress the need for business process re-engineering and management (BPR and BPM) in conjunction with or before an SCM IT implementation [2,17,29]. As such, it would be reasonable to think that if mature business processes are in place (with BPM practices), it is possible to implement mature SCM IT solutions. And business process integration (that requires BPM) is at the core of SCM according to the definition given above. In addition, a number of studies show that advanced SCM IT solutions improve communication, co-operation and visibility in the supply chain [22,40,28]. Thus, if advanced SCM IT solutions are in place (properly implemented also on a business process level) they will have a positive impact on SCM performance. So, while

not fully unambiguous, there is a connection between SCM IT maturity and overall SCM process maturity.

To better formalize the discussion, different SCM IT solutions have been divided to three categories: data management, data exchange, and data tracking. In addition to this, a fourth dimension is introduced: (related) process models. A summary of the different IT solutions and process models (with a timeline of historical evolution) that will be examined in this paper is given in table 1 (the acronyms in table 1 are explained in the corresponding sections below). It should be noted that the underlying principles in some of these solutions (for example material requirements planning, MRP) can be implemented with a spreadsheet and does not as such require stand-alone software.

Table 1 Summary of SCM solutions examined in this paper with related historical development

	Data Management	Data Exchange	Data Tracking	Process Models
1960s	ROP	Mail	Manual Inspection	PO based procurement
1970s	MRP	Fax	Barcodes	.
1980s	MRP II	EDI	.	.
1990s	ERP	email, e-Business	.	VMI
2000	APS	RosettaNet	RFID	CPFR

There are also other ways of categorizing SCM IT solutions. A somewhat similar model is by Auramo et al. [2]. They look at the different functional roles of IT in SCM, namely "transaction execution", "collaboration and coordination" and "decision support". Langley et al. [26] categorize the solutions into "business intelligence", "supply chain event management", "supply chain planning", and "supply chain execution". Dam Jespersen and Skjoett-Larsen [8] categorize supply chain information systems based on maturity into "early stages" and "advanced stages". Their classification follows the outline in table 1 with for example the implementation of ERP, APS, electronic data interchange (EDI) and VMI in the advanced stages. The main difference between the above models and the categorization proposed in this paper is its more encompassing nature; all companies (engaged in some form of supply chain management) use solutions in all four new categories (whereas companies do not necessarily use solutions in the categories proposed by previous authors). This is helpful in gaining a more comprehensive view of the field, one of the key goals with this paper.

All companies should not automatically strive for the latest advances in SCM IT; there are numerous drawbacks with particular solutions. This paper will analyze, in addition to the evolution of SCM IT over the years, the major benefits and drawbacks associated with many technologies. The proposed categorization gives a clear understanding of the main functionality that the selected technologies enable and helps in providing better understanding of the dependencies. The study has been done as an extensive literature review and adds to existing papers by creating a holistic understanding of how the technologies reviewed here interoperate and contribute to SCM process maturity.

In summary, this paper will look at the evolution of SCM IT solutions over the years and examine the dependencies between these with the help of the proposed categorization. This gives us a comprehensive overview of the field, as all companies need the capabilities outlined in the four categories. Since many companies still employ technologies that are fairly old it is also appropriate to look backwards in time. In order to gain a better understanding of the key characteristics of the examined SCM IT solutions, comprehensive studies of academic research as well as personal experience is reflected. With all of the above in mind, what are the pre-requisites and expected gains from a particular SCM IT set-up? This paper is structured so that each category is examined, followed by some limitations to the approach in this article, a further discussion, and conclusions.

2. Data Management

In this paper, data management refers to ways of handling and analyzing data for decision support in supply chain management. Early reorder point (ROP) systems set the basis for the evolution of system capabilities in this area. Originating in the sixties, these systems were designed to automate the calculation of economic order quantities (EOQ) and the economic re-order point [19]. In the late sixties, material requirements planning (MRP) systems started to emerge. This introduced the concept of bill of materials (BOMs) and later the concept of independent and dependent demands. The basic difference is that independent demand refers to end-products whereas dependent demand refers to the material (listed in the BOM) needed for producing the goods. The ROP systems and EOQ calculations were suitable for planning independent demand whereas the MRP systems introduced methods for calculating material requirements, or dependent demands [34]. The so called MRP II or manufacturing resource planning systems further expanded MRP capabilities to reporting, scheduling and overall business planning. The basic notion introduced by MRP and MRP II systems was that instead of looking backwards (where future demand is largely predicted based on past usage), requirements were now planned for the future [22]. These systems are still popular among many

companies, particularly for small and medium sized firms, despite being relatively old technology (ROP systems being a notable exception to this, which is also why it is excluded from table 2 below) [23]. A crucial point in terms of the quality of material requirements from MRP systems (or ERP systems below) is related to product data management [2]. If there are inconsistencies or inaccuracies in the BOM, this will cause significant challenges. Dedicated product data management systems also exist, but the review of these is beyond the scope of this article.

Further development took place during the nineties with the introduction of enterprise resource planning systems (ERP). The origins of ERP systems can directly be traced back to MRP and MRP II systems [14]. Kumar and Van Hillegersberg [24] define ERP systems as "configurable information systems packages that integrate information and information-based processes within and across functional areas in an organization". A few important points emerge: first of all, ERP systems are often implemented as different modules, depending on the particular needs of the company [14] and secondly, ERP systems indeed manage SCM processes but only within the company. One module could for example be an MRP solution. A third crucial characteristic of ERP systems is that of real-time transaction processing [14,19]. So, ERP systems allow for real-time tracking and processing of events in any functional area of the company (where we can note a strong link to the data tracking section in this paper). The improved cross-functional characteristics of ERP systems are in fact what set them apart from MRP II systems [41,19]. A further key goal is also that any piece of information is only entered once [15,33]. From a pure SCM perspective, all of the above is a tempting proposition, in particular combined with data exchange solutions to integrate your partners.

Reflecting on personal experience, ERP systems can indeed provide substantial benefits through real-time tracking of for example material and finished goods movements. A key thing to note is that this requires (at least nearly) all locations to the modeled in the system. While we enjoyed this benefit, this does not seem to be the case in many instances. Partial implementation (with only a few locations actually using the ERP system), or the same system implemented as several instances running independently, can cripple benefits from real-time processing. In addition to frequent errors related to product data in BOMs, life-cycle management is also a key challenge. Frequent component version changes were nearly impossible to model (as a timed change) as they also involved inventory management; old

components need to be "flushed out" of the system prior to taking the new version into use.

So why does not everyone take ERP systems into use? A key element is cost, both in terms of implementation and licenses. According to some surveys and case studies, there is a negative return on investment when looking at quantifiable gains from ERP implementations [41,22]. This might be because of a significant delay between the implementation and the benefits being realized, or because the benefits are more intangible in nature (and most probably a combination of both). According to a case study of a SAP implementation (one of the major ERP vendors) done by Kennerley and Neely [22], the main benefits are indeed intangible and qualitative in nature: efficiency and control (eliminating the need for phone, email and faxes), increased leverage on suppliers (the data available forms a robust platform for negotiation with suppliers) and improved planning (related to information availability and transparency). One clearly tangible, quantifiable benefit was observed, namely that of inventory reduction (through improved visibility on inventory quantities, location and type). All in all, this study found that the increased access to information (previously not available or hard to get to) created opportunities for improvements while also creating a complexity in the implementation. This brings us to "hidden" costs related to the vast implementation effort needed in for example training personnel. Also, in order to integrate business processes across functions, there is often a need to transfer and transform data from multiple systems (or even spreadsheets, archives and the like) to the new ERP system [41]. This cost can become very large as this is a tedious, time consuming and rather demanding task (familiarity with old systems, the new ERP and the associated business processes is needed).

Also after a successful implementation, ERP systems are very demanding in terms of maintenance. In our case, one ERP instance was implemented (with all factories, DCs, functional areas etc. modeled). As previously noted, this allows for reaping the greatest benefits from an ERP implementation but it also creates a very high dependency on the system. If crippled, business will grind to a total halt. This in practice resulted in extreme rigor in terms of management, maintenance and development. It was slow, costly and tedious to improve operations through ERP IT enhancements. The highly interlinked nature of ERP systems also caused practical challenges. If some parameter in for example the material management module was incorrectly set, it caused large issues with accuracy in material forecasts.

There are two key features normally missing in

standard ERP solutions: lack of advanced planning functionality [39], and a representation of the supply chain beyond your own company (as previously discussed). This has lead to the development of Advanced Planning and Scheduling (APS) systems (sometimes simply referred to as advanced planning systems or supply chain planning systems). Key features in APS systems are optimization [29,19] and constraint based planning [16]. Optimization can be done against a number of factors, including (but not limited to) capacity, transportation, distribution and product mix. For example using linear programming methods, you can make better decisions what to produce, where to produce it and in which quantities. Network design is another feature, indicating where to best locate production or inventory [20]. If capacity or supply is constrained, APS systems can also help with optimal customer allocation (after all, some customers might be more important that others). Using the notion of constraint based planning, customer orders can be compared to available material supply and production capacity. Any slack can be indicated as so called available-to-promise (ATP) and capable-to-promise (CTP) quantities [39]. A key thing to note is that an APS system does not replace ERP; it is merely an extension of it. APS systems are commonly reliant on information provided by the ERP system [12,20]. APS systems also span over company borders [8], and thus unlike ERP systems, you normally have at least part of your supply chain modeled in the APS. Software vendors often offer tailored solution for collaborative planning with customers and suppliers; and particularly the constraint based planning features of APS rely on this input [39]. We will further discuss this in the data exchange category.

Brown et al. [5] report on an APS that generated significant benefits for the Kellogg Company in the form of reduced costs for production, inventory and distribution. In addition, even bigger savings were generated through longer term capacity balancing. Kellogg was ahead of their time in the sense that they introduced advanced planning algorithms already in the beginning of the nineties. This was an in-house developed system, probably because at the time no commercial software was available for this purpose. Jonsson et al. [20] conclude in their analysis that these types of in-house developed APS systems might have

an advantage over standard, commercial offerings due to the inherent complexity and specificity of planning in different companies (both in terms of processes, data and organization).

Problems with data and how to model the planning set-up are highly relevant (and will be touched upon below). The organizational factor involved in APS implementations is also of great importance. In our case, there were three geographic regions (that at the time were profit centers) with a high degree of independence. Planning process inconsistencies and motivational aspects (between the different regions and towards the global, headquarters led APS implementation) led to significant issues in achieving a reliable and consistent sales plan on a global level. At the same time, many suppliers were operating on a worldwide scale with one order entry point. Needless to say, challenges were persistent also on an individual level. Due to cultural differences, language barriers and competence, it was extremely difficult to harmonize operations in a manner that was required by a global APS implementation.

These issues have also been looked at by Lin et al. [29]. They report on a case where a plan needed to be validated using spreadsheet solutions, and where in the end neither IT specialists nor planners fully understood how the APS system had ended up with the proposal. This of course does not enhance the credibility of the system and it is doubtful whether something like this can truly be taken into use. Problems with data [16], and the fact that even in an optimal situation all complexities associated with planning cannot be modeled in an APS system are frequent challenges. Also, humans are still an integral part of supply chain management and if they do not understand how the APS system works (or if there are problems with data accuracy), they are likely to do everything from start to finish in different solutions. Other shortcomings with APS systems are related to the lack of event based planning (unlike ERP systems, APS often require batch runs to re-calculate plans), handling of uncertainty, and challenges with getting accurate data from your partners (as constraint based planning requires input on for example supply capabilities) [39]. The main differences between APS and ERP (from a SCM perspective) relate to whether you are looking at the supply chain as a whole or your own organization,

Table 2 Summary of the data management category and its dependencies

Maturity	Technology	Main Benefits	Main Drawbacks	Dependency on
↓ (High)	MRP	Material forecasting, planning based on future demands	.	.
	MRP II	Better reporting and scheduling	More complex, requires links to different corporate functions	.
	ERP	Visibility, control	Cost (direct and indirect)	Data tracking
	APS	Optimization, constraint based planning	Complexity (implementation and maintenance)	ERP, data exchange

whether you model how constraints affect operations or not, and whether the main focus is on optimization or transaction processing [41,20].

The issue with batch runs can, if combined with data accuracy problems, cause massive challenges. We experienced situations were a weekly planning run was conducted and, after the fact, problems with input data were noticed. In certain instances, the results had already been communicated to suppliers. This caused problems on multiple levels as not only the internal plans had to be re-calculated, but also suppliers (in worst cases over 100 of them) had to re-balance also their production- and shipment plans. The high dependency on and integration with suppliers also demonstrated itself in the difficulties to get reliable supply input from all of them (and sometimes the weakest link in the chain can disable the whole process). The internal efforts to improve supply chain operations suddenly became an effort to improve supply chain competences and systems at a large number of partners. The handling of uncertainty is also a crucial point. For optimal handling of this, we were forced to implement a manual process where uncertainties in plans were discussed with certain key suppliers.

Table 2 summarizes the main aspects related to the data management category. From here we can see that especially for more mature solutions (ERP and APS), there is a need to ensure good capabilities in the data tracking and data exchange categories. Maturity refers to both IT solution maturity and, in accordance with what was outlined in section one, supply chain operations maturity gained with these technologies.

3. Data Exchange

Data exchange in this context refers to how supply chain partners communicate and the SCM IT solutions available for this purpose. Typical documents that are exchanged include invoices, product data, purchase orders (POs), and demand forecasts (the two latter will be examined further in the process model section). This is sometimes referred to as supply chain integration, although this can also refer to intra-company information sharing [32] (which is covered to some degree in the data management section of this paper). Done electronically, information transfer can in certain cases be fully automated but always with the intention of reducing dependency on physical print-outs sent by fax or regular mail. Supply chain integration can be divided into three categories; manual information sharing, semi-automated information sharing and fully automated information sharing [32]. Our focus here is on semi- and fully automated solutions, that is to say

methods that require human intervention on only one side of the transfer or no human intervention at all. Automated transfer between two computer systems is often referred to as system-to-system (S2S) communication.

We will start by looking at electronic data interchange (EDI). Although EDI has been around in some form since the late sixties, it was the development of two dominant standards (the so called ANSI X.12 and EDIFACT) in the eighties that triggered its more widespread use [43]. The definition of EDI is not unambiguous; you could argue that EDI is the transfer of any data in electronic format. However, for the purpose of this paper we will rely on Walton and Gupta [43] who define EDI as "the transmission of standard business documents in a standard format from one trading partner's computer application ... to the other trading partner's computer application". This excludes email, faxes (that require manual intervention) and any transfer of data in proprietary formats. It is to be noted, that this definition also holds for the use of other standards like RosettaNet (that will be discussed further below).

According to a study by Ahmad [1], EDI leads to better delivery performance as it positively impacts the timely exchange of information (especially in volatile conditions where a lot of information is exchanged). This is where EDI excels, if a lot of transactional data is exchanged it is obvious that EDI can reduce the need for manual intervention and thus speed up the process (and save costs in terms of manual labor). Yet not everyone is keen on implementing EDI, and in some instances the implementation is driven by mandate rather than need. Some organizations force their subcontractors to implement EDI if they wish to continue doing business with them [1,31]. So why are especially smaller companies reluctant to implement EDI? There is a clear link to the data management category, you need an information system that can process and export the data needed. Some smaller companies do not have for example ERP systems to support this. Secondly, the amount of transactions can be so small that the cost of the infrastructure needed cannot be justified [31].

Previously so called value-added networks (VANs) were the dominant way of exchanging information through EDI. These networks have a cost associated with their use. They are still used today, but as with RosettaNet XML-based exchange, EDI transmissions can also be sent over the Internet. This has lead to a decrease in cost, yet many organizations (even larger ones) are still reluctant to automate the transfer of information. One reason might be the fact that despite the existence of standards, there are still variances in

how the data is processed. In other words, even with an investment in EDI infrastructure, it is unlikely that you can "fire up" automated transfers to all partners without a significant amount of mapping and testing (that have significant costs associated with them). The EDI connections are tailor made for each partner [8]. For example, some companies base their business on the fact that logistics service providers (LSPs) all have slightly different data requirements and EDI mapping requirements. They provide services as mediators between customers and LSPs, so that customers using many different LSPs do not have to build EDI connections to all of them (or pay a penalty for not using electronic transmission) (Kim Friman, lecture on Unifaun Oy's business, 25th of April 2011). Lastly, the use of EDI (or any other S2S method) means that you rely on data in your system to be correct (as in accordance with the definition, no manual intervention is allowed). Even if there are obvious errors in the data these will be sent out to your partners. Walton and Gupta [43] look at this from a slightly different angle. When you automate the transfer of information, you also create a link to the underlying process. Any changes in the process will affect how and what is sent out (and probably requiring changes to your S2S set-up) and it means that your business process management just got a bit more complex. All in all, S2S messaging requires robust data, robust information systems and good process management. Automating chaos is not a good idea.

In order to avoid incorrect data transfers to suppliers, one region in particular made use of a built in possibility to review and make corrections to data in a web-frontend prior to transmission. When the process was enhanced (to be more frequent), this became nearly impossible to do in practice. This had a positive effect, as it triggered a rather massive "clean-up" operation to ensure proper MRP settings and better data quality in the ERP system. In this sense, the implementation of S2S solutions can also be used as a trigger to ensure better data quality.

With the advent of the world-wide web, a lot of hype surrounded e-business. As with EDI, there are a lot of different understandings of what this means. For the purpose of this paper, we will focus on any semi-automated information sharing over the Internet. Usually this means some form of extranet solution. A good example is Kone Corporation in Finland that uses S2S solutions for major suppliers, while smaller ones receive the information through a web-portal (and some, even smaller ones, by fax) [2]. As such, for very large numbers of transactions, these types of semi-automated solutions are not the best option (as they still require human intervention), while for occasional transfer of data they work well. One particular type of e-business solution that received a lot of attention in the Internet hype of the late 90s is the e-marketplace (for example for e-procurement). In the study of several companies' usage of e-business, Auramo et al. [2] found that these were notably absent. It appears the most widespread use of e-business is in semi-automation of information sharing with partners where not too many transactions are needed. Another notable area is in collaborative planning. As discussed in conjunction with the analysis of APS systems, constraint based planning requires understanding of supply capabilities and demands across a number of partners. While again, in a complex setting with a number of products, parts, and suppliers, it makes sense to fully automate this information exchange, web portals can still play a significant role in highlighting demand spikes or supply shortages (or for example ATP or CTP data). This requires rule-based systems that analyze the underlying data for any problems and then highlight these simultaneously for all partners in the chain. These types of applications are often referred to as "dashboards", "cockpits" or "command centers" [21].

The first attempt at an extranet solution for sharing demand forecasts with suppliers and gathering supply data from suppliers did not succeed very well. This was (among other things) due to the fact that the amount of transactions was high and the solution was mainly reliant on manual processing. Some refused to accommodate for the increase in manual labor. Later developments built automated S2S transfers for the data itself while the extranet solution provided administrative functions and highlighted problems that would require further attention (for example low inventory or demand/supply mismatches).

A cornerstone in the RosettaNet standard that was born in 1998 is the so called Partner Interface Process (PIP). The RosettaNet standard itself is based on the extended mark-up language (XML). The PIPs specify

Table 3 Summary of the data exchange category and its dependencies

Maturity	Technology	Main Benefits	Main Drawbacks	Dependency On
↓ (High)	EDI	Automation, delivery performance	Very high dependency on data management category, cost of integrating partners	Data management
	e-Business	Intelligent alerts, semi-automation	Unsuitable for automation of large transaction volumes	Data management
	RosettaNet	Process integration	Very high dependency on data management category	Data management

not only the formatting for business documents to be exchanged but also the associated business processes [4]. In this sense, RosettaNet goes beyond what EDI standards define, but otherwise a lot of similarities exist. These days both commonly use the Internet as the data exchange platform and automating chaos with RosettaNet as opposed to EDI is no better. Nurmilaakso [32] concludes that the comparison between EDI and XML is not a comparison between the Internet and VANs but a comparison of different frameworks for standardization. So the main difference relates to the standard itself, and RosettaNet is to a certain extent a more comprehensive and a more in-depth specification. For example Sridharan et al. [38] note that effective SCM requires a good understanding of how business processes work together, and RosettaNet can to a certain extent help in this (due to the process dimension in the specification). In a comparison between RosettaNet and "traditional" EDI over VANs it also clear that RosettaNet has a cost advantage [6].

Table 3 contains a summary of the discussion on the data exchange category. Again, all companies need some form of data exchange but the move to either EDI or XML-based solutions needs to matched with proper capabilities in back-end systems (reviewed in the data management category). Since we are talking about data exchange between partners in the supply chain, it is of essence to also ensure necessary capabilities at interfacing customers or in the supplier base.

4. Data Tracking

Data tracking in this paper refers to means of following the movement of goods while ensuring timely and accurate information on these movements. Barcodes have been around for some time already, this technology is however not examined in detail. Sufficient to say it is a well established method of tracking for example incoming shipments or outgoing products. Radio-frequency identification (RFID) is likewise a technology that has been around in some form already quite a while but it is only in recent years that it has gained a foothold as a new way of tracking material. RFID is defined as the usage of radio frequency to identify and track items that have a coded chip. This enables remote, real-time reading of the

material [37]. Compared to barcodes, RFID provides reading without line of sight (also in harsh conditions where barcodes would not be used), smaller tags and longer lifespan of the tags [27]. RFID tags also enable writing to the tag, which is impossible with barcodes. The big downside with RFID is the cost. There are investments needed in infrastructure to read the tags but the biggest part of the cost stems from the tags themselves. In 2006, prices ranged anywhere from 25 cents (USD) to 10 dollars for specialized tags with for example longer range [11]. Concerns about privacy have also been raised [23]. Consider the following example: a product is sold with RFID tags in the most expensive modules or components (enabling for example better warranty processes, through information on where it has been sold and manufactured, by whom, and who has manufactured any possibly faulty components). A good case for an OEM, but in theory anyone can read this information while for example tracking its movements.

According to Sarac et al. [35] there is a strong link between various IT applications (in our case in the data management category) and RFID as traceability and particularly the visibility in the supply chain is increased. As previously noted, data accuracy is a key challenge in for example ERP applications, and RFID is one method of improving this. Other benefits include increases in speed of processes and better decision support as real-time information is available. As with S2S communication, RFID technology needs a back-end system capable of handling the data.

RFID was put in place for fast moving goods where multiple deliveries were received daily. Cost was in this particular case not that big of an issue as one pallet (as opposed to one item) was tagged. With the implementation, we saw an increase in speed as operators did not have to spend time looking for the tag that sometimes was "hidden away" or simply torn (and made unusable). More importantly, data accuracy was improved as previously mentioned issues with barcodes no longer existed (an unreadable barcode mandated error prone manual processing). In addition, discussions were also held on how to possible improve warranty follow-up with RFID technology.

Table 4 illustrates the main discussion points related to the data tracking category. As with S2S solutions, more advanced tracking requires back-end system support. Modern ERP systems can certainly

Table 4 Summary of the data tracking category and its dependencies

Maturity	Technology	Main Benefits	Main Drawbacks	Dependency On
↓ High	Manual inspection	Easy implementation	Manual, error-prone	.
	Barcodes	Accurate tracking	Reading requires line of sight	Data management
	RFID	Fast and accurate tracking w.o. line of sight, small tags	Cost of tags, privacy issues	Data management

support this, but if for example material planning is done in spreadsheets, it is likely that manual intervention is needed for data entry (thereby reducing the benefits of more automated scanning solutions like RFID).

5. Process Models

The final category to be looked at is that of process models, summarized in table 5. For our purpose, this refers to ways of collaboration between customers and suppliers in the supply chain. The capabilities in focus here are vendor managed inventory (VMI) and collaborative planning, forecasting and replenishment (CPFR). As we will see, these methods for sharing forecasts and collaborating in the supply chain require strong IT support, and this is why these process models cannot be implemented without capabilities outlined in the data management and data exchange categories (and why these process models have been included in this analysis).

VMI originates from the late eighties when Wal-Mart and Procter & Gamble started piloting these processes [36]. Chopra and Meindl [7] define VMI as a process where the supplier is responsible for all decisions regarding inventory at the customer. In a traditional model, the customer is using an MRP or ERP system to calculate purchase orders (POs), taking into account the master production schedule or sales plan, current inventory, lead times, packaging sizes etc. The supplier effectively gets a plan with the "net" demand of what is needed at a particular time (and it should be noted that the supplier in this case has no or little visibility to actual, "gross" demands). In a VMI model, the supplier gains visibility to the above (sales plan or master product schedule, available inventory) and makes all decisions on how much to ship and when. Continuing with Chopra and Meindl [7], they also discuss push and pull strategies in the supply chain. A PO model is a typical pull model where the OEM or retailer "pulls" the material (and is thus alone steering the supply chain) whereas VMI is a push model where decision making responsibility is shared in the supply chain as suppliers "push" the material further downstream. In a VMI model, timely, accurate and comprehensive information sharing is a key. Poorly implemented, a VMI model is merely outsourcing of MRP calculations to suppliers (adding

to their burden and easing the load on the customer) [40], but with proper data management and data exchange support it is a powerful tool to increase visibility and responsiveness in the supply chain. This can be used to counter for example the bull-whip effect [36]. VMI is more suitable for fast moving goods. With only occasional demands, the investments in IT infra and process management might not be justified and a simple purchase order might be better.

VMI was largely put in place to reduce demand fluctuations resulting from poor supplier visibility to gross demands. It was perceived as successful (although no measures were put in place to compare it to customer managed inventory), and expanded to cover nearly the entire supplier base and later also "enhanced" with consignment inventory.

Wal-Mart was again a pioneer when they in 1995 introduced collaborative planning, forecasting and replenishment (CPFR). Later in 1998 this process was formalized by the Voluntary Inter-industry Commerce Standards (VICS) committee who define it as "a collection of new business practices that leverage the Internet and electronic data interchange in order to radically reduce inventories and costs while improving customer service". Essentially CPFR is an extension of the VMI model in that collaboration extends not only to the replenishment activities, but also to joint forecasting and planning [8]. An important factor of CPFR is that it goes beyond information exchange and communication to synchronization of plans and management of exceptions in the supply chain [9]. This is where we see a link to the APS and data management features discussed earlier. Danese [9] has looked at several case examples of CPFR implementations and two main reasons for implementation emerge: reduced costs (investments in stocks) and increased responsiveness (better availability). Several success stories related to the previous have also been reported by Aviv [3]. It should be noted that compared to VMI, CPFR requires a more substantial implementation and maintenance effort (and thus higher costs). Mutual trust of the parties engaged is also required. At the same time, CPFR has been shown to produce lower total cost and better customer service compared to VMI [36].

Supply confirmations were requested from a large part of the supplier base but true collaborative planning was only done with key suppliers. This

Table 5 Summary of the process model category and its dependencies

Maturity	Technology	Main Benefits	Main Drawbacks	Dependency On
(arrow pointing down) High	PO based procurement	.	Poor supplier visibility to demand fluctuations	Data management
	VMI	Better visibility, increased responsiveness	High dependency on data management and exchange	Data management, data exchange
	CPFR	Further improved responsiveness and visibility	Bigger implementation effort (than VMI)	Data management, data exchange

involved quarterly meetings that focused on supply chain planning (where for example uncertainties and flexibility were high on the agenda). Later, also weekly meetings were put in place on an operational level to manage exceptions. A key complexity with this was the modeling of this information in planning systems; a large part of the intelligence was still in the hands of key persons who "orchestrated" the decisions related to planning.

6. Limitations and Further Discussion

An analysis of benefits and drawbacks alone is of course not sufficient when making a decision on SCM IT capabilities. Correct understanding of needed business processes for a particular set-up is crucial. The few process models analyzed here do not however cover business process re-engineering and management in conjunction with SCM IT implementation. In the implementation of new ways of working and new information systems, the human factor is also a considerable challenge. Socio-technical challenges are examined only on a general level (the implementation of an APS system is more complex than the implementation of bar-code scanners from a purely change management perspective). Also, it can be difficult to distinguish between direct IT system benefits and benefits stemming from improved business processes [2]. In addition, there can be differences of opinion about when a system really is implemented (and thus where you are in the matrix in table 1); criteria for this are however not established in this article. Lastly, as the primary focus has been on SCM IT systems used by manufacturing companies, the characteristics of service supply chains are not dealt with directly.

Coming back to the discussion on SCM IT and process maturity, the obvious consequence of the thinking outlined here is that not all companies need be world-class performers in terms of supply chain management. Sometimes less is more, and slightly less mature IT and SCM process solutions can be sufficient and the most cost-effective solution. If however your company operates on a world-wide scale with highly volatile demand and with expensive products; while recognizing that your IT solutions (in accordance with what has been outlined here) are not particularly mature, there is cause for concern. Your SCM capabilities are not up to par with your required state and this can have severe implications in terms of competitiveness.

In the introduction, we looked at Langley et al.'s [26] categorization of SCM IT solutions. One of these was "business intelligence". This paper has approached the categorization differently from Langley, yet it is

clear that as we approach 2012 we are on the brink of the era of analytics and business intelligence. Davenport and Harris [10] write a compelling story on how analytics is becoming more and more essential to compete, and they look at supply chain analytics from many different perspectives (for example planning, location analysis, routing and simulation). Although many of these features are covered by APS systems, further development and refinement of these capabilities can be expected. Iyer [18] presents an analysis of IT analytic capability (referred to as "IT applications that provide managers with information and ability to plan and execute decisions"), specifically in conjunction with collaboration practices, and concludes that these do have a positive impact on performance in the supply chain. Trkman et al. [42] report on similar findings. All in all, in addition to managing, exchanging and tracking of data, decision support and business intelligence is becoming more and more important in a supply chain context.

7. Conclusion

As we have seen during the course of this paper, the different categories we set out to investigate are highly interlinked. Best in class companies like the Kellogg Company, Kone Corporation or Wal-Mart have an IT infrastructure and engage in practices that are relatively new but provide big benefits (from an SCM perspective). At the same time, this does not mean everyone needs to do the same; it is highly dependent on what type of supply chain the company operates in. An understanding of the potential downsides of these solutions is essential, while it is also of essence to understand the dependencies between them. For example, automated data transfer is dependent on a back-end system capable of processing the data. When for example an OEM requires the supplier base to implement automated data transfers, they should also ensure that necessary capabilities exist in terms of data management (which might not always be the case). Otherwise potential cost savings only result in an increase of cost elsewhere in the supply chain (as from the supplier's perspective, the cost of implementation is realized while the benefits are not). Another example relates to the use of APS systems and constraint based planning. To realize its full potential, this technology requires input from customers and suppliers. If they on the other hand do not have necessary capabilities in place, the benefit from such an implementation is watered down. These are merely a few examples; when companies make decisions on how to develop their SCM IT, they need not only to understand how these solutions relate to each other and operations in their company, but also whether they are

suitable for the supply chain as a whole. This means that the capabilities and requirements of key partners is also a factor when making decisions on the IT strategy.

The reviewed literature for this article forms a solid base of understanding that correlates very well with my personal experience. I made a conscious decision to include articles and books that corroborate my earlier work as a practitioner. Needless to say, there is a lot of research I could not relate to (or completely disagree with), but reviewing this is not possible within the context of a relatively short paper like this. A key thing to note is that many papers typically have a lot of subject depth compared to the approach in this article, where a broad approach to the analysis of SCM IT is presented. Both approaches are needed.

Acknowledgements

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ON THE NATURE OF SUPPLY CHAIN MANAGEMENT PROJECTS AND HOW TO MANAGE THEM

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Abstract

This paper explores the nature of complexity in Supply Chain Management (SCM) projects. We find three aspects to be critical in SCM projects: SCM business processes, information systems, and organizations (internal and external). We also argue that in essence, SCM projects are complex, demonstrating structural complexity, uncertainty, and interdependence between elements, all in a unique context. With this analysis in mind, we look at how established project management methodologies are suited to manage SCM projects. Correspondingly, we investigate the nature of agile project management methods and look at whether these are suitable in an SCM context. Secondary data on previous large-scale SCM projects are used to illustrate the nature of complexity in these projects and whether this could have had an effect on the outcome of the project.

Keywords: Supply Chain Management, Project Management, Complexity, Risk Management, Agile Project Management.

1   Introduction

Many large-scale supply chain management (SCM) improvement efforts fail in reaching goals within the defined limits of scope, budget and time. This paper theorises on one possible, widespread reason for SCM project failure: the selection of the wrong project management methodology. To analyze this, we will explore the nature of SCM projects and establish what types of complexities are associated with these. With these characteristics, we will look at what type of project methodology is suited to manage SCM projects. For the purpose of this paper, we will focus on manufacturing supply chains; even though many principles can certainly be applied in service supply chain, these are not directly investigated. Furthermore, our focus is on what we call "large-scale" SCM projects. These projects are typically in large organizations (+1000 employees) and cover many different parties in the supply chain.

A search for the terms 'logistics' or 'supply chain management' and 'project management' in major databases reveals very few results that focus specifically on this problem. Ayer (2009) dedicates his book "Supply Chain Project Management" to this particular issue and Krajewski et al. (2010) dedicate a chapter to project management in their book "Operations Management". While these address the challenge of project management in an SCM context, they do not question the suitability of particular methods in this context. We wish to address this gap in research.

Mentzer et al. (2001) define a supply chain (SC) as "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer". Common for many definitions of supply chain *management* is that they stress the need to integrate business processes across company boundaries to generate value for all parties in the supply chain (Lambert et al., 1998; Dam Jespersen and Skjoett Larsen, 2005). Given the definitions above, a few things become important: the need to manage business processes and related data, as well as the need for integration with supply chain partners, all in an effort to ensure timely and cost-efficient delivery of a product to a customer.

This brings us to the question of what constitutes a typical SCM project. Business processes are involved, and as we discuss processes directly catering for customer needs (one of the main goals for the enterprise), this usually covers a large part of the company. Secondly, effective SCM would not be possible without a significant level of IT support to orchestrate logistics and to communicate with supply chain partners (Auramo et al., 2009). This can range from simple solutions in a spreadsheet, printed out and faxed to a supplier, to highly sophisticated enterprise resource planning (ERP) systems combined with automated system-to-system (S2S) solutions. In addition to internal complexities of SCM business processes and IT solutions, there is an external component to be managed. Quite often we see one focal company in the supply chain leading the supply chain development activities (Belaya and Hanf, 2009). This company leads the project, and despite often being able to exercise authority in the supply chain, it is still dependent on the capabilities of partners. For example, if a customer is unable to give any reliable insight to future demands or a supplier does not have means of communicating shipment data or supply availability (either due to missing IT support or lack of business processes), key data is missing for the focal company. Internal supply chain improvement efforts often turn into exercises where also partner organizations are trained to perform better. In addition to customers and suppliers, other partners in the supply chain can also be heavily involved in the effort, such as outsourcing partners and 3rd party logistics service providers (LSPs).

The topic at hand presents us with multiple dimensions of interest in the information systems (IS) domain: the combination of IT and business processes, the organizational dimension (internal and external), and project management practises to steer these efforts. The rest of this paper will examine SCM projects further from a project management perspective in an exploratory manner. In Sections 2 and 3, we present the characteristics of such projects and challenges in them based on existing literature. In a similar manner, we use literature to portray project management approaches in order to investigate the conceptual fit between these and SCM projects (Sections 4 and 5). Section 6 will look

at secondary data of large-scale SCM projects to provide examples of the typical nature of these projects. The final section of the paper consists of concluding remarks and further research opportunities.

2　　　The nature of SCM projects

Bermudez (2002) states that supply chain business processes are difficult to comprehend as they cross many organizational silos and because few companies have multi-department supply chain processes defined on a corporate level. While these separate organizations in the company certainly might co-operate, there is still a lack of one entity overlooking all processes and data associated with supply chain operations unless you move high up in the corporate hierarchy. Mentzer et al. (2008, p. 40) conclude that typical SCM projects "should be assigned to a cross-functional, firm-level manager (such as the COO)" (COO, Chief Operating Officer). Hence, while SCM improvement projects often strive towards increased visibility and co-operation this is difficult to achieve as many business processes in many (quite often very independent) business units need to be aligned. While a person such as the COO can act as a sponsor for the SCM project, this still leaves the operative decision making to each business unit separately. Our focus on "large-scale" SCM projects also implies that we typically see a geographical spread of the organizations involved in the project. This refers to both the internal organization and other (external) parties in the supply chain. Independent business units, geographical spread and lack of an appropriate overview of supply chain processes pose challenges for improving visibility and cooperation.

Information systems have been used to overcome these challenges. At the same time, neither the IS employed nor the IS projects are simple. Thus SCM projects will be challenging also from an information systems perspective. Hsu et al. (2011) argue that IS projects can be characterized as "uniquely complex" as they need to incorporate end-users, developers, and specialists from multiple domains. Bermudez (2002) refers to a study by AMR research saying that less than 15 percent of manufacturing companies have successfully implemented the information systems they have purchased from leading SC software providers. While this figure has hopefully risen since 2002, it still adds weight to the fact that the IS dimension of SCM is difficult to manage. Table 1 shows a comprehensive framework of information systems to support SCM (Nyman, 2012), providing an idea of the vast complexity of managing the supply chain from an IT perspective. Data management in this context refers to ways of handling and analysing data for decision support in SCM. Typical solutions in this category are materials requirement planning (MRP), enterprise resource planning (ERP), and advance planning and scheduling (APS) systems. Data exchange solutions help companies communicate with partners in the supply chain. These range from relatively simple solutions like e-mail, to Electronic Data Interchange (EDI) or XML-based frameworks like RosettaNet that provide fully automated data exchange. The third category analysed was data tracking, again ranging from simple solutions like bar-codes to more advanced solutions like Radio Frequency Identification (RFID) tags.

Solution Maturity	Data Management	Data Exchange	Data Tracking
Low	MRP	Fax	Manual Inspection
⇩	MRP II	eMail, Partner Portals	Barcodes
	ERP	EDI	.
High	APS	RosettaNet	RFID

Table 1.　　　*SCM information systems or equivalent (Nyman, 2012)*

Nyman's (2012) conclusions indicate that the complexity of implementation increases with more mature IT solutions. This is due to the more "demanding nature" of the IT solutions themselves but also because of the dependency between the proposed categories. For example, mature solutions in data tracking will require mature data management solutions. As previously noted, there is also a clear link to the business process dimension. Auramo et al. (2005) conclude that to achieve strategic

benefits for supply chain operations, "the use of IT has to be coupled with process redesign". Similarly, Sridharan et al. (2005) put forward that the choice of technology is a secondary concern, understanding business processes and their dependencies comes first. Thus interdependencies between various information technologies and processes increase complexity in SCM.

We have identified three distinct areas that demand attention in SCM projects. These are internal and external organizations, SCM business processes, and information systems. It is important to recognize that these are not stand-alone elements in the SCM "landscape", there are no SCM business processes without organizational alignment (internal and external) and vice versa, nor are there any well-functioning SCM IT solutions without business processes and vice versa. These are thus key interdependent factors influencing the nature of the SCM projects.

3   The nature of complex projects

According to Williams (2005), structural complexity and uncertainty are the dominant factors in studies on project complexity. Structural complexity refers to the size and number of elements in the project where elements are the particular organizations (internal or external) taking part in the project, or the different tasks needed to be done in the project. The high number of organizations involved in the SCM project will contribute to structural complexity. The number of tasks in the project can of course also be high. Uncertainty, on the other hand, refers to what the precise goals of the project should be or what the means of achieving these goals are (Williams, 2005). Few projects are started without a goal, but the abstraction level in the project can be relatively high. For example, an SCM project might have as a goal to improve on-time delivery. This, however, is a high-level target that can be approached in many different ways: through faster production, optimized logistics routes, or inventory postponement, to mention a few. Once the way of achieving the target is selected, it is fair to argue that there are, for example, many ways of optimizing logistics routes. Thus project uncertainty in this context is a "double-barrelled" concept that can refer to either the lack of a specific vision, the lack of a specific path, or both.

Vidal and Marle (2008) look at this in a similar way: project size, variety, interdependence, and context contribute to project complexity. From our point of view, the interdependence and context are of particular interest. Interdependence is high when different parts of the project have a big influence on other parts of the project. Furthermore, context refers to the fact that something done in a previous project might not necessarily work in new surroundings. Similar conclusions are mentioned by Söderlund (2004) who stresses the need for understanding the contextual dimension in projects and the fundamental differences across projects. Supply chains tend to demonstrate a high dependency between elements (be it processes or organizations) and they tend to be unique in the sense that no particular supply chain is exactly the same as any other. After all, even if two companies manufacture exactly the same product, they most probably use slightly different suppliers or produce their goods in slightly different locations. Another study mentions many of the same factors as above but also adds "form of contract" to the list (Müller and Turner, 2007). Given the fact that many companies are involved in SCM projects (ranging from software providers, suppliers, outsourcing partners, to LSPs), the contractual dimension of the project cannot be overlooked. Antvik and Sjöholm (2007, p. 14) list, among other things, the number of interfaces, organizational layers, geographic locations and interested parties as key factors contributing to project complexity. If the number of any of these factors is high, project complexity is correspondingly high. These conclusions are very similar to that of Vidal and Marle (2008).

We can also examine this from the opposite side; what constitutes a non-complex project? Engineering and military endeavours have been credited with exemplifying the origins of project management (Bailey, 2005; Vidal and Marle, 2008). These types of organizations and projects are often characterized by tangible products, straightforward command and control structures and management hierarchy, a good balance between authority and responsibility, and objectives that are well understood by most stakeholders (Bourne and Walker, 2005). Looking at this from an SCM

perspective, the large number of internal and external stakeholders alone creates challenges in terms of "straightforward command and control structures" and "objectives that are well understood by most stakeholders."

Looking at the above, typical large-scale SCM projects often demonstrate structural complexity, uncertainty, and interdependence between elements, all in a unique context. While form of contract also contributes to complexity, we have opted to see that as a particular form of structural complexity and interdependence. All-in-all, SCM projects are complex.

4   SCM projects and traditional project management methodologies

For the purpose of this article, the standards promoted by organizations such as the US-based Project Management Institute and the United Kingdom's Association for Project Management are deemed as "established" or "traditional" project management. A vital part of these standards is risk management (Kutsch and Hall, 2009). Risk management processes have been introduced to either prevent or contain events pertaining to uncertainty (Geraldi et al., 2010). Koskela and Howell (2002) go further in saying that traditional project management methodologies in fact *assume* low uncertainty. That is, risk management is actually a tool to achieve the underlying assumption of the methodology.

Geraldi et al. (2010) have been looking at what constitutes a successful response to unexpected (or undesired) events. So-called unknown-unknowns (events that were impossible to foresee) are difficult or impossible to handle with risk management processes, yet these are frequently occurring in projects. We argue that complex projects, like SCM projects, are more likely to demonstrate unknown-unknowns because of their "chaotic" nature stemming from all the factors contributing to project complexity. Instead of a formal risk management process, "soft skills" and competence in the project team are indicated as suitable response mechanisms. Furthermore, a high degree of freedom, communication with stakeholders, and behaviour (self-awareness, ability to handle stress) are some of the appropriate measures to counter the negative effects of uncertainty. The alternative risk management put forward by Geraldi et al. (2010) show a striking similarity to what Martins and Terblanche (2003) consider as organizational traits that resonate with innovation. For example, freedom to make decisions, empowerment, mistake handling, risk taking and open communication are indicated as influencing innovation (Martins and Terblance, 2003). The relationship between handling uncertainty in projects and the need for innovation requires further attention but the same organizational traits seem to be needed for both.

In other words, risk management processes are a requirement for traditional project management (as the methodology assumes a low degree of uncertainty). However, SCM projects seem to resonate poorly with traditional risk management due to the inherent project complexity. Other measures are needed.

Traditional project management methodologies also stress the need for planning in advance, even so that planning ahead becomes the essential management tool (Williams, 2005). All possible events should be anticipated at the time of planning (Pich et al., 2002). Predetermined actions and activities work well as long as the assumptions, goals, and overall environment do not change from the time of planning to the time of execution (or go-live of the project). Where conditions are changing and uncertainty prevails, there is, however, increased criticism and awareness that traditional project management methodologies relying on proactive planning do not necessarily offer the best fit for purpose (Geraldi, 2008). From what we have established so far, this might well be the case for large-scale SCM projects.

The so-called unknown-unknowns are one of the most difficult "types" of uncertainty in projects. Traditional risk management processes struggle with these events, and they are nearly impossible to plan for in advance. There is however a paradox in the fact that management tends to respond to high uncertainty with more control. In other words, more planning and stricter risk management is put in

place where entirely other measures are needed (Bourne and Walker, 2005). This can be labelled as a "bureaucratization of chaos" (Geraldi, 2008). Clearly, there is a need for a different approach to uncertainty in SCM projects.

When looking at complex SCM projects, it seems the traditional approach of planning ahead and management of risks should be replaced by more communication, competence in SCM processes, information systems and methods, and freedom to innovate (Geraldi et al., 2010; Martins and Terblanche, 2003). When looking at the relationship between potential for innovation and traditional project management methodologies, there are several studies indicating that the opposite is true. Due to their deterministic nature, they actually act to stifle innovation (Bryde, 2003; Keegan and Turner, 2002). Thinking about this from a purely practical point of view this becomes clear. If you plan in advance who is doing what and when, there is little room for the flexibility and freedom needed in large-scale SCM projects.

In summary, we have established the nature of typical SCM projects and concluded that these type of efforts need a high degree of freedom and SCM competence, combined with a host of "soft skills" in the project team. Traditional plan-ahead project management techniques and risk management processes such as the Project Management Institute's PMBoK (PMI, 2008) might not offer the necessary conditions for these endeavours to succeed. Probing for alternative, newer modes of project management, eyes turn to agile approaches that have been proposed to conform to the uncertainty and complexity of the project world (Williams, 2005). The following will examine whether these methods provide a better fit-for purpose in large-scale SCM improvement efforts.

5   SCM projects and agile project management methodologies

In the domain of software development, a group of methods jointly called agile methods have gained popularity as many have considered them to better suit changing business and technology worlds. The core of agility is in adaptability to changes and the reduction of the cost associated with these changes. This is done by ongoing planning throughout the software development process and by splitting the process into short iterations. Agility also demonstrates a shift in principles, such as focusing on people instead of on a process (Cockburn and Highsmith, 2001).

In search for the characteristics of agility, Conboy (2009) used the concepts of flexibility and leanness to probe literature on management, manufacturing, and organizational behaviour. He saw the essence of agility not only in rapidly adapting to change but also creating it and learning from it "while contributing to perceived customer value" (Conboy, 2009, p. 340). This interest in and the use of agility in systems development reflects a similar trend in other areas: a shift from a mechanistic to a dynamic approach has been made also in organizational management. The environment is seen as unpredictable, problems are seen as wicked, the goal of problem solving is responsiveness, and learning has become generative (Nerur and Balijepally, 2007). This has also affected the view on managing projects. For example, Augustine et al. (2005) suggested an agile project management method based on projects as complex adaptive systems (nonlinear, open and dynamic, and interacting with their environment through uncontrollable inputs and outputs). In this view, project management consists only of some simple rules, such as small organic teams, guiding vision, free and open access to information, that keep chaos away. Such an approach based on principles rather than control by step-by-step guidelines is descriptive for the agile mindset.

Although some of the more specific agile methods proposed in systems development (such as Feature-Driven Development and Scrum) already cover project management aspects, these methods concentrate on the challenges of their domain, leaving many questions critical to other project management needs unanswered (Abrahamsson et al., 2003). More recently, also general practically oriented descriptions to agile project management have been provided (such as Wysocki, 2009, and Chin, 2004). To present agile project management as opposed to traditional, we refer to Wysocki (2009) who illustrates both agile and traditional approaches as project lifecycle models that include the five basic project management phases (that Wysocki refers to as scope, plan, launch, monitor and

control, and close). However, where traditional approaches proceed from start to finish, repeating the phases only once during a project, agile approaches make projects into a series of iterations, each of which containing all of the phases – possibly with the exception of scope. In the agile life cycle models, the iterations are not predetermined as in the traditional ones: changes are expected. Also, the client (internal or external) provides feedback at the end of each iteration. This feedback is input for the next iteration, providing opportunities for learning during the project. In a way, the iterations transform a project from a full-body cast with no flexibility into one with more functional joints that enable greater flexibility – and agility.

In line with Söderlund (2004), also Wysocki (2009) is an advocate of using a project management approach that is based on the characteristics of the project and its context. The essence of his reasoning is that uncertainty of the project goal and solution together form the basis for choosing the project management approach. He prescribes traditional approaches for projects where both the goal and the solution are clear, but SCM projects include uncertainties. Some of the uncertainties are related to the solution. As for the goal, SCM projects vary: SCM projects do have a stated goal even though its formulation may be abstract. An abstract goal that does not translate into detailed subgoals is, in fact, uncertain. For projects with a clear goal and an uncertain solution, Wysocki (2009) recommends agile project management whereas for projects where both the goal and the solution are highly uncertain, an extreme approach is suitable. Although these approaches have some common traits, the frequencies are different, as well as the size, inputs required, and outputs produced for iterations or salience of learning and discovery. For example, in the models Wysocki labels as "agile", the scope of an iteration is not changed, but in the so-called "extreme" approaches each iteration starts from the beginning with (re-)defining the scope. However, it is the general idea that is of importance; where Wysocki (2009) differentiates between agile and extreme project life cycles, Chin (2004) states that agile project management focuses more on execution than on planning (decisions are supported during project execution instead of making them all at the beginning of the project).

The whole idea of agile project management appears to stem from similar criticism towards traditional project management methods as we have presented in our analysis of SCM projects. For example, Chin (2004) describes the unsuitability of traditional project management methods to environments that "exhibit internal and/or external uncertainty, may require some unique expertise, and possess a high level of urgency" (p. 3), similar to the descriptions concerning the challenges of SCM projects. Even though a number of variations on "non-traditional" project management (agile or extreme) can be identified – as the essence of agility is in flexibility and adaptability – the same origins result in the same "non-traditional" core traits: reliance on people (and their competence), customer involvement, communication, prioritizing, frequent iterations to allow for change, and collaboration rather than control.

Some of these characteristics would seem to comply well with the demands of SCM projects. Allowing for changes provides for a higher degree of freedom in the face of uncertainty, and a greater involvement of the client increases communication that can alleviate the complications raised by complexity. Additionally, the learning opportunities give room for innovation. Also, agility relies on the competence of project members, instead of the bureaucratic approach that was deemed harmful for the success of SCM projects. Further, the improvisational nature of agility provides adaptable patterns (Leybourne, 2009) that can speed up the process of getting through the complexities of project life (instead of working in a total ad hoc mode). Relating Leybourne's argument to the idea of making decisions during execution, the improvisational approach supported by patterns is an approach to decision-making that sits well with the project management needs for complex SCM projects. A problem with an overall agile approach in SCM projects may be the interdependencies so typical for SCM. Agility strives for enabling flexibility through incremental work and minimal advance planning while the existence of many interdependent parts increases the pressure to plan. Although increased control may not be the way to cope with the intertwined SCM projects, the improvisational nature of a more agile mode may not be enough even if the patterns provided by the method can help in discerning interdependencies.

6   A look at previous large-scale SCM improvement efforts

As a first continuation on this conceptual exercise, we looked into existing analyses of some problematic SCM projects in order to see if the grains of our reasoning could be found in past projects. In this paper, three such projects are used as examples. The illustration is based solely on studies on large-scale SCM improvement efforts, published previously by other researchers. The examples have been chosen based on the availability of documentation as well as how known they are. Two of the cases, Nike and Hershey, are quite (in)famous and have gotten a lot of attention in both popular and academic press (e.g., Buxbaum, 2001; Sridharan et al., 2005). The third one, "Global beverages UK", has been described in conference proceedings (Brown, 2011).

These projects have experienced major challenges. To exemplify traits, we illustrate the nature and the critical aspects of SCM projects in terms of SCM business processes, information systems, and organizations. Two of the characteristics of project complexity, structural complexity and interdependence, manifest themselves through the three critical aspects of SCM projects. In addition, uncertainty (also an element of project complexity) is exhibited in the descriptions of scope in these examples, bringing together any possible lack of vision and/or path. We did not focus on the context aspect of project complexity in the illustration as the context was stated per definition to be unique in SCM projects. A summary is presented in Table 2. Naturally, we cannot fully isolate the characteristics of SCM projects and the project complexities from the cases. Other interpretations for the reasons behind the failure in these projects are possible, if not likely, and it is not our purpose here to demonstrate causality but to exemplify traits.

	Lack of scope	Organizational complexity	SCM business process complexity	IS complexity
Global Bev. UK	Yes	Yes	Yes	-
Nike and i2	-	-	Yes	Yes
Hershey	-	Yes	Yes	Yes

Table 2.   Summary of large-scale SCM project factors

6.1   Global beverages UK

"Global beverages UK" is a pseudonym for a UK subsidiary of a worldwide large alcoholic beverage manufacturer. The subsidiary belongs to the European business unit. The analysed case looks at the "social and political" implications of a project intended to reform the forecasting process in the subsidiary through the implementation of a new information system (Brown, 2011).

The analysis presented by Brown (2011) gives us insights to the complexity characteristics of this particular case, in particular related to organizations and business processes. There is also uncertainty regarding the scope as there does not seem to be a clear justification as to why a certain mode of working is to be implemented. Although the ultimate outcome and result of the project remains somewhat ambiguously described in Brown's analysis (the project at Global Beverages UK was still in progress), it is easy to conclude that major challenges have presented themselves. Insights to some of these challenges are illustrated and this gives us the opportunity to consider alternative discourses to the approach taken by Global Beverages UK and its European parent company.

The UK subsidiary has previously been relatively independent, now there is strive for more harmonized forecasting processes on a European level. Overlapping functions should be eliminated. The overall, high-level focus in the European business unit is on cost reduction and the forecasting process is deemed to have a direct impact on expenditure (or more precisely the accuracy level of forecasts and any possible duplicate activities). On management level, there is reliance on statistical forecasting methods and it is believed that these will improve the process. Based on this, the SAP APO (Advanced Planner and Optimizer) solution has been selected as the new IT solution to replace a

legacy system. With the new system (based on statistical forecasting methods), the business process, previously also relying on a qualitative dimension, should be adapted accordingly. There seems to be a level of uncertainty regarding the detailed scope of the project as well as the methods to achieve the objective. Despite the high-level targets being clear (cost reduction through improved forecast accuracy and a standardized solution), there is a mismatch to lower level objectives on how to re-design a largely qualitative process into a quantitative one. The somewhat naive assumption that a new information system will bring about (or force) changes in the business processes is proven to be incorrect: frustrated end-users end up working with a new unregulated process that somehow combines the old "judgement" process with the new statistical one (with, according to Brown, "unknown consequences"). The article also raises the question whether statistical methods really support the higher level objective of improved forecasting accuracy.

The forecasting department in the subsidiary retain that market conditions (in the UK) are such that a particular (qualitative) process is needed for forecasting. Top management blames problems with implementing the new statistical forecasting process on self-created particularities. Whether correct or not, this also illustrates the organizational complexities associated with streamlining operations across different divisions in a company (serving markets with different needs). Also, a top management driven, forced implementation of a new information system to re-design a vital SCM process is going to be difficult. The freedom to innovate could have been a critical step in achieving a process that fills the needs of various stakeholders. All in all, organizational complexities, business process modelling and uncertainty regarding detailed scope and tasks (how to redesign operations) may not have been properly handled in the project.

6.2   Nike and i2

Nike, the international apparel manufacturer, started a major SCM project in the late nineties. The original budget for the effort was $400 million, but as often with these types of efforts, the cost estimates did not hold and with the final stages of the project re-scheduled to 2006 (three years after the originally estimated completion of the transformation effort), the costs estimates were at half a billion USD (Koch, 2004). The SCM software bought from i2 technologies and its implementation (which was a small part of the total SCM project that also included ERP and Customer Relationship Management, CRM, components) is the focus of this analysis. With revenues and earnings soaring in late 2000, Nike reaffirmed targets for the full fiscal year. It then came as a shock to investors when Nike had to revise projections a few months later. The reason for this was significant inventory shortages and inventory excess at the same time (for different products). Nike put the blame on a failed implementation of i2 software (and i2 blamed Nike for not following proper implementation procedure), but the reality is (again) slightly more complex (Sridharan et al., 2005; Konicki, 2001a; Konicki, 2001b).

In terms of clarity of scope and goal of the project, there seems to have been a clear vision at Nike. Koch (2004) reports that there was a clear strategy to integrate ERP, CRM and APS systems across geographical areas and that despite the difficulties faced, this strategy was maintained (and ultimately apparently achieved). Also, clear targets were set in terms of manufacturing cycle times and other supply chain related metrics. This was to be achieved through the reduction of fragmentation of for example order management systems.

So what went wrong at Nike? There are several indications of lack of proper business process modelling and matching of this against IS capability (Wilson, 2001; Koch, 2004). Nike had a large number of products and variants, as well as data on these in several legacy systems, adding to the complexity of the task. Core business processes, in this case demand management and factory production steering, needed to be modelled and harmonized. The choice of the SCM software did not correspond to the needs of the business and later on, when a clearer picture of what the desired business process should look like, the role of the i2 software was revised and certain functionality was moved over to the ERP solution. If the business process – that today relies on both predictive

algorithms and data on orders and invoices – would have been properly designed from the start, many problems in the project might have been avoided.

6.3   Hershey

As a result of product line expansions and acquisitions, Hershey Foods Corporation had ended up offering over 3,300 different confectionery products, which their customers (retailers) wished to be delivered in increasingly sophisticated batches. In order to automate shipping and logistics functions between the retailers and the company's 25 plants worldwide, a $112 million supply chain system project, described by Lovata (2002) and Sridharan et al. (2005), had been undertaken towards the end of the 1990's. While the project included software from not one but three different vendors (ERP from SAP AG, CRM from Siebel Systems, and a logistics package from Manugistics), also hardware installations were to be made (including the mainframe, networks hubs, servers, 5,000 workstations, and telecommunications installations), guaranteeing nothing but a complex system implementation effort. The company was also blamed for ignoring or downplaying the importance of the interdependencies related to the tight system-business process link and to the complexity of the company's organizational structure. The new system concerned the work of 1,200 persons in sales and also other departments (in total, the company had 14,000 employees), covering the whole sales process from order placement to final delivery: accounting, production scheduling, purchasing raw materials, and placing products in trucks, for example (Lovata, 2002; Sridharan et al., 2005). The vast amount of transactions and the related business processes were not accounted for properly.

The system was implemented partly in a phased manner but much of it can be characterized as "big bang". The first implementation took place in April 1998 and the last modules went live in July 1999 (Lovata, 2002). According to Sridharan et al. (2005), implementing the whole system at once instead of a staged approach was Hershey's key mistake; also Lovata (2002) criticizes the lead times in the project and the timing of the go-live. By and large, the project had a clear scope that was not changed; it was the schedule that changed.

7   Conclusion

The main focus in this paper has been on looking at the characteristics of SCM projects and to relate project management methodologies to the SCM context. We have established that three dimensions are central for SCM projects: SCM business processes, information systems and organization (both internal and external). We have discussed how these play into the complexity of SCM projects. Criticism is put forward regarding the application of "traditional" plan-ahead methodologies combined with rigorous risk management processes in SCM projects. We argue that by the selecting a wrong methodology, you may stifle innovation and bring about bureaucratization that will have an adverse affect on the outcome. Further, we found agile methods (including extreme project management) to show promise in that the elements of agility allow for the intricacy of SCM projects. We also found that the agile approaches have drawbacks in the SCM context: there are concerns regarding the management of SCM dependencies with an agile project methodology. A principle-based working method may not be enough for managing the interdependencies present in SCM projects. SCM projects are in many ways unique in their complexity – even to a larger degree than IS projects in particular or projects in general. We feel that "traditional" project management offers a poor fit-for-purpose in the SCM context while agile project management approaches cater for the needs of SCM projects better. However, based on the analysis at hand, we cannot deduce how SCM projects are best managed.

The findings of this conceptual study bridge a gap in SCM/project management literature and provide a starting point for tackling a problematic issue. A conclusive answer to the question of how SCM projects exactly should be managed was, however, not provided. Considering the high relevance to practice of the topic, further studies are called for to look into how real-world SCM projects are steered and what constitutes an appropriate approach in terms of project methodology. Additionally,

the exact corollaries of the relationship between project methodology and SCM project success demand detailed attention. In order to come closer to a "best" project management approach for SCM projects, interviews are being conducted as an interpretive case study at the time of writing.

Acknowledgements

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3

Successful projects or success in project management - are projects dependent on a methodology?

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Abstract:
The purpose of this paper is to bridge two seemingly disparate views of project management: proponents of project management methodologies promote a view where a standard set of predefined project practices guarantee project success, while a contingent view of projects suggests that project management needs to be adaptive to project actuality and context. Our aim in this paper is to understand how these different forms of managing projects impact project success. We investigate projects through a lens of discretion, defined as autonomy in the project team to adapt the project to its context as opposed to a reliance on a pre-defined set of rules for project management. We also look at the role of exploration, that is, whether the project focuses on the development of new knowledge, or whether the focus is on furthering existing competences. Based on our analysis, we propose a framework to determine the right amount of discretion in a project, highlighting which project management methodology is suited for the work at hand or whether discarding methodology altogether is more likely to lead to project success.

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1. Introduction

Project work is often governed by standard work practices defined in a project methodology. Numerous studies and books advocate the use of these standardized ways of working for a successful project [1]-[6]. Project success, in turn, has traditionally been defined with the help of the "iron triangle" of efficiency, exemplified as adherence to budgetary constraints, a timeline, and the goals specified for the project. Despite the alleged panacea of project methodologies and standard practices, project success rates remain low [3],[7],[8]. Clearly, project methodologies do not work equally well in all projects.

Instead, contingency theory posits that an emergent project management style is needed to cope with the unique features and complexities of projects, thereby adapting the project to its organizational context [9]-[13]. This supports a notion of discretion, whereby project managers have the autonomy to independently decide how work should be organized. Naveh [14] defines discretion as spontaneity and breaking the rules of a methodology, as opposed to formality, where pre-defined processes govern project work.

In this paper, we review ways to determine which project methodology suits a given project type, particularly relating to traditional 'waterfall' methods and iterative agile methods. Both have been used in our case company. We also review studies that address the suitability of different project methodologies. These studies typically work with an assumption that a pre-defined methodology is needed for project success [3],[15],[16]. The more provocative question we seek to answer is whether methodology is needed at all, or whether it is sufficient that management practices in the line organization are applied in a temporary project context. This would assume that projects are better off with full discretion. We develop a framework to understand the characteristics of projects that benefit from a formal methodology and projects that benefit from discretion. Unlike previous ways to categorize projects based on, for example, complexity, uncertainty, and dynamism [10],[12],[16], we examine the role of exploration in projects [17]. We thus turn to organizational learning, looking at whether new competences are developed in the project, or whether the project relies on existing competences [18].

Earlier research on project contingency has focused on the project characteristics that call for emergent project management [10]-[12]. Similarly, research that advocates standardized project management list several factors why project management methodologies work [1]-[3],[5]. Alternatively, some studies maintain that projects benefit from altering between formality and discretion [14]. Our findings address a gap in literature by simultaneously examining project discretion and a view that promotes strict adherence to a formal methodology [19]. We address this tension by viewing project management as a continuum from established project management methodologies to fully emergent project management. At the same time, we move from a descriptive to a prescriptive study, detailing principles for when to adapt what kind of project management. In other words, we determine when a contingent view and discretion is advisable, and when predefined practices and formality should be applied for project success.

In the next section, we will examine relevant literature on the subject at hand. Section 3 outlines the context of our study, and the methods we used to analyze our empirical data. Section 4 details the results, followed by Section 5 which discusses the results considering previous literature. In the last section, we present key conclusions, limitations of the study, and recommendations for further research.

2. Project management and project actuality

Typical for most definitions of projects is the focus on two dominant traits: the project is a temporary endeavor, and it is unique in nature [4],[10],[20],[21]. Rather than focusing only on the "iron triangle", project success is increasingly also defined through stakeholder satisfaction [21]-[23]. This implies that success is "in the eyes of the beholder" [21, p. 768]. As such, project success is multi-faceted rather than limited to predefined metrics.

In this section, we review previous literature with respect to key elements of our framework. We discuss project methodologies as well as contingency theory in a project management context. Further, we identify discretion and

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exploration as key dimensions in projects. We also identify additional concepts, which we later use as control variables when we empirically test our framework.

2.1 Project methodologies

Project work often adheres to a set of rules. Ways of working are defined in a project management methodology and formality is strong. Joslin and Müller [13] outline processes, tools, techniques, methods, capability profiles, and knowledge areas as the building blocks of a project methodology. In other words, the methodology is a comprehensive toolkit that governs many, if not most, aspects of project work. The methodology is presented as proven good practice, implying that adherence to the outlined practices will result in well-run, effective projects, often stressing the universal applicability of the methodology in question [4],[6,],[15].

One underlying assumption of project research and practice is the plan-act-control cycle, whereby plans forms the basis of activities that are monitored for quality [24],[25]. This view has also been criticized. The agile manifesto, originating in software development but widely quoted in project management in general, exemplifies a shift of focus [26]. It states that, for example, "responding to change" is more important than "following a plan". In this view of projects, social interaction in the temporary organization is more important than planning of activities. As such, iterative planning, frequent customer feedback, and incremental steps lie at the core of agile project management (APM), whereas traditional project management (TPM) relies on one sequential plan-act-control cycle where customer feedback is gathered at the end of the project [27]. However, *any* project methodology relies on an assumption that certain pre-defined ways of working lead to project success. Further, APM merely breaks down the plan-act-control cycle to smaller entities. In practice, the cycle is reiterated several times throughout the project [3],[19].

2.2 Selecting a methodology for a successful project

APM's "rise to fame" has been rapid in recent years. For example, the latest edition of the Project Management Body of Knowledge [4] contains several additions covering agile practices. Practitioners and researchers alike stress that APM leads to higher success rates compared to traditional methods [3],[28]. So, does this mean that APM is the (only) way forward? It would appear there is more to the story: project success rates remain low, despite the prevalence of APM [7]. Overall, studies suggest that the benefits of APM are highest when there is uncertainty regarding how to achieve the project's goals [15],[29],[30], or when environmental dynamism is high, that is, there are frequent changes in the project's operating environment [16],[31]. Yet with growing support for APM, recent studies that advocate the use of TPM are hard to find. All-in-all, it would seem a shift has occurred, whereby APM is deemed suitable for most projects.

Studies have looked at structural complexity as a key dimension to consider when selecting project methodology. Structural complexity grows with the size, interconnectedness, and number of elements in a project [12],[20],[32],[33]. However, previous studies paint a somewhat contradictory picture regarding how structural complexity should be handled, some advocating APM [20],[32], and some declaring traditional methods unsuitable [16],[34]. In contrast, Shenhar and Dvir [12] conclude that the need for formality grows with structural complexity. Indeed, there are studies pinpointing specific challenges with APM, particularly in relation to managing interdependencies [35],[36]. A pertinent study by Paasivaara *et al.* [37] notes challenges with, for example, cross-site teams, integrations, and a common backlog in agile projects. As such, growing structural complexity might create challenges in agile projects. In summary, growing uncertainty and dynamism should drive the adoption of APM, whereas there are contradictory findings regarding structural complexity and project methodology.

Despite their promise, there is ambiguity on whether any given methodology can be universally considered the right approach to project management [38]. Several scholars have put forward that project management needs to consider organizational context and the actuality of projects (for an overview, see Hanisch and Wald [9]). This view of projects has garnered significant interest with studies advocating a contingent approach to project management based on, for example, complexity [10] and uncertainty [12],[39]. Some also promote a view where elements from methodologies are selectively used depending on prevailing circumstances [13]. All-in-all, a contingency view of projects assumes that

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organizational context beyond that of the project is considered when determining how the project should be managed. Next, we will examine what this means in practice.

2.3 Discretion in project work

Tatikonda and Rosenthal [40, p. 403] define discretion as autonomy in the project team to "meet emerging circumstances", as opposed to formality that assumes pre-defined rules, processes, and structures for the project [19]. According to Naveh [14], discretion is about breaking rules and structures in the face of a volatile environment. However, discretion does not imply that planning and control are absent, but rather that project practices are developed "on the fly" as opposed to being governed by a pre-defined process or template.

Previous research indicates that development projects benefit from both formality and discretion [14],[40],[41]. APM has been portrayed as a solution to this conundrum, allowing for structure and efficiency while at the same time promoting flexibility and iteration [3],[21]. This would imply that APM has a built-in mechanism to allow for a degree of discretion, despite the formality of a methodology. In practice, APM allows for adaptability and learning by splitting the plan-act-control cycle to smaller entities.

2.4 Exploration and the uniqueness of projects

Exploration refers to the acquisition of new knowledge in an organization as opposed to exploitation, the utilization of existing competences [17],[18]. Conceptually, exploration has been linked to innovation [17]. However, subsequent research has divided innovation to two types: exploitative incremental innovation and exploratory radical innovation, the former concerned with further development of existing competences and the latter with the development of completely new ideas [42]. Given that projects are unique and drive for change, one could argue that innovation lies at the core of the project's task. However, many projects clearly exploit existing competences while other projects seek entirely new solutions [39]. In other words, while 'uniqueness' might refer to innovation, it can be of both the exploitative and exploratory kind. In addition to supporting the development of new competences in projects, exploration can also act to mitigate negative effects of project uncertainty and dynamism [39]. In other words, new competences are needed when the path to the project's goal is unclear, or when the project environment undergoes significant changes. So, how can exploration in projects be enabled? Lenfle [43, p. 477] notes that exploratory innovation in a project requires a "fundamental shift in project management methodology" from a traditional, instrumental view of the project. Similar conclusions are presented by McGrath [44] and Shenhar *et al*. [45], noting that less oversight and a contingent view of projects are needed for exploration.

2.5 Combined lessons

We have examined previous literature regarding project management methodologies, discretion, and exploration in projects. Figure 1 summarizes the relationship between these constructs. In essence, we posit that a high degree of discretion corresponds to a contingent view of projects. This emergent project management style allows project work to be adapted to project actuality. A high degree of discretion also acts to enable exploration in the project. On the other side of the continuum, TPM relies on a high degree of formality and low discretion, while prohibiting high exploration. APM, while still reliant on a degree of formality, allows for more discretion, thus also supporting exploration to a higher degree. In effect, this creates a continuum of effective project management, which is tied to the level of exploration in the project.

Next, we will empirically test this framework. Considering the contradictory findings regarding structural complexity, we will also look at this project aspect in more detail. Given that a high degree of discretion and exploration mitigate the effects of project uncertainty and dynamism, we will not investigate these aspects further.

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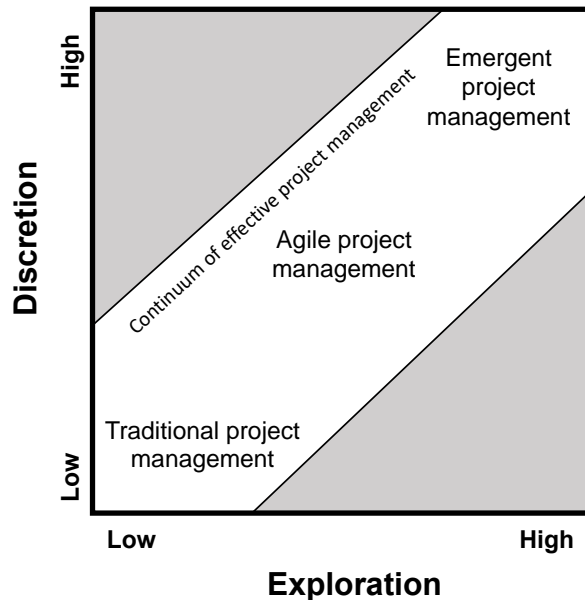
Figure 1. Relationship between discretion, project management, and exploration

3. Method

3.1 Interview data

In this paper, we examine different projects, how they were managed, and whether they were perceived as successful. In our analysis, we subscribe to a view of project success based on stakeholder satisfaction [21]-[23]. Our findings build on interviews with 32 project professionals and their managers at Nokia, an international telecommunications company (see Appendix A). The projects we examine varied in size and complexity, and they were managed with TPM, APM, or with full discretion for the project team (see Appendix B).

The sampling was purposive, including people who worked in projects and people who have switched from managing projects to managing teams (and project managers). As such, all our interviewees had experience in managing projects. Many of the projects investigated in this study also involved Nokia's suppliers. As such, we opted to interview supplier representatives from one of Nokia's largest partners (interviews number 14, 18, and 19 in Appendix A). The interviews were semi-structured; the central themes in the interviews centered around successful and unsuccessful projects, and the nature of exploration in projects. As the term 'exploration' is academic in nature, the word innovation was used in the interviews when referring to the process of seeking new knowledge. Each informant was asked to recall both successful and unsuccessful projects throughout their career and reflect on the role of innovation in said projects.

Data analysis was conducted in two steps. First, we did an inductive analysis of the interviews, starting with open coding [46]. After this, we gradually refined the coding categories to generate a conceptual model. To validate and extend the model, we conducted a qualitative comparative analysis [47],[48].

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3.2 Context

At the time of the interviews, Nokia was a full-blown telecommunications company, offering mobile phones as well as telecommunications infrastructure. Since then, Nokia has shifted focus to only infrastructure. The projects that were discussed in the interviews concerned information systems (IS) development and product development. All product development projects involved both software and hardware development. Many of the IS projects concerned the implementation of standard IT solutions, such as Enterprise Resource Planning (ERP), advanced planning and scheduling (APS), or various data management or data exchange solutions.

The formal approach to project management at Nokia has followed a similar path to many other high-tech companies: projects that were organized according to traditional waterfall methods have taken an agile form [28],[37]. At the time of the interviews, Nokia was transitioning from an internal project management methodology to APM. The internal methodology was a milestone-based, waterfall methodology largely built around practices outlined in earlier editions of the Project Management Body of Knowledge [4].

3.3 Data analysis

The data collection stretched over a period of 18 months. The interviews were transcribed and coded, starting with open coding [46]. After this, the coding results were discussed, and a common set of categories were formed. The interviews and memos were re-read, focusing on one category at a time, resulting in redefined subcategories, and adding of new data to existing categories. New categories were created if there was need for it; a practice similar to the principle of constant comparison was present throughout the analysis [46]. In the final step, linkages between the categories were created.

Previous literature was read throughout the process, but the role of previous research for comparison was especially important in the later stages of the analysis. The categories often emerged in discussions between the authors, and whenever a new coding category was formed, previous literature helped in refining and defining the category further. The final categories are outlined in Section 4.4. Once the conceptual model was ready, we proceeded with a separate step to validate the model.

3.4 Validating and extending the model using qualitative comparative analysis

We used Qualitative Comparative Analysis (QCA) to validate the result of the interview coding [47],[48]. In addition, the QCA was designed to account for alternative explanations to project success, such as structural complexity affecting the outcome. QCA applies Boolean algebra and Quine's minimization algorithm to find the most parsimonious combination of antecedent variables capable of explaining an outcome variable. Due to the exponential growth of computing time, the method is most feasible when the number of cases is below 50 and the number of conditions (i.e., antecedent variables) is less than 12. In our analysis, we had 30 cases (i.e., projects listed in Appendix B). Five projects had to be excluded from the QCA due to incomplete data on some of the variables. In other words, the interviews contained insufficient information to assess specific variables. We defined seven antecedent Boolean variables affecting project success. These were based on previous literature, findings from the interview analysis, and characteristics in the data:

- Traditional project management;
- Agile project management (variable name 'A');
- Full discretion (B);
- High exploration (C);
- High structural complexity (D);
- Holistic architecture (E);
- Successful internal sales (F).

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The first variable (traditional project management) was eventually excluded from the QCA as the second variable (agile project management) provided all necessary data. In practice, these variables contained opposite values and, thus, duplicate information. The number of cases (i.e., projects) is not directly tied to the number of interviews. Some informants referred to several projects, whereas some talked about projects in general without recalling a specific project.

We had clear criteria for assessing any given variable. Starting with the type of project management, some informants clearly indicated whether the project was milestone-based or agile. In other cases, we made the assessment based on how the informant described the project. One such example is when informants described projects having autonomy and a high degree of empowerment; project discretion was high. Some informants also described temporary undertakings as "not being projects". Given an organizational context that relied heavily on project methodologies, we believe some informants linked the definition of a project to the presence of a methodology. In line with the definition in this paper, we opted to classify these undertakings as projects with full discretion.

The role of exploration was determined based on the focus of the project. If, for example, the project concerned implementation, maintenance, or upgrades, we deemed that the focus was on exploiting existing competences. In contrast, some projects clearly aimed at developing new competences; we used the notion of exploratory innovation to guide coding of these cases [42].

Projects with high structural complexity always involved multiple organizational sub-units or partners where each entity had a big role in ensuring the success of the project. Typically, this resulted in multiple elements such as processes, partners, information systems, or product modules that needed to be combined in the project [12],[20],[32].

The last two variables, 'holistic architecture' and 'successful internal sales' were added because there were instances of project failure reported to us that did not fit any of the other antecedent variables. Projects 28 and 31 (see Appendix B) exhibited a lack of a holistic architecture. These were structurally complex new product development projects with hundreds of people working in smaller teams responsible for different product modules. Our informants described significant challenges with how interdependencies were managed. As such, a lack of 'holistic architecture' denotes a failure to manage structural complexity. Project 10 developed entirely new technology for mobile phones. However, at the time, no product team was willing to take the new technology into use. This was coded as a lack of 'successful internal sales', a challenge present also in some other projects.

3.5 QCA steps

We tabulated our data into a truth table (see Appendix B) composed of the outcome variable (project success) and seven antecedent variables. All antecedent conditions for the project outcome were coded as binary Boolean variables. This tabulation offers a useful way to represent variations in discrete data elements that underlie structured QCA. It also allows for systematically building an explanation, as opposed to an interpretation based on selected source text excerpts [49].

Next, we conducted the analysis using the Tosmana v1.1 QCA Excel Add-In [50]. We included six out of our seven antecedents in the analysis because of the duplicate information in the first variable (TPM). As a shorthand notation, we refer to the antecedent variables using upper case and lower-case letters to denote presence and absence of a project quality.

Our truth table was sparsely populated, as is usual, with only 19 causal conditions out of the theoretically possible $2^6 = 64$ combinations of values. Frequently there are no instances of some configuration – a challenge known as a "problem of limited diversity" [51]. Often, though, such "remainder" rows represent cases that are theoretically unfeasible. Remainder rows can be used during the analysis as simplifying assumptions to reduce combinations of causal conditions [52]. We followed this approach in our analysis.

In the final QCA step, programmatic simplification of the truth table produces *prime implicants*. These are combinations of causal conditions that account for at least one positive instance of the outcome (see the prime implicant

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chart in Appendix B). The prime implicants are further simplified to an equation that represents the causal conditions producing a given outcome.

The prime implicants in Appendix B contain some redundancy: only three of the six prime implicants cover a unique causal condition that needs to be included in a final reduced equation. The final reduced equation for project success combines these prime implicants with a fourth one:

O = abc + ACE + BCF + cd

As noted, upper case letters represent a condition that is present while lower case letters represent its absence. The letters represent the antecedent variables listed in Section 3.3, starting from 'agile project management' (that also details whether TPM was used or not). Separate conditions independently producing an outcome is represented with the logical OR operator '+'. These separate conditions are thus alone sufficient for the outcome (project success). Conditions that combined produce a given outcome are represented by writing the symbols for the conditions together. In such cases, all conditions are necessary, and no condition alone is sufficient for the outcome. We examine the reduced equation for project success further in Section 4.5 (results).

4. Results

4.1 Discretion in projects

Project management in our case company evolved from an empowered mode where people in the project were responsible for developing ways of working, towards a mode where the organization had an all-encompassing project management methodology. This formalization of ways of working, over time, was a recurring theme in the interviews. Some viewed this as a natural and positive development, whereas others saw it as less valuable for the success of the project. However, there were exceptions to how projects were run. Project discretion is well illustrated by one informant's response to the IT department's request for a formal review of the IT architecture:

> *Can we go with [name of IT tool]? I thought it had a funny name. In a way, this was very shocking*
> *[to them]. (Interview #6)*

The project selected the IT solution proposed by our informant and completed the project successfully in record time. The work in the project deviated from practices outlined in a methodology, focusing less on selecting the best possible IT solution and more on quickly getting the job done. Ultimately, formality and discretion were key coding categories in the interview analysis. Table 1 provides examples of formal practices linked with certain project methodologies, as well as examples of discretion where the project deviated from a project methodology.

Table 1. Examples of formality and discretion

Formality	Discretion
▪ Project plans with work-breakdown-structures	▪ Picking and choosing elements of different project management methodologies for the same project
▪ Project phases, milestones	
▪ Steering group meetings	▪ "Fluid action plans"
▪ Business case calculations	▪ Decision making without steering group approval, a "just-do-it approach"
▪ Project budgets	
▪ Scope specifications	▪ Allocation of work "through personal contacts"
▪ Project roles and responsibilities, e.g., communication specialist, change management specialist, quality manager	▪ Problem solving by re-allocating roles and responsibilities, "just getting these four guys to solve the problem" (as opposed to formal project planning)
▪ Concept descriptions (detailing business processes and high-level IT solution)	▪ Less emphasis on planning, more acting "in the moment"
▪ IT architecture documentation	
▪ Communication plans	▪ Accountability in the line organization (as opposed

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Formality	Discretion
▪ Change management plans	to in the project organization)
▪ Service level agreements	▪ No "cast-list" (roles and responsibilities) in the
▪ SCRUM	project
▪ Demo sessions	▪ "Empowering people to do any changes they can"
▪ Portfolio management practices	
▪ Exit criteria	

4.2 Exploration in projects

Exploration was another key theme in our interviews. When tying innovations to projects, some informants described how new ways of working or entirely new products was brought about by the project. At the same time, some informants saw no link between innovation and project work. This resulted in two categories of projects, low exploration projects and high exploration projects. Examples of these are listed in Table 2.

Table 2. Examples of low- and high exploration projects

Low exploration projects	High exploration projects
▪ Implementation of standard Enterprise Resource Planning (ERP) solution	▪ Development of entirely new supply chain capabilities (including business process and IT solutions)
▪ Readiness for the conversion of national currencies to the Euro	▪ Specification of a new business-to-business data interchange standard
▪ Implementation of new logistics capabilities	▪ New product development
▪ ERP upgrade project	▪ Cost saving project (for existing product)
▪ Product delivery/installation project (network infrastructure)	▪ Specification of a new mode of operations and organizational structure
▪ Implementation of new Product Data Management (PDM) solution	▪ Development of new in-house supplier collaboration solution
▪ Implementation of new Demand Planning solution	
▪ Improvements to existing products	

The first category of projects relied on exploiting existing competences. Typical for this category of projects was that the problem to be solved was well formulated, and the means to do so could be planned. The need for exploration was low. Examples include projects that focused on the implementation of standard IT solutions. While it could be argued that the organization needed to learn new skills for the effective use of these solutions, the projects were not tasked with defining these skills. Instead, the solution was to be implemented in accordance with instructions from the vendor. Projects where a high degree of exploration was needed became the second category. This category contained projects that specifically focused on developing new solutions and competences.

4.3 Formality, discretion, and exploration

As with formality, also project discretion was sometimes described with negative connotations. Many had a firm belief in structure and formal methodology as means of ensuring project success, and many examples of the positive effects of a strict methodology were presented. On the opposite side, the interviews also revealed cases where formality was misplaced, and discretion was called for. In this section, specific projects are examined in more detail to establish the relationship between formality, discretion, and exploration. Figure 2 illustrates a categorization of projects along these dimensions, summarizing which projects relied on a high degree of formality (example projects III, IV and V), and the projects that exhibited high discretion (projects I, II, VI, and VII). Further, Figure 2 details whether these projects were characterized as exploratory or not. These projects are a subset of all the projects included in the QCA (see Appendix B).

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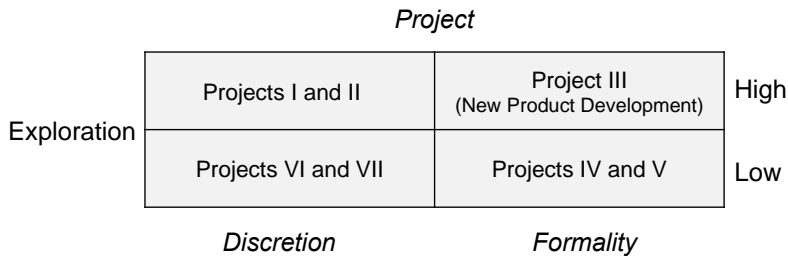
Project

Figure 2. Project categorization based on work practices and degree of exploration

One informant described a large-scale project (project I) that involved more than one hundred suppliers, several international logistics service providers, development of new business processes, as well as new IT solutions. Project I spanned over several years and as a result, highly innovative, new supply chain capabilities were developed. While there were major challenges along the way, the informant considered the project very successful. The way of working in the project was characterized by discretion.

I just remember that I wrote a concept description, since I thought a concept description is needed. [...] Then we concluded that a RosettaNet specification [XML based standard for electronic communication] is still missing. So, I went ahead and developed that. And then we started implementing all of this. [...] If I remember correctly, this was implemented mostly through personal contacts in IT. I convinced a person I know in IT that this is needed. Maybe there then was some sort of steering group that gave the final approval, but basically, we got this done through entirely other means. (Interview #3)

The next project (project II) concerned the development of a new database product. Conducted more than 30 years ago, the project developed a product that is still maintained and sold today. Discretion again played a big role in the project, and the informant indicated that this could have played a big role in the innovative nature of project II, both in terms of ways of working and outcome. The informant described the circumstances behind the success of the project as follows:

An open-minded attitude. We didn't have any practical experience with this kind of real-time systems. We basically went into it blind. [...] At the time, we didn't know anything about project management either, so there were no inhibitions. [...] We were also highly innovative because we also developed our own database query language. (Interview #11)

Projects I and II are positioned as projects that exhibit exploration, while work practices are characterized by a high degree of discretion.

The interviews also included examples of formality coupled with a need for exploration. Nokia experienced a high degree of competition from both low-cost manufacturers and other new competitors. The product development process for mobile phones (project III) essentially followed the internal TPM methodology, and several informants revealed a certain degree of frustration with the somewhat rigid fashion in which new products were introduced. While some acknowledged that there are clear reasons (e.g., quality-related) to pursue a very structured approach to product development, a more localized approach could be put in place to counter smaller competitors with innovative products. Also, truly "new and groundbreaking" products could have benefitted from a less rigid approach.

We have enough people, we have enough expertise, but we don't have enough of a practical approach. [...] We should be faster than them. (Interview #7)

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In this description, the lack of a "practical approach" is impeding the ability to counter small but fast competitors, who are very reactive to changing market conditions. As such, new product development projects are categorized as reliant on formality, while at the same time requiring a high degree of exploration during the project.

Project IV was a large-scale project concerned with the implementation of a new enterprise resource planning (ERP) solution for one division of the company. This project employed a milestone-based project methodology that later evolved into the companywide, formal methodology used across projects. The ERP solution was a standard, off-the shelf software package. A large part of the implementation involved the harmonization of business process across 44 different countries. In this sense, the formal methodology was used to sanction conformity rather than any form of exploration.

> *The challenge was specifically that every creek and island had their own managers, processes, ways of working, and system. There was a hell of a lot of complaints when we said, listen up, now each and every one should take [name of the ERP system] customer order management into use. [...] So, we ended up using a clear-cut template [for the implementation], for example, with milestones with clear criteria [for completion]. The primary use was to get rid of these endless discussions, that 'this is no good for us.' [...] The change management involved in getting global processes in place in a timely manner simply requires a clear project template. (Interview #2)*

One informant had been involved in an IS project concerning the readiness for the Euro currency (project *V*). This involved changes to accounting systems, but also a thorough review of existing contracts that were in soon to-be legacy currencies. Project V involved a high degree of planning ahead, together with a formalized risk management process.

> *So, then it became a matter of executing and just gathering the data and fixing it. So instead of innovation, it's just problem solving. [...] Let's communicate it well and let's keep monitoring and making sure that it's working. And then we have a fallback plan if that something fails. (Interview #16)*

In projects IV, and V, we saw formality coupled with a low degree of exploration.

Our next example (project VI) exhibits a high degree of management direction in terms of setting the schedule for the effort. The project in question concerned the implementation of the ERP solution in the second major division of the company. Formality and planning became difficult due to the aggressive schedule imposed by management.

> *It's completely chaotic, very poor this visibility to kind of what stage are we [in]? Which thing should we do first? By setting [a] very aggressive schedule they were basically really destroying the process there, not doing things in the right sequence. Trying to achieve something really, really fast and... That was a nightmare. (Interview #16)*

In project VII, the intention was to implement a demand management tool for a particular division. This tool had earlier been implemented elsewhere in the company. The earlier, successful implementation was described to us as a having a "process perspective" with "timetables, what is to be done, when, and how". However, the account presented to us of a later implementation in the other division was substantially different:

> *But then, when this was taken to [division 2 of the company] what happened was that they took the subjective opinions of different people and tried to implement all of them. In the end, it became an amoeba that no one controlled. (Interview #14)*

According to the descriptions portrayed to us, projects VI and VII lacked formality; we categorized these projects as having a high degree of discretion. These projects were implementing standard solutions already developed and implemented elsewhere. As such, the need for exploration was low. Project steering relying on discretion seemed misplaced, resulting in projects that were largely perceived as unsuccessful.

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4.4 Summary of interview results

A framework that summarizes our coding of the interviews is presented in Figure 3. The circles represent the final coding categories. Each project was first categorized based on the role of exploration in the project; was the need for exploration high or low? After this, the informant's view on the success of the project was determined, and what type of practices had an impact on the perceived success. Formality coupled with a low degree of exploration in the project, sometimes implying a need for conformity, worked well. On the other hand, a high degree of discretion in these kinds of projects was typically depicted as leading to failure. On the opposite side, when a high degree of exploration is required, discretion was better suited to govern the project than formality.
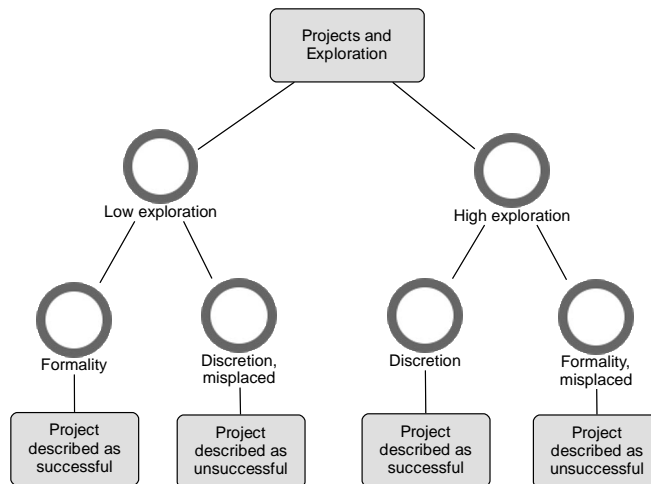
Figure 3. Interview coding categories

4.5 Validating and extending the model

The results of the QCA supported our findings from the interview analysis. The reduced equation for project success (O = abc + ACE + BCF + cd, see Appendix B) implies that successful projects with low exploration relied on TPM. Alternatively, projects with high exploration relied on either APM or full discretion to manage the project. In addition, a 'holistic architecture' was instrumental for agile projects, whereas projects with full discretion also demonstrated 'successful internal sales'. The last two conditions for successful projects, 'cd', imply that low exploration and low structural complexity lead to successful projects. This is likely to be the case. Yet, this "ideal" starting point for a project is far from the conditions many organizations and project managers face.

The need for a holistic architecture in structurally complex agile projects along with internal sales in projects with full discretion, prompted us to re-examine these projects in more detail. While agile projects 28 and 31 (see Appendix B) had challenges with managing interdependencies, similar projects such as numbers 12 and 35 had mechanisms in place to ensure that the overall architecture was managed. Quoting our informants, project 12 employed "architects", and project 35 stressed "collective code ownership" between teams to deliver customer value. In other words, there were specific roles and mechanisms in place to manage structural complexity. The lack of internal sales was exemplified by high exploration projects that had difficulties in anchoring developments with operations, such as project 10 (interview #9): "we should have discussed this more with marketing".

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5. Discussion

We set out to understand the role project management plays in enabling project success. In effect, our findings support a contingency view of projects. However, unlike previous contingency studies, we posit that understanding the role of exploration is key to adapting project management to context. In practice, the role of exploration in a project determines the amount of discretion needed. We maintain that there is a case for high formality and TPM in projects that rely on exploitation, whereas exploration projects benefit from discretion, either through APM or by fully discarding established methodologies.

Earlier studies that advocate oscillation between project formality and discretion largely fail to address the specific conditions that require either formality or discretion [14],[40],[41]. In this regard, APM is interesting. It represents a "compromise" between formality and discretion, effectively implementing both at the same time. This is perhaps why it has garnered such interest in a wide variety of projects. Yet, APM is not a "one-size-fits-all" solution to project management, as evidenced by persistent high failure rates also in agile projects [7]. One reason for this might be that APM is applied where TPM or full discretion would be more suitable.

5.1 Project management that enables project success

Figure 4 summarizes the results of this study; our data analysis supports the model outlined in the beginning of the paper. If the project focus is on refinement of the existing, formality should be high. Exploitation is emphasized, and TPM is suitable to manage these projects. On the other side, a need for high exploration to facilitate new ideas and competences calls for discretion. In practice, pre-defined methodology is discarded in favor of an emergent project. Deviating from the outlined continuum in Figure 4 creates challenges, either due to incoordination or a "red tape". Incoordination implies at insufficient rules, processes, and structures for the project, whereas "red tape" is methodology inhibiting exploration through the same mechanisms.
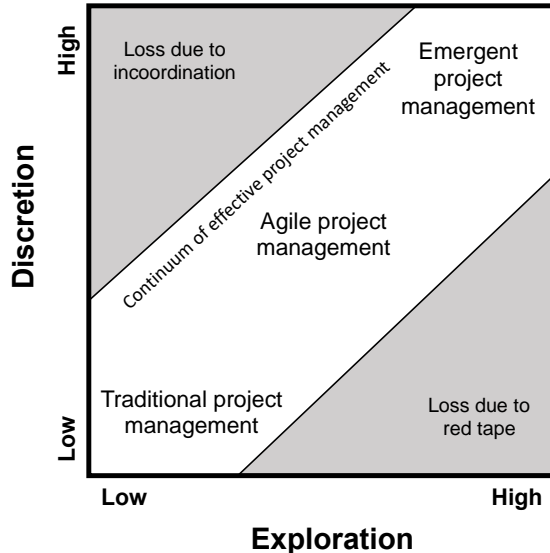

Figure 4. Relationship between discretion, project management, and exploration

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Looking at this principle with the help of the project examples outlined in Section 4.3, we note that project one (I) belongs in the emergent project management category. This does not suggest an unsystematic way of working, but instead, high discretion and little or no adherence to a predefined methodology. On the other side of the spectrum, project four (IV) concerned the implementation of a standard ERP solution. The need for exploration was small as the focus was on implementing a standard IT solution. The focus was on uniform ways of working, and no exception to this rule was deemed acceptable. Formality to regulate behavior was important, both in terms of the project activities, but also to manage change. TPM was used for effect.

The degree to which exploration was needed in projects one (I) and four (IV) was different, as was the approach to project management. In effect, the temporary organization was used to provisionally overturn organizational focus. In project IV, this effectively meant that methodology was used to ensure conformity, to a degree the antithesis of what a company in the high-tech sector needs. In contrast, project I used the temporary organization to ensure that established ways of working are discarded. This emergent project management methodology allowed for the development of entirely new competences and solutions.

Project management methodologies always contain a degree of formality, but APM allows for a degree of discretion that can support exploratory initiatives. At the same time, a complete departure from established methodologies might be needed under certain conditions. Several scholars have noted that high exploration requires a move away from an instrumental view of a project [43]-[45]. Our study shows that this can mean that project methodologies should be discarded altogether. Despite the prevalence of APM, we also note that TPM can be very effective when the need for exploration is low. The implementation of standard software might be such a case. These IS projects might in fact benefit from low discretion, emphasizing the word 'standard' also in terms of how the project is managed.

5.2 Other factors affecting project success

Based on the QCA, we note that agile projects require attention to handle the effects of high structural complexity, specifically challenges with project interdependencies and architecture. Similar findings have been reported in other studies [35]-[37]. Unlike previous studies, we do not see structural complexity as a determining factor for selecting a project methodology [12],[16],[20],[32],[34], but emphasize the need to address structural complexity in agile projects. In practice, structurally complex agile projects might require mechanisms or project roles that ensure a holistic approach.

Further, the data revealed that successful emergent projects need to pay attention to internal sales. As these projects developed entirely new solutions, it is reasonable to assume that acceptance by the operative organization is not given. As such, emergent projects can benefit from practices inherent to APM, specifically emphasizing customer involvement throughout the project [35]. This ensures that customer requirements are considered.

6. Conclusion

6.1 Implications for theory

Scholars recognize the challenge with adapting projects to their actuality [9]-[13]. Complementing previous studies, we posit that the role of exploration is a key consideration when determining how projects should be managed; this should drive the degree of discretion applied in the project. We stress the need to not only distinguish between low and high exploration projects, but also provide directions for the management of said project types. In practice, high exploration projects require a high degree of discretion, whereas low exploration projects benefit from formality. Unlike previous studies that suggest development projects benefit from both formality and discretion [14],[40],[41], we separate the specific project types that benefit from either formality or discretion. In this vein, we also note that high discretion might mean that project methodologies are discarded altogether. This can create the necessary conditions for developing entirely new solutions. APM is effectively a compromise between formality and discretion, yet no silver bullet. For example, applying APM when implementing standard software can be challenging; APM allows for iteration, feedback,

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and new paths that might in fact be undesirable in these projects. In these instances, TPM can be a better choice for managing the project.

6.2 Implications for practice

Projects can be used to both foster innovation and sanction conformity. Echoing previous research, this requires a move away from a uniform view of projects and how work therein is controlled [10],[11],[13]. Methodologies are used to legitimize formality – *sometimes* to their benefit. However, this paper puts forward that a uniform application of methodologies, be it traditional waterfall or agile, is the antithesis of what a successful project environment calls for. Further, the organization needs to consider whether to apply a methodology at all or whether to simply disregard predefined practices for project success. In effect, the temporary nature of the project needs to be used to its full potential. This means that structures prevalent in the organization can be provisionally overturned to either promote exploration and innovation, or sanction conformity and emphasize exploitation. These temporary structures need to be reconsidered for every project.

6.3 Limitations and future research

The focus of this study was on IS and product development projects. There are limitations in terms of the applicability of our findings to other project types. Further, this study looks at project work in one large high-tech company and its supplier. It is likely that the findings are applicable in this context; start-ups and smaller companies probably operate with far less bureaucracy and control. Similarly, public organizations might have time and budgetary limits that impact the choice of project management. At the same time, the projects examined in this study represent a diverse set of projects. As such, we believe the findings are useful in many large organizations having a wide variety of development needs.

Project management competence was not considered a variable in our analysis. All informants had a long background in managing projects, and some in managing teams of project managers. Organizations are likely to appoint people with experience in projects to manage temporary organizations, assuming experienced project managers are available. These experienced project managers are likely to be found in larger organizations, further stressing the applicability of our findings in this setting.

The limitations described above would merit further testing of the framework outlined in this paper in different contexts, including smaller companies, different industries, as well as public organizations. Given the prevalence of APM, we would also encourage studies that look at how suitable APM is in large-scale implementations of standard software, specifically in comparison with traditional methods with a higher degree of formality. The notion of disregarding methodology altogether is also a topic that would warrant further investigation, providing further descriptions of what a contingent approach to project management could look like in practice.

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Appendix A. The Interviews

#	Time	Title	Project type*	Language**
1	07/2011	Director	Product development	Finnish
2	08/2011	Director		Finnish
3	09/2011	Head of	Information systems	Finnish
4	09/2011	Vice President	Product development	Finnish
5	09/2011	Senior Manager	Information systems	Finnish
6	09/2011	Director	Information systems	Finnish
7	09/2011	Senior Specialist	Product development	English
8	09/2011	Director	Information systems	Finnish
9	09/2011	Senior Manager	Product development	Swedish
10	11/2011	Senior Manager	Information systems	Finnish
11	11/2011	Head of	Product development	Finnish
12	11/2011	Manager	Information systems	Finnish
13	01/2012	Senior Manager	Information systems	Finnish

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#	Time	Title	Project type*	Language**
14	01/2012	Director	Information systems	Finnish
15	02/2012	Senior Manager	Information systems	Finnish
16	02/2012	Manager	Information systems	English
17	03/2012	Senior Manager	Information systems	Finnish
18	03/2012	Vice President	Information systems	English
19	03/2012	Manager	Information systems	Finnish
20	04/2012	Vice President	Product development	Finnish
21	04/2012	Vice President	Information systems	Finnish
22	04/2012	Director	Information systems	Finnish
23	10/2012	Manager	Product development	Finnish
24	10/2012	Manager	Product development	Finnish
25	10/2012	Manager	Product development	Finnish
26	11/2012	Head of	Product development	Finnish
27	11/2012	Head of	Product development	English
28	11/2012	Head of	Product development	English
29	11/2012	Head of	Product development	English
30	11/2012	Head of	Product development	English
31	01/2013	Senior Engineer	Product development	English
32	01/2013	Manager	Product development	English

* Project type refers to what kind of projects were primarily discussed during the interview.

** When applicable, translation to English has been done by the authors.

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Appendix B. QCA Truth table and prime implicant chart

B.1. Truth table

Projects (case # in QCA/ project number in interview analysis)	APM (A)	Full discretion (B)	High exploration (C)	High structural complexity (D)	Holistic architecture (E)	Successful internal sales (F)	Project success (O) Yes	No
4, 16, 23/V	0	0	0	0	1	1	3	0
1/IV, 13, 17, 22, 24	0	0	0	1	1	1	5	0
18	0	0	0	1	1	1	1	0
14	0	0	1	0	1	0	0	1
6/III	0	0	1	0	1	1	0	1
19	0	0	1	1	1	0	0	1
2	0	0	1	1	1	1	0	1
5	0	1	0	0	1	1	1	0
21/VI	0	1	0	1	1	1	0	1
25, 26, 27	0	1	1	0	1	1	3	0
11/II	0	1	1	1	1	1	1	0
10	0	1	1	1	1	0	0	1
3/I	0	1	1	1	1	1	1	0
15	1	0	0	0	1	1	1	0
20/VII	1	0	0	1	1	1	0	1
30	1	0	0	1	1	1	0	1
29, 32	1	0	1	0	1	1	2	0
28, 31	1	0	1	1	0	1	0	2
12, 35	1	0	1	1	1	1	2	0
7, 8, 9, 33, 34 (excluded)								
All other combinations of conditions (45)							?	?

NOTE: 1 = yes, 0 = no. Variable names in parentheses are the mnemonics used in Boolean equations.

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B.2. Prime implicant chart for outcome (project success)

		Terms to cover (O = 1, project successful)							
		Primitive expressions							
		abcdEF	*abcDEF*	*AbCdEF*	*AbCDEF*	*AbcdEF*	*aBCdEF*	*aBCDEF*	*aBcdEF*
Prime implicants	abc	x	x						
	ACE			x	x				
	Ad			x		x			
	BCF						x	x	
	Bd						x		x
	cd	x				x			x

Reduced equation: O = abc + ACE + BCF + cd

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4

MANAGEMENT CONTROL AND AMBIDEXTERITY: HOW NOKIA'S AMBIDEXTROUS CAPABILITIES WERE LOST

ABSTRACT

Studies show that sustained competitiveness relies on exploring new markets and products while exploiting established business models for efficiency. The ability to pursue both exploration and exploitation is also referred to as ambidexterity. This paper analyzes exploration and exploitation at Nokia Corporation over a period of roughly 20 years. During this time, Nokia moved from a challenger position to a market leader, and eventually found itself outpaced by competitors bringing new, innovative products to the market. The results demonstrate challenges with structurally aligning separate units that focus on exploration while also demonstrating how a balance of formal and informal management control can act to create a supportive organizational context for ambidexterity.

Keywords:

ambidexterity; exploration; exploitation; management control

INTRODUCTION

"You need to work with your heart and your brain at the same time."

- Interview #18

In his pioneering work on organizational learning, March (1991) encapsulates striving for the new and unknown as exploration and reaping the benefits of the existing as exploitation. The simultaneous pursuit of both exploration and exploitation has been proposed as means to secure the long-term success of the firm, and the term ambidextrous has been used to denote firms capable of both exploration and exploitation (O'Reilly & Tushman, 2013; Tushman & O'Reilly, 1996).

Practical means to achieve ambidexterity include organizational and domain separation (Lavie, Stettner & Tushman, 2010). These imply a focus on exploration and exploitation in different units or in different domains. In practice, this can refer to separate R&D units, or a focus on exploration or exploitation through partnerships and alliances (Kauppila, 2010). Rather than a structural focus on organizational set-ups, contextual ambidexterity suggests that ambidexterity is achieved within the same business unit (Gibson & Birkinshaw, 2004). In this view, an organizational context that enables individuals to alter between exploration and exploitation is of vital importance. Fundamentally, ambidexterity refers to an ability to resolve tensions on multiple levels in the organization (Nosella, Cantarello, & Filippini, 2012; O'Reilly & Tushman, 2013). Top management strives to relieve structural tensions between units, and individuals divide their time between exploiting existing competences and exploring new venues.

Although there is an abundance of research on ambidexterity, there are a few specific areas that remain under-researched. Contrary to March's original ideas, the relationship between individual learning and mutual learning in the larger organization has been overlooked in a lot of research on exploration and exploitation (Burton & O'Reilly, 2021; Wilden, Hohberger, Devinney, & Lavie, 2018). In practice, more focus on the interaction between individuals and the larger organization is needed. Along this line, this paper will examine structural forms of separation as well as contextual ambidexterity. In their seminal article, Tushman and O'Reilly (1996: 24) refer to "contradictory structures, processes, and cultures" to enable ambidexterity. However, subsequent research has, to a degree, blurred the lines between these constructs, particularly relating to culture as an enabler for ambidexterity (Burton & O'Reilly, 2021; Uotila, Maula, Keil, & Zahra, 2009). A common view is that "mechanistic" structures, that is, formal procedures and bureaucracy support exploitation, while "organic" structures characterized by less authority support exploration. Yet there seems to be little research that empirically corroborates this notion, particularly focusing on ambidexterity as a capability rather than an outcome (Burton & O'Reilly, 2021; Jansen, van den Bosch, & Volberda, 2006). Burton and O'Reilly (2021) have investigated mechanistic and organic structures as antecedents to exploration and exploitation in an engineering project context, noting that mechanistic structures can indeed inhibit exploration. Rather than looking at a temporary project organization, this empirical case study moves the unit of analysis to the larger organization, while examining the role of mechanistic and organic structures. These structures are operationalized as management control, defined as the mechanisms through which organizational resources, capabilities,

and actions are aligned with its goals (Kirsch, 1996; Malmi & Brown, 2008; Ouchi, 1979). This paper specifically focuses on the interaction between formal and informal control, that is, bureaucratic control through procedures and rules and clan control epitomized in a culture (Ouchi, 1979).

This paper makes two contributions. First, in line with previous research, the analysis demonstrates the difficulties with structural and strategic alignment (Chandrasekaran, Linderman, & Schroeder, 2012; Gibson & Birkinshaw, 2004; Lavie et al., 2010; Levinthal & March, 1993; O'Reilly & Tushman, 2013; Smith & Tushman, 2005). In this paper, structural alignment refers to the successful integration of exploration and exploitation conducted in different units, whereas strategic alignment is defined as the ability to identify exploratory activities that can be exploited. Second, and more importantly, this paper also suggests a balance of management control, defined a as the "harmonious use of multiple forms of control" (Cardinal, Sitkin, & Long, 2004: 412), as a key enabler for the ambidextrous organization.

THEORETICAL BACKGROUND

Organizational ambidexterity

The roots of organizational ambidexterity lie in organizational learning and the concepts of exploration and exploitation (O'Reilly and Tushman, 2013). March (1991) characterizes exploration as risk taking, experimentation, search, innovation, and flexibility, while exploitation works to ensure focus, efficiency, and implementation. Subsequently, this definition has been refined to denote the firm's capability to leverage existing technologies

and skills, that is, exploit, versus the capability to build a new knowledge base, that is,

explore (Lavie et al., 2010; Levinthal & March, 1993). Innovation in relation to exploration

has also been reframed, distinguishing between the further development of existing

technologies and the development of entirely new technology, that is, exploitative

innovation versus exploratory innovation (Benner & Tushman, 2002).

March (1991) posits that there is an inherent contradiction between exploration and

exploitation, due to scarcity of resources and the self-reinforcing components of each that

impedes the other. Simply put, exploratory activities are uncertain and distant and thus

prohibiting efficiency right now. At the same time, superior performance is often attributed

to a balance of exploration and exploitation (Gibson & Birkinshaw, 2004; March, 1991;

O'Reilly & Tushman, 2013; Tushman and O'Reilly, 1996). However, performance benefits

are dependent on context, with the need to balance exploration and exploitation more

pronounced in environments with high technology dynamism (Junni, Sarala, Taras, &

Tarba, 2013; Uotila et al., 2009).

Successful exploitation can be defined in straightforward terms: it enables efficiency right

now. However, the notion of successful exploration is multi-faceted. Lavie et al. (2010)

note that exploration creates opportunities that can be exploited. At the same time, superior

performance must rely on new knowledge being used for effect. Put differently, successful

exploration must evolve into exploitation so that new competences and skills are used

effectively. Indeed, previous research notes that exploration without subsequent

exploitation can lead to a "failure trap" (Chandrasekaran et al., 2012; Levinthal & March,

1993). In this scenario, new competences are actively pursued but they are not sustaining or

increasing performance. As such, specific mechanisms are needed to ensure that exploration evolves into exploitation.

Organizational ambidexterity has been defined as the ability to compete in mature markets, while at the same time developing new products and services through exploratory innovation (Tushman & O'Reilly, 1996). This capacity for simultaneous exploration and exploitation can be enabled through organizational or domain separation, with specific units or alliances focusing on exploration or exploitation, respectively (Kauppila, 2010; Lavie et al., 2010). While a straightforward set-up, there are specific complexities associated with coordinating and aligning separate units and managing the inherent contradictions arising from a disparate focus (Lavie et al., 2010; O'Reilly & Tushman, 2013; Smith & Tushman, 2005). In practice, structural alignment between different entities becomes a top management imperative, ensuring that the "failure trap" is avoided. Rather than a focus on dual structures, contextual ambidexterity relies on an organizational context that supports an individual's ability to judge how to divide his or her time between exploration and exploitation (Gibson & Birkinshaw, 2004). Although this shifts the focus from an organizational level to the individual, the role of senior management should not be underestimated. In practice, senior management still provides legitimacy and resources to exploit new competences (Maclean, Harvey, Golant, & Sillince, 2021). This ensures strategic alignment and coherence, so that the new competences support the strategic direction of the company (Gibson & Birkinshaw, 2004; O'Reilly & Tushman, 2013). At the same time, Lavie et al. (2010) put forward that despite an apparent lack of structural separation, contextual ambidexterity contains organizational shifts of focus on a "micro-

level". In a similar vein, Kauppila (2010) argues that companies are likely to create ambidexterity through multiple forms of separation combined with a supportive organizational context. O'Reilly and Tushman (2013), in turn, put forward several examples of firm alternating between modes of ambidexterity. This would imply that structural separation or contextual ambidexterity alone are insufficient, and that both are needed for simultaneous exploration and exploitation.

Previous research into the antecedents of contextual ambidexterity work with constructs such as discipline, stretch, support, and trust (Gibson & Birkinshaw, 2004), a culture that supports diversity and a shared vision (Wang & Rafiq, 2014), as well as individual knowledge structures (Martin, Keller, & Fortwengel, 2019). Discipline and stretch refer to how performance is managed so that organizational goals are met while ambitious goals are set, whereas support and trust refer to a social context where people work together towards these goals. Diversity and a shared vision stress values that encourage different viewpoints in achieving commonly agreed goals for the organization. Individual knowledge structures, in turn, imply that individuals are aware of the conflicting demands of efficiency and renewal, and that they are empowered to manage the conflicts that arise between these goals. In other words, previous research stresses top-down direction, empowerment, as well as bottom-up perspectives as antecedents of contextual ambidexterity. Adler, Goldoftas, & Levine (1999:64) refer to the contextually ambidextrous organization as an "enabling bureaucracy". This paper uses management control to operationalize the constructs outlined in this paragraph.

Management control

Malmi and Brown (2008) note that there are several different definitions of control and stress the importance of being explicit with the definition in any given study. In line with their view, this paper defines control as a managerial effort to direct employee behavior. Without control, a coordinated and cooperative effort to achieve organizational goals would be impossible. While this definition could imply solely at a rule-based system, control is not necessarily an explicit, mechanistic process or code of conduct. It takes place in a social system and can also assume tacit and subtler forms (Lebas & Weigenstein, 1986; Malmi & Brown, 2008). This is an important distinction as the notion of control then captures both cultural, implicit forms of control, as well as explicit forms of control such as processes or rules. This also rules out influential frameworks such as Simons' (1994) 'levers of control', which focuses on formal routines and procedures. A suitable framework that captures both formal and informal aspects of control is by Ouchi (1979).

In his seminal work, Ouchi divides control modes to bureaucratic and clan control, exercised via specific mechanisms such as rules or values. In other words, specific control mechanisms result in a mode of control that ensures goal congruence in the organization. The rule based, bureaucratic mode of control distinguishes between how rules are enforced: are the activities of individuals monitored, or is the outcome of these activities measured? As such, the bureaucratic mode of control can be divided to two categories: behavior control that seeks to influence an individual's actions, and outcome control that measures performance (Ouchi, 1979). Examples of the control mechanisms that result in behavior control include rules, process descriptions, and incentives, whereas outcome control can be

established through, for example, performance criteria and performance measurement (Kirsch, 1996). Clan control, in turn, implies that individuals are socialized to a common set of beliefs, complementing the explicit surveillance characterized by behavior and outcome control. In practice, this is exemplified in the rituals, stories, and ceremonies of the organization that result in a particular set of values, beliefs, and traditions (Ouchi, 1979). These, in turn, form the organization's culture. Another way to look at control is to consider whether there are explicit or implicit codes of conduct. This is captured by the idea of formal and informal modes of control (Kirsch, 1996). Formal control implies at mechanisms that are documented, while the unwritten rules, values, and shared norms within an organization represent informal control.

An important distinction between forms of control is the presence of surveillance; a bureaucratic mode requires that performance is monitored (Eisenhardt, 1985; Kirsch, 1996; Ouchi, 1979). In other words, are rules observed, budgets adhered to, and processes followed? If surveillance is impractical or unnecessary, clan control can act to regulate behavior. In effect, this epitomizes trust in the subordinate to adhere to the firm's objectives without direct supervision (Ouchi, 1979). In effect, surveillance can act to suppress informal control as people's attention shift to being compliant with the controls in place, rather than independently judging where to focus. Previous studies also show that informal control can encourage experimentation (Ouchi, 1979; Richtner & Åhlström, 2010). Simply put, without explicit performance measurement there is more freedom to pursue new paths of knowledge generation.

Figure 1 provides a summary and synthesis of the control modes outlined and used in this

paper. It includes specific examples of control mechanisms that result in behavior,

outcome, or clan control, grouped as either formal or informal control.

Insert Figure 1 here about here.

Ultimately, top management plays a big role in the implementation of both formal and

informal control. Management determines the processes and rules of the organization that

are typically designed to improve speed and efficiency. At the same time, management can

also influence the organization's culture through, for example, careful selection of its

members, socialization, and training to promote desired values (Eisenhardt, 1985; Kirsch,

1996; Ouchi, 1979).

RESEARCH SETTING AND METHOD

The Nokia Corporation underwent dramatic changes during a period of roughly 20 years.

From the brink of bankruptcy, Nokia grew to become the market leader in mobile phones.

However, competitors bringing new, innovative products to the market led to the eventual

decline of the business. The starting point was to gain a better understanding of the events

that unfolded during a period from 1992 to 2013. Nokia as a case company was selected for

its interesting nature; the rise to fame and decline to obscurity was particularly fast. There

are few other examples of such a dominant market leader being dethroned as quickly as

Nokia.

Today, the Nokia Corporation focuses mainly on network equipment for service providers. However, the focus in this paper is on a time period when mobile devices accounted for most of Nokia's business. Previous studies focusing on Nokia have largely looked at a period from 2003 to 2013 when Nokia started to lose and ultimately lost its market dominance in mobile phones (Lamberg, Lubinaitė, Ojala, & Tikkanen, 2019; Vuori & Huy, 2016). Given that ambidexterity and firm performance are related to each other, Nokia's period of rapid growth is also of interest. Therefore, the starting point is in the early nineties, characterized by Nokia's rapid growth and expansion to market leadership.

Data Collection

Data was gathered through both primary and secondary sources. The primary source of data is a collection of 32 interviews; 28 were conducted with current and former Nokia employees, and four with consultants and representatives of supply-side companies (see Appendix A). Sampling was purposive, people were selected based on whether they could provide interesting information on the turn of events. The interviews were semi-structured in nature, formed around themes such as innovation, management, and leadership. The respondents were asked to reflect on their career and note how things had changed over time. All interviews were recorded and transcribed for analysis. The secondary sources include books about Nokia's history, academic papers covering Nokia, annual reports, product reviews, as well as articles in popular press.

Data Analysis

The data analysis was partly inductive and partly deductive (Graebner, Martin, & Roundy, 2012). Open coding was the starting point (Corbin & Strauss, 2008), essentially looking for interesting clues about how things had evolved at Nokia over time. Next, a practice similar to constant comparison in grounded theory was used to find similarities among the coded excerpts (Corbin & Strass, 2008), while also discarding many segments of text. At this stage, the analysis included categories such as 'atmosphere and culture', 'structures and processes', and 'change and changing' as well as factors that inhibit or promote innovation. The latter included categories such as 'role of management', 'empowerment', 'risk taking' and 'vision'. A picture emerged where many respondents described the nineties in very different terms compared to later events. This prompted a chronological list of events to examine changes over time; Nokia's financial performance was examined from the early nineties to 2013 (see Appendix B). At this stage in the iterative analysis, a closer examination of prior research was warranted. Literature on exploration, exploitation, and the ambidextrous organization reflected many of the categories coded thus far, but a concept to capture changes in leadership and management was also needed: management control. This led to a refinement of the coding to reflect the concepts outlined in literature. In the final stage of the interview analysis, the focus was exclusively on two central topics: examples of exploration and exploitation, as well as different modes of management control as defined in this paper.

A particular concern was the risk of post-rationalization. After all, events at Nokia had been tumultuous. At this stage, secondary sources were examined to understand Nokia's history

in more detail. These included several books about Nokia (Cord, 2014; Doz & Wilson, 2018; Nykänen & Salminen, 2014; Ollila & Saukkomaa, 2016; Siilasmaa and Fredman, 2019), as well as papers by Vuori and Huy (2016) and Lamberg et al. (2019). The secondary sources provided a rich account of events, particularly relating to how exploration and exploitation manifested itself at Nokia over time. This corroborated findings in the interviews. After this, specific events that marked a gradual shift of focus were identified: the so-called "logistics crisis" in 1996, market leadership in 1998, the N95 smartphone in 2006, and new competitors from 2008 onwards. This led to an examination of the timeline with three phases in mind: the time before and during the logistics crisis, market leadership from 1998 onwards, and reactions to new competitors on the market from 2008 until the mobile phone division was divested in 2013. Consequently, the interview coding was updated to reflect these phases.

In the next section, the results of the analysis are presented. The evolution of exploration and exploitation is described based on secondary sources. Although examples of exploration and exploitation were portrayed also in the interviews, the secondary sources provide a richer account of events. After this, we look at how management control changed over time. This analysis is based on primary data, that is, the interviews.

RESULTS

Looking at Nokia's history from 1992 to 2013, this paper discusses three distinct phases where exploration or exploitation was implicitly emphasized, or where they co-existed. Each phase culminated in important events in the history of the company: the logistics crisis of 1996, product and market leadership in 2007, and decisions in 2013 leading to the

mobile phone division being divested. At its peak in 2007, Nokia employed more than 100

000 employees and demonstrated very good profitability, whereas the competing disruptive

innovations that gained ground from 2008 onwards led to the decline of the company. Next,

we will examine the three phases in more detail to understand how exploration and

exploitation evolved during the period examined in this paper. In practice, exploration is

often exemplified through radically new products that required new competences. Further,

there is a section to analyze attempts at ambidexterity through organizational and domain

separation.

Phase 1 (1992-1997): Exploration to Satisfy a Growing Market

The first phase, a period between roughly 1992 and 1997, can be characterized as a time of

growth. The focus was on building capabilities to meet an ever-growing market demand for

mobile phones and networks (Ollila & Saukkomaa, 2016). At the same time, the product

portfolio expanded. The so called 'Communicator' was launched in 1996. This was in

many ways the world's first smartphone: it combined a phone with an Internet browser,

email, a calendar, and the ability to send telefaxes (Cord, 2014). While not a big

commercial success, it has nevertheless been described as a success in terms of mindshare

and marketing, giving Nokia a differentiated edge over its competitors (Ollila &

Saukkomaa, 2016).

Meanwhile, there was a lack of a systematic way of working that led to the logistics crisis

the company experienced in late 1995 and early 1996. There was a lack of competence in

supply chain management, leading to an oversupply of certain parts and short supply of

others. Material stockpiled, while mobile phone production ground to a halt. This had a

detrimental effect on profitability (Ollila & Saukkomaa, 2016). Purchasing, manufacturing,

and sales processes were not integrated, and IT solutions for visibility were lacking in

capability (Doz & Wilson, 2018). To fix these problems, new processes and IT systems had

to be developed. In summary, phase one was largely characterized by the pursuit of new

competences, exploration.

Phase 2 (1998-2007): Nokia as an Ambidextrous Organization

By 1998, clear measures had been developed to improve supply chain management and

logistics. A key effort in this respect was the introduction of an Enterprise Resource

Planning (ERP) solution, along with harmonization of related processes. The ERP system

provided real-time visibility to Nokia's global logistics that could now be exploited for

efficiency (Doz & Wilson, 2018). Nokia overtook Motorola as the largest manufacturer of

mobile phones in 1998, and the overall market share rose throughout phase two (see

Appendix B).

The scale of operations gives credence to the ability to exploit: Nokia sold 437 million

mobile phones in 2007, equivalent to around 13 phones per second, while reporting strong

financial performance (Nokia, 2008). But what about the ability to explore? What examples

of risk taking, experimentation, and innovation can be found in the data, and what new

competences were developed as a result of this? The following outlines three examples of

technology developments for mobile phones where Nokia played a key role in bringing

them to market. The list is by no means exhaustive: from 1992 until around 2008, Nokia

evolved to meet the needs of a fast-paced market through numerous exploitative and exploratory innovations. The three technologies below were selected for their ubiquitous nature, they are taken as self-evident features in any modern mobile device. Yet, at the time when they were introduced, they represented a shift away from existing competences.

Converged Devices

Convergence implies at "two separate devices coming together into one" (Cord, 2014: 16). Nokia's aim from the very start was to integrate more devices into one; the first mobile phone with a digital music player was introduced in 2001, and a full-fledged navigation device with Global Position System (GPS) capabilities and maps was introduced in 2006 (Nokia Museum, 2001, 2006). Mobility and convergence were at the core of Nokia's strategy, there was a desire to build one device that could cover a range of functionalities for its user (Cord, 2014). A key development in this respect was Nokia's first camera phone. In 2001, the development of the Nokia 7650 camera phone was a big development effort involving hundreds of people and significant new technology (Doz & Wilson, 2018). In a review of the history of camera phones, the Nokia 7650 has been characterized as "arguably one of the most important phones ever" (Thorn, 2013: 1). In 2006, Nokia surpassed Canon and Nikon as the world's largest manufacturer of digital cameras, albeit including a mobile phone (Cord, 2014).

Smartphones

Essentially, the smartphone is an extension of a converged mobile device. While there are numerous definitions of what constitutes a smartphone, a key feature is the operating system (OS) that allows for expansion and modification of the functionality through

additional applications (Siilasmaa & Fredman, 2019). The Communicator had started a development towards a smartphone OS called Symbian that would later command a significant share of the market. In 2007, Nokia held a 49% share of the smartphone market amidst growing competition (Vuori & Huy, 2016).

Towards the end of the phase two, one product stood out as something no-one had done before. The N95 was both a smartphone and a converged device, and in many ways the culmination of these efforts. For example, it was the first phone that included a GPS combined with maps. An external assessment of the Nokia N95 mobile phone sums up sentiments rather well: "[the N95] will become the new benchmark for anyone" (Techradar, 2007). More than 7 million N95 handsets were sold during the first year, and the phone remained on the market until 2010 (Hill, 2014).

Application and Service Ecosystems

The advent of the Symbian OS meant that users could now customize their device with new applications and other add-ons, such as ringtones. Early on, Nokia had a plan to tap into this opportunity; Club Nokia was launched in 1999 as a marketplace for digital content (Lamberg et al., 2019). Forum Nokia was created in 2001 as a developer community, with access to a software development kit, technical information, and support (Cord, 2014). However, faced with pressure from its biggest operator customers, Nokia decided to shut down Club Nokia in 2004. The operators feared Nokia's dominant market position and did not want competition in a burgeoning services market (Doz & Wilson, 2018; Ollila & Saukkomaa, 2016). This tendency to shy away from exploration and risk taking would grow stronger as we enter phase three.

Phase 3 (2008-2013): Exploitation and Organizational Decline

At the onset of phase three, Nokia was the undisputed market leader in mobile phones, including both feature phones and smartphones. Two years earlier in 2006, the previous CFO, Olli-Pekka Kallasvuo, had become CEO. Perhaps due to his background, Nokia now emphasized efficiency through a low-cost strategy (Lamberg et al., 2019).

From 2008 onwards, the company witnessed a rapid shift in the competitive landscape. Both Apple and Google introduced operating systems that supported capacitive touchscreens. These required only a gentle touch to detect input, unlike previous touchscreens that required a distinct tap of the interface to respond. Further, Apple and Google augmented smartphones with easy access to app-stores. Initially, sales of the competing products were deemed insignificant (Siilasmaa & Fredman, 2019). However, with mounting pressure Nokia eventually released a touchscreen-based phone. Yet rather than exploring new technologies, Nokia adapted Symbian to accommodate touch input using so-called resistive touchscreens. A resistive touchscreen responds to pressure on its surface, which was an easier way to accommodate touch to an OS built for physical buttons (Siilasmaa & Fredman, 2019). The user experience suffered compared to capacitive touchscreen devices on the market. Nokia was also late to the game in terms of application development and distribution, relaunching a renewed app-store in 2009 (Cord, 2014). Again, rather than exploring the features that made the Apple and Google app-stores successful, it would seem Nokia repeated mistakes from earlier iterations. In 2006, Nokia had launched a dedicated app-store for Symbian, but it was plagued by poor user experience (Cord, 2014). This also became the Achilles heel of the renewed app-store

(TechCrunch, 2009). Furthermore, Nokia had failed to address the difficulty of app development on the Symbian platform. Part of the problem was the fragmented nature of the OS: in 2009, Nokia had 57 (!) different versions of Symbian in use (Doz & Wilson, 2018).

Despite new competition with differentiating products and services, a focus on existing competences was prevalent. Exploitation had started to dominate, and the organization faced significant difficulties in responding to changed consumer preferences. This led to the mobile phone division being divested in 2013. However, there were attempts at exploring new competences also in phase three. In the next section, we will look at this in more detail.

Attempts at Organizational and Domain Separation (1998 – 2013)

From the late nineties onwards, Nokia used various forms of separation to attain ambidexterity. In some respects, this was successful. For example, the development of the 7650 camera phone involved numerous technology partners (Doz & Wilson, 2018). Nokia was also adept at leveraging efficiency through suppliers and sub-contractors (Ollila & Saukkomaa, 2016). However, exploration through organizational and domain separation also proved to be difficult, as exemplified below.

Organizational Separation

Contrary to common belief, Nokia recognized shortcomings with Symbian early on (Doz & Wilson, 2018). In 2005, Open Source Software Operations (OSSO) was set up to develop a modern smartphone OS, later to be named Maemo. This was a largely independent group with significant autonomy. Progress was swift and the first touchscreen device was released

that same year (Nokia Museum, 2005). The plan was to develop Maemo in parallel with Symbian and eventually replace it, a plan that never materialized. Internal resistance and fear of cannibalization between competing devices with different operating systems proved to be a big obstacle (Cord, 2014; Doz & Wilson, 2018; Lamberg et al., 2019). In practice, plans for a Maemo smartphone were debunked. After a series of "Internet tablets" without a phone, the Maemo N900 smartphone was launched as late as 2009 (Cord, 2014).

A similar challenge to apply new knowledge can be observed with research and development; Nokia's R&D budget was among the highest in the industry: in 2008 it was almost 6 billion Euros, accounting for 11.4% of sales (Cord, 2014). However, reaping the benefits of these investments proved to be difficult, especially in phase three. Nokia also had a dedicated organization tasked with finding new avenues of business. The Nokia Ventures Organization (NVO) was set-up in 1998 to find a "third leg" for Nokia, in addition to mobile phones and networks. NVO was coupled with a growth fund and a mandate to finance start-ups developing disruptive technologies (Doz & Wilson, 2018). Ultimately, NVO generated no new businesses for Nokia, and it was shut down in 2004.

Domain Separation

Nokia had numerous partners for the development of mobile operating systems. The Symbian OS was a joint venture between Nokia and several of its competitors, starting operations in 1998 (Cord, 2014). In effect, this created challenges with dispersed development of the OS and as a result, Nokia assumed full control over Symbian in 2008 (Doz & Wilson, 2018; Lamberg et al., 2019; Ollila & Saukkomaa, 2016). In 2010, Nokia also decided to partner with Intel for the development of Maemo. In practice, this further

slowed down the development of an alternative to Symbian (Doz & Wilson, 2018; Lamberg et al., 2019; Nykänen & Salminen, 2014). A third partnership for OS development was with Microsoft. In 2011, Windows Mobile became the only OS offered on Nokia's smartphones. This partnership failed to garner sufficient market interest and eventually, Nokia's mobile phone division was sold to Microsoft, later to be shut down completely (Nykänen & Salminen, 2014).

The above examples of organizational and domain separation highlight examples of key strategic focus areas where Nokia was in unable to exploit competences gained from a separate structural focus on exploration. There are no indications of funding or resources being an issue. Instead, the integration and alignment of a disparate focus was very challenging. In the next section, we return to the interview data to examine how management control manifested itself throughout all three phases.

Changes in Management Control

Many of the interviewees who had worked at Nokia during phase one in the nineties describe a time of hectic chaos. They worked in newly established teams with likeminded people of the same age, many quite recently graduated. The teams focused on creating new things. Working long hours was common, but not perceived as a nuisance. This period is reflected upon with a certain degree of nostalgia: it was a period of fun and passion for one's work. Examining phase one with different types of control in mind, a high reliance on decision-making on individual level and in smaller groups was identified. The overall focus was clear, but there were few rules:

When I joined the company in 93, we grew exponentially at an overwhelming pace, so

we didn't have any proper processes back then. The processes were built based on

one's own sense regarding what to do, how this is linked to a bigger picture, and on

what the necessary pre-conditions are at each stage. The whole thing was a kind of

chaos. However, in the end, things went pretty much according to schedule, at least as

far as our team of people is concerned. Perhaps there was some luck involved as well.

(Interview #17)

There weren't really that many rules, perhaps with the exception of financial decisions,

money. There we had some limits. (Interview #1)

Categorizing this period of time in terms of control, decision-making was decentralized and

reliant on the problem-solving ability of individuals in smaller teams, reminiscent of clan

control (see Figure 1). People were trusted to do their best. The overall atmosphere

promoted a sense of urgency and people were expected to work hard at solving the

problems at hand. The logistics crisis in 1996 can also be considered in terms of control, or

more precisely, lack of formal control. There were few processes and rules to secure

smooth operations. However, logistics capabilities would have required structure and

variance-decreasing activities to manage extreme growth. In this sense, a lack of formal

control was misplaced.

In phase two, new processes and standardized ways of working were in place. However, the

presence of strong accountability and fun continued; strong clan control lasted:

[Talking about a product that was released in 1999.] There was a lot of enthusiasm around the creation of new things, and at least I got the feeling that there wasn't a whole lot of like… like kind of boundaries, and still the guys were genuinely accountable for their own doings. There wasn't anyone, any steering in some headquarters or somewhere else. Instead, the guys themselves took responsibility for their doings. And there was no project or program that [led to people saying], well, this is how it happened to turn out – but instead, look at what I did! […] While there were tight deadlines and other challenges, there was an entrepreneurial spirit. (Interview #23)

While clan control still played an important role, the organization had also put in place clearly documented processes that acted to strengthen behavior control:

[Describing decisions made in the aftermath of the logistics crisis in 1996.] At the time, a decision was made to implement a common financial system, joint HR, joint everything. And not just [IT] systems, but specifically joint processes. (Interview #3)

In addition, outcome control was emphasized. This can be seen in, for example, development activities where clear measures were put in place to monitor costs and timelines of projects:

[Recollection by a person that started working for the company in 1998.] During the first years in various research projects, we had quite a lot of freedom in my opinion, but there were certain restrictions, regarding finances and the time allocated to accomplish something, which was always discussed with the [internal] customer, that

what are we going to focus on, but then we had quite free reins, the operative team and

the project manager. (Interview #13)

Many improvements and positive things were related to phase two, but without the same

nostalgia that was expressed for phase one. While the accounts of phase two still include a

sense of freedom and the passion often found in young people and young companies, there

was also a new-found clarity to how things were supposed to work and how they worked.

The way of working became less chaotic, including fewer ad hoc elements compared to the

nineties. Two contrasting approaches, one based on informal control and the other on

formal control, worked side-by-side without a conscious decision to emphasize one or the

other.

Looking at the third phase, Nokia's logistics and financial control systems were eventually

fine-tuned to perfection, turning the mind-set towards seeking similar efficiency in all

corporate functions. Efficiency became the new norm, to a certain degree replacing the joy

of discovery for discovery's sake – without, for example, financial incentives. Unless

something could be conclusively proven as good business, it had no justification and could

not be taken forward. There was also a very strong reliance on process management, to the

degree that without formally defined processes, decision-making became difficult:

To a large extent, even product development went into a factory mode of operation: we

just keep on replicating these things, the factory is churning, the product development

factory and otherwise. Once that kind of a mode is undertaken, innovations start

disappearing beneath operations, little by little. (Interview #22)

People started saying that we need a process. Structures need to be in place. At that

time, I started thinking, oh dear, we are actually hiding behind these. We can't do

anything if there's no process or a process isn't followed. (Interview #7)

The company had entered a phase where formal control in the form of both behavior- and

outcome control gained the upper hand. This was not necessarily a conscious decision nor a

quick shift, but rather the result of a development that had started with the logistics crisis

more than ten years ago. The interviews reveal a shift in the culture and norms of the

organization: things that earlier were the result of personal dedication were now based on

careful consideration by the organization. Goals and shared norms were now manifested in

the ability to create, for example, a business case to illustrate the efficiency of an

undertaking:

You cannot get any funding unless you have a proven business case. (Interview #16)

A business case was used as behavior control. Without a documented benefit, no new

activity can be undertaken. An important point to note is the simultaneous shift in culture.

There was little or no room for personal dreams, aspirations, or groups that had "great

ideas", unless these could be documented as leading to clear business benefits. Efficiency,

logic and deliberation became the new norm; cause and effect were examined through a

lens of formal control:

Then, when the overall atmosphere is deteriorating for one reason or the other, you

still aren't worried about spirits being down, but instead, your attention is focused on

the various consequences of this and the explicit reasons for this. […] We have the

wrong manager in the US, our strategy is wrong, or our brand image is deteriorating. But the organization has huge difficulties in capturing the de facto reasons behind morale deteriorating since it's not in its vocabulary. Then the organization takes corrective actions, like we need to be more visible in the Super Bowl and such, instead of upper management saying that we cannot continue like this at all. (Interview #21)

Rather than assuming responsibility for difficult decisions, the role of the decision-maker was to ensure that decisions were in line with internal norms that had become reliant on mechanisms typical for formal control. This is in stark contrast to the type of decision-making prevalent earlier, where also the unknown was embraced.

Summary

The data analysis shows that Nokia moved from an overemphasis on exploration, to ambidexterity, to an inadvertent focus on exploitation. At the same time, the data indicates that during phase one, the dominant mode of control was informal clan control. The relative absence of processes and documented ways of working led to the introduction of formal behavior and outcome control in phase two. Eventually, these took the upper hand, and the organization moved towards an emphasis on formal control. Table 1 summarizes this development. Examples of the control mechanisms found in the interviews are included, along with important events and financial performance for each phase (see Appendix B). When describing events taking place after the logistics crisis, the interviewee accounts of various formal control mechanisms increase dramatically. The introduction of the N95 smartphone was another key event that marked a shift. After this, the emphasis in the

interviews is almost entirely on formal control. In one of the secondary sources, the development of the N95 is described as one last push; one interviewee explains: "The culture had changed. The way of working had become stiff. When we released the N95 it took a huge push, an enormous effort to push our boundaries and capabilities" (Cord, 2014: 62). To illustrate how management control evolved across phases, Table 1 also includes the number of control mechanisms coded in the interviews.

Insert Table 1 about here.

DISCUSSION

Previous research supports a notion that performance gains from ambidexterity are highest in an environment of high technology dynamism (Junni et al., 2013; Uotila et al., 2009). This is characteristic of the environment Nokia operated in. At the onset of new competition in phase three, the degree of technology dynamism can be considered extreme and the need for ambidexterity acute. However, phase three was characterized by an inability to explore new competences to meet changing market demands, there was an implicit focus on exploitation. In phase two, exploration and exploitation were in balance and Nokia performed well. Looking at phase one, performance was hampered by a lack of exploitation. In practice, competences in supply chain management were lacking, resulting in the logistics crisis. In practice, an overemphasis on either exploration or exploitation was associated with lower financial performance, whereas simultaneous exploration and exploitation in phase two coincided with superior performance (cf. Gibson & Birkinshaw, 2004; March, 1991; O'Reilly & Tushman, 2013; Tushman & O'Reilly, 1996).

Implications for Theory and Practice

At the onset of the paper, we set out to understand the importance of structural and strategic alignment, as well as how management control can build an organizational context supportive of ambidexterity.

First, organizational ambidexterity is likely to be achieved with a combination of a supportive organizational context and different forms of separation (Kauppila, 2010; O'Reilly & Tushman, 2013). This was the case also at Nokia. At the same time, structurally aligning exploration through organizational and domain separation was difficult (cf. Lavie et al., 2010; O'Reilly & Tushman, 2013; Smith & Tushman, 2005). For example, Nokia's attempts at partnerships for smartphone OS development failed. This was also the case with the internal Maemo effort. Similarly, integrating results from R&D and the NVO organization proved to be difficult. In essence, these exploratory efforts did not materialize into exploitation. As such, it would seem contextual ambidexterity played a big part of Nokia's success during phase two. However, while an organizational context supported many of the exploratory innovations outlined in this paper, it is important to note that these were aligned with Nokia's strategic focus on convergence and mobility. That said, it was a combination of strategic alignment, various forms of separation, and a suitable organizational context that encouraged exploration that subsequently evolved into exploitation (cf. Gibson & Birkinshaw, 2004; Maclean et al., 2021; O'Reilly & Tushman, 2013; Wang & Rafiq, 2014).

This brings us to the role of management control in enabling ambidexterity. The primary data examined for this paper shows that management control evolved from a focus on informal control, to a balance of control modes, to an emphasis on formal control in phase three. This coincided with a shifting focus between exploration, ambidexterity, and exploitation. This raises a key question whether there is a causal relationship between how management control is applied and the propensity for ambidexterity.

In their seminal work, Tushman and O'Reilly (1996: 24) conclude that structures and processes are needed to leverage economies of scale and fight chaos. Similarly, previous research on the antecedents of contextual ambidexterity paints a picture of a duality that can be described as discipline versus discretion (Adler et al., 1999; Gibson & Birkinshaw, 2004; Martin et al., 2019; Tushman & O'Reilly, 1996). This is the duality observed at Nokia in phase two. The main contribution of this study is to define this duality in more detail with the help of management control, providing a concrete and actionable way to implement contextual ambidexterity. The case company in this study relied on a balance of formal and informal control for contextual ambidexterity. In practice, this meant that processes and rules were in place and performance was monitored, representing behavior and outcome control. At the same time, there was a degree of freedom for individuals and teams to independently decide on a course of action. This was coupled with a sense of accountability and trust. As such, informal control complemented various formal mechanisms to jointly enable contextual ambidexterity. At the same time, a balance of control is a necessary but not sufficient antecedent of contextual ambidexterity. Senior management has an important role in legitimizing new ideas and providing resources to

exploit these (Gibson & Birkinshaw, 2004; Maclean et al., 2021; O'Reilly & Tushman, 2013). The data examined for this paper shows that many successful innovations during phase two were aligned with Nokia's strategic focus on convergence. In all likelihood, strategic alignment facilitated successful exploration; it provided a frame of reference for the organization. In practice, individuals and teams had a notion of what to focus on. Similarly, top management knew "what to look for". In effect, this underlies senior management's role in recognizing the need for change and developing a strategic focus as an antecedent of contextual ambidexterity.

Enabling Ambidexterity through Management Control

The design of both formal and informal control is a management task, albeit the latter a more demanding concern for leadership. Starting with the obvious, top management must recognize that subtle, implicit mechanisms can govern operations. The following step is to shape the control mechanisms in place. In terms of formal control this is a straightforward task; managers set the rules, decide the boundaries of scope, and monitor performance. For informal control, a more nuanced approach is needed. Previous research stresses selection, socialization, and training as means to influence informal control (Eisenhardt, 1985; Kirsch, 1996; Ouchi, 1979). In practice, management selects who will be a part of the team. Socialization is likely to be a more complex process, whereby the stories and unwritten rules of the organization are disseminated. Lastly, management is also responsible for the training regime in place. More importantly, however, the data implies that the propensity for aspiration, ideas, and creativity was suppressed by the surveillance needed for formal control (cf. Ouchi, 1979; Richtner & Åhlström, 2010). Simply put, processes, business

cases, and measurable results required significant attention at the expense of new ideas. As such, it might be that the easiest way to ensure presence of informal control is to be careful in the design of formal control and not overdo it; management needs to emphasize a facilitating role rather than only a supervising role. Trivial as it sounds, this proved to be difficult in the case company in this study.

How Ambidextrous Capabilities Were Lost

At the onset of phase three, Nokia had the financial resources and competences in place to compete in a changing environment. Initially, Nokia lacked a recognition that the market was changing. However, by 2009 there was a renewed strategic focus and considerable attempts at renewal. The propensity for formal control crippled these efforts. Explicit control mechanisms such as rules, processes, and measurements were heavily enforced. This required surveillance, which led to a shift in the decision-making culture of the company (cf. Eisenhardt, 1985; Kirsch, 1996; Ouchi, 1979; Richtner & Åhlström, 2010). Where enthusiasm and pride in one's own work was once sufficient to justify a certain course of action, a lot of attention was now devoted to being compliant with various forms of behavior and outcome control. This is not to say that the latter would be a bad thing. It was precisely this way of thinking that had helped the company overcome a huge obstacle for growth: the logistics crisis in the mid-nineties. However, resolving the logistics crisis triggered actions that ultimately created an imbalance of control. Formal control became dominant, and control in the form of implicit mechanisms were secondary.

In phase three, the need for renewal had become acute. Attempts at organizational separation and domain separation for ambidexterity were unsuccessful, and a supportive organizational context would have been needed to pursue exploration. However, a too high reliance on formal control prohibited the duality needed to support contextual ambidexterity. In other words, despite a strong market position and ample resources, Nokia was unable to compete effectively from 2008 onwards due to an imbalance of control and missing ambidextrous capabilities.

CONCLUSION

O'Reilly and Tushman (2013: 333) conclude that ultimately, "ambidexterity is about survival". This seems appropriate in the context examined in this paper. Nokia urgently needed ambidextrous capabilities to counter new competition and a changing market but failed at renewal. A stronger focus on informal control alongside formal mechanisms could have enabled contextual ambidexterity and better abilities to compete in a changing environment.

This paper contributes to the discussion on the antecedents of ambidexterity. The findings support a notion that ambidexterity is achieved through various forms of separation coupled with a supportive organizational context. At the same time, this study stresses the importance of contextual ambidexterity and highlights the challenges with managing structurally separate entities for ambidexterity. In summary, this paper underlines the importance of understanding and maintaining a balance of informal and formal control as a key enabler for contextual ambidexterity.

Limitations and Avenues for Further Research

Generalizable conclusions from a single case study are challenging. At the same time, this

paper has provided a rich description of the context so that the arguments put forward in

this paper can be tested, extended, and applied in similar settings. A characteristic of the

environment Nokia operated in was the rather extreme level of dynamism, particularly in

phase three when rapid changes to the environment were prevalent. As such, one venue for

further research is to examine whether the link between management control and contextual

ambidexterity is equally pronounced also in less dynamic environments. Lastly, this study

focused on the manifestation of various mechanisms for management control rather than

how these were enacted. More in-depth empirical studies are needed to better understand

how informal control can be affected.

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APPENDIX A

List of Interviews

#	Time	Title	Started at Nokia[1]	Language[2]
1	06/2011	Executive Vice President	Phase 1 (1992-1998) or earlier	Other
2	07/2011	Director	Phase 1 (1992-1998) or earlier	Other
3	08/2011	Director	Phase 1 (1992-1998) or earlier	Other
4	09/2011	Senior Manager	Phase 2 (1999-2007)	Other
5	09/2011	Executive Vice President	Phase 2 (1999-2007)	Other
6	09/2011	Head of	Phase 2 (1999-2007)	Other
7	09/2011	Director	Phase 2 (1999-2007)	Other
8	09/2011	Senior Specialist	Phase 2 (1999-2007)	English
9	09/2011	Director	Phase 1 (1992-1998) or earlier	Other
10	09/2011	Senior Manager	Phase 1 (1992-1998) or earlier	Other

[1] To maintain anonymity, the exact year when the person started at Nokia is not specified. For supplier representatives, this time indicates when they started co-operation with Nokia.

[2] Indicating whether the interview was conducted in another language than English. Translation to English has been done by the author.

11	11/2011	Senior Manager	Phase 1 (1992-1998) or earlier	Other
12	11/2011	Head of	Phase 1 (1992-1998) or earlier	Other
13	11/2011	Manager	Phase 2 (1999-2007)	Other
14	01/2012	Senior Manager	Phase 2 (1999-2007)	Other
15	01/2012	Director	Phase 2 (1999-2007)	Other
16	02/2012	Manager	Phase 2 (1999-2007)	English
17	03/2012	Senior Manager	Phase 1 (1992-1998) or earlier	Other
18	03/2012	Vice President	Phase 2 (1999-2007)	English
19	03/2012	Senior Vice President	Phase 2 (1999-2007)	English
20	03/2012	Manager	Phase 2 (1999-2007)	Other
21	04/2012	Professor	Phase 1 (1992-1998) or earlier	Other
22	04/2012	Senior Vice President	Phase 2 (1999-2007)	Other
23	04/2012	Vice President	Phase 1 (1992-1998) or earlier	Other
24	04/2012	Vice President	Phase 1 (1992-1998) or earlier	Other
25	04/2012	Director	Phase 1 (1992-1998) or earlier	Other
26	10/2012	Senior Manager	Phase 1 (1992-1998) or earlier	Other
27	10/2012	Manager	Phase 1 (1992-1998) or earlier	Other
28	11/2012	Head of	Phase 1 (1992-1998) or earlier	Other
29	11/2012	Head of	Phase 1 (1992-1998) or earlier	English
30	11/2012	Head of	Phase 1 (1992-1998) or earlier	English
31	11/2012	Head of	Phase 1 (1992-1998) or earlier	English
32	11/2012	Head of	Phase 1 (1992-1998) or earlier	English

APPENDIX B

Financial Performance Obtained from Annual Reports

Year	Net Sales (M€)	Operating Profit (M€)	Profit to Net Sales (%)	Growth in Net Sales (Y-o-Y)	Market Share in Mobile Phones[3]	Notes
1993	3986	246	6 %	-	18 %	Reported in FIM (1€ = 5,9457 FIM)
1994	5075	605	12 %	27 %	20 %	
1995	6191	843	14 %	22 %	24 %	
1996	6613	711	11 %	7 %	22 %	Logistics crisis.
1997	8849	1422	16 %	34 %	20 %	Reported in FIM.
1998	13326	2489	19 %	51 %	24 %	Start of "phase 2".
1999	19772	3908	20 %	48 %	29 %	Reported in €
2000	30376	5776	19 %	54 %	32 %	
2001	31191	3362	11 %	3 %	34 %	
2002	30161	4780	16 %	-3 %	38 %	
2003	29533	5011	17 %	-2 %	38 %	
2004	29371	4326	15 %	-1 %	32 %	
2005	34191	4639	14 %	16 %	33 %	
2006	41121	5488	13 %	20 %	41 %	
2007	51058	7985	16 %	24 %	38 %	Networks division merged with Siemens.
2008	50710	4966	10 %	-1 %	38 %	Start of "phase 3".
2009	40984	1197	3 %	-19 %	36 %	
2010	42446	2070	5 %	4 %	28 %	
2011	38659	-1073	-3 %	-9 %	24 %	
2012	30176	-2303	-8 %	-22 %	19 %	
2013	12709	519	4 %	-58 %	13 %	Excluding mobile phone division.

[3] Including both feature phones and smartphones. Data obtained from Ollila and Saukkomaa (2016) and Nykänen and Salminen (2014).

FIGURE 1

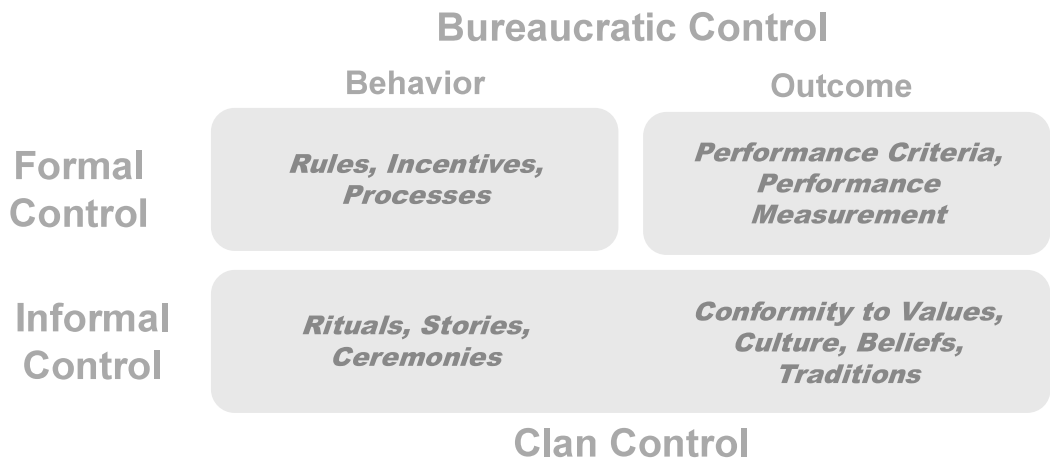**A Classification of Control Modes and Examples of Control Mechanisms**

Bureaucratic Control

	Behavior	Outcome
Formal Control	Rules, Incentives, Processes	Performance Criteria, Performance Measurement
Informal Control	Rituals, Stories, Ceremonies	Conformity to Values, Culture, Beliefs, Traditions

Clan Control

TABLE 1

A summary of the three phases

	Phase 1	Phase 2	Phase 3
Time	1992 -1997	1998 -2007	2008-2013
Exploration Exploitation	Exploration	Ambidexterity	Exploitation
Dominant Control Mode(s)	Clan	Clan, Behavior, Outcome	Behavior, Outcome
Formal Control Mechanisms in the Interviews (examples)	Vision (statements), Spending Limits	Checklists, Process Specifications, Follow-Up Practices, "Fact-Based Management", Committees (with formal decision making authority), Strategy Documents, Business Cases, Project Methodologies, Milestone Criteria	Very Tight Financial Control & Budgets
Informal Control Mechanisms in the Interviews (examples)	Intuition, Values, Culture, Accountability	Passion, Interests, Flat Organization, Self-steering, Trust	Public Recognition
Formal control in the interviews (# of interviewees / # of examples)	1 / 2	14 / 36	20 / 55
Informal control in the interviews (# of interviewees / # of examples)	10 / 21	14 / 26	5 / 5
Important Events	1996: Logistics Crisis	1998: Market Leadership 2006: N95 Smartphone	2008: Competition from Apple and Google 2013: Mobile Phones Divested
Change in Net Sales (Y-o-Y)	+22%	+21%	-18%
Average Operating Profit / Net Sales	12%	16%	2%
Market Share (Final Year)	20%	38%	13%