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Tine Petersen Malonæs • Creating room for innovation

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Creating room for innovation

A business history study of innovation in the Kongsberg Group, 2000 - 2015

Tine Petersen Malonæs

Creating room for innovation

**A business history study of innovation in
the Kongsberg Group, 2000 - 2015**

by
Tine Petersen Malonæs

A dissertation submitted to BI Norwegian Business School
for the degree of PhD

PhD specialisation: Innovation and Entrepreneurship

Tine Petersen Malonæs

Creating room for innovation: A business history study of innovation in the
Kongsberg Group, 2000 - 2015

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I dedicate this thesis to the memory of Ulf Harry, Gerd Reidun, Klara Henriette and Jørgen.

The engineer, salesclerk, accountant, and gardener that came from different parts of Norway and Denmark to establish new lives for themselves in Oslo after the Second World War.

Their devotion to life and work will never cease to inspire me.

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I have been employed at two different departments at BI during my doctoral studies, the former Department of Innovation and Economic organization and the Department of Law and Governance. I have also been part of the NORSI Research school in Innovation and Entrepreneurship. I would like to thank all of my former colleagues in these places for their support, and a special thanks to the management and administration, represented by Kjersti-Anette Ektvedt, Anne-Christine Thestrup, Tore Bråthen, Monica Viken, Morten Kinander, and Katrine Blindheimsvik. A warm thanks goes to Britt-Mari Sletto, for your friendship and consideration, and to Birte Marie Horn-Hanssen, for your cheerful encouragement and organizational skills guiding me through the NORSI program. Among the team of scholars involved in NORSI, I especially want to mention Professor Magnus Gulbrandsen at TIK, UiO, for constructive and valuable advice at the kappa seminar in the autumn of 2021.

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Tine Petersen Malonæs

Hamar, 6.1.2023

Abstract

The purpose of this thesis is to explore processes leading to a historical innovation breakthrough in the Kongsberg Group after 2000. To do this, I study the interaction between the company and the market, looking at how internal organizational processes are handled to correspond with shifting external market situations. The focus on organizational processes to explain innovative change is driven by the combination of three factors. First, the results from previous empirical research on the Kongsberg Group. Second, by the directions from international research on innovation in CoPS industries, and third, by recent calls to concentrate more on the underlying microfoundational processes of larger macro-level phenomena. By means of historical methodology, I apply an in-depth, longitudinal perspective, concentrating on three specific product cases from different parts (subsidiaries) of the corporation, each constituting the empirical foundation for a paper.

The first paper investigates how the Kongsberg Group and its defense company, Kongsberg Defence & Aerospace (KDA), built strategic alliances with US defense companies Hughes and Raytheon from the late-1980s until 2015 to enable the sale of the Norwegian air defense system, Nasams. In the second paper, I examine how a new concept for a remote weapon station (RWS) initially invented elsewhere was adopted by the Kongsberg Group's mechanical division, Kongsberg Protech, in the early 2000s, and how this new product area grew within the corporation until the Kongsberg Group had become a world-leading supplier of RWS' to armed vehicles. In the third paper I explore a process of strategic renewal in Kongsberg Maritime in the early 2000s, looking at how the company built a strategic concept from its historical capability in systems integration, and how this contributed to unite the organization and increase its competitiveness as a maritime automation systems supplier.

The thesis finds that during the early 2000s, the Kongsberg Group managed to create new 'rooms for innovation' within its subsidiaries. These new rooms became crucial arenas for innovation because they represented spaces where creative engineering capabilities could meet specific and ongoing market demands within a new and long-term corporate horizon. In the thesis synthesis, I discuss how these findings are connected to theories on dynamic capabilities, and furthermore, what the findings from the three papers add to our existing knowledge of innovation in CoPS industries.

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1. Introduction

The first decade of the new millennium represented a remarkable change of pace for the Norwegian company the Kongsberg Group. After a number of market breakthroughs, the company doubled its turnover between 2005 and 2010 (see table 1) and increased its level of profitability. This new profitability was significant not only because it represented a change when seen against the prior results of the company, but because it came from sales in some of the world's toughest global markets for high-technology defense and maritime systems, including the US defense market and the Asian shipbuilding market.

The Kongsberg Group produces customized, high-cost, technology-intensive, capital goods, also known as complex product systems (CoPS) (Hobday, 1998; Hobday et al., 2000). Companies involved in the production of CoPS are called system companies, defined as large, multi-technology, multi-business firms that are active in capital intensive, high-technology industries (Bonaccorsi et al., 1996; Hobday et al., 2000). The complexity of CoPS stems from the large number of components they involve, as well as the high level of knowledge and skills needed to produce them (Acha et al., 2004; Hobday et al., 2005). As a system company, the Kongsberg Group builds on the technological legacy of its predecessor, Kongsberg Weapons Factory (KW), a Norwegian weapons producer and industrial conglomerate with roots back to 1814. KW was forced to close down for financial reasons in 1987. Twenty years after this, the Kongsberg Group had managed what KW could not—to become a highly profitable and innovative company.

Previous research has focused on both external and internal factors when looking to explain changes in and around the Kongsberg Group in light of its recent innovation success. These include the emergence of high-tech industrial research and development in Norway after WWII (Sogner, 2007; Wicken, 2009; Øyangen, 2014), the role of the external environment (Isaksen, 2009), the re-establishment of the Kongsberg Group as a partly private high-tech enterprise (Sogner & Petersen, 2014), the importance of customer relations and project organizing for product innovation (Moen, 2011), as well as state policies and corporate governance structures (Sogner, 2021).

While these contributions have provided valuable insights into the historical development of the Kongsberg Group, they cannot fully explain how the corporation suddenly and almost simultaneously across different product areas managed to increase sales of its systems in global markets. One reason for this is that existing research has studied the company mainly

within a regional, national, or international perspective, but without considering the specific nature and complexity that defines the industrial context in which the company operates. The purpose of this thesis is to explore the processes leading to a historical innovation breakthrough in the Kongsberg Group in a way that captures the complexity of the CoPS context. Specifically, the thesis asks: *How did the Kongsberg Group succeed with innovation across different complex product systems in the years after 2000?*

To answer this research question, I concentrate on internal, rather than external, explanations. This does not mean that I do not recognize how external shifts have affected the opportunities of the company in the last twenty years. The defense and maritime industry are both highly sensitive to global changes, especially those driven by geopolitical shifts, financial downturns, or rapid technological developments. In these industries, global shifts can represent either unforeseen opportunities or new challenges for business. The global war on terror emerging in the early years of the new millennium undoubtedly brought new opportunities for the defense industry, and part of the increased income for the Kongsberg Group between 2000 and 2010 must be seen against this backdrop. In the same period, the impact of globalization brought challenges to the maritime industry in terms of global production chains and tough customer demands. However, it is the internal organizational responses to these external challenges and opportunities that I am seeking out in this thesis.

The focus on organizational processes to explain innovative change is driven by the combination of three factors. First, the results from previous empirical research on the Kongsberg Group. Second, by the directions from international research on innovation in CoPS industries, and third, by recent calls to concentrate more on the underlying microfoundational processes of larger macro-level phenomena. I will elaborate on these factors in the section below.

Positioning the thesis

The first factor underlying the positioning of this thesis is previous empirical research on the Kongsberg group. The Kongsberg Group is today a globally operating high-tech company. It is also partly state-owned, and one of the oldest companies in Norway, if we trace the origin back to 1814 (Myrvang, 2014). While it could be argued that KW was an inventive company in terms of applying new technology to develop complex defense and civilian products from the 1960s and into the 1980s, it was not an innovative company in terms of achieving

profitable sales in international markets (Øyangen, 2014). The revival of this industrial area after the financial crisis in 1987 tells a different story (Sogner & Petersen, 2014). The reorganization and restructuring of what used to be KW into the Kongsberg Group and several other companies operating in the oil and gas, automotive, maritime and defense industries after 1987, was followed by an increase in the exports of their products. Since then, some of these companies have not only survived but have become successful operators within global markets (Moen, 2011). This positive change has sparked research with different, but also overlapping, perspectives on the causes of innovative success in the Kongsberg area.

Historical research has focused on how KW together with the Norwegian Defense Research Establishment (NDRE) became an instrument for Norwegian industrial and technology policy after World War II (Njølstad & Wicken, 1997; Wicken, 1994; Øyangen, 2014). The specific focus on research, industry and government in this narrative paved the way for a national innovation system perspective, and this has proved valuable in explaining the emergence of high-tech industrial research and development in Norway in the period following WWII (Wicken, 2009). While this national innovation system helped create a high-technology platform for product development in KW, it failed somewhat in terms of commercial success (Sogner & Petersen, 2014; Øyangen, 2014).

Norwegian geographers have also taken an interest in the Kongsberg area, and different innovation perspectives have been used to investigate the positive development of high technology industry after 1987. A regional innovation system perspective emphasizes the importance of agglomeration of firms for co-locational benefits in terms of spillovers and innovative performance (Asheim & Isaksen, 1997, 2002; Cooke, 2001). This perspective was considered appropriate in understanding the increased innovative performance of the Kongsberg area after 1987 (Isaksen, 1999). After all, the companies making up Kongsberg's industrial base were often high technology firms located together, all successfully exporting technology to international markets. They have also attracted attention as a cluster (Porter, 1998). In 2006, the group of technology firms located in Kongsberg Technology Park received status as a Norwegian Centre of Expertise (NCE) in systems engineering, providing the area with the formal status of a cluster (Isaksen, 2009; Moen, 2011).

While theories on regional innovation systems and clusters have been important for our understanding of the emergence of research-based technological innovations, they cannot explain the complex firm-level processes that must also be in place for such products to reach the market (Kline & Rosenberg, 1986; Mazzucato, 2015, p. 49). This is relevant in the

Kongsberg context. Most of the former KW-firms continued their operations in the technology park in Kongsberg, which meant that they were located in the same area and benefitted from the same resource pool of engineers employed inside the park. Nevertheless, there has been little interaction and spillover between the firms (Austenå, 2011; Isaksen, 1999; Midelfart, 2002; Onsager et al., 2007). They do not compete in the same markets, and they have been more integrated with their international owners, partners, and customers than with each other (Isaksen, 2009; Njøs & Jakobsen, 2016; Sogner & Petersen, 2014). For these reasons, innovation systems perspectives cannot adequately explain the innovative capacity of the Kongsberg Group in the years after 2000.

Sogner and Petersen (2014) cover the recent history of the Kongsberg Group and note the fruitfulness of a new analytical perspective on the Kongsberg area, seeing the Kongsberg Group in a similar way to Silicon Valley in the US. This perspective indicates that while there are similarities in the historical development of the Kongsberg region and Silicon Valley as industrial IT-agglomerations, important differences in national policies and corporate structure lie behind the distinct forms of innovative success that characterize them. According to Sogner (2021), the new style of entrepreneurial state that developed in Norway in the 1990s combined state ownership, stock listing, and procurement considerations, and this proved successful for the continued development of the Kongsberg Group because it managed to protect old and established product lines at the same time as facilitating innovation in the core market segments of the company (Sogner, 2021). These historical contributions recognize the new market orientation of the Kongsberg Group after 1987, but they do not explain how this orientation shaped internal processes in the company.

The second factor underlying how I study the Kongsberg Group in this thesis is insights from the CoPS literature. The Kongsberg Group is a system company, and I believe this is important to emphasize to understand how the company has succeeded with innovation in this specific industrial context. Innovation scholars have emphasized that the complexity in CoPS in terms of product composition, production time, supplier-customer relationships, as well as market characteristics (Hobday, 1998; Hobday et al., 2000; Miller et al., 1995), differentiates CoPS industries from other industries. System companies develop specific organizational capabilities over time to handle this complexity. Especially relevant in this context is the capability to perform systems integration. This capability builds on the companies' existing (technological) knowledge base, defines their boundaries to other companies, and shapes their competitiveness in international markets (Davies & Brady, 2000; Magnusson et al., 2005).

Studying innovation processes in the Kongsberg Group from a CoPS perspective will give a clearer understanding of the Kongsberg Group's role as an international competitor and illuminate how the company used its organizational capabilities—in particular the capability to perform systems integration—to manage the challenges and opportunities related to innovation within this specific context.

Organizational capabilities are a central topic in studies of innovation more generally because they represent the capacity of an organization to do or make something, thereby connecting the intention for, and the outcome of, innovation (A. D. Chandler, 1990; Dosi et al., 2000; Lazonick, 2002). A general challenge with these types of concepts, however, is that it is often unclear how they are related both to the members of the organizations to which they refer, and to the larger macro-level phenomena they are meant to explain (Felin & Foss, 2005).

The third factor influencing how I have approached this study of the Kongsberg Group is my focus on microfoundational processes (Foss & Linder, 2019). The notion of microfoundations emerged as a critical response to how macro-level phenomena, like innovation, were understood and investigated in strategy research. The underlying critique was that we still know too little about the microfoundational processes that drive these larger macro phenomena. The authors behind the microfoundations perspective therefore encouraged researchers to “explain more by digging deeper” (Foss & Linder, 2019, p. 54). To uncover how firms use or change their capabilities, it is necessary to explore the inner mechanisms at work within different parts and levels of an organization. Exploring this link in the Kongsberg Group implies delving deeper into organizational processes than previous research has done. The next section explains how I have approached this task.

Research approach and papers

This thesis is a business history study of innovation in the Kongsberg Group, based on three cases from different parts of the corporation, each constituting the empirical foundation for a paper. These three “embedded cases” were not randomly selected. They were identified among several other product stories of the Kongsberg Group, chosen for their relevance as CoPS cases and their value in terms of sales, and thereby their importance for the innovative capacity of the corporation (Sogner & Petersen, 2014). Taking a longitudinal perspective, I traced each specific product area over time within the period of 1987 to 2017. The three studies are all based on business history methods, including the use of corporate archive

material and oral history interviews, in addition to secondary literature and publicly available reports and documents.

This thesis also takes an in-depth perspective. Concentrating on three specific product cases allowed me to trace developments down to not only the organizational level, but also the project level, encompassing the role of individuals and groups within the organization. Applying a micro perspective means seeing innovation as a result of the strategies and activities of people and organizations, taking into account that innovation is not simply about creating new products or developing new technology, but also about bringing these into organized forms and contexts where they can be sold. The three papers show how this was done in different ways across the subsidiaries of the Kongsberg Group.

The combination of both longitudinal and in-depth focus allowed me to explore how the Kongsberg Group organized and used its resources and capabilities in ways that enabled it to achieve innovation breakthroughs in several product areas over time. Looking deep into three processes in different parts of the corporation, the different cases provide grounds for comparing and discussing characteristics of the Kongsberg Group's innovative capacity from the early 2000s onward.

The findings from each case contribute to answering the general research question of the thesis. Nevertheless, the papers are designed to stand as independent articles addressing different streams of literature analyzing innovation in relation to strategic alliances, dynamic capabilities and sensemaking of the past. These streams of literature are explained and reviewed in the individual papers and will not be repeated in a similar way in this covering essay. However, they are all written within the confines of a research agenda that seeks to combine historical research methods with strategic management theories (Argyres et al., 2020). In doing so, the thesis attempts to show that contextualization through historical research and in-depth studies can play a valuable complementary role to strategy research in terms of understanding how processes of corporate innovation are managed in large firms. The papers are further structured in various ways to address and accommodate the different guidelines of the respective journals where I have sent them for review.

In the first article, "Strategic alliances and tactic maneuvers: The Kongsberg Group's path to innovation in air defense, 1988–2015", I investigate how the Kongsberg Group and its defense company, Kongsberg Defence & Aerospace (KDA), over time built strategic alliances with US defense companies Hughes and Raytheon from the late-1980s until 2015 to enable

the sale of the Norwegian air defense system, Nasams. The paper concentrates on the long-term aspects of innovation in the context of the post-Cold War international defense industry. It addresses the business history literature by discussing the complexity in these types of alliances, showing first how the driving forces shift from government-imposed offset agreements to deeper alliances based on technology sharing and trust, and second how KDA had to maneuver to strengthen its position as a product systems integrator against one of the prime integrators in the industry. The paper further reveals how strategic alliances can lead to innovation in two distinct ways: as a platform for product development, and/or as a platform for international marketing and sales.¹

In the second article, “Creating room for dynamism: A multi-level perspective on dynamic capabilities in Norwegian defense industry, 1997–2017” I investigate how a new concept for a remote weapon station initially invented elsewhere was adopted by the mechanical unit in the Kongsberg Group, Kongsberg Protech, and then given the room to grow within the organization to the extent that the Kongsberg Group became a world-leading supplier of Remote Weapon Station’s (RWS) to armed vehicles. The case illuminates how dynamic capabilities can emerge and operate through the integration of activities from different levels of an organization. Through the longitudinal study of the RWS case, I examine how the opportunity to develop an RWS was sensed at an individual level, seized at the project level and finally implemented at the organizational level to become a future platform for product development. The article aims to contribute to the strategy literature by increasing our understanding of how dynamic capabilities emerge and operate.²

In the third article, “Making sense of the past to compete in the future: Strategic renewal in Kongsberg Maritime, 2002-2012”, I investigate a process of strategic renewal initiated by the management of Kongsberg Maritime. Through this process I explore how a narrative built around the company’s historic systems integration capability was used to strengthen organizational identity through organizational action. This article addresses the combined strategy and business history literature on sensemaking and strategic uses of the past, and contributes to this literature by increasing our understanding of how firms use the past,

¹ This paper has been under peer review in *Business History Review*. It will be sent back in revised form in 2023.

² This paper has been under peer review in *Strategic Management Journal*. It will be revised and sent to a different journal in 2023.

showing what form it can take, how it contributes to innovation and when it becomes obsolete.³

While the three cases in this dissertation contribute to different streams of literature, they all illustrate how the Kongsberg Group in this period used its resources and capabilities to create and seize new opportunities within the context of CoPS industries. Aside from important differences between the maritime and defense industry markets, the empirical findings show interesting similarities across the cases that can help us understand how the Kongsberg Group, as a system company, was able to succeed with innovation in the years after 2000. These similarities are compared, synthesized, and discussed in the thesis's final section.

The dissertation is structured as follows. Chapter two provides a brief historical background of the development from KW to the Kongsberg Group. Chapter three presents the theoretical and analytical perspectives that have informed and inspired the thesis. Chapter four explains the overall research methodology, sources, and analytical process. Chapters five, six and seven comprise the papers. Chapter eight summarizes and elaborates on my findings across the Kongsberg cases before concluding the thesis.

³ This paper will be sent to an international journal in 2023.

2. Historical background: From KW to the Kongsberg Group

KW was established in 1814 as a state-owned company to produce munitions that could support an independent Norwegian army (Myrvang, 2014). From the 1960s to the late 1980s, KW developed from a manufacturing-oriented company to a company driven by research and development, in tight collaboration with national research institutions like the Norwegian Defense Research Establishment (NDRE), the Norwegian Technical University (NTH, later NTNU) and with support from the Norwegian Ministry of Defense as well as the Ministry of Industry (Øyangen, 2014).

This orientation toward research and knowledge intensive production was gradually reflected in the composition of the workforce, with an increasing number of employees having an engineering background. With the increasing focus on engineering-led research and development, the understanding of systems, i.e. the skills and knowledge to perform systems engineering, grew in the organization (Øyangen, 2014). Systems engineering demanded multidisciplinary thinking, was difficult to copy, and had to be built over time. This competence spread from the US to Norway with increasing demands for more complex and intelligent weapon systems from the 1960s.⁴ KW also established its own development department in the late 1950s, which was significantly expanded in the early 1960s in order to be able to handle the production of more complex weapon systems.

From the 1960s to the 1980s, an important part of KW's operations thus involved engaging in big projects, developing new technologies in collaboration with NDRE and establishing new product areas from scratch in Norway. For the defense segment, in more general terms, this involved the development of new missile technology and command and control systems. One example of this type of investment was the long-term development of the Penguin missile. The Penguin was the first western built anti-ship missile applying infrared technology. It was developed by NDRE, tailor-made for Norwegian topography demanded by the Royal Norwegian Army, and since the 1970s produced in several versions by KW, and later by the Kongsberg Group.

⁴ The first example of this was the development of the anti-ship missile system, Terne, from the late 1950s, the first 'intelligent' weapons system developed and produced in Norway. Another example was the NATO-initiated Sea Sparrow missile project in the late 1960s, where engineers from KW collaborated with the American company Raytheon and learned how the American defense industry executed complex system projects.

In the autumn of 1986, what was later known as the “KW-crisis” began to set in when it became publicly known that KW was facing massive losses and was close to bankruptcy. Throughout the 1970s, KW had extended its business to include turboshafts, mainframe computers, industrial electronic equipment, maritime electronics, car components, aircraft engine parts and components for offshore oil production. For a while these new civilian product lines turned KW into one of Norway’s largest exporters (Øyangen, 2014). At the same time, however, the divisional augmentation made the company fragmented and difficult to operate, lacking a clear strategic direction.

Until the 1980s, continued investments from the government had allowed KW to expand its business despite low profitability and rapidly-growing debt. However, in 1986, when a dramatic drop in the oil price hit the subsea division concurrently with a failing turboshaft market, the company’s weak financial situation became apparent. Total debt was expected to reach 2.7 billion NOK by the end of the year, in addition to an expected annual loss of 200 million NOK (Sogner & Petersen, 2014, pp. 28-29). The financial and political repercussions from the KW-crisis led to a speedy replacement of the board and CEO of KW. The new board decided to dismantle the conglomerate by selling off its former subsidiaries and civilian divisions to different owners in Norway and abroad, leaving only the former defense unit under state ownership.

The closing down of KW in 1987 was not only a historic and somber event for the local community in and around Kongsberg; it was a demonstration of the change in Norwegian industrial policy that had been underway since the late 1970s.⁵ From being an active promoter of new technology development and having strategically structured the national industry in the post-war decades, from the 1980s the Norwegian state took on a more passive role as industry owner, leaving it to the market to decide whether a business was viable or not (Sogner, 2003). The shift in policy made it unacceptable for the state to continue the operations of an insolvent company (Lie, 2012). KW’s financial problems in 1987 could therefore not be solved by providing more capital but had to involve restructuring and the sale of businesses (Øyangen, 2014). This clearly reflected that short-term profitability was essential.

⁵ By the end of the 1980s, the four big, state-supported companies—Tandberg, KW, Elektrisk Bureau, and Norsk Data—had either gone bankrupt or been completely reorganized.

The new company, originally called Norwegian Defence Technology, later renamed the Kongsberg Group, showed positive financial results only a year after the reorganization (Sogner & Petersen, 2014). This mirrored the fact that the defense unit was not among the segments that had suffered the largest losses in KW. It also reflected the changes introduced by new CEO Jan T. Jørgensen to ensure the company performed better than KW had. The new regime was characterized by an increased focus on financial control, decentralization of responsibility and a stronger orientation toward market needs. Under Jørgensen, the company began to prepare detailed 5-year strategic plans, where the different divisions, and later subsidiaries, had to develop clear paths for selected product segments. In these processes, the divisions were forced to choose some product segments over others, and the guidelines were decided by the future market outlook regarding both potential national and international customers. The idea was that by steering away from large and unfocused development projects, the company's operations would be more focused and stringent, with better financial results.⁶

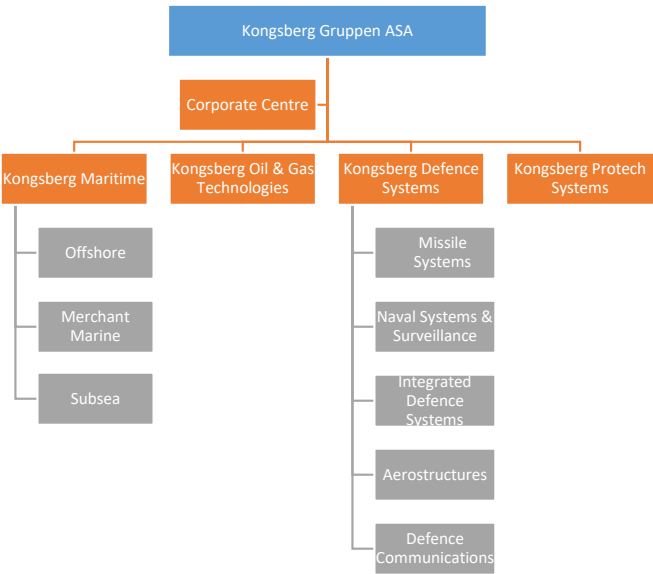
While the premises for the continuation of the defense unit in 1987 had been to protect and continue the production of important military technology rather than engaging in civilian projects, the end of the Cold War in the early 1990s altered this scenario. In the new situation, the outlook for future defense purchases diminished, and the company had to prepare for a less predictable customer relationship with the Ministry of Defense (Sogner & Petersen, 2014).

In this situation, the Kongsberg Group began to reorient toward new civilian segments, mainly in the maritime IT industry. In 1992, the company purchased the Norwegian maritime IT supplier Norcontrol, as the first step in a strategy to diversify its market opportunities. This strategy was also a necessary step in a plan to prepare the company for listing on the Oslo Stock Exchange, a mission that was accomplished in 1993, following a reduction in the state's ownership to 51 percent (Sogner & Petersen, 2014). The new and partly private ownership structure from the mid-1990s provided the Kongsberg Group with more financial space, and at the same time, sharpened the demand for short-term earnings. This had a disciplinary effect on the structure and operations of the Norwegian company and became an instrument to ensure industrial profitability and long-term considerations.

⁶ Kongsberg Group "Strategic plan 1994–1999".

In the following years, the Kongsberg Group pursued an even more offensive acquisition strategy and through the purchase of maritime companies Simrad in 1996/1997 and Navia in 2000, emerged as a large electronics supplier to the global maritime industry (Sogner & Petersen, 2014). The new purchases made the maritime segment the largest part of the company, which resulted in a division into the two subsidiaries Kongsberg Defence and Aerospace (KDA) and Kongsberg Maritime. This allowed for greater independence, responsibility, and financial control for the different units. It was also a signal that the Kongsberg Group had chosen to concentrate on specific niche products within these two segments.

Figure 2.1 Organizational chart with corporate structure, subsidiaries and divisions, 2010.



Source: Information obtained from company reports/website.

The implication of the strategic and organizational processes described here was that the room for strategic maneuver in the Kongsberg Group became very different from the situation under KW. During the KW-regime, the scope for strategic action and decision-making had lain between the corporate management and politicians. Under Jørgensen, this room to maneuver was moved down to the subsidiaries, followed by the necessary financial responsibility. The decade under Jørgensen's managerial regime thus involved important changes to the structure, administration, and market orientation of the Kongsberg Group (Sogner & Petersen, 2014).

The new measures that were introduced during the 1990s had a positive effect on the financial development of the Kongsberg Group. The company performed well, and this was reflected in the share price, which in the period between 1996 and 2002 outperformed the Oslo Stock exchange by 11.4 percent (Pareto Securities, 2003). However, unlike KW, which had diversified its business by developing new technologies and products, the Kongsberg Group's profitability in this period came for the most part from its new maritime acquisitions or from contracts based on existing product areas. There were few new product developments within the Kongsberg Group during the 1990s, and international market breakthroughs were not significant in terms of revenue (Sogner, 1997; Sogner & Petersen, 2014).

In 1999, Jørgensen resigned from his position to take on new challenges abroad, and the board introduced Jan Erik Korssjøen as new CEO of the Kongsberg Group. Korssjøen came from his role as head of Kongsberg Maritime; and was given a different mandate as CEO from the start. Whereas Jørgensen had been occupied with tidying-up operations, in a tough and uncompromising, yet reserved style, Korssjøen's task as an outgoing, internationally experienced salesman was oriented toward expanding the Kongsberg Group's operations worldwide. This panned out satisfactorily. Over the next ten years, the Kongsberg Group more than doubled its revenue and achieved global market breakthroughs in existing as well as new product areas (Sogner & Petersen, 2014).

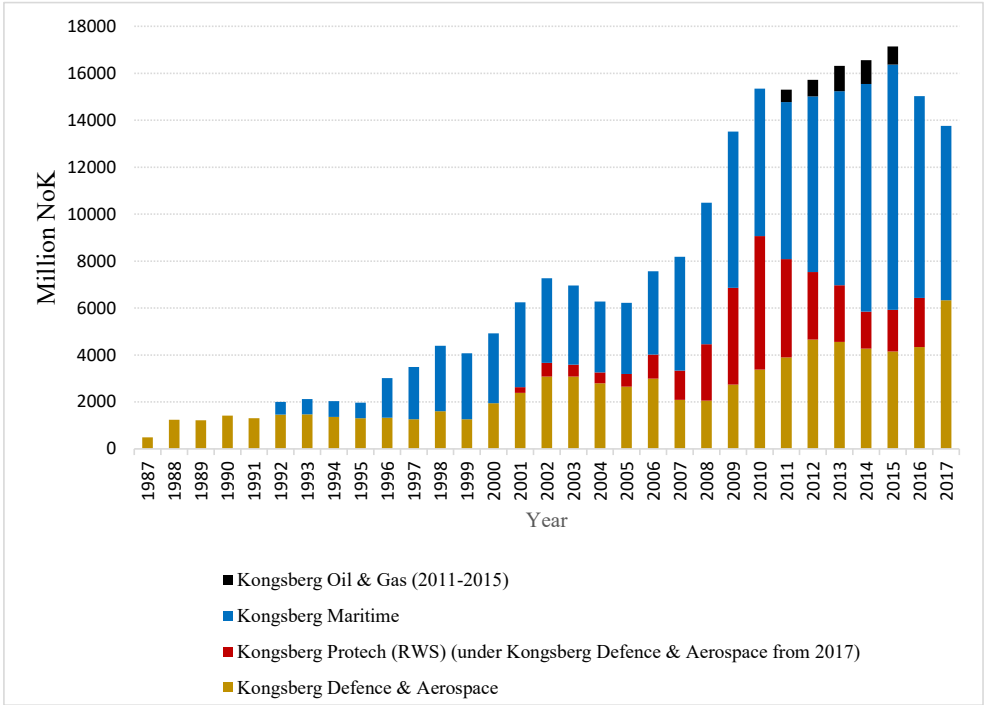
Table 2.1 The Kongsberg Group, key figures in fixed prices for the years 1988-2013

	Total turnover	Maritime	Defense	Kongsberg Protech (weapon station)	Event
1988	1783		1609		
1992	2321	609	1646		Norcontrol purchase
1996	3172	1769	1398		Simrad purchase
1998	4404	2790	1605		
2000	5020	2827	1842		
2001	5682	3329	2197		Navia purchase
2005	5031	2636	2302 ^a		
2006	5709	3019	2546 ^a		
2007	7003	4089	1760	1055	
2008	8981	4897	1669	1949	
2009	10991	5296	2175	3280	
2010	12032	4880	2621	4412	
2011	11601	5133	2987	3219	
2012	11912	5696	3542	2189	
2013	12163	6158	3393	1803	

^a Turnover from Kongsberg Protech included.

Source: The Kongsberg Group. The numbers are in million Norwegian kroner (NOK). The index is the consumer price index of Statistics Norway, 1998=100, ref K. Sogner, "Learning in an entrepreneurial state", *Enterprise & Society* (2021).

Figure 2.2 The Kongsberg Group, revenue per segment in current prices over the years 1987-2017.



Source: The Kongsberg Group/Key figures. See Sogner and Petersen, *Strategiske samspill*, 2014. The table illustrates the growth, decline and development of different segments of the corporation over time.

What can this development tell us about the innovative capacity of the Kongsberg Group in recent years? Was the positive development after 2000 simply a late reflection of the inventiveness that came out of KW, organized under a more stringent financial regime, or is it possible to identify a new form of innovativeness unique to the Kongsberg Group in the years after 2000? Extant research has established that both KW and the Kongsberg Group have played significant roles as national conservers of high-technology knowledge and competence (Sogner, 2002, 2007; Sogner & Petersen, 2014; Wicken, 1994; Øyangen, 2014). This thesis takes a step away from the national backdrop, to investigate how the Kongsberg Group has operated as a comparatively small system company in global markets, and to explore how the company has handled the challenges and opportunities related to innovation within this specific context.

3. Theoretical and analytical perspectives

It is commonly acknowledged today across business history and strategic management studies, that corporate innovation is dependent on how firms develop, use, and combine internal and external resources and capabilities (Dosi et al., 2000; Galambos, 1993; Lazonick, 2002; Teece, 2014; Teece et al., 1997; Wadhvani & Jones, 2016). This recognition builds on an intellectual heritage going back to Edith Penrose and Alfred D. Chandler who both emphasized the role of firms' resources and capabilities when exploring sources of innovative change historically (A. D. Chandler, 1990; Penrose, 1959/2009).

In my thesis, I build incrementally on this understanding of corporate innovation, by investigating it within the global and dynamic context of CoPS industries (Davies & Brady, 2000; Hobday et al., 2005). I do this within the confines of a research agenda seeking to combine historical research methods with strategic management theories (Argyres et al., 2020). My research into the history of the Kongsberg Group is thus inspired and guided by research on innovation and organizational capabilities stemming from business history, strategy, and the CoPS innovation literature. In the following, I present important concepts and insights from these strands of literature and point out areas where the thesis aims to contribute.

Corporate innovation and organizational capabilities

Through his studies of big business, Chandler identified corporate innovation by large multidivisional companies as one of the most important facets of the modern economy (A. D. Chandler, 1990; Galambos, 1993; Jones & Zeitlin, 2007). Chandler asserted, like Penrose before him, that firms are in control of both valuable physical facilities and human skills, and that these resources are the foundation for the development of unique organizational capabilities (A. D. Chandler, 1990; Penrose, 1959/2009). To be capable of something is to have a generally reliable capacity to bring that thing into action (Dosi et al., 2000, p. 2). For firms, it represents the ability to do or make something that someone wants.

Chandler showed how firms develop capabilities required to perform both strategic and functional activities. Strategic activities depended on the capability to move effectively into new and out of old markets, while functional activities revolved around the operative

capabilities necessary for a firm to perform its activities, i.e. production, product design, R&D, purchasing, finance etc. (A. D. Chandler, 1990). Chandler also recognized the role of top management in this process, indirectly demonstrating how the CEOs of large corporations played important roles as the entrepreneurs of the twentieth century. This was because their investments in production, marketing and distribution allowed for the introduction of new products to the markets, and the capitalization of these investments led to the growth of national and later international markets (Casson, 2010; Jones & Zeitlin, 2007).

In the increasingly global and competitive economic landscape of the late 1980s and 1990s, the Chandlerian ideal of large and hierarchically constructed firms was challenged by new types of organization, including smaller and more flexible and specialized firms (Piore & Sabel, 1984). This changing empirical configuration increased the need to understand how business organizations become and stay innovative over the long-term (Lazonick, 2002). At this crossroads, new streams of literature emerged in adjacent fields to business history that continued to build on—and challenge—Chandler’s legacy, but within the context of rapidly changing and/or complex technological and global contexts. The next sections look at some of these.

Adding dynamics to firm capabilities

In the 1990s, strategy scholars began to argue that it was not enough for firms to maintain existing organizational capabilities, they needed to develop *dynamic* capabilities that would enable them to reconfigure internal and external resources so that they could excel in competitive, swiftly changing environments (Leonard - Barton, 1992; Teece & Pisano, 1994; Teece et al., 1997). Helfat et al. (2009, p. 4) later defined these capabilities as the “capacity of an organization to create, extend or modify its resource base”. Building on former research, scholars argued that the development of dynamic capabilities depended on managerial and organizational processes, as well as on the firm’s asset position and the paths available to it (Teece et al., 1997).

Dynamic capabilities represents an important addition to literature on corporate innovation because it concentrates on the activities of firms and their ability to reinvent themselves over time, to allow new forms of organizational structure and product innovation to occur. It also addresses an implicitly historical question: why some firms are better than others at adapting

and reconfiguring their resources and capabilities to deal with, and create, innovative change (Eisenhardt & Martin, 2000; Suddaby et al., 2020; Teece, 2014; Teece et al., 1997; Wadhwani & Jones, 2016). Scholars have also found that capabilities are not only developed for different types of activities, but that they also exist in hierarchies between different levels of organizations, such as departmental, divisional, and corporate strata, and that they play very different roles for the innovative capacity of firms. The strategy literature therefore distinguishes between firms' ordinary or operational capabilities—the routines and activities where they make their living—and firms' dynamic capabilities; the processes that modify the operational capabilities to create or renew resources in line with changes in the environment (Ambrosini & Bowman, 2009; Cepeda & Vera, 2007; Helfat & Peteraf, 2003; Teece, 2014; Zollo & Winter, 2002).

While research on dynamic capabilities has swiftly accumulated across a vast area of disciplines over the last 20 years, the discussion has remained at a relatively high level of abstraction. It has therefore provided little insight into the actual processes that lead to, or open up for, the establishment of dynamic capabilities, and furthermore, what the nature of these capabilities essentially are (Ambrosini & Bowman, 2009; Arndt & Pierce, 2018; Bendig et al., 2018; Cepeda & Vera, 2007; Fallon-Byrne & Harney, 2017; Kay et al., 2018; Salvato & Vassolo, 2018; Schilke et al., 2018; Suddaby et al., 2020).⁷ Both Teece and Lazonick have emphasized evolutionary perspectives as important in understanding how dynamic capabilities emerge, and they have both argued for an enhanced role for business history in unlocking insights into the deployment of these capabilities (Lazonick, 2002; Teece, 2012).

The Kongsberg Group represents an interesting and relevant business history case in relation to the concept of dynamic capabilities. First, because the history of Kongsberg Weapons Factory and the Kongsberg Group illuminates how changes in the structure and management of an organization can influence the use of its organizational capabilities. Second, because the core capability of the company is systems integration, an organizational capability that has already been associated with dynamic capabilities in strategic and project management literature (Davies & Brady, 2016; Hobday et al., 2005; Prencipe et al., 2003). The second article in this dissertation addresses this issue specifically by exploring the role of different levels or units of an organization in the emergence of dynamic capabilities.

⁷ Exceptions are business historical papers like MacKenzie, N. G., Perchard, A., Mackay, D., & Burt, G. (2022). Unlocking dynamic capabilities in the Scotch whisky industry, 1945–present. *Business History*, 1-21.

Innovation in CoPS industries

Scholars studying innovation processes in different industrial contexts became increasingly aware that firms depend on different types of capabilities to manage innovation in their specific industries (Davies & Brady, 2000). In the late 1990s and early 2000s, a new stream of innovation literature emerged that directed attention to complex product systems, or CoPS, as a specific analytical category in terms of industrial production (Bonaccorsi et al., 1996; Hobday, 1998; Miller et al., 1995). CoPS are customized, singular, or small batches of capital goods and systems, characterized by high levels of technology and cost, acquired through business-to-business transactions. Companies involved in the production of CoPS are active in capital intensive, high-technology industries ranging from the aerospace industry to weapons, telecommunications and control systems, offshore installations, energy infrastructure and turnkey industrial equipment engineering (Bonaccorsi et al., 1996; Hobday et al., 2000).

The high entry barriers in these industries, as well as the tight supplier-customer relations, and the fact that governments are often among the buyers, makes the competitive landscape different from conventional markets. Scholars within this stream of research have noted that the complex production process behind CoPS distinguishes this product category from mass-produced commodity goods like consumer electronics, cars, or semiconductors (Hobday, 1998; Hobday et al., 2000; Miller et al., 1995). The definition of CoPS businesses is not obvious, since most products manufactured through a certain level of manufacturing can be decomposed into several subsystems and components (Ulrich, 1995). However, it is possible to draw a distinction based on some important characteristics; the nature of the capabilities involved, the intricacies of the product development process, and the atypical market conditions (Magnusson et al., 2005).

Systems integration as a core capability

System companies develop specific organizational capabilities over time to handle the complexity from the large number of components and the high level of knowledge and skills needed to produce CoPS (Acha et al., 2004). In addition to building on their existing (technological) knowledge base, these capabilities also define the firms' boundaries to other companies, as well as their ability to compete in international markets (Davies & Brady, 2000; Magnusson et al., 2005). Though scholars have identified different capabilities in

relation to CoPS production (Hansen et al., 2020; Hardstone, 2004; Ren & Yeo, 2006), systems integration stands out as particularly important (Davies & Brady, 2000).

The activity of systems integration is intimately related to systems engineering, an approach to solving complex problems and managing complex systems that was recognized among engineers, scientists, and managers involved in large defense and aerospace projects during and after World War II (Hughes & Hughes, 2000; Hughes, 1998; Johnson, 1997; Prencipe et al., 2003). By examining some of the biggest and most complex defense projects in the US, historian of technology, Thomas P. Hughes, showed that engineers and, in particular, system engineers, acted as important technological entrepreneurs in the introduction of new technologies, products and systems during the Cold War. These engineers became system builders in the modern industrial world, concerned not with individual components, but with interfaces, the interconnections among system components (Hughes & Hughes, 2000; Hughes, 1998). In this context, systems integration was considered an application of systems engineering and what Chandler (1990) would have defined as a functional (or operational) organizational capability; the sum of technological knowledge and engineering skills necessary to design and produce advanced systems by integrating high-technology components and subsystems into a finished system (Davies & Brady, 2000, p. 936). In this thesis, I talk about how the joint systems knowledge of many individuals was pooled to become a firm-level capability in systems integration. Systems integration capability can then be considered a collective term for the sum of capabilities present in individuals and organizational routines (Barney & Felin, 2013) that enables a firm to conduct systems integration on a broad scale (Hobday et al., 2005).

In the early 2000s, scholars began to see a change in the nature and role of systems integration in large system companies (Prencipe et al., 2003), suggesting that many of the world's leading firms⁸ were engaging in a new model of industrial organization, based on what they called “the two faces” of systems integration capabilities (Hobday et al., 2005). The first face corresponds to the functional role of systems integration capabilities when firms integrate different components to produce new products, and the second face concerns the increasingly

⁸ The authors specifically mention General Electric, ABB, Dell, Ford, IBM, Hewlett-Packard, BAE Systems, Cable & Wireless, Siemens, Nokia, Rolls Royce, and McDonnell and Thales. Hobday, M., Davies, A., & Prencipe, A. (2005). Systems integration: a core capability of the modern corporation. *Industrial and corporate change*, 14(6), 1109-1143.

strategic role of systems integration capabilities in determining how firms organize external activities to integrate components, skills, and knowledge from other organizations.

According to Hobday et al. (2005) this second face indicates that systems integration has become a modern-day strategic capability underpinning how high-technology companies compete by moving “selectively up- and downstream in the marketplace through the simultaneous ‘twin’ processes of vertical integration and disintegration” (2005, p. 1111). Hobday et al (2005) and Prencipe et al. (2003) argued that systems integration had become so important for firms in CoPS industries that it constituted a core capability within their broader competitive strategy and could therefore be said to represent an empirical example of a dynamic capability (Teece et al., 1997). This reasoning mirrors earlier reflections by Bonaccorsi et al. (1996) that systems integration is based on a distinctive management capability, a cognitive skill related to the management of uncertainty that comes from the dynamic nature of technological systems. In recent research, Muruganandan et al. (2022) employ the concept of “disciplined flexibility” to describe how systems integration can be managed as a dynamic process over time (Muruganandan et al., 2022, p. 608). This means that systems integration may not only be important for the design and integration of systems, but also in strategic decision making processes regarding business partners and decisions over what to make internally versus what to source externally (Brusoni et al., 2001; Gholz et al., 2018).

The pace of technological development since the 1990s, especially in software development, has made awareness around the boundaries of firms even more critical (Hobday et al., 2000, p. 794). CoPS have a high degree of tailor-made components and complex set of component interfaces built within a hierarchical system structure. As noted by Hobday et al. (2005, p. 1137), when the complexity of product systems increases, the number of feedback loops in the design and production of systems increases as well, from the later to the earlier stages of production. Moreover, as control systems interact with and take in a higher number of components, these interdependencies are increasingly governed by interface software (Brusoni et al., 2001). Giving up control over processes like the design of subcomponents can be a risky strategic choice (Gurca et al., 2021; Hobday et al., 2000; Takeishi, 2002). The second paper in this thesis, concerning the RWS-case, shows how ownership of software design became an increasingly strategic issue for the Kongsberg Group, and why this is key to competitive advantage for product systems integrators.

Even so, modularization and standardization are also used in complex products and systems (Henderson & Clark, 1990; Sanchez & Mahoney, 1996), and the more modular a technology is, the more scope for outsourcing through technology markets (Arora et al., 2001). Another response to this development has been the growth in so-called “integrated business solutions” (Ceci & Masini, 2011). This refers to new business models where system companies expand downstream in the value chain to cover larger parts of the market, offering maintenance, financing and service operations alongside their product systems (Brady et al., 2005; Davies, 2004; Davies et al., 2006; Mathieu, 2001). The third paper in this dissertation shows how this eventually became an important part of the global strategy for Kongsberg Maritime.

Product development, collaboration, and market demands

The production and development of CoPS is normally organized on a project basis (Brady & Davies, 2004; Davies & Brady, 2000; Davies & Hobday, 2005; Hobday, 2000). The combination of the large amounts of knowledge necessary to produce components, as well as entire product systems, typically exceeds the engineering capacities and capabilities of one company, making it necessary to assemble a group of companies to form a network or alliance. This includes prime integrators, product systems integrators, and subcontractors, in addition to governmental and regulatory agencies (Davies & Hobday, 2005; Dedehayir et al., 2014). Product development in CoPS is therefore driven by strong interaction and continuous dialogue between producers and users (Hobday, 1998). A key stage in these types of processes is when a concept is turned into a prototype (Wheelwright & Clark, 1992). Prototyping plays an important part in driving innovation processes, as proof of a concept’s viability, as an opportunity to implement potential customer feedback, and as a boundary object to connect different actors whose involvement is required for the innovation to succeed (Carlile, 2002; Garud et al., 2013; Hargadon & Sutton, 1997). Prototyping has the potential to take a product all the way from conceptual design to commercial development. The combined findings from the three papers in this thesis contribute to demonstrating how and why prototyping, and especially rapid prototyping, is crucial to a successful innovation outcome in complex product systems industries.

Bonaccorsi et al. (1996) have described how CoPS markets are characterized by peculiar features. First, the buying process is often long and complex, and characterized by a high degree of discontinuity, due to the many stakeholders involved. Second, although the

existence of a need does not easily translate into concrete market demand, the marketing process must start very early, so that the firms can mobilize the capabilities to bid successfully and to influence, when possible, the specifications of the call. Third, these markets are often highly sensitive to cyclical turns, which means that demand can also appear suddenly and equally disappear overnight. These different characteristics make the environment less predictable and difficult to control (Bonaccorsi et al., 1996). Large prime integrators dominating global markets often have substantial power in terms of setting market standards. The very nature of the market demand and customer requirements within these industries can therefore create conflicting interests, which may affect the opportunity for successful project execution and innovation to take place.

When it comes to military systems, different stakeholders like governments, regulators or prime integrators, can influence product development by dictating matters relating to safety or interface standards between different product systems going into the larger technical systems (Bonaccorsi et al., 1996). This can potentially have large implications for product systems integrators if they must choose between protecting their intellectual property and the need to offset risk and stay competitive by sharing or unveiling sensitive technology in strategic alliances with other companies. So far, research has provided little insight into how these dilemmas have been solved (Hobday et al., 2000). The first paper in the thesis addresses this issue empirically, by investigating KDA's long process of achieving innovation breakthrough with its air defense system, Nasams, and the role of strategic alliances in this process. In doing so the thesis illuminates the path of a comparatively small, European product systems integrator, and explores how it maneuvered this role against larger competitors, and in collaboration with partners.

Innovation challenges and missing perspectives in the CoPS literature

System companies must manage uncertainty as well as strict requirements concerning technology, collaboration, and market conditions. This creates both opportunities for—and limitations to—innovation. Finding the right balance to successfully maneuver in this complex landscape may require substantial changes to the organization and strategies of companies. In response to this, system companies tend to change their organizational boundaries quite often, by means of both mergers and acquisitions, and different forms of alliances (Bonaccorsi et al., 1996; Gurca et al., 2021). However, these are only the most

visible of their strategic responses. System companies also need to operate with flexible boundaries when it comes to issues around design and production, intellectual property and the resources available within their organizational boundaries (Hobday et al., 2005).

The CoPS literature has made great contributions in analyzing the characteristics of initial conditions for innovation in CoPS industries. Previous research has focused on system companies from the US and Europe, either prime contractors or smaller systems integrators (Acha et al., 2004; Ceci & Masini, 2011; Davies, 2004; Geyer & Davies, 2000; Prencipe, 1997; Prencipe et al., 2003; Safdari Ranjbar et al., 2018). Recently, a stream of literature looking at the conditions and characteristics of latecomer firms and industries in a CoPS context has also begun to grow, paying attention to emerging economy firms' strategies toward specific markets and technological regimes (Kiamehr et al., 2015; Kiamehr et al., 2014; Park & Ji, 2020). Findings from this area have led to a division in the literature, separating the CoPS' practices of developed nations from those of emerging nations (Safdari Ranjbar et al., 2018).

While this is a relevant distinction, it overlooks the fact that there are also differences between system companies within developed nations, depending on their position in the CoPS' hierarchy (Hobday et al., 2000). In the defense industry, and elsewhere, prime contractors or prime integrators are among the world's largest companies, dominating global markets in their sectors (Hobday et al., 2005). With the changing political landscape in the aftermath of the Cold War, many smaller firms in Europe had to move beyond their formerly protected national markets to compete in the same global CoPS markets. These systems companies were faced with tough competition and had to create new opportunities for themselves.

In general, there seems to be a market and/or competition perspective missing in this literature. How do product system companies respond to market demands and characteristics (Appio & Lacoste, 2019; Bergek et al., 2008; Liu & Su, 2014), and how do they use their capabilities in different ways to handle this (Davies et al., 2011; Gurca et al., 2021; Hobday et al., 2005; Su & Liu, 2012)? On the specifics of systems integration, more research is also needed to understand how it is performed in practice, and how it varies between different levels (Whyte & Davies, 2021). We still know little about how system companies deploy their systems capabilities in different ways to optimize their position (Hobday et al., 2005; Hobday et al., 2000). This thesis complements existing knowledge on CoPS innovation by connecting theoretical perspectives on capabilities with empirical research from the

Kongsberg Group, exploring the different and less visible ways firms can maneuver to compete for market share. In doing so, the thesis explores the *microfoundations* of innovation.

Microfoundations, capabilities and business history

Since organizational capabilities change over time, history is considered an important determinant of asset strengths and technological opportunities connected to the use of capabilities (Teece, 2007; Teece, 2012; Teece et al., 1997). For this reason, analyzing business history cases has been suggested as a relevant way to understand how different types of capabilities are important for innovation processes in firms (Danneels, 2002, 2011; MacKenzie et al., 2022; Suddaby et al., 2020; Wadhvani & Jones, 2016).

The idea that historical research can provide valuable insights into topics in strategy research is not new (A. D. Chandler, 1962). The last 15 to 20 years have seen a growing interest in the application of historical reasoning and methods to strategy research (Argyres et al., 2020; Rowlinson et al., 2014; Suddaby & Foster, 2017). This reflects business history's long-term position as "a discipline at the crossroads between history and management science" (Álvaro-Moya & Donzé, 2016, p. 124). While the agenda has been set, Wilson et al. (2022) note that it is so far not clear "Whether any of this academic endeavor has proved beneficial to either", pointing to the epistemological differences that exist between historical and social science research as the main reason for a continued divergence between the fields.

The concept of *microfoundations* offer an opportunity to show how business history can provide important empirical insights through its traditional longitudinal case study approach. As maintained by Felin & Foss (2005), a general challenge with strategy research on concepts like capabilities, is that it is often unclear how these concepts are related both to the members of the particular organizations under scrutiny, and to the larger macro-level phenomena they are meant to explain. They therefore applied the notion of "microfoundations" as a critical way of trying to explain the social phenomena under study in strategic management. It is not my intention here to provide a broad examination of the microfoundations concept, but rather to sketch out why this perspective is relevant in a business history study of innovation. And to do the opposite—to explain why a business history study of innovation should be of interest to adherents of a microfoundations approach.

According to Felin et al. (2012) the microfoundations of capabilities can be divided into three overarching categories: individuals, processes, and interactions and structures. As analytical categories, they make up the primary components that underlie how capabilities are built, maintained, extended, leveraged or phased out (Felin et al., 2012, p. 1352). The purpose of choosing a microfoundations perspective is according to Foss and Linder to open “black boxes” by explaining “how micro-level factors like individuals’ characteristics, their decision-rights, their interactions, and so on impact meso-and macro-level outcomes – for example, how the interaction of individuals leads to emergent, collective, and organization-level outcomes [...]” (Foss & Linder, 2019, p. 2).

Microfoundations has become a popular concept in strategy and innovation literature, tied to concrete strategic management issues (Foss, 2011). In 2007, Teece also decomposed the concept of dynamic capabilities into microfoundations, by describing them as the lower level functions (the activities and processes) that enable an organization to sense, seize and transform opportunities into profitable action (Teece, 2007). However, so far, there has been limited research looking at how individual-level knowledge and activities actually aggregate to shape firm-level capabilities and innovation (Davis & Aggarwal, 2020; Schneckenberg et al., 2015). Felin et al. (2015) note that interesting questions remain regarding the structural arrangements under which employees operate within organizations because this can have significance for how individuals’ capacities are realized. Structures specify the conditions that enable or constrain individual and collective action and establish the context for interactions within an organization. This is likely to have an effect on the use and leverage of an organization’s capabilities (Felin et al., 2012; Gurca et al., 2021). For example, regarding Teece’s (2007) microfoundational definition of dynamic capabilities, who is allowed to sense, seize and transform opportunities, and how are these activities performed within an organization to ensure the best possible outcome?

One reason these microfoundational questions have not been further investigated could be methodological. Conducting empirical microfoundations research is difficult, since it tries to enhance our understanding of macro-level phenomena by means of micro-level explanation (Foss & Linder, 2019). Linking the individual to the organizational level of analysis demands an understanding of how actors jointly engage in attempts to increase performance, what these shared experiences mean for the organization, and how managers attempt to coordinate these through guided efforts. It makes little sense to argue that managers can intervene directly on the level of capabilities. If managerial choices and decisions influence

capabilities, it is because they influence the motivations, abilities, and opportunities of organizational members (Foss & Linder, 2019, p. 7). For research to move forward, it is necessary that scholars understand how this can and does happen in business.

The authors behind the microfoundations perspective therefore essentially urge researchers to dig deeper (Foss & Linder, 2019, p. 54). In doing so, yet without explicitly stating it, the microfoundations movement in strategy research expresses a need for empirical methods that align with those of business history and historical reasoning. Micro to macro explanations often evolve over longer periods and demand a long-term perspective to be visible in research. Business history can contribute in this field by showing through narrative analysis how dynamic capabilities develop and function within firms (MacKenzie et al., 2022). In fact, as noted by Winter (2013, p. 122) in his critical essay on the “microfoundations project”, relevant work on microfoundations in adjacent fields like business history already exists.

Exploring the role of firms and their capabilities in pursuing innovation remains a key endeavor in business history (Graham, 2007), and one which continues to build on—and challenge—the Chandlerian legacy (Álvaro-Moya et al., 2022; MacKenzie et al., 2022; Wilson et al., 2022). I believe the increasing calls for microfoundations research offer a window for business history to demonstrate its methodological strengths and relevance for broader management theories as well as the more practice-oriented needs of the business world (Wilson et al., 2022). In the context of this thesis, applying a microfoundational perspective means looking at how individuals, processes, and structures have impacted on the innovative capacity of the Kongsberg Group, that is, the company’s ability to develop *and* sell new products in international markets. The next chapter elaborates on the methodological practices and choices that lie behind this research.

4. Method

Choice of methods in research is related to epistemology: how can we know, where does our knowledge come from and is it valid? As a historian, my epistemological view is shaped by a belief in historicity; that we cannot truly understand the present without relevant knowledge about the past. In business historical research, this epistemic view is often connected to uncovering sequences and processes of the past that can explain the works of complex phenomena in the present. This is especially relevant for a phenomenon like innovation, a complex process that cannot be predicted, and which has historically been studied longitudinally and retrospectively (Kline & Rosenberg, 1986; Schumpeter, 1943/1976; Wadhwani & Jones, 2014).

In my search to discover how the Kongsberg Group has succeeded with innovation across different product areas, I rely on the methodology of business history. This approach has received both new interest and been the subject of critical debate over recent decades. On the one hand, we have witnessed increased interest in the use of historical sources in diverse business and management disciplines (Argyres et al., 2020; Bucheli & Wadhwani, 2014; Clark & Rowlinson, 2004; Kipping & Üsdiken, 2014; Rowlinson et al., 2014; Wadhwani et al., 2020).⁹ On the other hand, the discipline has been criticized for its lack of openness regarding its historical methods, especially its form of reasoning and treatment of sources (Bell & Taylor, 2013; De Jong et al., 2015; Decker, 2013; Decker et al., 2015; Popp & Fellman, 2017).

As a historian following a PhD program at a business school, these discussions have both motivated and challenged me, and to a large extent shaped the path of this PhD. During my research I have found encouragement in the emerging literature recognizing and discussing the premise for a historical turn in business and organizational research (Bucheli & Wadhwani, 2014). This literature inspired me to engage in a cross-disciplinary dialogue on the nature of organizations and their capacity to innovate based on my historical methodology, either by providing complementary explanations or by challenging existing theoretical claims based on contextualized generalizations (Wadhwani, 2016a, 2016b; Welter & Gartner, 2016). With the above-mentioned criticism in mind, I will here describe in more

⁹ Especially within strategy, entrepreneurship and management and organizational studies.

detail and reflect on the methodological choices and trade-offs that I have made throughout this project, as well as the interpretative process and reasoning that has resulted in this thesis.

From commissioned history to triple case study on innovation

In *Historical Knowledge, In Quest of Theory, Method and Evidence*, Fellman and Rahikainen (2012, pp. 15-16) refer to what Jacques Revel considers to be the principle that all historians ought to adopt: “why make it simple when one can make it complicated”.¹⁰ I find the principle relevant for this thesis for several reasons. First, because the thesis involves the use of intensive case studies, with the complication that the richness in this type of research can provide (how to deal with too much material). Second, and more personally, because I think Revel’s words sums up the process of working on a PhD-thesis.

The starting point for this thesis was my involvement—as co-author—in a two-year commissioned business history project to write the corporate history of the Kongsberg Group over the period from 1987 to 2014. The project was funded by the Kongsberg Group on the occasion of the 200th anniversary, in 2014, of the establishment of Kongsberg Weapons Factory, and was preceded by two book projects covering the history of Kongsberg Weapons Factory from 1814 to 1945 (Myrvang, 2014) and from 1945 to 1987 (Øyangen, 2014). The project to write the third volume—1987 to 2014—took place from 2012 to 2014.¹¹

As I studied the company and its different product areas, I discovered that even though the Kongsberg Group possessed advanced technology and had developed high-technology systems that were clearly compatible with, sometimes even superior to, similar systems in the market, this was not enough to create market breakthroughs. Accomplishing commercial innovation was a complicated process. In some instances, it happened extremely rapidly, while in others, even within the same industrial context (i.e. the defense sector), it took years, even decades from invention to innovation. This tells us something about the unpredictable nature of markets, and the importance of matching their needs at the right moment in time. Nevertheless, the period between 2000 and 2010 stood out in terms of market breakthroughs for the Kongsberg Group, both for established products and completely new product areas.

¹⁰ “...pourquoi faire simple quand on peut faire compliqué?” Revel, “L’histoire au ras du sol”, XXIV.

¹¹ The primary task was to cover the last 27 years of this multinational company in no more than 150 pages. Once we were done, this limit was stretched to over 350 pages, Sogner, K., & Petersen, T. (2014). *Strategiske samspill : Kongsberg gruppens historie 1987-2014* (Vol. 3). Pax.

I did not have time during the commissioned history project to study in depth the different innovation breakthroughs. When the project was over, I was still curious about some of these processes. Being fortunate in establishing my own research project as a PhD candidate, I decided to concentrate my attention on three cases within the Kongsberg Group:

1. Kongsberg Defence and Aerospace (KDA) and the development of the anti-air missile system Nasams.
2. Kongsberg Protech and the development of Protector Remote Weapon Station (RWS).
3. Kongsberg Maritime and the new product and marketing concept, “The Full Picture”.

These cases stood out from the other ‘product stories’ we had come across while working on the commissioned history project because of their value in terms of sales, and their importance as innovative breakthroughs in the period between 2005 and 2010 (Sogner & Petersen, 2014).

In this thesis, the word “case” signifies that the research has been confined to the boundaries of the specific processes that I wanted to understand and explain through retrospective research. As noted by Garud et al. (2013, p. 801), a process perspective is well suited to the study of innovation because it allows us to capture the complexities associated with the phenomenon, especially when it comes to the non-linear path from invention to implementation (Kline & Rosenberg, 1986). However, historical cases are not “cases” in the conventional social science sense of being qualitative evidence about a particular unit that can be used to build general theory or develop a testable claim (Robert K Yin, 2012). Rather, historical cases are narratives that piece together analyzed evidence into representations of events in the past from the perspective of the present (Ricoeur, 2004 in ; Wadhwani, 2016b). This mirrors the reconstructive character of historical methodology (Decker, 2013).

Data collection and source criticism

The empirical foundation for this dissertation consists of four sources; archival material from corporate archives, project documents collected from different sources within and outside of the organization, secondary sources (newspapers, corporate magazines, public documents, reports, books, etc.) and oral history interviews. The choice of sources reflects the business history perception that to understand how business organizations evolve in their institutional,

national and international contexts, it is necessary to engage with a variety of source materials (Jones & Zeitlin, 2007; Wilson et al., 2016; Wilson et al., 2022). However, historical sources are not created to answer research questions. They are created by actors with a specific agenda, and it is therefore necessary to consider the incompleteness and biases involved in applying these sources to answer specific research questions in retrospect (Kipping et al., 2014). We do this through source criticism, a key element of the historical method which determines not only what the sources can tell us about a specific development or topic, but also what limits the knowledge we can gain from a particular source. In the following sections I describe the different sources I have used in this dissertation and elaborate on how I have judged their validity and reliability.

Corporate archive material

During the time I worked on the commissioned history of the Kongsberg Group, I had access to corporate archives, as well as parts of the archives of the subsidiaries of the corporation. The archive belonging to the Kongsberg Group (1987-)¹², is considered a private corporate archive, and since the Kongsberg Group is part of the defense industry, some archives were confidential, or clandestine, especially those containing sensitive information about the defense industry.¹³

Archival sources are materials collected and stored for the purpose of preserving history. They function as the memory of an organization (Decker, 2013) and this makes them important, yet problematic for knowledge production (Popp & Fellman, 2017). First because of the serendipity in this type of historical work, and second, because of the many and different motives inherent in the archived materials. Not just the individual motive, but the institutional setting and the organizational structure of which it forms part (Kipping et al., 2014; Orlikowski & Yates, 1994; Yates & Orlikowski, 1992).

The documents I have relied on from the corporate archive of the Kongsberg Group were clearly constructed for specific organizational purposes, and then included in the corporate archive for transparency reasons.¹⁴ This means that they were written for internal purposes,

¹² The archive after KW (1814–1987) was deposited with the State Archive in Kongsberg (part of the National Archive) during the 1990s and is publicly available, with the exception of certain embargos.

¹³ I did not get access to archives containing clandestine information. However, after receiving security clearance I was approved to work in the main corporate archive.

¹⁴ For stock listed companies there are specific demands for documentation regarding board meetings.

but with the acknowledgment that they might be scrutinized by others in retrospect. While this represents a possible bias in the construction of the sources, it does not make these sources invalid for the purpose of understanding innovation.

I worked in concentrated periods of time between 2012 and 2014 on collecting material from the Kongsberg Group's corporate archive.¹⁵ To maximize coverage, the research strategy was to sample on the basis of chronology and periodization. The archive consisted of a sizeable record collection. For my research, the most relevant documents included top management team (TMT) minutes, internal memos, board meeting minutes including appendix (i.e. TMT's presentations of various topics to the board, policy statements), subsidiary board meeting minutes (KM and KDA), materials on company strategy (including the preparations for and the reports on the company's 5-years strategic plans from the 1990s until 2014), documents and discussions on various company changes (organizational changes, M&As etc.), reports from external consultants, internal and external correspondence and so forth. These documents were important as they provided me with valuable information about the company and I used them to build up a description of the organization and its history. Much of this material was still relevant as I continued to work on my PhD—in particular sources providing information on how product areas had evolved over time, how the top management considered their market potential, which strategies they developed and why.

However, and as noted by Decker, while it is standard practice in business history to begin working on the files originating from the top of the hierarchy—that is from the board minutes downwards—this is not necessarily the best way to find the most interesting sources to answer your research questions (Decker, 2013). The top-down method might just provide one perspective on the development. As I continued to work on my own project, it was clear that I needed insights that went beyond the corporate managerial perspective. To learn more about the three product-cases I had chosen, I had to find out more about what had been going on further down in the organization, directly related to the product development process and the specific projects where this had happened. These types of sources were more difficult to obtain, as they were either part of so-called “clandestine” archives (within KDA), or simply

¹⁵ When I worked on the source material for the Kongsberg Group history, I covered material from TMT-meetings and board meetings from the same year, before moving on to the next. This provided me with insights into how the TMT had discussed topics as well as possible disagreements herein, before seeing how the same topics were treated or presented in board meetings. After covering these meetings, and establishing timelines and an overview of important topics, I moved on to the files containing more documentation on specific topics (i.e. strategic issues, organizational changes, questions about acquisitions or sales etc.).

not yet filed within any archive, but held by specific people or milieus in the corporation.¹⁶ I therefore had to change strategy as I approached the three cases individually, to find ways to get ‘inside’ the projects and activities that had shaped the innovation paths of Nasams, RWS, and ‘The Full Picture’.

“Project- documents”

Not all materials that provide primary documentation are found or obtained from archives. As noted by Lipartito (2014), experience shows that interesting papers may continue to reside in the possession of individuals. Moreover, the validity of a source does not necessarily rest on its location, but on source criticism that considers its production, its perspective, its proximity to the event and its value in addressing the questions asked (Lipartito, 2014, p. 297).

Continuing my research, I had to depend more on key people connected to the specific cases, and their access to sources that could be relevant for my project. Through specific people I gained access to different types of sources that I have called “project documents” since they provided me with insights into the specific projects I was investigating. These documents contained primary sources, but they had also been constructed in a way that made it difficult to label them as such. In my view these sources were therefore both very valuable and at the same time heavily biased. I will explain what I mean by this.

As I began working on the Nasams-case, I tried to get access to a project archive that someone in the organization had told me about. In spite of several attempts, this was unsuccessful. Instead I discovered during one interview that a retired engineer from KDA had written a 200-page manuscript documenting the history and idea of air defense (including Nasams) going all the way back to the 1950s. The material for this large document was a number of interviews with former members of the air defense division in KDA, as well as people from the air force and research institutions like NDRE, white papers from the Nasams project, documentation that had been taken from the project archive before it was moved or destroyed, annual reports, private memos etc. In some cases, important documents had also

¹⁶ I made an agreement with the Kongsberg Group when the commissioned project was over that I could continue my own research into the three specific cases. However, this did not mean that I got access to more archives.

been copied and included in the manuscript.¹⁷ I was fortunate to have full access to this manuscript, to read it and refer to it.

When I turned my investigation toward the RWS-case I pursued the strategy of asking my interview subjects for access to source material. I was informed that since the Protector RWS-project was established very rapidly and under unique circumstances, much of the documentation from this time had not been preserved in a systematic way. However, the former development manager on the Protector RWS project recalled that the organization had collected a lot of documents as support material for a course that they had prepared in “Project management of complex systems” at the University of South East Norway, in Kongsberg in 2010. I was granted access to this material and to several folders documenting the RWS Program In-Review process from 2001 to 2003. During previous interviews (in 2013), I had also obtained internal documents from people involved in the RWS-case.¹⁸

Finally, regarding Kongsberg Maritime and ‘The Full Picture’, I had already during the commissioned project obtained access to a report documenting the process of establishing this strategic sales concept. This was not acquired through the archives, but from the former CEO of Kongsberg Maritime, who was himself the instigator of the project. As I continued working on ‘The Full Picture’, I struggled to get access to other sources documenting the project, and I also had trouble getting more people to agree to interviews.¹⁹ However, during one interview with a former engineer who had also worked as a consultant for the company in recent years, I got access to source materials (several files) from the predecessor company of Kongsberg Maritime (Kongsberg Albatross), documenting project processes similar to ‘The Full Picture’, but from 20 years before (now 40 years ago). This source material became important for how I came to understand the historical role of systems integration in Kongsberg Maritime.

Clearly these sources that I gained access to through my new interview contacts were biased from the way they were constructed and from the desire of these current or former employees to document different parts of the (less known) history after KW and the Kongsberg Group. At the same time, they represented valuable insights into sources that I would otherwise not

¹⁷ Bjørn Abrahamsen (2015), “Historien om luftvern på Kongsberg/The history of air defense in Kongsberg” (unpublished draft/manuscript).

¹⁸ For an overview of what this material included, see table in paper on RWS-case.

¹⁹ I am not sure why this was so difficult. I do not believe it had to do with the sensitivity of the project, but rather that people were so busy they did not want to prioritize it. It was an interesting contrast to the parallel process with people from the defense industry where they were more than willing to show up for interviews.

have gained access to. For example, they detailed the long and complex history behind Nasams, including important insights into the early phase of product development, and the many and different (political, defense and business) considerations that lay behind the project to develop a new air defense system to protect Norway. In similar ways, the sources related to the RWS-case provided important documentation of the process, the people and organizations involved, the technology and the methods used, feedback from the customer, and so on. In terms of ‘The Full Picture’, the problem was rather that I had not gained access to more sources directly related to ‘The Full Picture’ process. To complement the information from these project documents, I have used a range of publicly available documents, as well as several of the oral history interviews I had already conducted. More on this below.

Secondary sources

A basic principle in historical research is that primary (archival) sources—those that were closest in time to the event in question—are the most valuable sources, especially if they were not created or intended for public release. However, the use of sources ultimately depends on the research questions and what the historian is trying to find out (Rahikainen & Fellman, 2012, p. 25). When dealing with recent contemporary history, secondary sources and oral sources also become important, not simply to verify the accounts of primary sources, but because they fill in gaps in the material, provide a larger context and put forward different perspectives. Among the secondary sources I have used to inform my understanding of the three cases are public company documents such as annual reports, customer (commercial) magazines, company newspapers and newsletters, public relations material online (i.e. product information brochures), scientific and research-based documents and reports, academic and non-academic books, and newspapers and technical journals.

These sources have provided me with more detailed information on the specific systems investigated and the product development processes involved. With the Nasams case for example, internal company newspapers and newsletters became important sources of information about internal product development processes as well as sales and market approaches abroad. From the opposite perspective, and as noted by Lipartito (2014), public sources can also be important because they help us understand how organizations represent themselves to the public and to their customers, providing a different perspective than internal sources. In example, with ‘The Full Picture’ case, public information from magazines

and online brochures informed me on how the company communicated its capabilities to its customers for commercial purposes. This was quite interesting because it provided me with insights into how they used this information strategically. The next section introduces the fourth source in this thesis, that of oral history.

Oral history interviews

In addition to primary and secondary sources, oral history makes up an important part of the material for this dissertation. By oral history I refer to interviews and how the material from these interviews is used to answer my research questions (Grove & Heiret, 2018). The business historical approach to interviews might resemble qualitative social science interviews, but they differ in important ways (Yates, 2014). Whereas in qualitative interviews informants are typically asked pre-defined questions about a specific topic so that all answers can be measured against each other or compared to a specific theoretical perspective, in oral business history the informant is often asked to reflect upon his or her own life story or career path within an organization, and the interview proceeds more as a conversation where the historian has some topics that he or she wants the informant to shed light on (Grove & Heiret, 2018).

Oral sources are increasingly recognized in contemporary business historical research (Keulen & Kroeze, 2012; Ryant, 1988). Jones and Comunale (2019) show that oral history is a particularly valuable tool because it can fill in gaps in the historical record by providing information about topics which are rarely formally documented, and by providing a level of nuance about topics investigated that is “[...] hard to obtain even if written archives are accessible” (Jones & Comunale, 2019, p. 19). Crawford and Bailey (2019) add to this by emphasizing that oral history’s contribution is not only to fill in gaps in the archive, but also to document specialist knowledge that is otherwise difficult to obtain. This is particularly relevant in the context of this thesis, since how an organization understands and uses its capabilities can be difficult to capture in written documents.

A total of 38 informants and 43 interviews are referred to across the papers in this thesis. These interviews took place over two periods, between 2013 and 2014, and between 2016 and 2019. Some informants were interviewed several times. I conducted a little more than half of these interviews together with another historian (my former co-author and supervisor, Professor Knut Sogner), the rest I conducted alone. In the majority of the interviews we took

notes manually, and these were transcribed shortly after. However, in some of the interviews, especially those related to the RWS-paper, which I conducted alone, I used a dictaphone. This allowed me to concentrate more on the conversation. In some instances, I also contacted the informant by email afterwards, to clarify details or to ask for more information on specific topics.

Table 4.1 List over interviewees

Name	Affiliation/ relevant (former) position in the Kongsberg Group	Place and date of interview(s)
Tom Gerhardsen	KDA, Managing director	Oslo, 23.1.13*
Nils-Oddvar Hagen	KDA, Senior engineer, expert on fire control systems	Kongsberg, 11.4.13*
Jan Erik Korssjøen	Kongsberg Group, CEO	Kongsberg, 14.5.13*/10.3.17 Oslo, 20.2.19
Torfinn Kildal	Kongsberg Maritime, Managing director	Oslo, 3.5.2013*/ 16.5.17
Vidar Lande	Kongsberg Protech, Union official	Kongsberg, 13.5.13
Rolf Arne Klepaker	Kongsberg Maritime, Manager subsea division	Horten, 16.5.13*
Geir Vinghøg	Vinghøg, CEO	Tønsberg, 12.6.13
Nils Albert Jenssen	Kongsberg Maritime, Senior engineer	Kongsberg, 6.8.13*
Egil Haugsdal	Kongsberg Protech, Managing director	Oslo 14.8.13*
Finn Jebsen	Kongsberg Group, Chairman of the board	Oslo, 14.8.13/* 8.2.19*
Morten Hasås	Kongsberg Maritime, Product manager	Horten, 30.8.13*
Lars Gørvell-Dahll	Kongsberg Maritime, Business development	Oslo, 3.9.13
Kjetil Lund	Kongsberg Maritime, Head of operations China	Oslo, 6.9.13
Geir Håøy	Kongsberg Maritime, Managing director/Sales and operations Asia	Oslo, 26.9.13*
Hans Petter Eriksen	Kongsberg Maritime, Sales and operation Asia	Oslo, 11.11.13
Tor Erik Sørensen	Kongsberg Maritime, Sales manager	Kongsberg, 11.12.13*
Stig Trondvold	Kongsberg Group, Business development	Oslo, 22.1.14*
Harald Ånnestad	KDA, Managing director	Kongsberg, 20.2.14*
Sverre Gotaas	Kongsberg Group, Chief technology officer	Kongsberg, 21.2.14/* Oslo, 23.10.16
Leif Linbäck	Department of Defense, Head of purchase	Oslo, 21.3.14*
Eirik Lie	KDA, Head of air defense division	Kongsberg, 1.4.14*
Henry K. Johansen	NDRE, Research director	Oslo, 26.5.14*
Finn Åge Østern	KW, Head of prod. dev.	Kongsberg, 29.10.16
Rolf Qvenild	KW, CEO	Oslo, 2.3.17*

Gunnar Berge	KW/KDA Engineer, project manager	Kongsberg, 10.3.17
Bjørn Abrahamsen	KW/KDA Engineer, head of prod. dev	Kongsberg, 10.3.17
Alberto Sols	HSN University Norway, Professor in Systems Engineering,	Kongsberg, 9.5.17
Espen Henriksen	Kongsberg Protech Systems, Managing director	Kongsberg, 12.2.18
Steinar Sælid	Kongsberg Maritime, Senior engineer	Fredrikstad, 14.2.18*
Trond Jacobsen	Kongsberg Protech, RWS Technical manager (head of product dev.)	Kongsberg, 27.2.18
Knut Sæter	Kongsberg Protech, sales manager	Kongsberg, 6.3.18
Roald Theisen	Kongsberg RWS Project manager	Kongsberg, 11.4.18
Stig Nordmoen	RWS Software manager	Kongsberg, 12.4.18
Per Inge Jensen	RWS Sights manager	Kjeller, 25.4.18
Geir Morten Rud	RWS Quality manager	Kongsberg, 26.4.18
Ole M. Reinemo	RWS Mechanical Design manager	Kongsberg, 27.4.18
Jørgen Furumo	RWS Purchasing manager	Kongsberg, 15.5.18
Nils Løkken	RWS Test manager	Kongsberg, 15.5.18

Semi-structured interviews lasting between 1-4 hours. *Interviews conducted together with another historian

Several of the interviews from the first period (2013–2014) can be considered key informant interviews. These conversations started with a broad outlook on the development of the Kongsberg Group between 1987 and 2013 and moved on to illuminate several or all of the product areas included in the thesis. These interviews were important in providing a window into the organization and to outline specific product areas of interest. The interviews that were conducted after 2016 were also approached as conversations, but were the topic became more directed either at the overall systems competence of the Kongsberg Group, or at different product categories, i.e. Nasams, RWS or ‘The Full Picture’.

As historical sources, interviews are contested material. First because of the risk of bias caused by memory lapses and distortions from the time passed, and second because the interviewer is implicated in the situation, constructing the source material from the questions he or she asks. In terms of possible bias, in addition to the risk of memory lapses and my own role in guiding the conversation, there was also the chance of hidden agendas. I had to take into consideration that many of the people I interviewed had spent a lot of time over the years reflecting on some of the things I was curious about. After all, many of them had spent their entire careers working for KW/ and or the Kongsberg Group. While this could be considered

a positive thing in terms of memory (some of them had even documented parts of the history themselves), it also meant that they could have a preconceived agenda behind how they wanted me as a researcher to understand the history of KW and the Kongsberg Group— for example, whether the roots to innovation success should be traced back to KW or whether the answer lay in more recent processes in the Kongsberg Group. I will now move on to explain how I have applied the different sources in my analysis of innovation across different product areas.

Analysis: Verifying, reconstructing and interpreting sources

Historical analysis is ultimately about reading and interpreting sources and then piecing together different parts of the material to form a coherent historical explanation, most often in the form of a narrative—a written account of connected events. This process involves maintaining a careful balance between the two sides of historicity (Trouillot, 1995 in Decker, 2013, p. 160): The *present* where we have our research questions, our concepts and our ideas about coherence, and the *past* that we access through evidence from archival records, secondary sources and oral history statements. It is in through the intertwining of these two sides that history is created, and the past reconstructed. This is not an objective process, and I will not attempt to pretend it is. Rather, as Decker notes, this process “[...] suffers from uneven, complex and confusing evidence, multiple explanations, the eventual choice to prioritize one account over another, the bias inherent in the intellectual framework of the researcher, and the fundamental silence of some historical sources” (2013, p. 160-161). I have previously elaborated on the sources I have collected and my thoughts on their validity and reliability. In the next sections, I further describe how my knowledge claims are based on a triangulation of these sources, interpretation, and reconstruction in the form of narratives, and finally, what type of contribution this research aims to make.

Triangulation of sources

To overcome the limits that source criticism reveals, historians combine and triangulate various types of sources to cross check and validate results (Kipping et al., 2014). In this thesis I have triangulated between sources by comparing and contesting information from written corporate archival documents, primary and secondary source “project-documents”,

other secondary sources and oral history statements to see how these different sources provide information on the larger context, and to verify the accounts and the sequence of events. To differentiate between source materials and scholarly literature, I use both footnotes and APA reference style in this thesis. Table 4.2 shows how I have triangulated the different sources across the three papers.

Table 4.2 Triangulation of sources

Source category:	Primary archival sources	“Project” documents	Secondary sources	Oral history
Cases:				
Nasams	Kongsberg Group Archive (KGA) 1987-2014: - Board minutes - Executive group minutes - Board minutes KDA - Other files	Bjørn Abrahamsen: “The history of air defense in Kongsberg”, 2015, (unpublished manuscript)	Annual reports, <i>NFT i fokus</i> (internal company newsletter) newspaper articles, technical articles from NDRE, books/articles on the company history and the defense industry in Norway and the US	8 interviews: managers and engineers from The Kongsberg Group, KDA and the Department of Defense (DoD)
RWS	Kongsberg Group Archive (KGA) 1987-2014: - Board minutes - Executive group minutes - Board minutes KDA - KPS internal documents	Kongsberg Protech: “Support material for project management of complex systems” 2010	Annual reports, newspaper articles, technical articles, historical works on the company	27 interviews with managers, engineers and people with insights into the company and the case (KW, Kongsberg Group, KDA, Kongsberg Protech and actors outside of the organization)
The Full Picture	Kongsberg Group Archive (KGA) 1987-2014: - Board minutes - Executive group minutes Kongsberg Maritime Archive (KMA) - Board minutes	Kunde&Co: “Purpose of the project” Stenar Sælid: «P16, Internal project minutes” 1984	Annual reports, <i>The Full Picture Magazine</i> (commercial company magazine), Kongsberg Group Web: Press release and stories Other commercial product documents, books/articles on Norwegian maritime IT-industry (the companies in Kongsberg Maritime)	16 interviews with managers and engineers from KW, the Kongsberg Group and Kongsberg Maritime

The table shows that the priority and weight given to the sources used in the three papers has varied, depending on the access to sources and the size of the material, as well as the result of the reconstruction process. In this sense, the archive material has not, as many historians claim, defined the narrative. It is rather the result of the triangulation process that has defined the final narrative.

While we historians triangulate different sources to gain a more complete picture, and thereby seek multiple perspectives before drawing conclusions, we also deliberately select the perspectives that are deemed most relevant to answer the problem at hand. Lipartito explains this in a way that is particularly relevant for this thesis (2014, p. 290):

To learn about innovation in a large corporation, one might focus only on the engineers and technologists, not because they are correct or more truthful, but because their perspective may reveal the problems of translating technical knowledge into commercial products within a large corporate bureaucracy.

In my work to explore how the Kongsberg Group has succeeded with innovation I have mainly combined two different perspectives from the sources. The first is the “managerial perspective”, how the top management evaluated the corporation’s opportunities in the market, the company’s core capabilities and how this shaped the company strategy across different product areas. The second is the “engineering perspective”, meaning what and how the engineers have thought about the organization’s capabilities in relation to both product development and innovation (market breakthroughs). I have traced the first perspective mainly from archival documents and oral history interviews, while the second perspective was found in project-documents and oral history interviews. I have concentrated on these perspectives because I believe they represent two sides that are important if one wants to understand innovation processes in this industrial context. It is the top managerial level that makes decisions and sets the overall strategy, but it is the engineers who develop the systems and work closely with the customers. The characteristic managerial style in Norway, with a low hierarchical structure and highly empowered engineers, also means that these two levels are equally important to capture.

Interpretation

The findings from this thesis have emerged from my interpretation of how innovation processes unfolded in different parts of the Kongsberg Group. The key to this interpretation,

and to historical interpretation in general, is the relationship between the source material and the context in which it is understood, also referred to as hermeneutics (Grondin, 1994 in Kipping et al., 2014). Hermeneutics involves going back and forth between the sources and the context, understanding one in relation to the other. This process is often conducted through the creation of narratives—which is an important way to interpret and present historical research (Decker, 2013; Rowlinson et al., 2014). This is because it is in the process of constructing and re-constructing a narrative that we get an in-depth understanding of how one or several processes unfolded. By grouping together events, actors, and actions, and looking at motives, meanings and causes, we establish relationships, sequences, and consequences between them (Fellman and Rahikainen, 2012). As we move back and forth between sources and context, we might also adjust our research questions to include new discoveries (Lipartito, 2014). Once the narrative is as complete as possible, when the level of saturation from the sources is reached, the narrative is often shaped on the basis of the topics or themes that have sprung up from the material as particularly important (Andersen, 2013; George & Bennett, 2005).

While the practice of constructing narratives has received enormous attention in historiography and the philosophy of history over the last decades, Popp and Fellman (2017) describe how it has struggled to find recognition in business history. This seems to be related to different perspectives on the role of the narrative, whether it is simply a means to communicate ‘the story’ as it happened (an objective narrative approach), or whether the very writing of the narrative itself is central to the production of historical knowledge (narrative composition as analytical method) (Popp & Fellman, 2017, pp. 5-6). While I can relate to the notion that business history work to document and uncover the truth, and that this is presented to an audience through the form of narrative text, I acknowledge that the narrative plays a bigger role than simply to communicate history. It also represents a way to interpret the historical material, and we must acknowledge that the particular way we do this means that the narrative is constructed by the historian.

As noted by Wadhvani (2016a), the interpretative process in historical research also involves considerations of whether the evidence when seen together demands a revision of the established historical narrative or what the case itself was about. When we wrote the corporate history of the Kongsberg Group, we also wrote about the RWS contract that Kongsberg Protech had won, and how this weapon station was industrialized very quickly to become a large source of income for the corporation. As I started to re-investigate this case as

part of my own PhD project, I carried out several new interviews and gathered more empirical material in the form of reports and project documents. This provided me with new insight and a much better understanding of the way this project had emerged and developed over time, under the influence of different parts and levels of the organization. As I wrote and re-wrote the narrative on the RWS-case, I began to realize that what had happened during this process seemed critical for the development of a new understanding in the Kongsberg Group about the organization's own capabilities. And that the learning curve between different contracts had been steep in terms of how the company had positioned itself with regard to its American customers and its international competitors. This insight also influenced my perspective on the two remaining case narratives. Once I had finished and compared the narratives of the three cases I found that how the Kongsberg Group understood its own systems integration capability, how it evaluated its own advantages and how it communicated these aspects was also integral to the achievement of commercial breakthroughs in different markets. I found different examples of this across the three papers. So, what type of contribution can I offer with these insights?

Context, generalization and extending theory

There has been an ongoing debate over many years regarding how business history can engage in the development of generalizations or attempts to verify specific theoretical claims (Clark & Rowlinson, 2004; Lipartito, 2014; Rowlinson et al., 2014; Suddaby et al., 2020; Wadhvani et al., 2020). Fellman and Rahikainen (2012) emphasize that most historians work with generalization to a certain extent, through the use of concepts and identifications of patterns and by finding and revealing as many interconnections as they can. The findings from historical research can therefore apply to specific contexts, and at the same time provide valuable insights into the many and complex interrelationships that exist in specific types of phenomena.

What I do in this thesis is to seek contextualized answers to theoretical and empirical research questions related to innovation, asked not just by historians, but by scholars in management and strategy studies as well. This is an area where in-depth historical case studies can play a powerful role, in spite of their small sample size (Andersen, 2013; Davis & Aggarwal, 2020; Foss & Linder, 2019). This is because historical methods are directed at exploring

phenomena, illuminating processes and meanings within a specific context, and studying change over extended periods of time (Yates, 2014, p. 267).

Individually all the three cases in this thesis are used to extend theories and assumptions related to innovation. In the Nasams-case this concerns the role of strategic alliances, and how and when these can contribute to commercial breakthroughs. The RWS-case serves to illuminate how companies operate dynamic capabilities, and to reject the notion that this phenomenon only emerges from the top down. In 'The Full Picture'-case it concerns our understanding of how the past can be used strategically. Together, the three cases also provide a synthesis of the innovative capability of the Kongsberg Group. In the final section of this thesis, I align and compare the findings of the three papers to see what they together tell us about Kongsberg Group in recent years. In this sense, I ascribe a representativeness to the three cases I have chosen, because I believe they capture the broader picture of what the Kongsberg Group has managed across its three subsidiaries in terms of strengthening the ability to carry out innovations in international markets. Working comparatively with three cases does not however, cover the entirety of the company, so this approach is chosen because it can add perspectives that complements prior research.

Critical reflections on the research process

In this methods chapter I have attempted to describe and elaborate on my research approach and the methodological choices that lie behind it. In this final section, I will comment on some of the challenges, weaknesses and ethical considerations that remain part of the thesis, and how I relate to them.

Possible bias from methodological choices

Zooming in on some cases ultimately involves leaving others out. That this study is based on the findings from three cases, demonstrates how the making of history also involves the silence of that which is omitted (Decker, 2013). This represents the first of several possible biases. Still, concentrating on a few cases was a deliberate decision, dependent on my choice to study the Kongsberg Group from a CoPS perspective, and also influenced by the time available and my access to sources. For reasons of secrecy and classification of information, I did not, for example, wish to engage in an in-depth case study on missiles where I knew that

almost all the documentation was clandestine. However, that decision does not rule out the fact that the overall conclusion could have been different had I included other, completely different, cases in this study.

This thesis is also biased for other reasons. I have mainly concentrated on the perspective of the Norwegian corporation, leaving out the point of view of the company's many customers and partners. I can partly defend this by the decision to concentrate on internal processes. Yet, I do not think it would have hurt my research if I had received more input from actors outside, especially those of the customers in the US. I have compensated for this in the Nasams paper by collecting sources reporting from the American defense industry online. In the source material from the RWS case I also got a lot of insights through reports and reviews on how the American customer viewed the process. In addition to this I interviewed people from outside the corporation, for example from research and development institutions, and these interviews have provided valuable insights on the company's different advantages, disadvantages, and positions from an 'outside' perspective.

Ethical concerns

Doing research is subject to both regulations and ethical guidelines. The Norwegian National Research Ethics Committees has provided guidelines for groups within different scholarly traditions. Guidelines for history are provided by The National Committee for Research Ethics in the Social Sciences and the Humanities (NESH, 2022).²⁰ When we conduct interviews as part of the historical material, we are subject to stricter regulations. To collect personal data in a research project in Norway, regardless of how it is used, requires notification to and approval from the Norwegian Centre for Research Data (NSD). The general research ethical guidelines state that one should not conduct research on groups or individuals unless they have explicitly consented to this. This approval must be freely given and informed. In an interview context this means that informants must know in advance the purpose of the interview and how the material from the interview will be used (Grove & Heiret, 2018).

This study has been evaluated and approved by the NSD. A formal statement was prepared and provided to the informants with information about the purpose and status of the project.

²⁰ <https://www.forskningsetikk.no/en/guidelines/social-sciences-humanities-law-and-theology/guidelines-for-research-ethics-in-the-social-sciences-humanities-law-and-theology/>

When the commissioned history project was over, and I continued on with my own PhD project, I had a meeting with the company to clarify my project plans and get approval to continue with my research as a PhD candidate. This was provided without further conditions.²¹ Due to the specific circumstance of the defense industry I was subject to a clarification by the Norwegian National Security Authority (NSM) prior to the commissioned history project. I believe this was important for the decision to allow me to continue my research and to access both people and sources from the company. I also made it clear that I was not interested in confidential information that could not be used for research, and that my primary goal was to explore innovation.

One conflicting interest emerged from the question of verifying sources in one of the papers. Research based on historical sources needs to be verifiable. One way to achieve this is through source transparency, linking claims and evidence to specific sources and documents. In historical research this is often done through the use of footnotes or references to sources in other ways (Lipartito, 2014). The expectation of source transparency does however make it difficult to uphold demands about confidentiality, which might be required in cases of contemporary oral history interviews, in particular revolving around defense industry-related questions, and the relationship between Norway and the US. This issue is why I have anonymized my informants in the paper based on the RWS-case (chapter six).

The next three chapters in this thesis comprise each of the three papers upon which this thesis builds.

²¹ This was provided by our former main contact in the organization, Even Aas, the Executive Vice President of Public Affairs, Communication and Sustainability, in May 2015.

5. Paper I: Strategic Alliances and Tactic Maneuvers: The Kongsberg Group's Path to Innovation in Air Defense, 1988–2015

Abstract

This article explores the role of strategic alliances for innovation in the context of the post–Cold War international defense industry. It does so through the study of the Norwegian defense company the Kongsberg Group and its subsidiary Kongsberg Defence and Aerospace (KDA) and its efforts to commercialize a new air defense concept through strategic alliances with US defense companies Hughes and Raytheon from the mid-1980s until 2015. By applying historical methodology, the article offers an important window into the complex processes of defense industry innovation, demonstrating the role of not only offset policies and competitive technology, but also deeper alliances based on complementarity and trust.

Keywords: Innovation, strategic alliances, defense industry, software technology

Introduction

The reshaping of the defense industry after the Cold War meant that existing defense firms had to find new ways to operationalize their big technology skills in an increasingly competitive and transnational market landscape. For many companies, strategic alliances became a key strategy to navigate the market and build competitive advantage (Butler et al., 2000; Kopač, 2006). While much of the literature on this industry has focused on explaining how and why firms engaged in different forms of alliances, the specific dimensions concerning how these alliances affected innovation remain underexplored (Bishop, 2003b; Bitzinger, 2009; Satta et al., 2015).

This article investigates the role of strategic alliances for innovation in the context of the post-Cold War international defense industry. It does so through a historical study of the Norwegian defense company the Kongsberg Group²², through its subsidiary Kongsberg Defence and Aerospace (KDA) and its long-term strategic alliance with American defense companies Hughes and Raytheon from the mid-1980s until 2015. Specifically, the article investigates how these alliances with the US defense industry were used to commercialize its new air defense concept, the National Advanced Surface-to-Air Missile System (Nasams). Innovation is thus understood here as the implementation of a new product system through market sale.

By applying historical methodology, this article provides important insights into the long-term aspects of innovation in the defense industry. Despite having developed a potentially revolutionary air defense concept, it took the Norwegian defense industry nearly 30 years to move the concept from an invention into an innovation. The analysis of this process is based on primary sources from the Kongsberg Group's corporate archive, secondary sources gathered from newspapers, journals, and books, as well as oral history interviews with some of the key figures in this narrative. The next section contextualizes the article, identifies a problem in the existing literature and clarifies why a business history perspective on this topic is especially enlightening. What follows is the historical narrative that reveals how KDA and its parent company the Kongsberg Group maneuvered to develop and sell its new air defense concept through its engagement in strategic alliances with large American defense

²² The Kongsberg Group is the successor after Kongsberg Weapons Factory (KW), a Norwegian weapons producer founded in 1814. When KW was dismantled and restructured in 1987, the defense segment of KW was reestablished under the Kongsberg Group, before becoming its own subsidiary as Kongsberg Defence and Aerospace (KDA) in 1997.

companies. Based on this historical material, the article introduces a temporal perspective on strategic alliances, demonstrating how a combination of offset policies, competitive technology, complementarity, and trust represented key ingredients behind KDA's export breakthrough with Nasams in the 21st century. A final section summarizes the findings and concludes the article.

Strategic Alliances and Innovation in the post-Cold War Defense Industry

Until the end of the Cold War, the defense industry was considered a highly innovative sector, and a driving force in technological development (Hughes, 1998). From 1946–1989, this development was strongly influenced by national investments in research and development (Belin & Guille, 2019; Mazzucato, 2015; Mowery, 2012). However, in the post–Cold War defense landscape, the foundational motivations for defense industry innovation changed. By the early 2000s, the industry showed strong consolidation—the result of declining defense budgets, rising development costs, and new exposure to open market practices. This resulted in a handful US and European megafirms dominating the industry as systems integrators and gatekeepers to the market (Amara & Franck, 2019; Guay & Callum, 2002; Lorell et al., 2002).²³

In this context, many European defense companies, especially from countries with smaller defense markets, focused on the collaborative approach of strategic alliances (that is, cooperative inter-firm agreements involving two or more companies) (Calcara, 2020). This configuration—“half-way” between full merger and licensing—offered advantages to these companies, such as the opportunity to protect key technologies and national identity, and to maintain control of key strategic decisions (Butler et al., 2000; Kopač, 2006). Strategic alliances thus became an alternative to the increasing consolidation of the defense industry, providing crucial support for innovation and competitive performance in small and large defense firms alike (Satta et al., 2015).²⁴

The literature on strategic alliances in the defense sector is however not clear on how these alliances have contributed to innovation (Bishop, 2003a; Satta et al., 2015). On one hand,

²³ These included Lockheed Martin, Boeing, Raytheon and Northrop Grumman, the European Aeronautic Defence and Space Company (EADS) (France, Spain and Germany), BAE Systems (UK), and the Thales Group (France).

²⁴ This was not just the case for firms within the defense sector, but a general trend in high-tech industries during this same period.

theoretical analyses of the industry point to the role of primary integrators as constraining on product innovation across the industry because their power imposes strong entry barriers on new component firms (Zervos & Swann, 2009). Existing research even indicates that collaboration has been used by primary integrators to uphold the status quo with their component suppliers, particularly by impeding their capacity to develop disruptive products on their own (Rao et al., 2019). While several European defense companies engaged in strategic alliances with US companies, many of these firms had to settle for only licensing their products, instead of selling them directly to the market, which would afford them greater profits (Kopač, 2006). On the other hand, studies have shown that strategic alliances in high-tech industries, including defense, are positively associated with innovative performance (Barbaroux, 2019; Das & Teng, 2000; Eisenhardt & Schoonhoven, 1996).

These conflicting findings on the link between strategic alliances and innovation can be attributed to the complexity of the sector itself, which is grounded in the strong regulations that continue to influence the defense sector. These regulations, in turn, invoke other mechanisms that affect the intersection of alliances, innovation, and technology. Further, it takes a long time to develop new products in the international defense industry, along with the elaborate efforts involved to sell them. Uncovering the focal relationships in these types of processes can be difficult without a long-term perspective.

This article applies a business history lens to learn more about the role of strategic alliances for successful innovation in the defense industry. While historical research on businesses and war has often focused on companies as inventors or producers of game changing weaponry (Lakomaa, 2017), much remains to be learned from defense industry cases about how diverse stakeholders can be innovative in times of industry transition (Raff & Scranton, 2017).²⁵ A historical approach is also an effective means to explore and navigate the role that trust plays in these relations. Indeed, it is difficult to measure or even discover the relevant trust relationships within a shorter timeframe. As noted by Panico in a recent article on strategic interaction in alliances, the development of trust takes time, and cannot be assumed at the outset. Rather, it is built from the strategic choices made by firms in the postformation of an alliance, a phase that is much less studied and understood (Panico, 2017). Historical

²⁵ See, in particular, the chapter by Martin Collins on the case of Motorola's Iridium Satellite Communications venture in the 1980s and 1990s.

explorations are advantageous in this context, providing opportunities to trace processes over time and to note various participating mechanisms (Bucheli & Wadhvani, 2014).

Alliance for New Product Development: From Noah to Nasams

By the early 1980s, Norwegian military authorities had spent two decades evaluating the country's options for acquiring a new and modern air defense system that could protect the country's airports and establish a reliable defense of NATO's northern flank.²⁶ Advanced simulations by the Norwegian Defense Research Establishment (NDRE) had demonstrated that to operate in the peculiar Norwegian topography, which was characterized by high mountains and deep valleys, a future air defense system should be mobile and internally connected by means of a modern digital communication system. After having eliminated several international candidates, the Royal Norwegian Air Force (henceforth, the Air Force) decided to create an adapted version of the old American Homing All-the-Way to Kill (Hawk) missile system—a Norwegian Adapted Hawk (Noah).²⁷

An air defense system consists of radar, a fire distribution center (FDC), a number of missiles, and launchers. When the radar detects a threat, the FDC analyzes the situation and communicates to the launcher if the missile needs to fire. The capabilities of the missile are critical to the capacity of an air defense system, as is the radar. However, the FDC is the key to the overall system performance. The idea behind Noah was to develop a new and flexible FDC adapted to specific Norwegian needs, but compatible with missiles and radars currently on the market. If the Air Force could acquire an FDC system with this capacity, Norway could lease missiles and radars from the US and assemble a new air defense system at considerably lower cost than previously evaluated systems. The question then remained, who could develop the system?

Compared to defense industries in the other Scandinavian countries, the Norwegian industry occupied the middle ground (Castellacci & Fevolden, 2015). It was larger and more

²⁶ Skogen, E. (red.) (2003). *Luftvern og sårbarhet av flystasjoner. Olje, gass og norsk sikkerhet. (Fra forsvarets forskningsinstituttts historie, nr.8)*. Forsvarets forskningsinstitutt.

²⁷ Bjørn Abrahamsen (2015), "Historien om luftvern på Kongsberg/The history of air defense in Kongsberg", unpublished draft/manuscript documenting the history of air defense in KDA from the 1960s until early 2000s, written by a former employee of KDA. The manuscript is based on personal notes, interviews with the key figures involved in the development and sales of Nasams, archive material from KDA and secondary material. The project was initiated by a former CEO of KDA to document the history and background for Nasams while the people involved in the early phases were still present to tell it.

diversified than the Danish defense industry, but smaller and more narrowly focused than the Swedish industry. Sweden had developed its industry early on to be self-sufficient with regard to defense equipment, whereas Norway became a member of NATO in 1949. It could therefore depend on other member countries for access to large military acquisitions. The Norwegians nevertheless recognized the need for defense equipment adapted to specific Norwegian requirements, as well as high-end military technological expertise (Wicken, 1984; Wicken, 1990). After WWII, Norwegian governments therefore put major effort into transforming the old, state-owned weapons manufacturer Kongsberg Weapons Factory (KW) into a high-tech company that could implement this intention in the ensuing years (Øyangen, 2014).

From the 1960s, the Norwegian Department of Defense (DoD) increasingly worked to include the country's defense industry in its large military procurements. Nevertheless, KW often ended up with only licensed production of technology and products developed by Norwegian research institutes like NDRE, or large international companies, with few opportunities to develop and export its own technology (Njølstad & Wicken, 1997; Øyangen, 2014). Thus, in 1983, after witnessing almost twenty years of studies and analysis of the requirements of a new national air defense system, KW made an important strategic decision. It would fight for the opportunity to develop its own technology for Noah, so that it could later pursue the export market with this technology. Key to this strategy was collaborating with an American defense company to develop and produce a Norwegian air defense solution that they could then export together.²⁸

Hughes, the American helicopter and missile producer, was a shortlisted candidate for the Noah program, based on its competence in radars and its role as the producer of Hawk missiles. KW proposed to Hughes that they cooperate on the Noah program, as it already had a close relationship with this American company from years of collaborating on NATO programs for command, control and information systems. KW sought, in particular, to develop a combined FDC and radar system (an Acquisition Radar and Control System). The idea was that the Norwegian company would take full responsibility for the FDC, while Hughes developed a new seeking radar and took responsibility for integrating the Hawk missiles into the new system. It was a bold suggestion from KW, but the company eventually convinced Hughes, and then the Norwegian government. Early in 1984, Hughes and KW won

²⁸ Abrahamsen (2015), "The history of air defense in Kongsberg" (unpublished draft/manuscript).

the contract for Noah and shortly thereafter established a joint venture to collaborate on the program (Øyangen, 2014).

In 1988, Noah was officially approved by the Norwegian Air Force supply command.²⁹ The timing was important. In 1987, KW was restructured after a financial crisis.³⁰ In this process, large parts of the company were sold, but not the defense segment. This part remained under state ownership and was re-established as a new company, eventually known as the Kongsberg Group. The news about Noah was important because it contributed to solidify the decision that was made to keep the defense technological milieu after KW intact, under the new organizational structure of the Kongsberg Group (Sogner & Petersen, 2014).

While the news about Noah was crucial for the defense of northern Norway, the Air Force knew when conceptualizing Noah that the next air defense system would need stronger firepower and more flexibility than the Hawk missiles offered, especially if it was intended to protect all parts of the country. The old air defense system, Nike Hercules, which still protected the Southeastern parts of the country, including the capital of Oslo, also needed replacement. To meet this need, Lieutenant Colonel Jan Hovland, the architect behind Noah and head of the weapons division with the Air Force supply command, identified Hughes' upcoming Advanced Medium Range Air-to-Air Missile (Amraam) as a candidate for future upgrade of Noah.³¹ The future came sooner rather than later. Shortly after Noah was deployed in Norwegian terrain, Hughes and the Kongsberg Group signed a new contract with the Air Force for the development of a Nasams, adaptable to Amraam missiles.³²

In 1989, the Norwegian company participated for the first time in the large international aircraft fair, the Paris Airshow, where it demonstrated its Noah FDC together with Hughes' Hawk missiles. Although this experience clearly demonstrated how small the Norwegian defense industry was in an international context (for instance, the Norwegian pavilion measured 250 m² compared to Canada's 2000 m²), the Norwegian system nevertheless

²⁹ «Luftforsvaret erklærer NOAH overleveringsprøve fullført og bestått», *NFT i fokus*, Nr.2 Mars 1988.

³⁰ In the decades following WWII, KW had expanded its business to include production of electronic equipment and components for a number of different industries like the car industry, the maritime industry, offshore oil production, aircraft engines and so forth. Over time, this diversification made the company fragmented and difficult to operate. In 1986 and 1987, the company was dismantled after a financial crisis unveiled KW was facing massive losses and was near bankrupt. See Øyangen, K. E. (2014). *Moderniseringslokomotivet : 1945-1987* (Vol. 2). Pax.

³¹ Amraam was a new generation missile with active radar target-detection, enabling the missile to "fire-and-forget," thereby making it possible for the soldiers to fire multiple targets simultaneously.

³² Gunnar Berge, «Viktig kontrakt til NFT» *NFT i fokus*, Nr.6 Desember 1988.

attracted attention; this gave the Kongsberg Group an opportunity to tell other nations about the development of Nasams. This was during a period when many countries were analyzing concepts for the next generation of air defense systems.³³ Norway, it seemed, had actually made real strides toward conceptualizing this next level air defense system.³⁴

Notably, from the late 1980s, the Kongsberg Group had taken part in a subgroup within the Independent European Program Group (IPEG) in NATO—a study collective focused on the possibilities of replacing the American Hawk system with a European system by 2010. IPEG uncovered two crucial facts that impeded the creation of such a system: (a) too many national programs were underway, and (b) too many different views were in play about what was appropriate to achieve this end. For Norway, it was unacceptable to wait until 2010 to roll out a new air defense system, but the country remained in the group to “observe.” This participation provided the Kongsberg Group with important access to industry information and an opportunity to build new relations within NATO. The company also got a chance to market Norwegian ideas about the need for an air defense system that was open for integration with different systems.³⁵

Under the heading: “Norway as Rocket Pioneer,” Norwegian newspaper *Aftenposten*, stated in the summer of 1989 that the country was becoming a global leader in developing the world’s most advanced surface-to-air missile system, which could potentially replace the old Hawk system by 2000.³⁶ According to Lieutenant Colonel Hovland, several NATO countries had shown an interest in the new concept. Applying Amraam missiles in an air defense system represented a completely new approach: air-to-air missiles would be fired from a launcher on the ground instead of from an aircraft. This had hardly ever been done before. Whereas a Noah battery contained one radar, one FDC, and three launchers with three missiles each, a Nasams battery would have three radars, three FDCs, and nine launchers with six missiles each, meaning a single battery could contain up to 54 missiles.

After running air attack simulations based on the Norwegian landscape, NDRE concluded that Norway needed an air defense with increased mobility and greater distances between

³³ Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript).

³⁴ Andersen, J. E., «At Paris Air Show», *NFT i Fokus*, Nr. 3 July 1989.

³⁵ The experience from IPEG led to a tighter coordination between the Norwegian DoD, The Air Force, and KDA in searching for ways to market Noah /Nasams on the international market. Bjørn Abrahamsen was KDA’s representative in this group from 1989 and he writes in detail about this experience based on his own notebooks from the time.

³⁶ Guhnfeldt, C., «Norge som rakett pioner» *Aftenposten*, July 13, 1989.

components. NDRE noted that this could be achieved by developing an area defense system where the components were internally connected through a real-time network.³⁷ Thus, if one or two radars or FDCs were destroyed or lost connection, the real-time network would allow a remaining FDC to take over and secure the capacity of otherwise disconnected launchers. Based on NDREs simulations, the Kongsberg Group, NDRE, and the Air Force cooperated in developing a military network for Nasams, allowing the different units in the system to exchange information in real time and obtain the same version and image of the situation (Sogner & Petersen, 2014).

Since air defense systems are destined for a long life, the management recognized early in the development of Nasams that this system would require constant upgrading, concurrent with the rapid development in information technology. This demanded the development of new software, as well as new hardware that could meet the increased need for computer power.³⁸ An important change here was that the computer hardware was not designed by the company itself, which had previously been the case under KW.³⁹ KW's engineers had been engaged in developing and building hardware components for different product areas since the 1960s (Øyangen, 2014). Until Nasams, building computers had been one of the company's core competencies, and one of the things that qualified it to develop advanced military equipment. With the development and growth of the commercial electronics industry in the 1980s however, the quality and price of computers off the shelf made them increasingly attractive to employ, even in protected industries like defense.⁴⁰

What strengthened this change taking place between KW and the Kongsberg Group toward commercially developed components was a new generation of software engineers who began their careers working on Noah in the mid-1980s. Many of these people had been recruited directly from the Norwegian Technical University in Trondheim and shared an understanding that it was through software, not hardware, that new technology was built (Sogner & Petersen, 2014). In the early 1990s, several of these engineers got involved in an internal projects under the Kongsberg Group to design new software that could align with the Nasams concept. The result was a software program named Compas, which had an open source

³⁷ Skogen, E. (2003). *Luftvern og sårbarhet av flystasjoner* (Fra Forsvarets forskningsinstitutt historie, Issue.

³⁸ Interview with Harald Ånnestad, February 20, 2014.

³⁹ Interview with Nils-Oddvar Hagen, April 11, 2013.

⁴⁰ Kongsberg Group Archive (KGA), File: Industrial development: Svein Arild Langelø, «NFT goes for future oriented information technology—new opportunities in commercial” Presentation at the Technology seminar February 2, 1995.

architecture that made it possible to add new capacity to the system over time as well as to adapt it to different components—a critical feature.⁴¹ The impetus behind Compas came from the need to secure greater computing power and to avoid the costs and risk associated with unique established interfaces that were difficult to upgrade. Further, the program also enabled the FDC to be integrated with Hawk and Amraam missiles, along with other types of missiles, radars, and sensors.

Nasams at this time was unique both because of its increased firepower, but also because of the system's flexible architecture (its adaptability with other components), which represented an important innovation. Two distinct aspects of this innovation embody the Kongsberg Group's embrace of new opportunities based on commercial technology: (1) The company shifted from building computers with internally developed electronics to applying off-the-shelf equipment. This gave Nasams FDCs better capacity to calculate and to present information graphically, in addition to lowering costs for hardware development. (2) The company established reuse and standardization of defense software programs, an idea grounded in software systems designed to be modular and interchangeable.⁴²

In 1992, the company attended the Farnborough International Aerospace exhibition in the UK to demonstrate Nasams. Hughes and the Kongsberg Group had an agreement with Siemens Plessey Radar in Britain to compete for the delivery of a new air defense system to replace the British Bloodhound from the 1950s.⁴³ Following the exhibition, the participants from the Kongsberg Group reported that the Norwegian system was considered a unique concept across the globe; additionally, several countries had showed an interest, including the UK Air Defense.⁴⁴

The first version of the Norwegian Advanced Surface-to-Air Missile System was rolled out in Rygge airport in December 1994. The ceremony received major coverage from the Norwegian press, instigated by the Air Force. The military had spent 4 billion Norwegian kroner (NOK) acquiring a new anti-aircraft defense system and aimed to demonstrate why this was money well spent. Journalists from Norway's biggest newspapers learned that Nasams represented a completely different form of firepower than earlier air defense systems,

⁴¹ Interview with Eirik Lie, April 14, 2014; Interview with Gunnar Berge and Bjørn Abrahamsen, March 10, 2013; Interview with Harald Ånnestad, February 20, 2014.

⁴² KGA, File: Industrial development: Svein Arild Langelo, «NFT goes for future oriented information technology—new opportunities in commercial» Presentation at the Technology seminar February 2, 1995.

⁴³ Tore Sannes, «Tilbud på luftvern til Storbritannia», *NFT i fokus*, Nr.1 juni 1991

⁴⁴ Tor Erik Langrind, «Farnborough International», *NFT i fokus*, Nr.4 desember 1992

and that the system was the most advanced in the world in terms of technology and capacity.⁴⁵

In the hangar at Rygge airport, journalists and civilians from Norway and abroad were invited to close-up investigations of the various components in Nasams. Inside the FDC, a box the size of a shipping container, they could explore screens with joysticks that were hardly distinguishable from those used to play computer games. However, the officer inside assured the audience that no military secrets were revealed, despite this astonishing openness. The secrets were well hidden within the electronics and in the software program—and no one was demonstrating that.⁴⁶

A New Alliance Formed Through Offset, 1994-1998

By the mid-1990s, the Kongsberg Group was confident about exporting its new air defense system with Hughes. However, every time they attempted to market Nasams internationally, they encountered a powerful opposition from the American company Raytheon and the US Army Missile Command (Micom). Norway also wished to sell an adapted Hawk system, but it was impossible to complete a sale—even though 23 NATO countries possessed old Hawk systems.⁴⁷ According to Harald Ånnestad who managed the international marketing of Nasams at that time, the company later realized it had approached the task too aggressively; it had criticized Hawk instead of focusing on the competitiveness of Nasams. Once the company understood this tactical error, it “changed the sales pitch to Hawk-evolution, not revolution.”⁴⁸ Unfortunately, the new tactics still did not open up sales.

While Raytheon continued to challenge the Norwegian company, Micom was interested in learning more about the Norwegian air defense program, particularly its solutions for surface-launched Amraam.⁴⁹ It is likely that these different attitudes were both related to the US Army’s plans for an air defense program called CORPS Surface-to-Air Missile (SAM) system that could replace the old US systems (including Hawk).⁵⁰ The grand idea was that

⁴⁵ Olav Trygge Storvik, «Verdens mest avanserte rakettbatteri i sin klasse: Nytt våpensystem til Norge», *Aftenposten*, 6.12.94, Stål Talsnes, «Norsk pangnyhet», *VG*, 6.12.1994

⁴⁶ Olav Anders Øvrebø, «Bedre luftvern til fire milliarder», *NTB* 6.12.1994

⁴⁷ Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript).

⁴⁸ Interview with Harald Ånnestad, February 20, 2014.

⁴⁹ Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript).

⁵⁰ KGA, File: Defense, air defense: «Safe Air 1995» 4.8.1995

CORPS SAM would operate together with other weapon and control systems, as a distributed network-centric system, a familiar idea in the Norwegian air defense milieu.⁵¹ CORPS SAM was not planned until 2005, and by the mid-1990s, the system was pending Congress approval for financing.

The Kongsberg Group realized it was impossible to compete with Raytheon's well-established market apparatus and strong support from the US government.⁵² Although Nasams was qualified through the Norwegian Air Force program, the system's future market potential was clearly dependent on a "seal of approval" from a leading Western country, preferably the United States.⁵³ The company therefore tried to negotiate an agreement where Norwegian components could be part of a new American air defense system. Regardless of massive network-building efforts, Raytheon refused to cooperate with the Norwegians, even though Raytheon admitted that the Kongsberg Group was two to four years ahead of the company's own development in command and control.⁵⁴

The recognition soon dawned among Norwegian politicians that even its largest defense company would have a hard time competing under these conditions. Another concern also emerged: that without participation in broader defense industrial collaborations, the Norwegian defense industry could be cut off, leaving the Norwegian military unable to get its material needs covered (Sogner & Petersen, 2014). In 1995, the Norwegian DoD therefore presented a new strategy for defense procurements and sales involving a larger role for the national industry.⁵⁵ This change would enhance opportunities for export of the industry's niche products, coupled with the government's intensified efforts to support the industry through offset agreements related to future military acquisitions. In addition to direct sales, these agreements could be used to create strategic alliances and collaborations between Norwegian and foreign defense companies, a means to access otherwise closed markets in Europe and the US.

This new strategy to support the defense industry was by no means given. It was introduced only a few years after the Kongsberg Group had become stock listed and partly privatized, a

⁵¹ Micom had visited Norway in 1982 because the country was far ahead in developing the next generation, networked air defense systems. Abrahamsen, B. (2015), "The history of air defense in Kongsberg" (unpublished draft/manuscript).

⁵² According to SIPRI, in 2002, Raytheon was the fifth largest arms-producing company in the world, whereas KOG (KDA) was the 95th. www.sipri.org

⁵³ KGA, File: Defense, air defense: «Safe Air 1995» August 4, 1995.

⁵⁴ KGA, File: Defense, air defense: «Safe Air 1995» August 4, 1995.

⁵⁵ St.prp. nr.48 (1994–1995) (Proposition to the Storting)

development signaling the opposite—a gradual detachment from the state. However, in the mid-1990s, Norway was also in the market for new air-to-air missiles for the country's F-16 aircrafts, and the Norwegian DoD was actively evaluating candidates for this purchase. During a visit to the US in the fall of 1994, representatives from the Norwegian DoD made it clear to American defense suppliers that an opportunity for industrial cooperation between Raytheon and KDA would affect the choice between American and French missiles.⁵⁶ While Hughes had developed Amraam, the company shared a production contract with Raytheon; the Norwegian DoD wanted to leverage the fact that its potential purchase of Amraam missiles would make Norway the biggest user of these missiles outside of the US. Norwegian defense authorities therefore continued to push for an industrial countertrade agreement from the US and Raytheon, in exchange for its purchase of Amraam missiles.⁵⁷

Hughes also promoted the Norwegian case. In 1995, after many years as bitter competitors in missile manufacturing, Hughes and Raytheon were engaged in discussions about teaming up for the CORPS SAM program.⁵⁸ In this new dialogue on air defense, Hughes lobbied to include the Kongsberg Group and Nasams in a future cooperation. Raytheon however continued to resist. Through Hughes, KDA learned that one reason Raytheon was resistant to Nasams was the FDC size. It was too big to be carried on the high mobility multipurpose wheeled vehicle (Humvee) used by US Army in the field.⁵⁹

With this information at hand, the Kongsberg Group decided to spend its own resources to develop a prototype for a new type of FDC, a mobile Air Defense Operations Center (ADOC) that could fit into the back of a Humvee.⁶⁰ Based on off-the-shelf solutions and its own flexible software architecture, the Norwegian engineers redesigned the existing FDC under the lead of Harald Ånnestad and his air defense team, employing a hybrid concept Hawk/Amraam solution that was adaptable to both Raytheon's old Hawk system and Nasams. The new ADOC was the result of a rapid prototyping process; in other words, it was far from ready, but sufficient to demonstrate its capabilities. After seeing a demonstration of the new prototype, Raytheon agreed that it could work in a joint air defense system. The

⁵⁶ KGA, File: Defense, air defense: "Visit with Hughes og Raytheon September 23–27 1994» Travel report from Bjørn W. Bjune, November 7, 1994.

⁵⁷ Interview with Leif Linbäck, March 21, 2014.

⁵⁸ "Teaming arrangements due next week: Army Taps Lockheed Martin, Hughes-Raytheon as Corps Sam Contractors" (1995), *Inside the Army*, 7(41), 1–2.

⁵⁹ Abrahamsen, B. (2015), "The history of air defense in Kongsberg" (unpublished draft/manuscript).

⁶⁰ Kongsberg Group, *annual report* 1995, 42.

company also agreed that the prototype could be shown at the Safe Air exhibition in Alaska in August 1995.⁶¹

During that exhibition, four Amraam missiles were successfully fired from a modified Hawk launcher, controlled by the Norwegian-developed ADOC.⁶² Shortly afterwards, Raytheon, Hughes, and the Kongsberg Group signed a Memorandum for Record, stating that the companies “together as team members, will pursue the worldwide MSAMs market. [Furthermore,] no company will promote competitive MSAM products, with the single exception of CORPS SAM, which H&R [Hughes and Raytheon] Company is jointly pursuing.”⁶³

In March 1996, the memorandum was followed up by an exclusive ten-year teaming agreement that finalized the joint marketing of a Nasams, consisting of the Kongsberg Group’s new ADOC, an MPQ 64 radar from Hughes, and a modified Hawk launcher from Raytheon (combined with either Amraam or Hawk missiles). According to the agreement, all parties could operate as the primary integrator on a sale. The US market was however excluded from the agreement. As a Norwegian company, the Kongsberg Group was subject to strict weapon export regulations (Wicken, 1992). The agreement nevertheless accepted that the Norwegian’s could deliver modules and components to American partners and that the end systems in this collaboration could be sold according to American export regulations.⁶⁴

In 1997, Raytheon bought Hughes, among several new acquisitions. The Kongsberg Group thus found itself alone on the doorstep to a partnership with one of the world’s largest defense and aerospace companies, a situation that came with both significant risk and opportunity. Engaging in such a strategic alliance represented an alternative to the fast-growing mergers and acquisitions that were taking place in the industry. At the same time, the Norwegian company’s position was in no sense considered safe. Moreover, the teaming agreement between Raytheon and the Kongsberg Group met opposition from a broad range of actors within the US defense industry, including forces within Raytheon itself.⁶⁵

⁶¹ Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript).

⁶² Cohen, J. (1996). “Raytheon, Hughes merge with Norwegian company: Hawk-Amraam Medium Air Defense System to go on International Market”. *Inside Missile Defense*, 2(17), 11–12.

⁶³ Memorandum for Record 9.8.95, cited from Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript); KGA, File: Defense, Air defense. «Safe Air 1995» August 4, 1995

⁶⁴ Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript).

⁶⁵ KGA, KDA board Minutes: “STP 2000”, June 13, 2000.

While Hughes had been preoccupied with the opportunity to sell Amraam missiles worldwide, people in Raytheon and Micom were more concerned about selling the remaining Hawk equipment and developing CORPS SAM.⁶⁶ The US Army refused to provide the Kongsberg Group with the necessary software data to integrate the system, while Micom itself made a point of challenging the Norwegians to hand over sensitive data that controlled the interface between the new ADOC and Amraam missiles. In the spring of 1997, the Norwegian DoD, represented by Head of Material Leif Lindbäck, again stepped up on behalf of the Norwegian government to support the Kongsberg Group. In a letter to the Under Secretary of Defense Acquisition and Technology, Dr. Paul Kaminski, Lindbäck wrote:

I am disturbed by the fact that the progress in developing the HAWK/AMRAAM system and fielding of a credible system to the international market, is being set back by inability to resolve issues with the U.S. Government, specifically the U.S. Army. The team needs access to technical data relating to the HAWK system as well as close co-operation with the U.S. Army to offer the HAWK/AMRAAM system or subsystem components to foreign countries, either through the FMS or FMF procedures. Despite numerous initiatives, including the willingness to provide Norwegian developed software as a quid pro quo and mutual benefits from such co-operation, limited progress has been made during the last 13 months.⁶⁷

The letter appeared to have an effect, as not long after it was sent, the Kongsberg Group received news that the information necessary for integrating the Norwegian ADOC with the American Hawk was on its way. The Norwegian defense company had learned through its former alliance with Hughes that it had the technological capabilities necessary to deliver at an advanced level, even though it was the smaller actor. It also had the agility to deliver results rapidly, an attribute much valued by its partners. The Kongsberg Groups agreement with Raytheon was nevertheless forged in a different political and economic context than the partnership between KW and Hughes and was characterized by the more competitive climate of the post–Cold War. Raytheon was also a markedly larger company and a major integrator in the industry, which put pressure on the Norwegians to demonstrate their compatibility, notably within the technology.

The climate of the post–Cold War was also the backdrop of a number of civilian oriented acquisitions made by the Kongsberg Group during the 1990s. New purchases in the maritime

⁶⁶ Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript).

⁶⁷ Letter from Leif Lindbäck FD to Dr. Paul Kaminski. April 30, 1997. Archive central marketing KDA, cited from Abrahamsen, B. (2015), “The history of air defense in Kongsberg” (unpublished draft/manuscript).

segment resulted in a divisionalization into two subsidiaries under the corporate organization in 1997, Kongsberg Defence and Aerospace (KDA) and Kongsberg Maritime. For the defense segment in the Kongsberg Group, this allowed for greater independence, responsibility, and financial control. It was also a signal that the Kongsberg Group had chosen to concentrate strongly on specific niche products within these two segments, command and control in air defense being one of the most significant.

The Effect of Competitive Technology, 1999–2004

Though the partnership had a rough start, the attitude of Raytheon soon changed from reluctance to active cooperation. Several factors account for how and why the collaboration between Raytheon and KDA was strengthened in the early years of the 2000s. First, Raytheon was excluded from the former CORPS SAM program, which had evolved into the US–European program Medium Extended Air Defense System (Meads). In 1999, the NATO Meads management agency chose a Lockheed Martin–led multinational team for the next phase of the program.⁶⁸ While Raytheon initially contested that decision, it enabled Raytheon to concentrate on KDA and Nasams in a way that had not previously been possible or desirable. By then, KDA knew how demanding the Americans could be. In the words of Tore Sannes, head of KDA’s command and control unit, the Norwegian engineers “constantly needed to stretch upward [to meet this demand].”⁶⁹

The second factor that strengthened the collaboration between Raytheon and KDA was the international marketing breakthrough for Nasams in 1999, resulting in the first sale of an upgraded Hawk-delivery to Greece.⁷⁰ When, in the early years of the 2000s, this was followed by a general reduction in military procurement budgets worldwide, several countries reported an interest in upgrading their existing Hawk systems with what was now KDA and Raytheon’s solution.⁷¹ The new threat picture after the terror attack on the US on 11

⁶⁸ Sirak, M. (1999). Company Executive Calls Action 'Reprehensible': Lockmart Upset over Raytheon decision to Appeal Denial of Meads Protest. *Inside Missile Defense*, 5(17), 1-11.

⁶⁹ «Spennende internasjonalt gjennombrudd på luftvern / fokus, June, 1999», s.6-7.

⁷⁰ Kongsberg Group, annual report, 1999.

⁷¹ KGA, KDA board minutes: «STP 2001», May 22, 2001.

September 2001 solidified this trend and triggered an increased focus on the use of air defense systems to protect ground targets.

A third and final factor that affected the relationship between KDA and Raytheon in this context was KDA's early capabilities in network-centric technology, which corresponded to the new military doctrine centered on network-centric warfare (NCW), heavily propagated by the US military at the turn of the 21st century. This type of warfare put interoperability, and thus command and control systems, in the center of action. Advocates of network-centric warfare believed that improved communications networks and sensor technologies could allow new, more decentralized forces to work together as a system, increasing their effectiveness at traditional missions (Gholz, 2003). Having developed one of the world's first operational network-centric, ground-based air defense systems clearly strengthened KDA's case with Raytheon. Gholz and Dombrowski describe how proponents of network-centric warfare in the US were concerned with the ability of big defense companies like Raytheon and Northrop Grumman to deliver the necessary cutting-edge technology to fulfill the demands of the new military doctrine.

When he was President of the Naval War College, Vice Admiral Arthur Cebrowski traveled across the country playing the pied piper for his vision of NCW, and he became concerned early on that industry would not produce the cutting-edge technologies that he believed necessary for its implementation. As he reported to the authors, in his visits to firms like Northrop Grumman and Raytheon and to government organizations [...] he had been struck by how poorly their managers understood the concepts of NCW (Dombrowski & Gholz, 2006, p. 30).

Vice Admiral Cebrowski and many like-minded military analysts in the early 2000s argued that a transformation to network-centric warfare in the US could happen by reducing the role of the defense industry itself, to the benefit of leading commercial IT companies like Microsoft, Sun, and Cisco Systems (Stowsky, 2004). This view was also found in industrial policy reports from the office of the Deputy Under Secretary of Defense, looking to identify smaller, innovative, and emerging suppliers that could solve difficult defense problems in the future. According to Gholz and Dombrowski, this supposition did not prevail. Once the big players in the defense industry figured out the principles of network-centric warfare, they responded quickly and accurately to the demand for new technologies, and took up close work with Congress, specific military customers, and other firms to produce network-centric equipment, software, and services (Dombrowski & Gholz, 2006). Developing tactical network links quickly became a priority in the collaboration between KDA and Raytheon,

and Nasams' capability to communicate across countries and between systems on the ground and in the air became a key factor in the international marketing of the system.⁷²

Significantly, if cooperation between the two companies had ceased, KDA could have taken its concept to a competitor, or tried to sell Nasams outside the purview of a primary supplier, as the Kongsberg Group had originally planned in the early 1990s. This was possible because the software KDA had developed for the command and control system in Nasams was a so-called "plug and play" software, adaptable to any communication system. The flexible component-based open source architecture enabled interchangeability at a level not often introduced in defense contexts. This capacity represented, "the beginning of a productification of software" in the defense sector, according to software engineer and later CEO of KDA, Eirik Lie, and was thus a key component for future systems integration.⁷³ Consequently, military customers could buy and adapt the command and control system to reuse existing weapon systems—in theory, allowing for the practice of mixing and matching components, and thus tailoring the air defense system according to preferred products and national needs. Since the system was not confined to American Amraam missiles, it could be adopted to any mid-range missiles from a NATO aircraft, which could potentially challenge Raytheon's position as a primary supplier of air defense systems.

In February 2004, Raytheon and KDA signed a new 10-year contract for the international marketing of Nasams, this time including the market for American homeland defense. Raytheon's vice president, Dan L. Smith, explained this decision in the Kongsberg Group's (KDA's mother company) annual report: "The co-operation agreement with Kongsberg is one of the best strategic partnership agreements we have, which is why we have prolonged it until 2016."⁷⁴ Later that year, the US Air Force chose the Norwegian-developed command and control system with Amraam missiles to protect the airspace around the White House before the 2005 inauguration of President George W. Bush. The two companies also signed a contract that included KDA in the development of a new American air defense program for surface-launched (sl) Amraam. The top management in KDA travelled to the US with the CEO of the Kongsberg Group, Jan Erik Korssj  en, to participate in the official launch of this American system (Sogner & Petersen, 2014).⁷⁵

⁷² Interview with Eirik Lie, April 1, 2014.

⁷³ Interview with Eirik Lie, April 1, 2014.

⁷⁴ Kongsberg Group, annual report 2004, p. 45.

⁷⁵ KGA, appendix board minutes: "CEO operations report" by Jan Erik Korssj  en, May 3, 2005.

The reinforced collaboration between KDA and Raytheon from 2004 showed that the Americans were not only willing to remain a contract partner in the sale of Nasams, but that Raytheon had accepted KDA's command and control system as a key component in its own system. This clearly was important for how KDA and the Kongsberg Group developed its future strategy for technology sharing in the alliance with Raytheon.

Trust and Complementarity: Toward a Deep Strategic Alliance, 2005–2015

Shortly after the new agreement was signed with Raytheon, CEO of KDA, Tom Gerhardsen, presented the Norwegian company's strategic standpoint and reflections to the board of the Kongsberg Group. When discussing how and why KDA could succeed in a world of giants, Gerhardsen pointed out that from an international market perspective, the company was considered a harmless supplier of cost-effective solutions.⁷⁶ This was important, because regardless of its good relationship with Raytheon regarding the command and control for air defense (the Ground Combat Program), some actors of the American company were skeptical about allowing KDA to maintain a crucial role. KDA certainly believed some forces in Raytheon wanted to reduce the company's position to that of a sub-supplier, instead of a partner.⁷⁷ In KDA's experience, this echoed a general skepticism in the American defense industry about committing to and engaging in partnerships with small, and especially, foreign companies.⁷⁸

KDA saw its advantage in the role of a flexible and complementary component systems integrator. The company did not wish to dilute this position; rather, it aimed to demonstrate how this offered Raytheon a valuable asset. In particular, the goal was to have Raytheon perceive KDA as providing all necessary technology for the ADOC, such that Raytheon did not invest its own resources in this domain. Ideally, Raytheon would then focus on being a prime supplier and developer of missiles and radars.⁷⁹ Put simply, to avoid being outpowered, KDA needed to establish a complementary balance in its alliance with Raytheon.

⁷⁶ KGA, appendix board minutes: "Strategic standpoint and strategic decisions by Kongsberg Defence & Aerospace", by Tom Gerhardsen, March 17, 2004.

⁷⁷ Raytheon also explored the possibility of a partial purchase of KDA, but later withdrew from pursuing the idea further since the company itself was going through significant readjustments.

⁷⁸ KGA, appendix board minutes: "Strategic Standpoint and Strategic Decisions by Kongsberg Defence & Aerospace," by Tom Gerhardsen, March 17, 2004.

⁷⁹ KGA, Kongsberg Group Strategic Plan 2004–2009.

This goal shaped how KDA and the Kongsberg Group handled the demand in 2005 from the US government to give it access to its source code—a part of the Nasams software that contained a detailed description of the program—to be used in the development of the new American air defense system sl-Amraam. The demand was based on American claims that US military systems contained detailed classified knowledge; thus, integration work was limited to “US eyes only”,⁸⁰ and KDA would not be allowed to participate in the final integration of the American system. The company was instead asked to provide Raytheon with the source code to do so, even though KDA normally would not reveal this aspect of the software systems. However, to continue collaborating with Raytheon—and enter the US market—KDA had little choice but to engage in a trade-off: relinquishing the source code to get contract orders. In its evaluation, KDA noted the following:

Raytheon’s opportunities to misuse KDA’s technology and the value that can be achieved by this type of abuse, is considered small. Nevertheless, the source code does contain core competence that can be abused. KDA considers the commercial value of the collaboration well balanced against the risk, and that entering the revised agreement was necessary to protect our role in the international market.⁸¹

This line of reasoning reflects the fundamental dilemma faced by KDA—the desire to control the development and key technological assets of the company balanced against the need for a broader market access that could allow commercialization of its niche defense products (Jordan & Lowe, 2004). For this reason, KDA chose as its future strategy to be the most flexible and valuable partner possible, demonstrating its system competence and ability to develop software rapidly and economically, as well as its acceptance to share sensitive technology.⁸²

This decision underscored that KDA had to stay ahead in software development. The company soon recognized that advancements in computer capacity and interfaces happened rapidly and that it had to reinforce its capacity in this regard. In 2006, KDA acquired Canadian software company Gallium Software Inc, whose main product was InterMAPichs.⁸³ This software program could identify large numbers of movements at high speed in real time, a graphic tool used in military command and control systems. The capability was a key

⁸⁰ KGA, appendix board minutes: «Protecting KDAs IP Rights within Air Defense in Collaboration with Raytheon Company, USA», Tom Gerhardsen, August 15, 2005.

⁸¹ KGA, appendix board minutes: «Protecting KDAs IP rights Within Air Defense in Collaboration with Raytheon Company, USA», Tom Gerhardsen, August 15, 2005.

⁸² KGA, appendix board minutes: Discussion draft STP 2005–2010, June 21–22, 2005.

⁸³ Kongsberg Group *annual report* 2005, p.9. Gallium was purchased for approximately 174 Million NOK.

component in the provision of network-centric systems. Gallium's location and customer base were also strategically important. InterMAPichs was used by the American Marine Corps and Gallium had positioned itself to enter the Air Force program for sl-Amraam, where KDA was already heavily involved.⁸⁴

By purchasing Gallium, KDA signaled that it was confident about its position as a future global supplier of air defense systems. Participation in the American development of sl-Amraam boosted this confidence. In 2006, the company commented, "The agreement we have, and the relationship we have established with Raytheon seem to have secured us from competition from the American version SL-AMRAAM, because we are now a part of this."⁸⁵ Despite Raytheon's development efforts, the US Army did not receive the necessary funding to produce this system, and the US continued to deploy Nasams in 24/7 operation to protect the air space above Washington, DC, after 2006. This undoubtedly sent an important message to the global military market about the functionality and capability of Nasams to protect both civilian and military assets on the ground against threats from the air.

From the late 1990s until 2005, KDA sold its Nasams command and control system to Greece, Turkey, Poland, and Sweden, while Norway, Spain, and the US implemented the Nasams system with Amraam missiles.⁸⁶ Despite being an international sale, the Spanish implementation of Nasams arose from an offset agreement, which meant that it could not be used as a proper reference sale. With the news that Nasams had become the protector of the White House, a new phase in the commercial development of the system began.⁸⁷ Between 2006 and 2014, Nasams was sold to the Netherlands, Finland, Chile, and Oman. These sales were important because they were not due to offset demands from the Norwegian government; they also demonstrated the advantage of the dual-prime agreement between KDA and Raytheon. This agreement ensured that both countries could take the role as prime integrator in the sale of Nasams and thus adapt their marketing to the diverse political contexts of the countries in which they sought sales.

The impact of this agreement was exemplified in the sale to Finland in 2009, which was a highly political case. KDA's concept for Nasams had caught the interest of Finnish military

⁸⁴ KGA, appendix board minutes, KDA: «Gallium», January 5, 2006.

⁸⁵ KGA, appendix board minutes: STP 2006–2011, June 15–16, 2006

⁸⁶ The US implemented this in a limited version that covered Washington, DC.

⁸⁷ Interview with Finn Jebsen, February 8, 2019. For an overview of the growth in Norwegian defense export in this period, see Hove, K. H., & Pedersen, J. O. (2019). The Norwegian defence industry. In K. Hartley & J. Belin (Eds.), *The Economics of the Global Defence Industry*. Routledge.

authorities in the early 1990s, when the country began to prepare for its eventual replacement of Russian material. In 2003, Finnish Defence Forces visited KDA to assess Nasams. The Finns' awareness of the system's country of origin informed the marketing process that followed, in which KDA emphasized the opportunities that Nasams offered for closer and stronger Nordic defense cooperation (Sogner & Petersen, 2014).

When KDA delivered its bid for a medium range system to Finland in 2007, KDA was identified as the primary supplier of a Nordic air defense solution, leaving Raytheon as the sub-supplier of missiles. Two years later, Finland accepted the Norwegian bid. According to Eirik Lie, "The sale of air defense to Finland put KDA and Nasams on the map".⁸⁸ It reflected the company's strong position as a Nordic systems integrator, which demonstrated its compatibility with Raytheon in terms of market access. The sale to Oman in 2014 had the reverse representation: Raytheon operated as the prime integrator and provider of Nasams, while KDA represented a sub-supplier of Norwegian components to an American system. In the sale to Oman however, KDA's part of the contract was 3.7 billion NOK. To date, that was the single largest defense contract ever procured by the Norwegian company.

In 2015, Raytheon and KDA signed their third strategic agreement, extending the partnership another ten years. The new agreement was followed by sales to Lithuania, Indonesia, Australia, and Qatar from 2017 to 2020, bringing KDA new orders for more than 13 billion NOK. These latter sales made air defense the biggest sales driver in KDA at the time, and Nasams the most sold air defense system in NATO.⁸⁹ Significantly, it was first when Nasams was sold as an American system with Norwegian components that KDA began to profit on the system. This happened almost 30 years after its invention.

In the Pursuit of Defense Industrial Innovation: Lessons from Norwegian-US alliances

This article explores the role of strategic alliances for the international breakthrough of a Norwegian-developed air defense system. Through the means of a historical in-depth approach it provides insight into the complex, non-linear and political processes involved in defense industry innovation. The Kongsberg Group and KDA was dependent on both

⁸⁸ Interview with Eirik Lie, April 1, 2014.

⁸⁹ Per Erlend Dalløkken, «Solgte luftvern for 13 milliarder på tre år – Kongsberg tror det vil fortsette slik», *Teknisk Ukeblad*, February 11 2021.

external and internal factors to achieve the goal of successfully selling Nasams in international markets, findings that illuminate our understanding of different aspects of defense industry innovation.

The defense industry is a regulated industry, dependent on the size and direction of politically determined defense budgets. This has important implications for the opportunity of small country firms to develop and sell their own systems internationally. Over time, the Kongsberg Group essentially relied on two types of alliances to manage this: (a) a national alliance with the Air Force, the NDRE, and eventually the Norwegian DoD, and (b) an international alliance, first with the American company Hughes, and later with the American company Raytheon.

KW made the strategic decision already in 1983 to collaborate with an American defense company to develop and produce an air defense solution that could later be exported. Hughes turned out to be a good fit when developing its new command and control system. The mutual trust and experience from former collaborative efforts established a good climate for product development. However, size matters in defense. When the Kongsberg Group attempted to enter the international market with its new air defense system, Hughes was not a big enough partner to compete with US defense giant Raytheon. Ultimately, Raytheon itself was the better match for an alliance when it concerned the international sale of Nasams. These different partnerships demonstrate that strategic alliances can contribute to innovation in two distinct ways—as a platform for product development and/or as a platform for international marketing and sales.

While it became clear for the Kongsberg Group that Raytheon could also have much to gain from an alliance, it needed to acquire the political support from the Norwegian DoD to succeed. This support was crucial both in terms of establishing a formal agreement with Raytheon in 1996, and later in terms of getting the necessary access to begin the integration of the two companies' systems. Only by being politically and commercially pressured did Raytheon give in. It is interesting to note the symmetry in how the Kongsberg Group and the Norwegian DoD in these situations was standing up against Raytheon and American defense authorities, demonstrating how power was exercised through political constellations.

Being a relatively small defense component integrator, KDA from the early 2000s adapted its own position strategically to ensure successful international sales. It did so through even stronger commitment to its alliance than before, building on an increasing awareness of the

tactical measures it would demand. A key to achieve innovation in the hierarchical defense industry was to provide complementarity in technology and component delivery. As shown, this involved being willing to share sensitive technology with a partner, in example the source code to an important component. This was one of the most risky strategies a high-technology company could pursue as abuse was a risk, but it could also be considered among the most effective to establish trust and prevent Raytheon from investing its own resources in the technological domain of KDA. KDA's decision to share technology guarded against Raytheon developing a competing system of its own, safeguarding a common effort.

The long path toward innovation shows that while advanced technology was an important premise to participate in the post–Cold War international defense industry, the gradual breakthrough was achieved through conscious tactical and strategic decisions based on emerging situations over an extended period of time. The Norwegian company had to deal with geopolitical circumstances, a new US military doctrine, and the outcome of US defense procurement decisions. Finally, in the pursuit of defense industrial innovation, the trade-off between technology and market access made it more important for the Kongsberg Group and KDA to prioritize agility and complementary assets over the ownership to a potentially revolutionary new concept. This might sound defensive, but instead turned about to be a dynamic approach to market thinking—increasing the opportunities for both KDA and Raytheon.

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6. Paper II: Creating Room for Dynamism: A Multi-level Perspective on Dynamic Capabilities in Norwegian Defense Industry, 1997–2017

Abstract

This article examines how the integration of activities and perspectives from different organizational levels of a firm can help us understand how dynamic capabilities emerge and operate in mature firms. While past research has primarily emphasized either a macro or micro perspective to explain the emergence and enactment of dynamic capabilities, findings from a longitudinal case study of Norwegian defense company the Kongsberg Group illuminate how a meso project-level can be considered the focal link that integrates these two levels and provides important directions for future reconfiguration of resources. The article is founded on historical methods and analysis. It applies a historical narrative to explore the underlying microfoundational processes of dynamic capabilities (Teece, 2007). Specifically, the article argues that the adaptive capacity to take on new opportunities and successfully deliver lies in the room to maneuver at different levels of the organization, and that shifting organizational ownership is therefore pertinent to creating room for dynamic capabilities within mature firms.

Keywords: dynamic capabilities, project, systems integration, defense industry

Introduction

How do dynamic capabilities emerge and operate, and what is the role of different levels of an organization in this process? For years, strategic management research has argued that to be successful in global markets, firms must develop dynamic capabilities to respond to and shape changes in their environment (Eisenhardt & Martin, 2000; Teece & Pisano, 1994; Teece et al., 1997). There seems to be a consensus in the literature that dynamic capabilities reflect the capacity of firms to renew themselves by adapting to changing customer and technological opportunities, developing new products and processes, and designing and implementing viable business models (Schilke et al., 2018). However, where exactly in an organization the capacity to capture new opportunities and create change lies, and whether these capabilities are found in stable routines, or non-routine activities, is the source of ongoing debate (Salvato & Vassolo, 2018).

The purpose of this article is to examine how the integration of activities and perspectives from different organizational levels—a multi-level perspective—helps us understand how dynamic capabilities emerge and operate in firms. It does so through a longitudinal study of the Norwegian high technology defense company, the Kongsberg Group, through its subsidiary Kongsberg Defence and Aerospace (KDA) and its mechanical division Kongsberg Protech, in the period from 1997 to 2017. In the late 1990s, the Kongsberg Group and KDA was presented with what the top management found to be a highly unexpected opportunity to develop and sell remote weapon stations (RWS) to the United States (US) Army. At the time, RWS was not a product in KDA's portfolio, and yet within a few years, KDA had become the world-leading supplier of remote weapon systems to armed vehicles.

This study shows how this happened and discusses what this can tell us about how dynamic capabilities operate in mature firms. Specifically, the article examines how the process to develop RWS' was initiated at the individual level, executed and explored at the meso project level, and strategically adapted, modified and implemented at the organizational level—to become a platform for future product development in the Kongsberg Group. This is important because while previous studies have examined how dynamic capabilities emerge through either firm-level routines (Eisenhardt & Martin, 2000; Teece, 2007; Zollo & Winter, 2002) or individual managerial capabilities (Adner & Helfat, 2003; Eggers & Kaplan, 2013; Helfat & Peteraf, 2015; Teece, 2012), they have not looked at how initiatives and activities at the individual level are integrated through organizational means into firm-level capabilities, and

how this results in competitive advantage. As such, our understanding of dynamic capabilities remains incomplete (Arndt & Pierce, 2018; Bendig et al., 2018; Felin et al., 2012; Kay et al., 2018; Wilden et al., 2013). This article seeks to fill this gap by providing a more holistic understanding of how firms can create room for dynamism to emerge throughout multiple levels of the organization. The article thus contributes to the literature in strategy by providing more nuance to our understanding of how dynamic capabilities operate, showing how different organizational levels play unique roles in processes of sensing, seizing and reconfiguring.

The article is founded on historical methods and analysis. It applies a historical narrative to explore the underlying microfoundational processes of dynamic capabilities (Teece, 2007) in order to inform and extend existing conceptual claims about their workings. Historical methodologies are increasingly recognized as important for understanding critical aspects of strategic management theories (Danneels, 2002, 2011; Suddaby et al., 2020; Teece, 2012; Wadhvani & Jones, 2016). This is related to the acknowledgment that strategic change is not achieved in an instant but over time and through multiple steps (Schilke et al., 2018). Providing rich descriptions of the activities that generate dynamic capabilities, the processes through which they emerge, and the contextual features that drive or moderate these processes can therefore contribute to illuminate what dynamic capabilities are really about (Salvato & Vassolo, 2018).

The problem of rigidity and the promise of a multi-level approach to dynamic capabilities research

Helfat et al. (2009 p.4) define a dynamic capability as “the capacity of an organization to purposefully create, extend, or modify its resources base”. According to Teece (2007 p.1319-20) dynamic capabilities can be divided into the microfoundational processes (1) sensing and shaping opportunities and threats, (2) seizing opportunities, and (3) maintaining competitiveness through reconfiguring the business enterprise’s intangible and tangible assets. While there is consensus on the importance of dynamic capabilities for the competitive advantage of firms, the question has remained of exactly how firms sense and seize opportunities and reconfigure resources to create sustained competitiveness (Arndt & Pierce, 2018; Bendig et al., 2018; Felin et al., 2012; Kay et al., 2018; Wilden et al., 2013).

The basic premise in the dynamic capabilities' framework as developed by Teece and colleagues is that higher-level capabilities modify or influence lower-level capabilities, and through this enable firms to adapt to market changes in ways that bring about sustainable competitive advantage (Collis, 1994; Teece et al., 1997; Winter, 2003; Zollo & Winter, 2002). This perspective builds on the understanding that capabilities exist in hierarchies. Ordinary, operational or "zero-order" capabilities enable firms to perform their everyday operations (Cepeda & Vera, 2007; Zollo & Winter, 2002), while dynamic capabilities—also described as first-order, second-order or higher-order capabilities—represent the capacity of firms to adapt to rapid change and new opportunities through the development of new products, processes or business models (Danneels, 2008; Hine et al., 2014; Teece & Pisano, 1994; Winter, 2003).

Research has come a long way in recognizing the role that top management plays in enabling firms to leverage existing resources (Danneels, 2011; Danneels et al., 2018; Teece, 2007; Teece, 2012, 2014; Tripsas & Gavetti, 2000). Scholars have, for example, connected the cognitive capabilities of chief executive officers with the ability of firms to develop dynamic capabilities (Adner & Helfat, 2003; Andersson & Evers, 2015; Buil-Fabregà et al., 2017; Helfat et al., 2009; Helfat & Martin, 2015; Kor & Mesko, 2013; Schilke et al., 2018; Zeng & Mackay, 2019). This means that scholars have often investigated dynamic capabilities from different analytical levels, most often from the actions and perspectives of the top managerial level (Schilke et al., 2018). One consequence of this is that it has left little room to explore and understand the role that lower level individuals and collective action play for firm dynamics, for example how initiatives and activities at the individual level are integrated through organizational means into firm-level capabilities and how this results in competitive advantage (Felin et al., 2012; Foss, 2007; Lazonick, 2002; Nayak et al., 2020).

Ultimately, however, firm heterogeneity cannot and is not explained exclusively by the cognitive capabilities of top management. In his study of product development at Italian kitchenware company Alessi, Salvato (2009), for example, showed that ordinary (micro) activities carried out by individuals from all levels of the organizational hierarchy were central in determining the unique content of capabilities existing in the organization as a whole and their dynamic adaptation over time (Salvato, 2009, 397). Nayak et al. (2020) further propose that the key to understanding dynamic capabilities is finding out more about how individuals, and environments shape firm strategy and how firms develop adaptive capacities to respond to unplanned opportunities in sometimes unpremeditated yet value-adding ways. The idea that firms are dependent on the effective interplay between the acts of individuals searching for

opportunities and decision-makers at the top managerial level is not new but echoes the earlier work of Burgelman (1983, 1984).

Salvato and Vassolo (2018) have taken a step further by introducing a multi-level approach to resource dynamism, claiming that emergent phenomena like dynamic capabilities essentially encompass three levels of activity; a lower individual level at which the phenomena originates, a meso interpersonal level where the initiatives are developed, and a higher organizational level at which the collective property manifests. A key component in Salvato and Vassolo's multi-level dynamic capabilities conceptualization is the meso interpersonal level, a level which has been sorely neglected in research so far. According to the authors, this level is particularly important "because it houses the mechanism through which the abilities of individual employees to address change are transformed into a dynamic capability for asset reorganization at the firm level" (Salvato & Vassolo, 2018, p. 1745). While they point to relational engagement and dialogue to show how this level is conducive to dynamic capability development, they fail to explicate what type of operational forms this meso-level activity takes, nor do they explain how, in practice, initiatives from lower levels are developed and become implemented as dynamic capabilities in firms.

Based on the findings from an in-depth historical study of the Kongsberg Group, this article suggests that projects can be considered an operational example of a meso-level activity that provides important directions for future reconfiguration of resources at the macro, organizational level of firms. As noted by (Davies & Brady, 2016), project level factors remain underexplored in the dynamic capabilities literature, despite the fact that an increasing number of organizations rely on projects in some form (Eriksson, 2014; Lundin et al., 2015). By zooming in on how sensing is conducted at an individual micro-level, how seizing occurs at a project meso-level and how reconfiguring happens at the organizational macro-level, this article argues that the adaptive capacity to take on new opportunities and successfully deliver lies in the inherent room to maneuver at different levels of the organization.

Method: Historical research on dynamic capabilities

While historical research has been criticized in the past for lacking clear nomothetic claims, there has been an increasing recognition by scholars of the value of business historical methods to address areas within strategic management research, including processes of capability development (Argyres et al., 2020; Ingram et al., 2012; Lazonick, 2002; Raff & Scranton, 2017;

Teece, 2012; Wadhvani & Jones, 2016). This is related to the fact that dynamic capabilities are context-dependent (Helfat et al., 2009), and it takes time for emergent phenomena to manifest at a higher level. Survival and firm growth over time are therefore suggested as appropriate measures for analysis of dynamic capabilities (Helfat et al., 2009), measures that align with longitudinal and historical research (Salvato & Vassolo, 2018; Suddaby et al., 2020). According to Argyres et al. (2020, p. 347), historical methods are complementary to large statistical research in the strategy field since they can “uncover in a detailed way the mechanisms of action and the complex unfolding of how individuals, groups and organizations interact with the external context [...]”.

The purpose of a historical case study is not however to provide broad generalizations (Eisenhardt, 1989; Yin, 2012) but to generalize inductively on the basis of specific examples (Maclean et al., 2016). The historical narrative provides an opportunity to retrospectively examine the processes by which dynamic capabilities emerge, and on the basis of the findings, to elaborate on and complement existing conceptual claims. What makes the RWS-case from KDA appropriate and relevant for an analysis of dynamic capabilities is that it allows us to follow the whole process of how a new product area was discovered, established and developed across different organizational levels, to eventually become a new strategic business unit and platform for continued product development.

Sources

The article is based on empirical data from interviews, archive sources, and secondary sources. Data collection was spread over two stages, the first taking place in 2013 and 2014 and the second stage from late 2016 to early 2019. During the first stage, the author collected material from KDA's corporate archive and conducted interviews with people in the top management. From these interviews, it was clear that the development of RWS in KDA had been driven from the bottom-up in the organization and that there was an important project-level perspective missing. This directed the next stage in the research process, from 2016 to 2019, toward people who had been involved in the first RWS-project to develop stations for the US Army Stryker vehicles, as well as people who continued to work on RWS contracts in KDA. All interviews lasted between 1.5–4 hours, notes were taken manually and transcribed directly afterward, and about one-third were recorded and then transcribed. E-mails were later exchanged with some of the interviewees to clarify certain elements or gather more information.

Relying on information from key informants does involve a risk of both random error and informant bias (Kumar et al., 1993). Since the interviews were conducted in retrospect, there is a critical element with regard to memory loss and/or selective memory. The views of people in positions of power are also likely to differ from those further down the hierarchy. However, in historical research, informants are not chosen randomly from the employees of the firm or organization. They are chosen because they have knowledge about the issues being researched and because they have different perspectives to offer (Eisenhardt & Graebner, 2007). In this study, the way to control for bias was by conducting a multiple-informant study, and by including actors from other relevant organizations. Another measure was to triangulate interview data with archival material and external documents in order to verify the accounts and sequence of events (Kipping et al., 2014). Twenty-seven interviews (involving 23 respondents) are included in the data material. Table 1 and 2 provide further information about the archival documents and interviews included in the study.

Table 6.1 Overview of informants. Semi-structured interviews lasting between 1-4 hours.

Interviewee	Place and date of interview
Top executive level:	
Former CEO KOG (1999-2008)	Kongsberg, 14.5.13*/10.3.17/Oslo, 20.2.19
Former Managing director I KDA	Oslo, 23.1.13*
Former Managing director II KDA	Kongsberg, 20.2.14*
Former Managing director I Kongsberg Protech Systems	Oslo 14.8.13*
Former Managing director II Kongsberg Protech Systems	Kongsberg, 12.2.18
Former Chief business development KOG	Oslo, 22.1.14*
Former Chief technology officer KOG	Kongsberg, 21.2.14/*Oslo, 23.10.16
RWS project level (people from Kongsberg Protech/KDA):	
Former Union official Kongsberg Protech	Kongsberg, 13.5.13
Former RWS Technical manager (head of product development)	Kongsberg, 27.2.18
Former Sales manager in Kongsberg Protech	Kongsberg, 6.3.18
Former RWS Project manager	Kongsberg, 11.4.18
Former RWS Software manager,	Kongsberg, 12.4.18
Former RWS Sights manager	Kjeller, 25.4.18
Former RWS Quality manager	Kongsberg, 26.4.18
Former RWS Mechanical Design manager	Kongsberg, 27.4.18
Former RWS Purchasing manager	Kongsberg, 15.5.18
Former RWS Test manager	Kongsberg, 15.5.18
External perspective:	
Former Chairman of the board KOG	Oslo, 14.8.13/* 8.2.19*
Former CEO Vinghøg	Tønsberg, 12.6.13
Former Research director NDRE	Oslo, 26.5.14*
Former Head of prod. dev. in Kongsberg Weapons Factory	Kongsberg, 29.10.16
Former CEO of Kongsberg Weapons Factory	Oslo, 2.3.17*
Professor in systems engineering, HSN University Norway	Kongsberg, 9.5.17

*Interviews conducted together with another historian

Table 6.2 Overview of archival material and secondary material

Type of document	Collected from	Period/ Date/Time
Annual reports	From Company/Online	1996-2018
Strategic Plan Kongsberg Gruppen (5-year plans)	Kongsberg Gruppen Archive (KGA)	1996-2010
Strategic plan 96 Mechanical Production	KGA, File: Mechanical Production	29.5.1996
Internal document on the restructuring of the mechanical production apparatus/	KGA, File: Mechanical Production	30.1.1991
Press release: Kongsberg Protech and Vinghøg	KGA, File: Mechanical Production	14.6.1999
Technical documents/specifications for Advanced Multi-Role Weapon Station.	KGA, Mechanical Production	Undated (1999)
US RWS Program In-Review process files	Obtained from previous RWS Development Manager, Kongsberg Protech	2001-2003
Project management of complex systems (support material):	File obtained from previous technical manager, Kongsberg Protech Systems (KPS)	Documents from 2001, collected and reproduced in 2010
Product information		
Project information/Budget/costs		
RWS Process design		
Examples of risk reporting		
Project organization chart 2001 and 2010		
Program overview – development plan		
Information on internal monitoring		
Information on external monitoring		
Agenda/participants IPR meeting		
Full list of project participants		
Project execution		
Information on financial reporting, contracts, systems delivered per year, revenue, EBITA, investment in product, accumulated profit		
RWS Masterplan (detailed project schedule)	Obtained from RWS Program Manager	30.10.2001
Internal document: Horizons. Kongsberg Protech Systems timeline 1997-2009: Strategies, events, locations	Document obtained from HR Manager by e-mail	2010
Kongsberg Group executive group minutes (All business areas represented)	KGA, Files: Executive group minutes	1998-2008
Kongsberg Defence & Aerospace board minutes	KGA, Files: Board minutes, KDA	1997-2009
Board minutes Kongsberg Gruppen	KGA, Files: Board minutes	1997-2010
FFI Report: “Remotely operated weapon stations for vehicles and ship”. Technology input FS07	Report available online	2006
Vinghøg unofficial history, Pictures and product information sheets	Obtained from Geir Vinghøg in interview June 2013.	Undated
Technical documents specifications Ninnox remote towers/ Presentation “Remote Towers” by representative for Avinor/Jan Østby	Online	2017
Newspaper articles	Online	2000-2015

Analysis

Data analysis and theoretical orientation for this article were parallel activities, ensuring an iterative process between the empirical findings and theoretical perspectives. Trying to uncover the main explanations behind the success of the RWS-case turned out to be a demanding task. As the narrative unfolded, it became more complex, and ever more factors were revealed that seemed important, but at different times and from different organizational levels of the firm. It became clear that ownership of the process had shifted from an individual level to a project level and then to an organizational level and that the strategic future of the RWS concept in the Kongsberg Group had emerged gradually. The relationship between method and theory in this process is further explained in table 6.3

As noted by Schilke et al. (2018), scholars have developed different ways to break down dynamic capabilities. This study adopts the typology developed by Teece (2007), considering dynamic capabilities as reflected in the capacity of an organization to effectuate distinct organizational processes directed at sensing (understanding opportunities and threats), seizing (making strategic choices among investment opportunities and business models) and reconfiguring (transforming or changing organizational structures and resources).

Case company

The Kongsberg Group is the successor of the former Kongsberg Weapons Factory (KW), established in 1814 as a state-owned producer of weapons for the Norwegian Army (Myrvang, 2014).⁹⁰ Between the late-1950s and 1987, KW was gradually restructured from being a producer of technology developed by others to becoming a developer and integrator of technology for complex systems (Øyangen, 2014). In 1987, KW had to close down for financial reasons, and the Kongsberg Group was established to take over the defense segment of what had become a large industrial conglomerate (Sogner & Petersen, 2014). Today the Kongsberg Group is a global supplier of complex high technology systems for the defense, aerospace and maritime industries, and the former defense segment after KW continues to exist in one of the Kongsberg Group's two main subsidiaries, Kongsberg Defence and Aerospace (KDA). In 2018, KDA ranked nr.89 by revenue in Deloitte's global analysis of the 100 major aerospace and defense companies worldwide (Lineberger & Hussain, 2018).

⁹⁰ Until 1987 under the name Kongsberg Weapons Factory (KW).

Table 6.3 Steps in the analysis process

Stage	Research objective/questions	Methodology	Role of theory	Research output	Relevance for theory
1	What happened and how? What is the narrative?	Analyze interviews and archival data Triangulation Narrative drafted	Passive	Rich information and descriptions of the case	Bottom up innovation story “Against all odds”
2	What are the stages in the story? What are the key themes arising from the case?	Timeline Case divided into stages Establish patterns/key themes within the empirical material	An orientation towards theoretical explanations, driven by the case findings	Detailed analysis of the case	CoPS context Different process from the rest of the organization Interactive process Role of projects, systems integration Connection to dynamic capabilities?
3	What type of process/phenomenon is this?	Analyze patterns/key themes from the case Compare with theory	Active iteration between theory and empirical findings	Links between the empirical findings and the theoretical literature	Processes of sensing, seizing and reconfiguring capabilities? Shifting ownership to product over time
4	How does the empirical findings stand in relation to theory, and what does this mean? What can this study add to theoretical perspectives?	Align and contrast empirical findings with theoretical framework	Existing theory is discussed and challenged/criticized	Empirical data is used to extend the theoretical framework	How dynamic capabilities emerge and operate over time, the role of shifting organizational ownership in this process, not simply a top-down process

Findings

This section presents the findings from the case study, organized into three phases corresponding to processes of sensing, seizing, and reconfiguring, and the different activities involved. The narrative is supported by citations from interviews, illustrating how the people involved experienced the process and how process-ownership shifted over time between different levels of the organization.

Sensing a new opportunity

In 2000, the Kongsberg Group and its subsidiary KDA, was presented with an unexpected opportunity arising from Kongsberg Protech (henceforth Protech), the former mechanical division of KDA. Together with the Norwegian defense supplier Vinghøg, Protech had managed to attract the interest of one of the largest American defense suppliers, General Dynamics Land Systems (GDLS) and its partner General Motors Defense (GM Defense),⁹¹ for a remote weapon station originally developed by Vinghøg to support Norwegian air forces in case of an airport attack.⁹² Located within an armored vehicle, the RWS would enable the soldiers to destroy mines from a protracted position without endangering the lives of personnel (Castellacci & Fevolden, 2014).

At the time, the mechanical milieu in Protech was struggling to survive since the type of work it conducted was increasingly being outsourced. Protech was, therefore, actively looking for new projects where the unit could utilize its expertise toward more specialized production, and in this way, remain part of the Kongsberg Group.⁹³ In 1997 Protech entered into a partnership with Vinghøg to industrialize and find new market opportunities for the RWS.

In 1998, Vinghøg and Protech won a contract to deliver 16 RWS' to the Norwegian Army for a mission to destroy mines in Kosovo. The same year, the sales manager in Protech traveled to Canada to try to win a big contract for RWS there.⁹⁴ Protech lost the contract, but in his

⁹¹ This was a joint venture where GDLS was responsible for the serial deliveries of the Stryker Vehicle, and GM Defense was responsible for integration and development of the vehicle and subsystems. GDLS later acquired GM Defense.

⁹² Vinghøg unofficial history/ pictures and product information sheets remote weapon station, by Geir Vinghøg. Obtained June 12, 2013.

⁹³ Kongsberg Group Archive (KGA), executive group minutes, March 8, 1998; August 24, 1998; August 3, 1999.

⁹⁴ KPS Internal document: Horizons, timeline 1997-2009: Strategies, events, locations, 2010; interview with former managing director (I), Kongsberg Protech August 14, 2013.

determination to continue to win contracts, the sales manager asked to be debriefed afterward to find out what went wrong.⁹⁵ It turned out the customer's purchasing manager was busy, so the sales manager ended up in a meeting with the American company GM Defense, which delivered army vehicles. In the meeting, the sales manager told them about the RWS being developed in Norway. He did not hold back. "In the meeting, I told them about the weapon station, and to be honest, what I presented did not really exist. It was the future".⁹⁶ The RWS developed by Vinghøg was designed to destroy mines, not to participate in combat. Still, it was operable from within a vehicle and could thus potentially fulfill the future operational needs of the US Army. According to the sales manager, the representatives from GM Defense found the weapon station very interesting but did not have any specific requirements for it at that time.⁹⁷

A year later, the sales manager learned that the US government was going to equip their new vehicles with weapon stations, so he called GM Defense to find out more. It turned out GDLS and GM were looking for a remotely operated weapon station to be used as the main armament for a new generation of light armored vehicles. With very few resources at his disposal, over the summer, the sales manager worked out a proposal for the development and production of a remote weapon station to the US Army and sent a bid. Unfortunately, Protech and Vinghøg neither had a prototype ready nor funding to travel to the US for a demonstration.⁹⁸ Without an operable prototype, the system could not be evaluated.

In 2000, the sales manager heard from his contacts in the US that the Americans were still searching for a remote weapon station. By this time, Protech and Vinghøg had delivered their first four stations to Norwegian forces in Kosovo and therefore had a prototype ready to demonstrate. On their way to negotiate with another potential supplier, the sales manager convinced GM Defense to stop in Norway to witness a demo of the Norwegian RWS.⁹⁹ The demonstration was a success. In the autumn of 2000, KDA and the corporate management of the Kongsberg Group learned that one of the largest defense companies in the US had offered Protech a contract with a potential value of 2 billion NOK to develop and produce an RWS for

⁹⁵ Former sales manager Kongsberg Protech in interview March 6, 2018.

⁹⁶ Ibid.

⁹⁷ Ibid.

⁹⁸ Interview with former managing director (I) Kongsberg Protech, August 14, 2013; KPS Internal document: Horizons, timeline 1997-2009: Strategies, events, locations, 2010.

⁹⁹ Former sales manager Kongsberg Protech in interview, March 6, 2018.

a new generation of vehicles to the US Army.¹⁰⁰ Protech had thus received the largest single contract offer in the history of the Kongsberg Group.

One could justifiably ask why one of US's biggest defense industry contractors was willing to depend on a comparatively small Norwegian supplier for a product that would be of great strategic value for US Army's future brigade combat teams (Castellacci & Fevolden, 2014). One answer is that GDLS had identified a need for an RWS when designing the new concept for combat vehicles, and the prototype based on Vinghøg's concept was the best available in the market at the time. GDLS' partner, GM Defense, could have developed the weapon station itself but it would have taken a lot more time.¹⁰¹

Initially, there were conflicting views concerning how and why the Kongsberg Group would accept a contract to develop an RWS for the US Army. As described by the former union official in Protech:

KDA was not very positive in the beginning. Discussions about whether to take the project or not went all the way into top management. They fought for the contract, and Z (Former managing director Protech) did a great job in getting resources to Protech. He had big faith in the project and did not quit.¹⁰²

For the management in KDA, the contract offer from the US came as a big surprise.¹⁰³ Not only because of its size but because RWS was a very different product from KDA's existing portfolio. Due to the simple mechanical nature of the concept, KDA was not interested in the product.¹⁰⁴ After all, a remote weapon station was not a typical high-tech product; it was rather a new way to operationalize an old mechanical concept.¹⁰⁵ Nevertheless, the contract was of a size that made it impossible to ignore. The managing director of KDA, therefore, mobilized very specific people to evaluate the contract once it arrived. Senior engineers and project managers handpicked from all parts of the organization were asked to give their opinion of the product specifications and the costs.¹⁰⁶ Their first reaction was that the specified costs for product development and the time to delivery were critically underestimated.

¹⁰⁰ Interview with former CEO of the Kongsberg Group, May 3, 2013; March 10, 2017; with former managing director (I) Kongsberg Protech, August 14.

¹⁰¹ KPS, File: Project management of complex systems, 2001/2010.

¹⁰² Former union official Kongsberg Protech in interview May 13, 2013.

¹⁰³ Former managing director KDA (I) in interview January 23, 2013. This was mentioned by several of the engineers interviewed.

¹⁰⁴ KGA, executive group minutes, January 24, 2000.

¹⁰⁵ Former managing director KDA (I) in interview January 23, 2013.

¹⁰⁶ KPS, File: Project management of complex systems, 2001/2010.

Nothing was accounted for. It was just an amazing project and an opportunity. X [sales manager in Protech] had made an analysis of price and used it as a basis for the offer. [...] X wrote it with almost no help. Worked around the clock. People told him to quit the nonsense. Of course, you couldn't get a contract like that with the US army.¹⁰⁷

The new Stryker¹⁰⁸ concept was based on the ability of American forces to operate anywhere in the world within 96 hours, meaning the equipment had very specific requirements for weight and performance. In his efforts to secure the contract with GDLS and GM, the sales manager in Protech had promised a product that did not yet exist, and at a very low cost. Not only that, the contract challenged important aspects of the existing business model in KDA as it demanded mass production on a scale unlike anything in the company's existing portfolio.

The Kongsberg Group did not work on systems for the Army. We had produced canons back in the old days, but it was a long time ago. We had departed from this, and as such, this project popped up like a jack-in-the-box. It was probably why so much energy was spent upfront, considering whether to dare to say yes or not. As I understood, they were quite divided on this question.¹⁰⁹

The discussion continued in top management meetings.¹¹⁰ The original inventor company, Vinghøg, did not have the resources to commit to a contract of the size GDLS and GM proposed, which meant the Kongsberg Group had to secure full IP rights to the prototype.¹¹¹ Once this challenge was overcome, it was a question of organizational ownership of the project. Protech was a mechanical division with few resources to lead a development project.¹¹² The managing director of KDA was reluctant to let his organization take on the responsibility for the contract.¹¹³ In case of failure, the project would not only become a financial hazard, it could also damage KDA's brand in the US and jeopardize future sales opportunities related to other products. Another concern was that the project would take engineers away from already pressing tasks. At the time, several hundred engineers in KDA were working on a prestigious project to develop a next-generation long-range subsonic precision strike missile for the new frigates and coastal corvettes of the Royal Norwegian Navy. It was the first time KDA had

¹⁰⁷ Project manager RWS project in interview April 11, 2018.

¹⁰⁸ The Stryker name came later in the process, but it is used to describe the operational idea behind the new American brigade combat team concept.

¹⁰⁹ Technical manager RWS-project in interview February 27, 2018.

¹¹⁰ KGA, executive group minutes: "Committing to RWS. Discussion on clarification" by/chief business development, October 23, 2000 (the minutes document the different positions towards the project).

¹¹¹ Interview with former managing director in Kongsberg Protech, August 14, 2013.

¹¹² KGA, KDA board minutes, case nr. 3 "STP 2001", May 22, 2001; KGA, board minutes, STP 2001–2006; challenges, May 29, 2001.

¹¹³ KGA, executive group minutes: "Status weapon station project", chief business dev., November 20, 2000.

been the lead developer on a missile project. This was considered a key undertaking for the company and demanded a lot of resources (Sogner & Petersen, 2014).

The CEO of the Kongsberg Group acknowledged that taking on the development of an RWS for the US Army in just a few months was a risky project, but he nevertheless encouraged the opportunity.¹¹⁴ One reason for this was that he recognized that the product seemed to be a good match with existing competencies in KDA related to mechanical engineering and systems engineering, especially servo control, electronics and systems integration. In addition, over the years, the company had developed strong professionalism in executing projects as well as in collaborating with demanding customers. According to the CEO of the Kongsberg Group, the resources were there, they just had to be made available.¹¹⁵

In the end, the top management agreed that the balance between risk and opportunity favored the latter. It helped that the American customer was willing to adjust some of the technical specifications in the contract to get KDA and Protech on board. The Kongsberg Group's top management also decided to move Protech from Business Development and back into KDA, but as an independent unit reporting directly to Business Development and to the Kongsberg Group's corporate management. This arrangement gave Protech access to necessary resources from the corporation without placing the financial responsibility for the new project on KDA alone.¹¹⁶

It was decisive that the top management said yes. With the Stryker contract they could have said yes or no. He [the CEO of the Kongsberg Group] put a protecting hand over the project. That was also decisive for it to move on and become a success.¹¹⁷

By joining the innovation activities of another firm, the former mechanical unit of the Kongsberg Group was thus able to create a new product area for itself and ended up targeting a different defense market. It is highly unlikely that KDA would have ended up selling RWSs on a global scale had it not been for the marketing efforts of Protech, tightly related to the entrepreneurial mindset of its sales manager. Prior research has demonstrated how companies have missed out on opportunities even as they were standing on their doorstep due to misunderstandings concerning the fungibility of the company resources, top management's

¹¹⁴ Interview with the CEO of the Kongsberg Group May 14, 2013 and February 20, 2019.

¹¹⁵ KGA, executive group minutes: "Status weapon station project", chief business dev., November 20, 2000.

¹¹⁶ KGA, executive group minutes: "Weapon station project", chief business dev. and managing director KDA, December 18, 2000.

¹¹⁷ Mechanical design manager RWS project in interview April 27, 2018.

risk aversion or simply different opinions about strategic or technological directions (Danneels, 2011; Lucas Jr & Goh, 2009; Tripsas & Gavetti, 2000). A key to understanding how some firms are able to sense new opportunities might therefore be to consider the room for entrepreneurial action from the micro as well as the macro perspective of an organization.

Seizing the RWS opportunity

The Stryker RWS project was established in January 2001, with an official kick-off in March. By then, 50 people from 20 different organizations were working on the project.¹¹⁸ A senior engineer with broad experience in leading projects for American clients was appointed project manager. He gathered a team of people around him, most of them senior engineers from KDA. People were also brought in from the Army and from the industry generally, including engineers from the original inventor company, Vinghøg.¹¹⁹ By placing the RWS project in a separate organization with an experienced project team, KDA solved the challenges of managing a new opportunity alongside already established strategic development projects, a noted challenge in innovation research (Birkinshaw et al., 2016; Raisch et al., 2009).

Once the project was established, the corporate management pulled back, allowing Protech and the project manager of the RWS-project to handle all further aspects of the contract themselves. The project was thus run from the bottom-up, under the protecting hand of the top management.¹²⁰ Because of time pressure, the project was exempt from normal corporate bureaucracy and all engineering disciplines were involved from the start. This freedom to execute the project, and the broad experience of the senior engineers leading it, was later described by the project members, as well as by the corporate management, as critical for the successful delivery of the Stryker RWS project.¹²¹ As explained by the then quality manager on the RWS project;

It was a skunk-work activity. We were working in a team, in a small location. For the engineers, it was quite fun. They could see changes every day—a constant progress. However,

¹¹⁸ KPS, File: Project management of complex systems, 2001/2010.

¹¹⁹ Interview with project manager RWS project, April ,2018; KPS, File: Project management of complex systems, 2001/2010.

¹²⁰ Interview with project manager RWS project April, with former union official Kongsberg Protech May 13, 2103; with former CEO of the Kongsberg Group May 3, 2013.

¹²¹ KPS, File: Project management of complex systems, 2001/2010; KPS Internal document: Horizons, timeline 1997-2009: Strategies, events, locations, 2010.

it could not be completely chaos either. It was decisive that those who were there were seniors in their depth and approach.¹²²

Specific characteristics of the Norwegian engineering culture were also brought up as important in explaining why Kongsberg Protech was able to deliver the product so fast. These revolved around the autonomy and flexibility of the project team, traits that allowed for quick decision-making processes, rapid prototyping, and a short industrialization time.

In Norway, we are short on resources, and we do not apply big teams to create systems or develop new things. We work closely together, and we try to keep the suppliers tight as well. Then it becomes very open what you do. Communication is not long. These strong ties create an advantage.¹²³

Norwegians are not smarter than people from Spain, US or Germany. It is a different attitude and behavior [...]. It is about psychological safety. You are able to have a different opinion than your boss. You are held accountable, but you have your freedom.¹²⁴

In high-value capital goods industries like the defense industry, project capabilities are especially important as this is what enables firms to procure, execute, manage and hand over complex products and systems tailored to one or a few specific customers (Brady & Davies, 2004; Davies & Brady, 2000). Project capabilities in KDA included the ability to handle a direct and intense partnership with American customers. During the development phase alone, the project had four official progress review meetings where 30–40 representatives from GDLS/GM and the US government participated.¹²⁵ This strong involvement of GDLS was an indication of how important it was for the Americans that Kongsberg Protech delivered the RWS on time.¹²⁶

Once the Stryker RWS project was established, the engineers immediately began the process of redesigning the original RWS prototype to fit American qualifications. The Norwegian RWS, named ‘Protector’, would allow the soldiers to operate from a protected position within a vehicle, using stabilized precision optics and lasers to observe, detect and engage targets with increased accuracy and enhanced soldier protection in nighttime as well as daytime.¹²⁷ In this process, the project benefitted from KDA’s strong capabilities in systems integration, built up

¹²² Quality manager in interview April 26, 2018.

¹²³ Ibid

¹²⁴ Professor in systems engineering at University in South-East Norway, in interview May 9, 2017.

¹²⁵ US RWS Program In-Review process, 2001.

¹²⁶ KPS, File: Project management of complex systems, 2001/2010.

¹²⁷ E. H. Andås, *FFI Rapport*, «Fjernstyrte våpenstasjoner for kjøretøy og skip – teknologiinnspill til FS07», FFI/2006.

over many years. This enabled the engineers to translate customer requirements into a total systems solution and then redesign, engineer, test and integrate the different knowledge inputs and components that made up the RWS.¹²⁸

To make products of complex systems. The technology is not necessarily invented here, but to use the technology to create new products for new appliances in a good and effective way. I believe that is where we are excellent. This competence is in our bones in a way. It has been built up over many years, so it sits deep.¹²⁹

As emphasized in previous research, one of the distinctive strengths of systems integration capabilities is that it enables a firm to choose whether to buy, make, or collaborate in the design and production of systems (Hobday et al., 2005). When redesigning the Protector RWS for American customers, KDA could have designed the most of the components itself, but that would have taken too much time. Instead the engineers decided to make extensive use of components off-the-shelf and to subcontract other parts.¹³⁰ According to the former chairman of the board, this was essentially one of the secrets to finishing the first RWS project in time; “They were able to develop a great product in a short time because of suppliers. They became great at purchasing and they knew where to find the best suppliers in specific areas”.¹³¹ Protech managed to develop a remote weapon station for the US Stryker vehicles—one adapted to the customer’s requirements—in only nine months. By October 2001, the first prototype of Protector RWS was ready, and in December, the first six stations were sent to different parts of the US for testing in the field.¹³²

During the Stryker RWS project, Protech received a lot of feedback from its American customer, which was used to improve the station.¹³³ The managing director of Protech at the time recalls a specific episode of rapid problem solving.

A central problem was that the RWS needed to be much lower on the American Stryker-wagons because they had to be loaded and transported onboard airplanes. The general attitude amongst suppliers was that the customer had to adjust these things. However, this was not the way Kongsberg Protech operated. One of the engineers stayed up and worked on a solution all night, after 24 hours he had designed a solution [...].¹³⁴

¹²⁸ KPS, File: Project management of complex systems, 2001/2010.

¹²⁹ Technical manager RWS project in interview February 27, 2018.

¹³⁰ KPS, File: Project management of complex systems, 2001/2010.

¹³¹ Chairman of the board in interview, August 14, 2013.

¹³² KPS, File: Project management of complex systems, 2001/2010; Cpt. Kevin Cline, “The Stryker Remote Weapon system” *Infantry* Sept/oct 2005, p.8.

¹³³ Ibid.

¹³⁴ Interview with managing director (I) Kongsberg Protech, August 14, 2013.

Once Protech had begun to produce and deliver the stations to the US, feedback also came directly from the soldiers in the field. In this situation, Protech took advantage of innovation from other projects within KDA. One example was the development of a new lock-on target function developed by engineers working on the new subsonic Naval Strike Missile, which ensured complex missile technology was put to new use in the future development of the RWS.¹³⁵ Another was a new laser range finder, based on technology and methodology from the said missile project, which was used to provide a more accurate range measurement for the RWS.¹³⁶ Over the next few years, KDA and Protech experienced that the ability to respond quickly to new customer demands, followed by the capability to rapidly develop new product models (rapid prototyping) was a strong competitive asset within the RWS-market.¹³⁷

The intense communication and collaboration with the American customers also opened up for knowledge transfer from the US defense companies to Kongsberg, specifically related to the development of man-machine interfaces. Since many of the engineers employed on the RWS-project had previously worked on missile technology, they had little experience with man-machine technology (since a missile does not interact directly with humans once it has been sent off). Man-machine interaction represented a completely new dimension to component design in KDA, because technology needed to be developed with attention to human premises for interpretation and use.¹³⁸ Initially, these engineers did not have methods for verifying technology that would interact directly with humans. As noted by one of the engineers from KDA who had worked on IR technology in missiles before contributing to the RWS project:

In missiles, there is no ‘man in the loop system’. It is easier, because then there are algorithms that interpret the image, identify contrasts and make the image recognition. We did not have experience with ‘man in the loop systems’ and that type of methodology. It was actually a bit semi-empirical. We had to seek information outside and build competence in this area. We have spent a lot of time on this. Management was not aware that this was necessary. It happened during the project.¹³⁹

Engineers from KDA adopted this new verification methodology from the American customer and continued to develop competence in man-machine interaction through the work with new

¹³⁵ KGA, KDA board minutes: case nr 4. “Budget 2006,” January 5, 2006.

¹³⁶ Interview with sight manager RWS project April 12, 2018.

¹³⁷ KGA, KDA board minutes: case nr. 3: “New factory for mechanical production KDA, March 27, 2007

¹³⁸ Interview with sight manager RWS project, April 12, 2018.

¹³⁹ Ibid.

RWS systems. This new competence was later also used to develop new and related civilian products.

The first deliveries of the Stryker RWS in 2001 and 2002 gave Protech a first-mover advantage in the highly protected US defense industry. With the war in Iraq beginning in 2003, the market for remote weapon stations increased quite dramatically. During 2004 and 2005, Protech sold its RWs to Australia, Finland and Canada, opened a subsidiary sales company in Johnstown in the US and arranged procurement programs in about 20 more countries (Sogner & Petersen, 2014). Because of this fast growth, Protech was reorganized into a unique division for dynamic systems in KDA.¹⁴⁰

Reconfiguring the organization for future opportunities and growth

In 2004, Protech learned that the US Army was looking for a weapon station for its new Common Remotely Operated Weapon Station (CROWS) program. The US Army wanted a common RWS for a number of armored vehicles that previously had several different solutions from assorted manufacturers. CROWS represented the next big opportunity in the US market for weapon stations, and potentially involved contracts for several thousand RWSs.¹⁴¹ Protech's sales manager responded quickly to keep the firm's advantage in the market. But it turned out that an American supplier got the contract up front to develop a prototype.¹⁴² This was surprising to KDA and Protech considering the recent success of the Protector RWS in the US. After seeking advice from corporate American lawyers, in 2005 and 2006 KDA took the case through the US courts system. The result was a settlement that gave the Norwegian company an opportunity to compete for the next contract on equal terms (Sogner & Petersen, 2014, pp. 253-254).

By 2006, RWS had become one of the most important product areas for KDA and the Kongsberg Group in terms of future opportunities. The goal was to try and achieve dominance in seven of the biggest markets for weapon stations worldwide: US, Canada, Australia, UK,

¹⁴⁰ Kongsberg Group annual reports 2004 and 2005. KGA, appendix to board meeting: case nr. 4, "CEO operations report" May 3, 2005.

¹⁴¹ KGA, appendix to board meeting: «CEO operations report, more RWS' opportunities in the US», December 7, 2005.

¹⁴² Interview with former sales manager Kongsberg Protech March 6, 2018; with former managing director (I) Kongsberg Protech August 14, 2013; KPS Internal document: Horizons, timeline 1997-2009: Strategies, events, locations, 2010.

France, Germany, and Poland. In the corporate strategic plan for 2006, top management emphasized that the company should, “[...] not only milk the profitability of our current product but aim to procure a minimum 50 percent market share within the whole product segment”.¹⁴³

Achieving dominance in the US market meant Protech would have to win the contract for CROWS II, competing against the American supplier, Recon Optical, and the Israeli firm Rafael, alongside BAE Systems. In 2000, after GDLS and GM had taken an interest in the Norwegian RWS for the Stryker program, the learning curve on how bids to the US Army ought to be formulated and specified had been a steep one. This experience was now brought into the bid for CROWS II. The amount of money and people spent on the CROWS II contract signaled the new and aggressive market strategy in this area. The project to create a formal bid for CROWS II cost 30 million NOK, involved 60 people and invoked the aid of an American consultancy firm.¹⁴⁴ When finalized, the bid consisted of no less than 21 000 pages and was followed by another round of RWS demonstrations, this time in the US.¹⁴⁵ In August 2007, Protech won the bid and was awarded the general agreement for 6 500 remote weapon stations and a contract for 8 billion NOK. The contract was later increased to 10 000 stations (Sogner & Petersen, 2014).

Procuring the contract for the CROWS II program was a different undertaking than the high-priority RWS contract for the Stryker program. It was not only a matter of developing a new remote weapon station and producing it in large numbers. Protech also had to establish production in the US and develop a global supply chain.¹⁴⁶ This aspect required a new way of conceiving the core assets of the company. They would have to be managed in such a way that provided KDA and Protech with a sustainable advantage over its competitors. Several of the engineers working on the RWS project and then the CROWS program, reflected over this change.

Then came what happened later, when we got the CROWS-contract and when it really became a success. Why did it become a success? There were other parameters. We put it into system.¹⁴⁷

¹⁴³ KGA, Kongsberg Group strategic plan 2006–2011, June 15, 2006.

¹⁴⁴ Interview with former managing director (I) Kongsberg Protech, August 14, 2013.

¹⁴⁵ KPS, File: Project management of complex systems, 2001/2010, interview with former managing director Kongsberg Protech (I) August 14, 2013.

¹⁴⁶ KGA, appendix to board meeting: “CEO operations report”, August 24. august 2005.

¹⁴⁷ Mechanical design manager RWS project in interview April 27, 2018.

There were different criteria for success in different stages of the process. First, it was the capabilities to put the product in place. Later came the ownership and having our own design, more quality control of the process and the ability to change things fast.¹⁴⁸

Within few years, KDA became a world-leading supplier of weapon stations to armed vehicles, and between the Stryker and the CROWS contract, the RWS project in Protech grew from a single project of approximately 50 people to a multi-project organization comprising 550 employees and its own development unit, procurement section and IT division.¹⁴⁹ An important change in strategy took place between the Stryker RWS project and the CROWS project. During the first project, Protech applied the corporation's competence in systems integration to redesign the weapon station by applying a combination of its own components and components developed elsewhere. This enabled the project team to develop the product on time.¹⁵⁰ When redesigning the RWS to fit the new qualifications and demands for the CROWS II contract, however, Protech reversed this process to control more of the critical components itself.

We have taken more control of the product. Why? It is about costs and control. We design so we own the IP ourselves, and then we can outsource this to any supplier that makes circuit boards and ask them for an offer. Then it is easier to locate the problem and solutions. If they exist. It is a kind of innovation. We design more of the systems in-house.¹⁵¹

The experience after the Stryker RWS contract was that the Americans were demanding customers, and to keep its position in the market, Protech would have to deliver continuous improvement.¹⁵² With the rapid progressions in information technology, product improvements happened through software development. Decisions on which components the company designed in-house, and which components it could buy elsewhere, were therefore made according to the strategic value for the firm of having control of specific components—in terms of risk, economic value of selling important spare parts, and the importance of controlling—and thereby defining—vital software systems in-house. According to a former managing director of Protech, controlling key technology in-house was an essential part of the company's growth in the RWS market:

¹⁴⁸ Software manager RWS project in interview April 12, 2018.

¹⁴⁹ KPS, File: Project management of complex systems, 2001/2010.

¹⁵⁰ Ibid. Also confirmed across the interviews conducted (see table 6.1).

¹⁵¹ Technical manager RWS project in interview February 27, 2018.

¹⁵² KPS, File: Project management of complex systems, 2001/2010; Cpt. Kevin Cline, "The Stryker Remote Weapon system" *Infantry* Sept/oct 2005, p.7-9.

Some of our success, which I have been very clear to sell to others, is that we control our technology all the way from the bottom to the top. Many others buy, for instance, the servo system, but then you do not control the electronic cards within that servo amplifier which controls that system, and then you cannot... if something happens you have a difficult time analyzing and finding out what the problem is. Therefore, we have competence from that very card, through software and system and the whole thing. We have the competence in all levels.¹⁵³

A reason why ownership of technology became so important was related to the nature of the product. RWS was not an advanced military product. The core function was to enable a soldier to fire a gun from within a vehicle. However, the RWS was a complex product due to its high number of integrated components.¹⁵⁴ Because software was key to making all components in the product communicate and perform their functions according to the purpose of the entire system, the more control Protech could exercise over the different software packages, the easier and faster it would be to improve the overall functionality of the RWS.¹⁵⁵ This became very clear when KDA established its first factory to produce CROWS in the US. While an entire production line was established in the US,¹⁵⁶ design remained heavily integrated in the Norwegian system. According to the former managing director of Protech the company did not build an engineering capacity related to the RWS in the US, because they wanted to protect the company's intellectual property (IP).¹⁵⁷

In 2009, Protech was turned into the strategic business unit, Kongsberg Protech Systems (KPS), a subsidiary under the Kongsberg Group.¹⁵⁸ By then, the market share in the US had reached close to 100 percent. For the rest of the world it was between 80 and 90 percent, and the established customer base consisted of 17 countries.¹⁵⁹ Sales of RWSs reached their highest level in 2011 and the existing CROWS contract was followed by a new 5-year contract in 2012. After experiencing a period of stabilization in the market, Protech was reintegrated into KDA in 2017 as a division for dynamic systems. However, in 2018, KDA signed a new 5-year CROWS contract, reflecting that the Norwegian-developed RWS had become the industry standard in its category.¹⁶⁰

¹⁵³ Managing director (II) Kongsberg Protech Systems in interview, February 12, 2018.

¹⁵⁴ Ibid.

¹⁵⁵ Software manager RWS project in interview, April 12, 2018.

¹⁵⁶ KGA, appendix to board meeting: "CEO operations report, August 24, 2005.

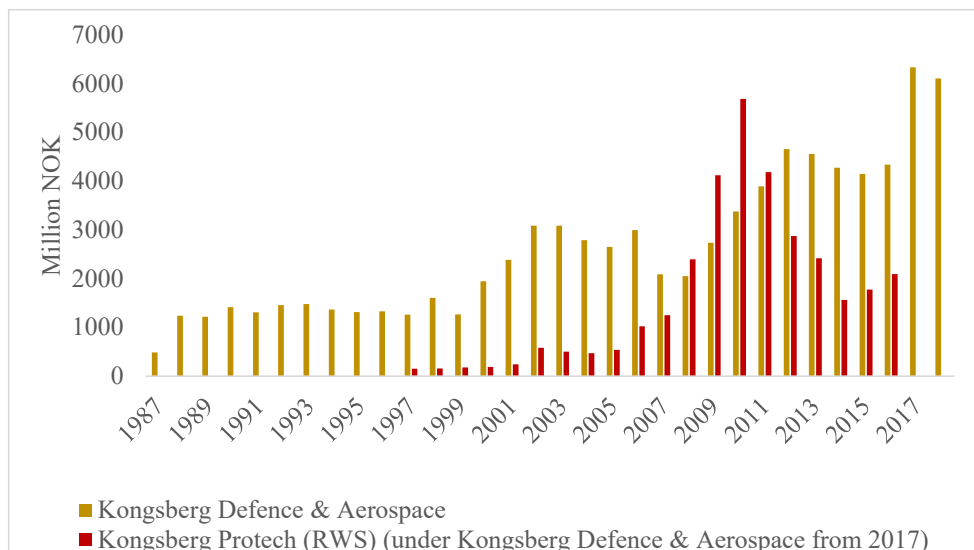
¹⁵⁷ Interview with managing director (II) Kongsberg Protech Systems, February 12, 2018.

¹⁵⁸ Kongsberg Group annual report 2009.

¹⁵⁹ KGA, appendix board meeting KDA, Notes to budget KDA 2009, March 26, 2009.

¹⁶⁰ Kongsberg Group annual report 2018.

Figure 6.1 Turnover Kongsberg Protech and Kongsberg Defence & Aerospace 1987-2017.



Source: The Kongsberg Group, annual reports, and internal company reports. Numbers are in million NOK, running prices.

Developed as an individual product in 2001, in few years, the Protector RWS evolved into a product family, with a series of closely related remote weapon systems sharing the same technological platform yet accommodating different tactical and national needs. This included versions to be used on land or at sea, on mobile or static platforms, and for payloads varying from small caliber weapons to medium caliber automatic cannons.¹⁶¹ Learning from the RWS-project was also used to implement new routines for quality assurance and production processes. As noted by the quality manager on the RWS project:

We developed new routines that became learning. We established a tool to report deviation during production. It later became an all-encompassing system. Production, design and development. It is a tool that now supports the entire organization.¹⁶²

¹⁶¹ Technical manager RWS project in interview February 27, 2018; Article from Kongsberg Group web: [PROTECTOR Remote Weapon Systems - Kongsberg Defence & Aerospace](#)

¹⁶² Quality manager, RWS-project, in interview April 26, 2018.

In a few years, experience from the first RWS project became integral in the development of new products directed at the civilian market. One example of this was a new remote and digital tower system for air traffic security.¹⁶³ In this project, KDA used electro-optical sensor technology originally developed for missiles in combination with the new IR camera technology and the new methodology it had acquired and adapted specifically for man-machine interaction in the RWS.¹⁶⁴ As noted by the sight manager on the RWS project: “We continued to work on this [MMI technology] in connection with Avinor and remotely controlled towers for airports. The type of methodology we acquired in the RWS context was relevant and we have used it to work on this—a civilian application.”¹⁶⁵

In the same way as an RWS operator could lock and target its object, flight leaders would be able to zoom in and target an airplane or a vehicle and follow it—from a completely different and remote location. In 2015, KDA procured a contract to develop the Ninox Remote Tower System together with Indra Navia on behalf of the Norwegian airport control service, Avinor.¹⁶⁶ With more than 36 sites designated for remote air traffic control, it was at the time the largest program for remote tower systems in the world. This ensured that the remote tower systems (RTS) was established as a unique product in KDA.

In 2000, many people in the Kongsberg Group dismissed RWS as something that was not worth pursuing since it was only a mechanical product. Almost 20 years later, people in and around the organization reflect on the role that the RWS project played in revitalizing the company’s market thinking. There was a general belief among those interviewed—from the top management level to middle managers and the former project members—that the way the RWS opportunity was handled triggered a new acknowledgment about the dynamic potential in the organization. One example of this recognition can be seen in the top management’s own reflections on the RWS as an internal growth driver, as presented to the board in 2008:

¹⁶³ «Remote towers», presentation by Jan Østby, Avinor, March 17, 2016 (available online).

¹⁶⁴ «Kjeller technology to revolutionize airports», *Romerikes Blad*, September 28, 2015.

¹⁶⁵ Sight manager RWS-project in interview April 25, 2018.

¹⁶⁶ “Ninox-remote and virtual tower systems”, commercial brochure by Indra Navia, KDA and Avinor, October, 2016; “Kongsberg Remote Towers”, product brochure, October 2021 (available online: [kongsbergprt_oct21_crop-marks.pdf](#))

The RWS activities in KDA have developed far better than our plans a few years ago, and this has also been noticed abroad. There are many factors that have contributed to this, but the most significant has probably been a dynamic environment for sale and prototype development that has been able to take advantage of many aspects of the broad competence in KDA and which has therefore been able to grow much faster than a small start-up environment. We are now established as the leading producer of weapon stations and it is therefore reason to look with new eyes on how this position can be exploited to ensure a best possible continued development. This concerns both to be able to continue as the leading producer of weapon stations, but also to consider how this position can be utilized to bring forth related products and thereby contribute to growth in other areas.¹⁶⁷

Furthermore, as a previous managing director of KDA commented; the RWS provided confidence; “It opened the eyes of the outside world to the Kongsberg Group because of the big success. We became one of the biggest suppliers to the US Army—this hadn’t happened before”.¹⁶⁸ That KDA was able to expand from remote weapon stations to remote tower stations in 2015 can be seen as one example of the new potential that had been released after the first RWS project, related to the company’s capabilities to create new product systems by integrating existing components for new purposes.

¹⁶⁷ KGA, appendix to board meeting: “RWS as growth driver”, case nr. 18, June 16-17.2008.

¹⁶⁸ Former managing director of KDA (II) in interview February 12, 2018

Table 6.4 Overview of turnover/important events for Kongsberg Protech/Kongsberg Protech Systems (KPS) between 1997 and 2017

Year	Turnover	Event	Location in the organization
1997	153	Kongsberg Protech enters joint venture with Vinghog (invests 750' in RWS engagement)	Kongsberg Protech forms the mechanical division of KDA
1998	160	The two companies win contract for stations to be used in UN mission in Kosovo (16 systems)	Kongsberg Protech becomes a separate company for mechanical work, placed under business development in the Kongsberg Group.
1999	167	Kongsberg Protech invests 750' in RWS	
2000	189	Kongsberg Protech buys IPR to product from Vinghog (which becomes key supplier)	
2001	221	Stryker RWS contract with GDLS/GM Defence for 1700 systems. The first 6 stations sent for test in the field.	Kongsberg Protech becomes a subsidiary under KDA and establishes RWS Stryker-project with support from KDA (operates for 421 days).
2002	527		
2003	443		
2004	415	RWS contract Australia	Kongsberg Protech is fusioned into KDA as division Dynamic Systems.
2005	469	The Kongsberg Group and Kongsberg Protech takes US gov to court Establishes offices in the US RWS contract Finland and Canada	
2006	866		
2007	1055	CROWS contract for 6500 systems with US Army	
2008	1949	Decision to develop Medium Caliber RWS New RWS production factory opens in US	
2009	3280	CROWS contract increased to 10 000 systems	Kongsberg Protech Systems is established as a business unit and subsidiary under the Kongsberg Group
2010	4412		
2011	3219		
2012	2189	New CROWS contract	
2013	1803		
2014	1144		
2015	1271	Contract for Remote Tower System	
2016	1447		
2017			Kongsberg Protech Systems is fusioned back into KDA as division Protech Systems
2018		New CROWS contract	

Source: The Kongsberg Group. The numbers are in million Norwegian kroner (NOK), fixed prices. The index is the consumer price index of Statistics Norway, 1998=100

Discussion

A multi-level perspective on dynamic capabilities

How do dynamic capabilities emerge and operate, and what is the role of different levels of an organization in this process? The case study explored in this paper explains how KDA, through its former mechanical unit Protech, became a world-leading supplier of weapon stations to armed vehicles. One thing that characterized this process was the way that, over time, organizational ownership of the opportunity (and later of the new product) shifted between different levels of the organization. Another characteristic was the dependence of these processes on a combination of non-routine and routine activities, as well as the creation of new routines. The next section discusses why these features were important for the successful development of a new RWS venture in KDA, and furthermore, what this adds to our understanding of dynamic capabilities.

Sensing: A room for bottom-up entrepreneurial enactment

Past research has emphasized the role of top management when looking to identify micro-level drivers behind dynamic capabilities (Adner & Helfat, 2003; Helfat & Martin, 2015; Helfat & Peteraf, 2015). This study suggests that an important component in terms of whether an organization develops dynamic capabilities or not is the room available within it for individual sensing of opportunities. This includes the possibility to get such ‘hunches’ evaluated in top management, even if the opportunity emerges from outside existing boundaries or from not playing exactly by the rules. The RWS opportunity did not emerge as the result of a strong corporate strategy. Instead, it was created through the entrepreneurial effort of a sales manager residing in a part of the company that was located far away from the strategic plans of the top management. When the opportunity was presented in the form of a large contract, it was first met with surprise and reluctance. However, this skepticism did not stop KDA’s management from mobilizing very specific people to execute a thorough evaluation and discussion of the contract once it arrived, nor from moving Protech within the organization to find a proper balance between risk and resources. What provided the Kongsberg Group with the capability to sense an exceptional opportunity was thus the room for entrepreneurial action that could connect individual-level perspectives further down with managerial perspectives at the top.

These notions echoes the earlier work of Burgelman (1983, 1984), where he argues that for

established firms, new opportunities often arise through a combination of autonomous entrepreneurial activity and strategic management evaluation. This shows that firms need entrepreneurial behavior to create new opportunities outside of their existing structural contexts because managers situated at different levels of a company's hierarchy interpret their company's experiences differently (Gavetti, 2005). Higher-level managers also devote limited attention to situations that appear ambiguous compared to situations where the organization is already engaged. This effect is particularly strong when companies are involved in multiple, heterogeneous domains simultaneously (Gavetti, 2005, p. 613), as in the case of the Kongsberg Group.

Seizing: The role of autonomous project groups

Once an opportunity has been discovered, it must be integrated into the firm's strategy to be successfully seized. What can jeopardize a possible emerging opportunity is the lack of operational relatedness and whether it can be nested in the larger resource combination constituted by the firm. This depends on both risk assessments and the mobilization of resources from a managerial level. This type of problem has been discussed in a number of academic fields, and—among other answers—solutions have been identified in different forms of ambidextrous organizing, i.e., through the form of exploratory projects (O'Reilly & Tushman, 2004; Raisch et al., 2009; Tushman & O'Reilly, 1996). This literature has also been connected to the literature on dynamic capabilities (Birkinshaw et al., 2016; O'Reilly III & Tushman, 2008). However, as with most research in this area, it mainly focuses on the role of management in orchestrating different forms of activities (exploitative and explorative) at the same time. It does not explain how change initiatives undertaken at the individual level can emerge in an organization to manifest as organizational dynamics.

What can explain this link, according to Salvato and Vassolo (2018), is a previously missing level in dynamic capabilities research: the interpersonal meso-level connecting individual (micro) initiatives with organizational (macro) capabilities. Salvato and Vassolo (2018) argue that interpersonal relationships emerge and become the context for later reconfigurations of resource bases, when individuals feel free and come together to find shared solutions to environmental changes. The findings from this study suggest that autonomous project groups can play a focal role as a meso-level context for the process of seizing opportunities. Projects are the practical way that many firms solve the challenge of taking on new opportunities, and

this form of organizing provides the necessary conditions for the interpersonal activity and social relationships needed to create new solutions to emerging market needs (Davies & Brady, 2016; Frederiksen & Davies, 2008). The process of seizing the RWS opportunity was essentially delegated to an autonomous project group controlled by Protech, with resources from KDA, and supported by the top management in the Kongsberg Group.

This room for autonomous execution was important for several reasons. First, because it enabled fast decisions making processes and rapid prototyping based on existing engineering routines. Second, because it provided room for creative and ad hoc product development uniquely linked to the Stryker RWS-project, but with potential areas of application far beyond this project. And third, because this later enabled the emergence of new strategic directions for KDA, exemplified through the global market focus for RWS, and the subsequent development of remote tower stations. The first RWS Stryker-project allowed the development of new learning and routines within KDA and provided emerging new insights on how the company's core capabilities could be used for new and dynamic purposes (Hobday et al., 2005; Meyer & Utterback, 1993; Prahalad & Hamel, 1990; Teece, 1986). To enable this, however, the emerging dynamics needed to be implemented at a broader organizational level.

Reconfiguring: Implementing dynamics at the organizational level

The reconfiguration of resources is a vital step in the dynamic capabilities' framework (Teece, 2007). Firms capable of transforming or renewing their assets are able to sustain a competitive advantage over time (Helfat et al., 2009). The RWS-case demonstrates that this process is not necessarily about building new capabilities. It can also be about acquiring a new understanding of how existing capabilities can be used in new and more dynamic ways and how implementing new routines can enable this change.

The way Protech, through the RWS-project, was able to respond to new market demands not only opened the eyes of the outside world to what KDA could do but—as a former CEO of KDA explained—it also opened the eyes of the management itself to the dynamic potential of the capabilities operationalized further down the organization. This is demonstrated in the difference between the functional ad hoc use of systems integration capabilities by the engineers working on the Stryker RWS-project and the new tactical, judicial and financial considerations that were added in the application of the same capabilities to procure and deliver the CROWS contract, and to redesign the RWS for a global market. This was particularly

apparent when it came to the new focus on securing control of the component design. When the company geared up to go after the upcoming CROWS opportunity, both existing and new routines were used to adapt the organization for this purpose. This time, systems integration was not simply performed with a functional purpose in mind (how different components must be integrated to perform the desired function) (Davies & Brady, 2000), but also with a strategic purpose (Hobday et al., 2005), keeping in mind that innovation was performed through software and that ownership of system design, therefore, constituted a key to market dominance.

What generated this difference was not a change in the capabilities themselves but rather a change in the organization's perception of how they could be used. Once this acknowledgment, originating from the experience of the first RWS-project, began to spread in the organization, it was time to reorganize the new RWS domain, turning it into a separate business unit and subsidiary of its own. This shifting of organizational ownership created room for the RWS-domain, in particular, to grow and for the Kongsberg Group as a company to adapt to the new change dynamics emerging from below.

Table 6.5 Microfoundations: Different routine and non-routine activities identified in the RWS-case

Activity	Level in the organization	Existing routine	Non-routine	New routine/ practice
Microfoundation				
Sensing	Individual activity	Searching for new market opportunities	Creating opportunity through entrepreneurial enactment (risk-taking)	
	Top management team activity	Evaluating opportunity		
Seizing	Project group activity	Executing opportunity by exploiting existing capabilities under high autonomy	Exploring new processes in product development	
Reconfiguring	Managerial organizational level activity	Implementing change through strategic adaptation of organization		Implementing new routines in product development
				Implementing new practices for control and ownership of design

Conclusion

This article has demonstrated how the integration of activities and perspectives from different organizational levels of a firm—a multi-level perspective—can help us understand how dynamic capabilities emerge and operate in mature firms. Specifically, the article illuminates how entrepreneurial enactment at the individual level is important for sensing new opportunities, how autonomous project groups can play a focal role in seizing opportunities, and how learning and experience from these initiatives can shape new strategic directions for firms by enabling a reconfiguration of resources at the organizational level (i.e., changing the structure of the organization, taking control of necessary assets and systematizing product development processes). From these insights, the article suggests that dynamic capabilities should not be seen as dependent on their location at the top of a hierarchical structure, but rather as dependent on interactions among different components of a firm or an organization.

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7. Paper III: Making sense of the past to compete in the future: Strategic renewal in Kongsberg Maritime, 2002–2012

Abstract

How can the past be used strategically to fulfil goals related to innovation and organizational renewal? This article investigates how the past was mobilized to initiate a process of strategic renewal in Kongsberg Maritime, looking at how the company built a strategic concept on its historical capability in systems integration. The article is an empirical contribution to the growing literature on strategic uses of the past, aiming to extend our understanding of how firms use the past strategically, what form it can take, why it can create value for companies and when it becomes obsolete.

Key words: sensemaking, history, narrative, strategic renewal, innovation, systems integration

Introduction

The advantage of history for organizational development was for a long time considered on the basis of its role in the accumulation of resources over time and the way this formed the paths and opportunities available to a firm (Barney, 1991; A. D. Chandler, 1990; Penrose, 1959/2009; Teece et al., 1997). Recent years have seen the emergence of a new and less objective perspective on the advantages of history, one which emphasizes the role of sensemaking and historical narratives and the way the past can be reconstructed and communicated for strategic reasons (Foster et al., 2017; Hansen, 2006, 2012, 2014; Hansen & Magnussen, 2018; Mordhorst & Schwarzkopf, 2017; Suddaby et al., 2010).

The past can be a powerful tool to unify a company, or it can become an impediment for future development. At the start of the new millennium, Norwegian engineering company Kongsberg Maritime was experiencing problems because of its inorganic development, which had left the organization fragmented and without a common purpose. At the time, Kongsberg Maritime was a collection of companies that had developed concurrently, and in an overlapping fashion, within different segments of the Norwegian maritime electronics industry from the late 1940s to the mid-1990s. The result after a long line of acquisitions was that different engineering cultures had become encapsulated in separate units to continue developing their unique product portfolios. When market changes increased demand for new and integrated product solutions, this became a problem for the competitive position of the company. The management needed to find a way to integrate the organization to be able to develop better solutions. How could this be solved?

In this article, I explore how the past was mobilized in Kongsberg Maritime to build a new strategic concept called The Full Picture, and how the narrative around this concept became key to a process of strategic renewal in Kongsberg Maritime. The aim of the article is to show how, through the case of a particular business, the past can be used strategically. The next section addresses the literature on strategic uses of the past, reviewing the phenomenon of sensemaking and the use of historical narratives in business history. The article then provides an account of the methodology and sources applied, before briefly presenting the historical background of Kongsberg Maritime. The empirical section shows how the new strategic narrative was created, built, and effectuated and how it influenced the innovative capabilities of the company. The analysis further discusses the role of the past in this process.

Making sense of the past in strategic renewal

Sensemaking is a process involving new interpretations of past events in a way that provides relevant meaning in the present (Maitlis & Christianson, 2014; Suddaby & Foster, 2017; Weick, 1995; Weick et al., 2005). In management and organizational studies, sensemaking has long been considered a key corporate activity to influence organizational outcomes. According to organizational scholars, firms engage in sensemaking to initiate strategic change, to change current modes of cognition and action, and to enable their organizations to take advantage of important opportunities or cope with environmental threats (Gioia & Chittipeddi, 1991; Thomas et al., 1993).

The implicit role of history in sensemaking processes has received increased attention among management and organizational scholars in the last decades, emphasizing the importance of historical consciousness in the study of organizational change (Suddaby & Foster, 2017; Wadhvani et al., 2018). These reflections are not new, but build on earlier organizational research noting the role of history in promoting or constraining organizational success (Barney, 1991; A. D. Chandler, 1990; Penrose, 1959/2009; Stinchcombe, 1965; Teece et al., 1997). What *is* new in recent research is that history is perceived not only as a determinant of access to or use of resources, but as an interpretive device to create competitive advantage in itself (Brunner, 2009; Suddaby et al., 2020; Wadhvani & Jones, 2016).

By means of sensemaking processes, company histories and narratives based on the past are recognized, not just as the origins of specific paths and resources, but also as strategic tools used to develop organizational legitimacy, identity, and brand architecture (Ravasi & Schultz, 2006; Schultz & Hatch, 2003; Schultz & Hernes, 2013; Zundel et al., 2016). One example of this is the way organizations make use of history rhetorically to facilitate processes of change, meaning that history or the past is used in a strategic way to manage key stakeholders of a firm (Popp & Fellman, 2020; Suddaby et al., 2010; Wadhvani et al., 2018). In these cases, history is not constrained to represent the past exactly as it was, but is open for reconstruction to serve a specific strategic purpose. This could mean that some parts of history are emphasized, while others are repressed, or that different parts of the past are combined in new ways to form new meaning in the present and the future.

Though business history came late to this research arena, there is now increasing interest among business historians in the way actors and organizations use historical narratives for different strategic purposes (Mordhorst & Schwarzkopf, 2017). Hansen (2006, 2012, 2014)

shows how narratives, created, and upheld through processes of sensemaking, are used strategically by companies as well as whole industries to promote some parts of history, while suppressing others. Gasparin et al. (2022) demonstrate how the construction of processes, practices and storytelling has been used to transform project failures of the past into project successes for the future. Foster et al. (2017) provide an important contribution to our understanding of the circumstances under which managers react by using historical narratives to influence or change the internal and external environments of their organizations. Smith and Simeone (2017) historicize the use of rhetorical history by illustrating how the Hudson's Bay Company began to make use of its long history to win over a wide variety of stakeholders after WWI. From her studies of German businesses uses of the past in colonial India, Lubinski (2018) also demonstrate how rhetorical history is a situated phenomenon, strongly dependent on the context and time in which it is applied.

While research over the last two decades have taught us more about how organizations and firms make use of history through processes of sensemaking, we still know little about what forms the past take in these processes (Wadhvani et al., 2018), and how it creates value for companies. Especially when it comes to how organizations leverage knowledge and resources pertaining to the past to achieve and maintain an advantage, in the form of innovation, entrepreneurship or organizational renewal (Argyres et al., 2020). According to Argyres et al. (2020) these are directions of research where historical methodology is especially well positioned to inform theories and topics originating in strategy research.

The article thus places itself in the crossfire of the ongoing debate about the relationship between history and strategy, most recently actualized by Lamberg et al. (2020, p. 19) in their investigation into whether business history is being “colonized by strategic management concepts and practices”. The use of concepts originating from organizational and strategic research (notably strategic renewal and sensemaking) denotes that the processes and phenomena studied in business history are similar to those studied and conceptualized within adjacent fields. It also demonstrates the interdisciplinary dialogue that has emerged between these fields in recent years (Argyres et al., 2020; Decker et al., 2015; Gasparin et al., 2022).

Linking sensemaking of the past to strategic renewal is not just an interesting avenue to connect historical and strategic research, it is important because it directs our attention to the often-neglected emotional side of competitive dynamics (Baden-Fuller & Teece, 2019). Emotions is an emerging topic within the fields of strategy and organization studies, and

there is a growing awareness of the need for longitudinal studies in this area, especially to explore the potential link between emotions at the micro-level and strategic outcomes at the macro-level (Brundin & Liu, 2015). This awareness resonates with broader calls to include more microfoundational perspectives in strategy research in order to untangle the role of microprocesses for larger macro-level phenomena (Foss & Linder, 2019; Schmitt et al., 2018).

Historical research has showed how the past can invoke strong sentiments within some companies because history represents important traditions related to vital skills and crafts. Hatch and Schultz (2017) demonstrated how this was the case in Danish beer producer Carlsberg, where the historical motto “semper ardens” became crucial for the company’s new identity statement because it played back on the authenticity of the craftwork of the old company. Professions or industries where historical knowledge may be embodied in skills and practices represent an interesting domain for further exploration of how and in what form the past is used strategically (Wadhvani et al., 2018). Engineering is one such area, where technological skills have evolved over time, but with strong roots in specific disciplines and communities. By looking at the strategic use of the past in a Norwegian engineering company, this article explores how an engineering heritage could be targeted strategically as well as emotionally, and what effect this could potentially have on the innovative capabilities of the company.

Research methodology and process

The method applied in this article is consistent with what Vaara and Lamberg (2016) have called “realist history” in the sense that the purpose was to reconstruct past events in the form of a historical case study. In this article, the case concerned a process of strategic renewal in Kongsberg Maritime. To develop historical case studies, historians combine and triangulate the analysis of different sources of data. In this case, data comprise primary documents from corporate and private archives (collected in the period 2013-2014, and 2018), commercial corporate material available online and oral history interviews with some of the principal actors from the firm (16 interviews with 14 people). Secondary materials such as books, reports and newspaper articles were also used to document the history of the companies in Kongsberg Maritime. Having a variety of sources is necessary to avoid the bias of one

authoritative source and is a way for historians to validate source criticism (Kipping et al., 2014).

Lamberg et al. (2019) show how oral sources—i.e. the histories told by persons with a current or former connection to a company—can play a pivotal role in allowing the study of processes. A common feature of the interviews included in this study was that the subjects were not confronted with a firm set of questions, but were rather encouraged to tell their “life stories” from the company, and the interviews took form from there (Lamberg et al., 2019, p. 8). The exception was the follow-up interviews that were conducted with a few of the former employees where the agenda was to learn more about previously visited topics. What became clear after having conducted several interviews, was that the process of constructing “The Full Picture” concept and the role of systems integration capabilities were important elements to understand the history and growth of Kongsberg Maritime. Interviews with the former CEO, and with managers from different parts of the organization were especially important to elucidate this impression.

After having completed archival search and interviews, I conducted a search for publicly available corporate material developed and published in the period from 2004 to 2012. This allowed me to see how Kongsberg Maritime had promoted its new strategic concept to its customers and external stakeholders. What became clear when analyzing the archival sources, interviews and commercial material together was that in the establishment of The Full Picture, the past was recreated for different purposes. The Full Picture was not simply an example of commercial rebranding; it was a process initiated to unite the organization *and* to strengthen its innovativeness and market position. In this process, the role of the past changed over time. The empirical section of the article describes the details of this process and explains how the new concept contributed to increase the innovative capability of Kongsberg Maritime. First follows the historical background of the companies in Kongsberg Maritime.

A collection of maritime companies

Kongsberg Maritime was established in 1997 to become the second subsidiary of the Kongsberg Group, the legal successor of the former state-owned, munitions producer and high-tech conglomerate Kongsberg Weapons Factory (KW) (1814–1987), which was

dismantled in 1987 (Sogner & Petersen, 2014).¹⁶⁹ With the end of the Cold War in 1989, the top management in the Kongsberg Group began to look for a civilian market to balance off its possibly waning defense business. The new management was also carrying plans of partly privatizing and stock listing the company. Augmenting the business with a civilian unit could potentially make this process easier. The maritime IT-industry stood out as a promising area. Important parts of the Norwegian IT-industry had emerged through the development of maritime IT equipment such as radios, satellite navigation, echo sounders, sonars and automatic control and surveillance systems for the merchant marine fleet. The maritime sector was regarded as an important driving force in the Norwegian economy, and it was also considered an industry for the future (Reve et al., 1992).

The Kongsberg Group took the first step in this process in 1992, by acquiring the ownership of the maritime ship automation company Norcontrol. For those who knew the industry, this was somewhat ironic. Norcontrol was established in 1965 by the Norwegian companies Norsk Hydro, KW, and Noratom to develop computer-based control systems for ships—an idea that was quite revolutionary for its time (Høivold & Bjerva, 2006). Nevertheless, demands for standardization and mass production in the shipbuilding industry brought down prices in the late 1970s, which hurt Norcontrol. In 1978, the company was merged into the maritime division of KW to keep important technological competence intact in a difficult financial situation. Estimates later revealed that this rescue operation cost KW approximately 100 million NOK before Norcontrol was split into four separate companies and sold in 1986 (Høivold & Bjerva, 2006). When in 1992, the Kongsberg Group reacquired parts of the former Norcontrol, in spite of its long history of financial problems, it revealed something about the unrealized commercial potential that people still believed existed in the company's maritime automation systems (Sogner & Petersen, 2014).

The second company to enter the maritime constellation in the Kongsberg Group was Simrad. Simrad was established in 1947 as a producer of radio-telephones to the merchant marine (Sogner, 1997). In 1949, the company expanded its production with the development of echo sounders, followed by sonars in 1953. Between the 1950s and late 1960s, Simrad became an internationally renowned supplier of advanced electronic fishing equipment and one of the world's leading suppliers of fish finding sonars (Sogner, 2009). In the 1970s, the company

¹⁶⁹ The other subsidiary was Kongsberg Defence and Aerospace (KDA), the formal successor to KW.

turned its eyes on the emerging Norwegian oil sector, developing a hydroacoustic reference position system that could help vessels remain in position during offshore operations. In the mid-1990s, a new prototype for an autonomous underwater vehicle brought Simrad to the forefront in autonomous subsea survey capability, an area of increasing importance for the oil and gas industry. In 1996, the Kongsberg Group performed a fast take-over by acquiring the majority of Simrad's shares overnight. Through this maneuver, the company secured ownership of a large and important part of Norwegian maritime electronics industry.

By taking over Simrad, the Kongsberg Group also acquired a third company, Albatross. Albatross was established in 1975 as a unit in KW to develop and sell dynamic positioning systems to the offshore oil industry. Dynamic positioning is an automated control system that enables a vessel to stay in position by automatically measuring and counteracting environmental forces like wind, waves and currents as well as controlling the propulsion system by actively engaging the vessel's thrusters (Breivik et al., 2015). During the 1970s, dynamic positioning systems produced by British, American, and French companies were introduced and applied in the offshore oil industry. In 1977, Albatross delivered the first dynamic positioning system based on modern control theory, using reference systems not previously employed in these systems. This system rapidly became the leading product in its category worldwide (Breivik et al., 2015). Simrad had been engaged in the project to develop dynamic positioning from the start, providing its hydroacoustic positioning system as one of the reference systems. When KW was facing dismantlement in 1987, Simrad bought Albatross, and continued to promote and develop dynamic and hydroacoustic positioning systems to offshore and oil drilling operations all over the world (Sogner, 1997).

With the acquisition of Simrad and Albatross, the Kongsberg Group had achieved the goal of balancing its defense operations with a civilian business. However, it did not end there. In 2000, the company acquired another maritime constellation, Navia, consisting of the two IT-suppliers Autronica and Seatex, the former delivering systems to the merchant marine, and the latter to the oil and gas industry (Sogner & Petersen, 2014). After integrating these companies, Kongsberg Maritime had become a holding company for three maritime companies: Simrad, Kongsberg Simrad (Albatross and Seatex), and Kongsberg Maritime Ship Systems (Norcontrol and Autronica).

Several of these companies had crossed paths through their former connection to KW (Øyangen, 2014). However, the interaction between the companies was highly artificial. The

Kongsberg Group had not defined an independent purpose for its maritime project, and this soon became a bigger challenge than anticipated. Although they all operated within the maritime IT industry, the units were directed toward distinct market segments, and they had over time developed very different organizational cultures. The idea behind the decentralized corporate structure from 1996 had been to keep important capabilities and market knowledge intact by insulating these cultures within separate units.¹⁷⁰ Yet, this resulted in a fragmented organization with units that operated independently of each other (Sogner & Petersen, 2014).

When, around the turn of the century, the previously clear separation between the high-end offshore market and the low-end merchant market began to blur as customers increasingly wanted to buy more products from selected key suppliers, this introduced new challenges for Kongsberg Maritime, which created a lot of friction in the organization. The changes in customer demand meant that Kongsberg Simrad and Kongsberg Maritime Ship Systems suddenly became competitors in some areas of the maritime market. It was difficult for customers and people outside of Kongsberg Maritime to understand why companies within the same conglomerate would compete with each other. It caused the companies to think about independence, which created an even more fragmented organization. According to the CEO at the time, Torfinn Kildal, the different companies all cultivated their uniqueness, and that did not make Kongsberg Maritime competitive.¹⁷¹ When the market stagnated around 2000, so did Kongsberg Maritime's sales, and in 2002, total turnover began to fall (Sogner & Petersen, 2014).

Strategic renewal in Kongsberg Maritime

Deconstructing to reconstruct

In 2002, Kildal contacted the Danish-based brand agency Kunde & Co. As he saw it, the inorganic development of Kongsberg Maritime had created a formal, but not an emotional, connection between its resident companies. As CEO, Kildal needed to define a vision for Kongsberg Maritime that could unite the company, and at the same time increase its competitiveness.¹⁷² Kildal was introduced to Kunde & Co when his predecessor in

¹⁷⁰ Kongsberg Group Archive, (KGA) minutes executive group meeting August 31, 1998.

¹⁷¹ Interview with Torfinn Kildal May 3, 2013 and May 16, 2017.

¹⁷² Interview with Torfinn Kildal May 16, 2017.

Kongsberg Maritime and the new CEO of the Kongsberg Group, Jan Erik Korssj  en, hired the agency to strengthen the corporate profile in 2000. As the new head of Kongsberg Maritime from 1999, Kildal had some ideas about the future direction of the company, but he recognized that it was important for the process that he did not impose a new strategy on his own. Kildal had after all spent the better part of his career in Albatross, rising from financial secretary in 1979, to CEO of Simrad Albatross from 1988 until he left the company in the mid-1990s. He acknowledged the need for a holistic process to bring Kongsberg Maritime closer together, including gathering perspectives from all parts of the company.¹⁷³

In the course of 5 weeks, Kildal and a project team consisting of people from Kongsberg Maritime and consultants from Kunde & Co interviewed employees from different parts of the organization in Norway and abroad, in addition to a number of customers and competitors. The goal was to investigate both the internal and the external perception of Kongsberg Maritime.¹⁷⁴ The findings on internal perception showed that employees from Simrad, Kongsberg Simrad and Kongsberg Maritime Ship Systems all took pride in belonging to the Kongsberg Group. This pride came primarily from its historic stature and the fact that it was considered an exciting technology corporation. At the same time, few of the employees saw Kongsberg Maritime as being important to their business. Neither did they identify with Kongsberg Maritime as a company, nor did they see any co-operative linkages with the other business units. Consequently, the separate units kept a distance from each other.¹⁷⁵ The overall conclusion was that the fragmented history of Kongsberg Maritime was reinforced by the divisionalized structure, and the purpose behind Kongsberg Maritime's long list of acquisitions remained unclear.¹⁷⁶

The external point of view confirmed the challenge of seeing Kongsberg Maritime as one single company. Customers of Simrad, Kongsberg Simrad and KMSS agreed that the companies offered state of the art technology in their specific niches, yet they could not see why it was important to keep them together, since they were barely connected, and still operated under their original company brands. At the same time, several customers noted that Kongsberg Simrad and KMSS delivered only parts of the systems they needed, which meant that they sometimes lost out if a competing company could provide a broader set of

¹⁷³ Interview with Torfinn Kildal May 3, 2013 and May 16, 2017.

¹⁷⁴ Kongsberg Maritime Archive (KMA), "Purpose of the Project", Kunde&Co, 2002,

¹⁷⁵ KMA, minutes board meeting: "Kongsberg Maritime budget 2003", December 6, 2002.

¹⁷⁶ KMA, "Purpose of the Project", Kunde&Co, 2002.

products.¹⁷⁷ In conclusion, neither the employees nor the customers recognized Kongsberg Maritime as an important industrial actor. The lingering question was how could the company organize and communicate its competence and high-tech products in a way that both employees and customers would appreciate?

In search for a solution, the project group began to deconstruct some of the most successful product stories so far in Kongsberg Maritime, to find the key to their uniqueness. Simrad's autonomous underwater vehicle, Hugin, for example, used by the oil industry and marine research to map the seabed, consisted of many complex components such as acoustic control, transponders and telemetry, a unit steering system, data processing software, acoustic positioning, hydroacoustic reference systems and an echo sounder. The workings of Hugin had so far only been truly understood by experts within this specific field. However, when the components were translated into core technologies that described their function, the uniqueness of Hugin could be seen in the integrated use of systems for communication, navigation, automation, positioning and detection, which together provided sharp and detailed images of the ocean floor visible on a screen. Interestingly, the integrated use of these technologies was not unique for underwater vehicles. When delving deeper into the products, the project group found that some or all of the five technological competences—communication, detection, navigation, positioning and automation—had historically been combined and used in products across the different business areas. A commonality shared by the units was therefore the capability to integrate systems to create solutions that could optimize operations at sea.¹⁷⁸

When defining Kongsberg Maritime's products from the functions they served, and the purpose they had, the project group came up with the concept "The Full Picture". By integrating different systems, the company could give an operator at sea, whether a captain on a merchant ship or a process control manager on an offshore oil platform, a coordinated image of necessary information down to the sensor level, providing a total picture of what was happening, under, on, or around the vessel at sea. According to Kildal, "The Full Picture" was a strong concept because it was oriented toward products, emotions, and strategy all at the same time. It thus had the potential to make the units see themselves as part of a bigger picture.¹⁷⁹ By engaging the entire organization, Kildal as CEO established a

¹⁷⁷ Ibid.

¹⁷⁸ Ibid.

¹⁷⁹ Interview with Torfinn Kildal May 16, 2017.

common ground, and by using technology he appealed to the rational as well as the emotional side of the engineers working in the organization.

Recognizing systems integration as a core competence across all of the companies was a way of connecting them through their past. The capability to integrate systems and build systems architectures had evolved in these environments since the 1960s, as an integral part of the broader discipline of systems engineering (Øyangen, 2014).¹⁸⁰ In the beginning, what had characterized the growing need for systems integration in the maritime IT industry was its technical nature. With increasing automation came the need for increasing integration. In the 1970s and early '80s, this was primarily considered a consequence of the complexity in technology, and an important consideration for optimal technological function (Høivold & Bjerva, 2006). However, as the number of systems onboard ships and offshore vessels increased, so did the need for systems that could control the systems. Over time, this triggered a trend for increased strategic implications; suppliers that could take responsibility for a larger part of the value chain. As explained by the former corporate technology officer, Sverre Gotaas, in Kongsberg Maritime:

Integrating ever more functions, and thereby systems, with DP was about climbing the value chain. DP was one of many applications needed on a ship. Nevertheless, why should another supplier provide the customer with something that Albatross could provide itself? The idea emerged that the more systems—the bigger part of the cake.¹⁸¹

With The Full Picture concept, the top management signaled that Kongsberg Maritime could take this development a step further, giving the customer a total overview by combining these technologies in “one picture” and, at the same time, claim a larger part of the value chain. If the company started to sell packages consisting of a spectrum of applications instead of single applications, it had the potential to increase the share of total deliveries to almost all types of vessel.¹⁸² In this sense, the concept built further on an emerging recognition in Kongsberg of what systems integration could be.¹⁸³ Not just a technical capability, but also a strategic capability (Hobday et al., 2005; Moen, 2011).

¹⁸⁰ Interview with Sverre Gotaas, October 23, 2016; Jan Erik Korssjøen, March 10, 2017 and Rolf Qvenild, March 2, 2017.

¹⁸¹ Interview with Sverre Gotaas, October 23, 2016

¹⁸² Interview with Lars Gørvell-Dahl, September 3, 2013

¹⁸³ Interview with Jan Erik Korssjøen, March 10, 2017 and Rolf Qvenild, March 2, 2017.

Implementing a new “old” strategy

The Full Picture concept had important organizational implications. In 2003, shortly after the value position project was finished, the management under Kildal decided to turn Kongsberg Maritime into one operating company divided into two divisions: Offshore & Merchant Marine and Fishery. Establishing Kongsberg Maritime as one organization was important to unite the different business units. Because they had overlapping markets, Kongsberg Simrad and Kongsberg Maritime Ships Systems ceased to exist as independent brands, while the fishery and yachting segments continued operating under the old Simrad brand.¹⁸⁴ Kildal had high expectations for this organizational process, and explained this to the company’s partners and customers:

Uniting Kongsberg Maritime, Kongsberg Simrad and Kongsberg Maritime Ship Systems (KMSS) means pooling all our resources under one company name, Kongsberg Maritime, and the Kongsberg brand. Our mission is to maximize marine performance by providing our customers with “The Full Picture”. We aspire to earn respect and recognition for our dedication to providing innovative and reliable marine electronics that ensure optimal operation at sea. Uniting all our business units will enable us to utilise and share resources and information more openly and effectively.¹⁸⁵

One important aspect of this structural change was that all profits from sales now went into the same company, instead of going back to each individual company.¹⁸⁶ The most demanding, yet perhaps the most significant change in this process, was therefore the establishment of a joint sales and market department for the merchant and offshore units (Sogner & Petersen, 2014). The various acquisitions over the years had brought different sales and marketing divisions into the company. Since Simrad was internationally established in a global market for fishing equipment, it kept its brand and sales unit intact, continuing more or less “as is”.¹⁸⁷

The challenge mainly concerned the large differences between the original Albatross offshore culture in Kongsberg Simrad and the formerly Norcontrol merchant marine culture in Kongsberg Maritime Ship Systems. Both organizations were founded on important scientific and technological breakthroughs, but while Kongsberg Simrad had developed an offensive and market-driven sales culture based on promoting the value of dynamic positioning for the

¹⁸⁴ The yacht business was sold in 2005 after an acknowledgement that this segment was no longer part of the core business.

¹⁸⁵ Kildal, T. (2004). “We maximise marine performance”, *The Full Picture Magazine*, (01/04), 1.

¹⁸⁶ Interview with Tor Erik Sørensen, December 11, 2013.

¹⁸⁷ KMA, minutes board meeting, October 13, 2003.

offshore oil industry, Kongsberg Maritime Ship Systems remained more oriented toward the technological aspects of ship automation, and less preoccupied with commercialization strategies (Kvaal, 2009).¹⁸⁸ This difference was more or less cultivated within the two companies, and had created a strong sense of us versus them. According to Kildal, it was clear to him and the rest of the management team that the sales group behind dynamic positioning in Kongsberg Simrad was commercially the strongest.¹⁸⁹ Without explicitly stating it, the former Albatross unit therefore became the template for Kongsberg Maritimes new joint sales organization in Norway, located around the former Albatross environment in Kongsberg.¹⁹⁰

When it came to the sales organization abroad however, Norcontrol's long established agent network in South-East Asia became the key to a significant commercial commitment. Beginning in the 1970s, Norcontrol had established a large network of agents in South-East Asia, to gain the entry necessary to sell its automation systems. In the 1980s, the company forged important strategic alliances within the South Korean, and later the Chinese, shipbuilding industry, which resulted in a stronger presence in these countries (Høivold & Bjerva, 2006). Kongsberg Simrad, on the other hand, had been working toward the entire Asian market from an office in Singapore. The offshore unit's main customers were Norwegian ship owners, and these were primarily still located at home. Around the turn of the century, South Korean and Chinese yards increased their share of offshore constructions, which meant that Norwegian ship owners also turned their attention toward these countries. Until this point, there had been limited contact between the different sales units abroad (Sogner & Petersen, 2014). Yet, these globally driven market changes demonstrated the premise behind The Full Picture process, that there was a need for stronger integration—and this applied to overseas operations as well.

The logic behind the restructuring process followed that of Albatross—to build fewer, but more solid units. Consequently, this included a reduction in Norcontrol's large network of agents around the world, with a negative effect on the number of middle management positions in KMSS.¹⁹¹ It also resulted in a stronger concentration in some of Norcontrol's

¹⁸⁸ Interview with Lars Gørvell-Dahll, September 3, 2013; Nils Albert Jenssen August 6, 2013, and Tor Erik Sørensen, December 11, 2013.

¹⁸⁹ Interview with Torfinn Kildal, May 3, 2013; Tor Erik Sørensen, December 11, 2013.

¹⁹⁰ Interview with Torfinn Kildal, May 3, 2013.

¹⁹¹ Interview with Morten Hasås August 30, 2013.

locations. From 2003-2005, Kongsberg Maritime gradually built a more collaborative sales organization abroad (Sogner & Petersen, 2014). It started with a coordination of management positions across the different market segments, meaning that, for example, a former sales manager from the merchant marine unit was brought into the offshore unit. After a few years it resulted in the moving of the sales unit for the offshore segment from Singapore to the merchant marine sales unit office in China.¹⁹²

In addition to reorganizing the entire organization according to the new strategy, Kongsberg Maritime had to make new and existing customers familiar with The Full Picture. To promote the company's products under the new concept, the communication department in 2004 consolidated all newsletters and magazines into one publication: *The Full Picture Magazine*. From then on, product development in Kongsberg Maritime would be performed "Bearing in mind the goal of projecting The Full Picture".¹⁹³ *The Full Picture Magazine* was actively used to promote this new strategy. In this magazine, Kongsberg Maritime distilled its more than half a century of knowledge and experience of developing different marine and offshore operations into the essence of the company's historical capability to deliver effective and sustainable integrated solutions to its customers. As explained in an article entitled "Kongsberg's backbone: Strong systems":

Marine and offshore operators are challenged every day with requirements for safe operations in sensitive environments and increased efficiency for increasingly complex operations. At Kongsberg Maritime, we are committed to use our more than 50 years of experience to help customers meet these challenges [...]. Kongsberg is an original manufacturer and thus in greater control of product technologies. We are in a unique position to tailor our solutions to individual operational requirements. Both our integrated solutions and individual products are fully scalable and can therefore be tailored to different vessels without losing the quality and reliability inherent in technology.¹⁹⁴

The reorganization process in Kongsberg Maritime meant that some of the business units were restructured and moved. When the management decided to merge the navigation unit from Kongsberg Norcontrol with the product area Dynamic Positioning from Kongsberg Simrad, this reflected that products such as bridge control systems on both rigs and commercial vessels would be marketed and sold as integrated solutions with dynamic positioning systems, keeping vessels in position by automatically measuring and

¹⁹² Interview with Geir Håøy September 26, 2013; Torfinn Kildal, May 3, 2013 and Kjetil Lund September 6, 2013.

¹⁹³ Kasin, A. T. (2005). "A new bridge concept is born". *The Full Picture Magazine*, (01/05).

¹⁹⁴ Larsen, R. (2007). "Kongsberg's backbone: Strong systems". *The Full Picture Magazine*, (02/07).

counteracting environmental forces as well as propulsion systems (Sogner & Petersen, 2014). Steps taken in this period reflected the full extent of the global changes in the maritime market. The competitive situation was changing, challenging even the company's strong position in dynamic positioning. The result was an increased focus on developing user friendly and integrated solutions for dynamic positioning, navigation, and automation systems.¹⁹⁵

Effectuating strategic integration for innovation

One example of the type of product development that was brought forward under The Full Picture slogan was the prototype for Kongsberg Maritimes new integrated offshore bridge solution, developed between February and August 2004. The company needed a new bridge solution that could be presented at the Offshore Northern Seas (ONS) trade fair in Stavanger in August 2004. The project manager explained how this project was different from similar projects in the past; "We chose to drop the red tape and traditional decision-making hierarchy, concentrating instead on achieving a result".¹⁹⁶ They did so by including a range of people from within and outside the organization. The goal was to create a product that could embody and represent the new values in Kongsberg Maritime; "We worked on the basis of the idea that the bridge solution should be perceived as a whole: "The Full Picture".¹⁹⁷ With this mission in mind, the concept was developed to integrate the full range of ship handling and automation tasks on offshore support vessels. This included complete functionality for navigation, maneuvering by manual levers and joystick, dynamic positioning, and ship automation including power, alarm system, thruster and propulsion control, auxiliary control, and the safety system.

While the project group knew what they wanted to build in terms of technology, they realized that the product would not be competitive unless it also included great functionality for the customer—the operator onboard the ship. The project thus invited industrial designers to help create a proper functional design for the bridge solution. By filming officers' experience with existing bridge solutions on board, the designers suggested a cleaner and more structured design for the console panel. This ensured that Kongsberg Maritime not only developed a

¹⁹⁵ KMA, minutes board meeting: "Kongsberg Maritime budget 2005", January 18, 2005.

¹⁹⁶ Kasin, A. T. (2005). "A new bridge concept is born". *The Full Picture Magazine*, (01/05).

¹⁹⁷ Kasin, A. T. (2005). A new bridge concept is born. *The Full Picture Magazine*, (01/05).

better technological solution integrating more control functions than before, but also accorded operator-machine considerations a critical role in product development.¹⁹⁸

A challenge with delivering these tailor-made solutions based on existing systems was that the systems had been developed independently of each other toward distinct market needs with different interfaces and solutions for integration. As noted by the management in the 2003 budget:

Today we have two strong automation milieus in KM. These milieus have developed from different starting points; KMSS Horten from “simple” merchant demands, while KS Kongsberg come from “demanding” offshore oil and gas process control. It is challenging to maintain two technological platforms even though these address different market needs. We will throughout 2003 work to find solutions to this.¹⁹⁹

The plan was to develop one technological platform that could provide integrated solutions for automation and positioning systems for different types of vessels in different segments.²⁰⁰ This was not a new idea. In the mid-1980s, when Albatross and Norcontrol were both part of KW’s maritime division, the question was raised as to whether it might be useful to develop a process control and data acquisition (PCDA) system that could integrate components from both Albatross and Norcontrol, as well as from KW’s oil division. It turned out a joint platform for communication between the different components was not realistic at the time. Instead, Albatross went on to develop its own integrated multifunction system, called AIM. The conclusion was, however, that this type of interface represented a real potential for the future.²⁰¹

In 2005, Kongsberg Maritime established a project to create one common technological platform that could enable Full Picture systems across all products and divisions. The goal was to be able to embrace everything. Perhaps was it also an attempt to streamline the organization. Yet, it was never realized. It turned out that the architecture became too complex, and the project was eventually halted. This failure to build a common platform was frustrating for the top management.²⁰² However, it was not considered a disappointment by

¹⁹⁸ Ibid.

¹⁹⁹ KMA, minutes board meeting: “Kongsberg Maritime budget 2003”, December 6, 2002.

²⁰⁰ Interview with Torfinn Kildal, May 16, 2017 and Steinar Sælid, February 14, 2018.

²⁰¹ Sælid-Archive, P16 Internal project minutes, September 31, 1984.

²⁰² Interview with Torfinn Kildal May 16, 2017; Steinar Sælid February 14, 2018 and Jan Erik Korssjøen February 2, 2019.

most of the employees in Kongsberg Maritime. As noted by the former manager for the subsea division:

The idea of coordinating this technology was driven by the top management, and it was not successful. Having a common technology for these big environments does not necessarily work. Choosing processor and operative systems is therefore up to the different divisions. It is too complicated with all these applications, and they cannot force through common systems down to this level of detail.²⁰³

Instead of a joint technological platform, The Full Picture resulted in increasing the coordination and standardization of interfaces, documentation and manuals following a common pattern. For the customer, it meant that an operator moving from a console for dynamic positioning to one for navigation would recognize the interface, functionality, and aesthetics of the equipment (Kvaal & Østby, 2015).

In 2009, the company took its bridge concept even further by presenting its newest addition to offshore vessel bridge systems, the K-Master bridge workstation. With this product, the company turned the traditional bridge console—which normally measured 5-6 meters—into a single operator chair with multiple computer consoles integrated in the armrests. It was the most advanced system solution for after bridge control on the market, providing unique access to all major control systems as well as complete situational awareness for navigation, control and maneuvering of critical offshore operations within reach of the seated operator.²⁰⁴ One year later, Kongsberg Maritime combined the K-master chair with its offshore vessel simulator to provide complete simulation in an environment identical to the vessel at sea. The need for personnel training in the offshore sector was significant, and by combining efforts between personnel in Kongsberg Maritime's simulation and offshore departments, the company was able to increase its sales in this growing market.²⁰⁵

What characterized these product development processes in Kongsberg Maritime was that incremental innovations were developed across and between company departments and units that had previously been confined to separate silos, focusing on their own niche markets. The Full Picture therefore not only became a tool to unite the organization toward a common purpose, it also became key to implement new and innovative product development procedures. An important component in this process was the new premise inherent in The

²⁰³ Interview with Rolf Arne Klepaker May 16, 2013.

²⁰⁴ KOG-Web, "K-master aft bridge solution takes centre stage at offshore Europe, August 24, 2009.

²⁰⁵ Midtbø, G. H. (2010). "Integrated reality", *The Full Picture Magazine*, (01/10), 50-52.

Full Picture concept; that Kongsberg Maritime's role for the future went in the direction of a technology user. As explained by a former head of business development in the Kongsberg Group, "You get the impression that technology is the driver, but that's not correct. Engineers use world-leading technology as building blocks—and that is in a sense a technology in itself".²⁰⁶

By providing new solutions from already established technologies, Kongsberg Maritime made new products and targeted a broader market than before. This had an effect. The company experienced a significant increase in orders after 2005 including deliveries to both large and complex drilling rigs and ships, and new vessels in the merchant marine. Measured in constant prices revenue doubled from 2005 to 2009, in current prices rising from 2.7 to 6.7 billion NOK (Sogner & Petersen, 2014). This rising turnover came through the new joint sales department and reflected the strategic processes behind The Full Picture concept. These processes also paved the way for a reconfiguration of business – in Asia.

Table 7.1 Kongsberg Maritime, key figures in fixed prices from the years 1992-2013.

	KOG Total turnover	Maritime	Event
1992	2321	609	Norcontrol purchase
1996	3172	1769	Simrad purchase
1998	4404	2790	
2000	5020	2827	
2001	5682	3329	Navia purchase
2005	5031	2636	
2006	5709	3019	
2007	7003	4089	
2008	8981	4897	
2009	10991	5296	
2010	12032	4880	
2011	11601	5133	
2012	11912	5696	
2013	12163	6158	

Source: The Kongsberg Group. The numbers are in million Norwegian kroner (NOK). The index is the consumer price index of Statistics Norway, 1998=100, ref K. Sogner, "Learning in an entrepreneurial state", *Enterprise & Society* (2021).

²⁰⁶ Interview with Stig Trondvold, January 22, 2014.

Following the systems: Expanding globally to deliver The Full Picture

As we have seen, the premise behind The Full Picture process—a need for more integrated products—had important implications for how the international sales apparatus in Kongsberg Maritime was restructured in the early 2000s. A few years later, time had come to consider the consequences of this process for the production apparatus as well. Even though Kongsberg Maritime consisted of units that had always been internationally oriented in terms of sales, the company differed from many Norwegian industrial companies by having a small proportion of employees working abroad.²⁰⁷ This can be explained by the fact that Kongsberg Maritime was a knowledge-intensive company, having its R&D functions located at home as well as a highly educated workforce operating from Norway (Midelfart, 2002). Until this point, Kongsberg Maritime's internationalization efforts had therefore mainly involved engagement in strategic partnerships with South Korean and Chinese agents to be able to access these markets (Sogner & Petersen, 2014). Since Chinese yards wanted to buy ready-to-install packages of electronic boards, cabinets and consoles fully integrated with machine monitoring, bridge control, alarm systems and surveillance systems, Kongsberg Maritime sold automation systems to China—in cooperation with the German supplier HDW Hagenuk, which delivered boards, cabinets and consoles.²⁰⁸

This cooperation mirrored an understanding in Kongsberg Maritime as well as in the Kongsberg Group, that it was in developing high-tech systems that the company had its advantage—not in the production of cheap electronic or mechanical equipment (Sogner & Petersen, 2014). While the niche as a maritime IT supplier and systems integrator could be seen as very compatible with this idea, in reality it was not. In 2004, the Dutch system supplier, Imtech, bought HDW Hagenuk and shortly after moved its production of electronic cabinets and consoles to China.²⁰⁹ This meant that Kongsberg Maritime had not only lost its supplier, but the company's position in the Chinese shipbuilding market was threatened by a development that company itself had pushed for: The delivery of fully integrated systems. The question then arose of whether Kongsberg Maritime should continue to search for suppliers of electronic equipment or begin to produce electronic equipment directly in China under its own brand. While strong forces in the company, including CEO Torfinn Kildal,

²⁰⁷ This is spite of the fact that in 2002, 80 percent of revenues came from export.

²⁰⁸ Interview with Hans Petter Eriksen, November 11, 2013; Lars Gørvell-Dahl, September 3, 2013 and Kjetil Lund, September 6, 2013.

²⁰⁹ Hans Petter Eriksen in email to author on November 14 and 15, 2013.

pushed for the latter, it was a controversial decision, as production in China was generally not considered compatible with the historically high quality of Kongsberg Maritime's products.²¹⁰

Finally, the company decided to follow the systems integration logic. In 2008, the company established the joint venture Kongsberg Maritime China Zhenjiang Ltd (KMCZ) with a Chinese agent, and began to deliver complete E-packages of integrated systems to the Chinese shipbuilding industry.²¹¹ To be able to deliver the whole package—or “The Full Picture”—of the product, Kongsberg Maritime thus moved production of electronic equipment to China.²¹² This worked well. So well that when Kongsberg Maritimes own sensor factory in Trondheim had trouble operating at a profit, the company closed sensor production in Norway and decided to expand the factory in China.²¹³ Over the next few years, Kongsberg Maritime invested NOK 90 million in a 25,000 square meter new and modern factory for the production of marine switchboards, bridge consoles, engine consoles, cabinets, transformers, and various sensors to the maritime market.²¹⁴

The flexibility to address customer needs was extended with the development of Kongsberg Maritime's global customer support system. The idea of building a worldwide service organization to handle product life-cycle support was established under Kildal, but the strategy demanded a certain volume before it could be effectuated. While the volume grew, so did the demand for services across the globe. In 2009, Kongsberg Maritime launched a global customer support division, and in 2012 this was extended with a new 24/7 service concept called “Follow the Sun”, established under Geir Håøy, the new CEO of Kongsberg Maritime from 2010.²¹⁵ Divided between service offices in Kongsberg, Singapore and New Orleans, the company could offer its customers complete technical support around the clock (Kvaal & Østby, 2015). Irrespective of whether an enquiry related to dynamic positioning, automation systems or drilling, the customers would receive instant expertise, either by telephone, digital meeting or on location.²¹⁶

²¹⁰ Interview with Hans Petter Eriksen November 11, 2013, Morten Hasås, August 30, 2013; Torfinn Kildal, May 3, 2013 and Kjetil Lund September 6, 2013.

²¹¹ KOG-Archive, Minutes from board meeting: “CEO report 19.9.2007, Strategic matters” by Jan Erik Korssjøen.

²¹² Fladberg, E. (2011). Mester på maritimt. *Automatisering*, (03/11), 22-24.

²¹³ KM-Archive, minutes board meeting: “Restructuring operations in Lade”, June 2, 2008.

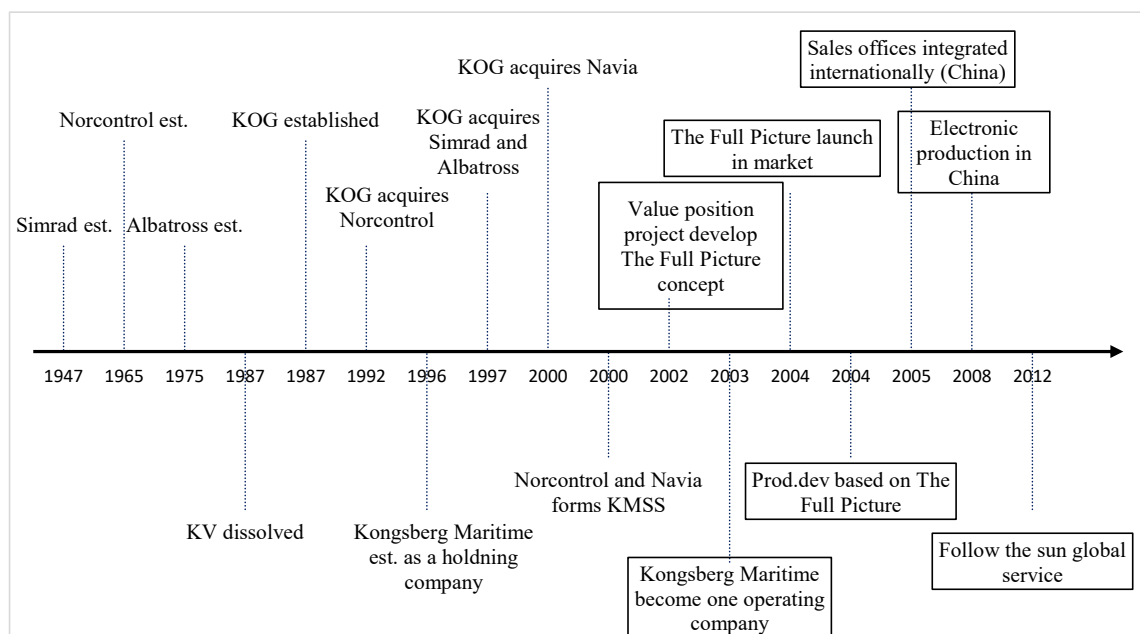
²¹⁴ KOG-Web, News and media/our stories: “Major investment in high-tech factory”, November 24, 2011.

²¹⁵ Kongsberg Group, annual report, 2012.

²¹⁶ KOG-Web, News and media/our stories: “Global customer support follows the sun”, November 30, 2012.

The expansion to a global service apparatus was undertaken to take a larger part of—and profit more from—the aftersales market, an important and growing market in the maritime industry.²¹⁷ Going from one-off product sales to a focus on life cycle meant that the company began to offer lifecycle support plans where training, customer support, service on site, and retrofit was included.²¹⁸ Providing a global support network and service offices in all continents signaled that Kongsberg Maritime was, by assuming control over this final part of the value chain, extending its role as a systems integrator (Davies & Brady, 2000; Davies et al., 2006). It also meant that the narrative behind The Full Picture strategy was changing. It was not only the historical experience in technical systems integration that enabled Kongsberg Maritime to deliver great products, but also the organization’s exceptional customer support and global presence.

Figure 7.1 Kongsberg Maritime historical development and strategic renewal process



²¹⁷ KM-Archive, Torfinn Kildal, presentation to the board; KM presentation, Strategic plan 2010-2014, September 2009.

²¹⁸ Kongsberg Sales/Commercial brochure: «K-fit, Mid-Life/Refit/Retrofit/Conversion. Creating fit for purpose vessel solutions», 2011.

Analysis

How can the past be used strategically to fulfil goals related to innovation and organizational renewal? And what is the value of using the past in strategic processes? As depicted in the previous section, the process of strategic renewal in Kongsberg Maritime evolved over four phases. In this section, I emphasize how the role of the narrative behind the strategic concept changed over time during these four phases.

Deconstruction and reconstruction—mobilizing the past to build a concept

By deconstructing past successful product “stories” to find out what they consisted of—and if they had a common factor—the value position project in Kongsberg Maritime found a common denominator in the capability to perform systems integration. In this process, the past was used to construct a narrative that fitted the new strategic concept. The emotional aspect was clear. The new narrative was meant to replace existing grudges by promoting the companies’ mutual historical and technological past. Introducing The Full Picture was in this sense a way to strategically eliminate the parts of history that were linked to differences, in favor of the parts that reflected the commonalities of the past. While this vision was initiated from the top-down, it used the experience and opinions of the entire organization to create a new sense of purpose for Kongsberg Maritime.

Implementation—using the past to legitimate a process

The new strategic concept had important organizational consequences, leading to a restructuring where Kongsberg Maritime became an operative company. In this process, the past was used to legitimize organizational changes, both internally and externally. The new concept was promoted on the basis of Kongsberg Maritime’s 50 years of experience with technical systems integration. However, while this was done implicitly to strengthen the marketing value of the new concept, it was done explicitly to strengthen the organizational identity, especially since the new structural changes had stronger implications for some parts of the organization than others.

Effectuation—the past loses importance, while the strategy delivers results

In this phase, between 2004 and 2009, the new strategic concept was operationalized in the organization through new product development processes. By defining the core capability of the organization as the capability to integrate complex systems, The Full Picture became a recipe for how older existing resources, i.e. technologies, could be used to create new and improved products, thus providing the spur to prototyping and incremental innovation in Kongsberg Maritime. This process was strengthened by the organizational integration because it brought people together and ensured that product development processes, as well as sales and marketing, increasingly involved people from previously disconnected divisions with knowledge of different technologies. Yet, as the new organizational structure fell into place, and the new product development processes showed results, the historical aspect gradually lost its role. Furthermore, it became clear during this phase that The Full Picture concept established a new balance between the roles of technology and the market as drivers of innovation. Technical systems integration capabilities were key to deliver integrated solutions, but it was not necessary to develop a new integrated systems platform to achieve this goal. Achieving innovation was more about delivering the solutions that the customers wanted.

Global expansion—absorbing the past and replacing the narrative

The final phase in the strategic renewal of Kongsberg Maritime demonstrates the importance of The Full Picture concept and the organizational changes it provoked. The process of restructuring the company and cleaning-up the sales organization at home and abroad had not only made the organization more united, it also made it easier for Kongsberg Maritime to handle the strategic balance between tailor-made systems and mass production. With one central sales organization, it became clearer how the company had to maneuver to adjust to market changes in different areas. One example of this was the decision to establish production in China. Another was the implementation of a new global service organization. However, when these processes gathered pace, between 2008 and 2012, the historical narrative behind The Full Picture concept had been absorbed in, or become obsolete for, the organizational identity, structure, and product development processes. The historical aspect of Kongsberg Maritime's technical systems integration capabilities was therefore no longer

actively invoked. Instead, the company's position as a global component systems integrator needed a different narrative – not connected to its technological past, but to its global future.

Final remarks

Research over the last ten years has demonstrated an increasing alteration in the assumptions that exists about history and its relationship to organizational capacity for change. In particular how the ability to control the narrative of history can be key to handle important organizational processes connected to either firm identity or strategic change. Studies on firms and organizational identity have for example shown how uses of the past differs depending on whether the history of an organization brings out positive or negative associations in the present. Research on sensemaking and rhetorical history has also shown that the past can be used strategically in different ways to facilitate processes of change. In some instances, narratives of the past are mobilized and remain important for organizations and their stakeholders for a long time. In other instances, as demonstrated in this article, the past is mobilized for a strategic purpose, or several purposes, and loses its function once the goals are achieved.

This article finds that in the case of Kongsberg Maritime, the past was first actively invoked to support the building of a new strategy and then applied to legitimate the implementation of this strategy. However, once the strategy had become operationalized in the organization, the historical aspect increasingly lost its importance, and finally, when the company stepped up its internationalization process (the final phase), a new narrative emerged to support the increasingly global service organization. The study thereby illustrates how the past can be used in an instrumental way to initiate and legitimate strategic change processes, but once the strategy is operationalized and submerged in the organization, the narrative becomes less important, and the strategy more so.

In conclusion, The Full Picture concept and the strategic renewal it activated in Kongsberg Maritime represented an important step to unify the organization and adapt the company toward a changing global market. Simultaneously, and for the first time, this process also involved the strategic subjection of technology to commercial forces. It turned out that while The Full Picture was promoted as a technological concept, it was not dependent on a new technological platform to succeed. It was more contingent on the strategic and historical

narrative created to unite the organization. The value of using the past thus came from bringing people closer together – to identify with the larger purpose, to integrate the organization and to innovate the products.

Future research

The findings from this study show that the past can be mobilized to consolidate post-merger and acquisition processes by highlighting historical commonalities to create new future-oriented identities. While not explicitly addressing the topic as such, this article has demonstrated the potential role that sensemaking can play in post-merger integration processes (Kroon & Reif, 2021). In line with calls to strengthen the research on emotions, there is now increasing focus on the “human side” of mergers and acquisitions and their post-integration processes in strategic management research (Graebner et al., 2017; Sarala et al., 2016; Sarala et al., 2019). I believe this is an arena where a business history approach can offer important insights in the future.

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8. Thesis synthesis: Creating room for innovation

This thesis is a business history study of innovation in the Kongsberg Group. The aim of my PhD project was to explore processes leading to the historical innovation breakthrough of the Kongsberg Group in the early years of the new millennium, to do so by concentrating on the CoPS context, and by applying a microfoundational perspective. The overall question guiding this work has been: *How did the Kongsberg Group succeed with innovation across different complex product systems in the years after 2000?*

The three papers that make up this dissertation show how the Kongsberg Group and its subsidiaries maneuvered to develop and sell complex product systems in various ways. While the papers are individually designed to contribute to specific streams of research, they also form part of the grand narrative of this thesis concerning how the Kongsberg Group as a corporation achieved its historical innovation breakthrough. With this in mind, the final part of the thesis has three main purposes. First, it elaborates on what these three papers *together* tell us about the innovative capability of the Kongsberg Group after the year 2000 and discusses how this can be related to the notion of dynamic capabilities. Second, it explains how and why a microfoundational perspective was necessary to gain this insight. Third, it shows how the insights from these different cases increases our knowledge of innovation in CoPS industries.

How did the Kongsberg Group succeed with innovation across different CoPS? Prior research looking to explain the recent innovative capacity of the Kongsberg Group has emphasized national, regional and global perspectives, including a long tradition of high-tech industrial research and development (Sogner, 2007; Wicken, 2009; Øyangen, 2014), a strong external environment (Isaksen, 2009), the importance of projects and customer relations (Moen, 2011), the role of the state, corporate governance and a new partly-private corporate structure (Sogner, 2021; Sogner & Petersen, 2014). By means of three in-depth case studies, this thesis goes deeper than previous studies, searching for the internal, micro processes involved in this endeavor.

Taking such an approach, I found that during the early 2000s the Kongsberg Group redefined its boundaries internally and externally, thereby creating and re-creating new ‘rooms for innovation’. Applying this metaphor of ‘room’, I point to how the Kongsberg Group as a corporation facilitated innovation by opening—and creating—spaces within the subsidiaries,

and between the subsidiaries and their partners and customers to achieve product sales. I here specifically refer to the new and deep alliance built between KDA and Raytheon to better compete for Nasams-contracts in international markets, the new organizational structure that was established in Kongsberg Maritime to increase its competitiveness, and the new project that was established between KDA and Kongsberg Protech to serve the rapidly growing—and rapidly changing—RWS-market worldwide.

In establishing these ‘rooms’, whether it was in the form of an alliance, a project or a new organizational structure, the Kongsberg Group assumed ownership of product ideas through its subsidiaries—unlike in KW where emerging ideas and opportunities were nurtured within the confines of a single development-department (Øyangen, 2014). The specific strategic and tactic measures by the top management at the Kongsberg Group to create these new rooms for innovation within the organization demonstrates a form of intentionality and purpose toward market demands that clearly separated it from KW. It also had a new type of long-term horizon differentiating it from its predecessor. Whereas KW’s top management had been impatient, rapidly diversifying into many new technological directions and markets where politicians and the board agreed that Norway should have a stake (Øyangen, 2014), the top management in the Kongsberg Group took the time to adapt its strategy to opportunities as they emerged (Sogner & Petersen, 2014).

The dynamics of creating ‘room for innovation’

This capability to solve innovation challenges by creating rooms for innovation can be related to the notion of dynamic capabilities (Teece, 2007; Teece et al., 1997). As emphasized in the theory section of this thesis, dynamic capabilities revolves around the activities of firms and their ability to reinvent themselves over time, to adapt and reconfigure their resources and capabilities to deal with, and create, innovative change (Suddaby et al., 2020; Teece, 2007; Teece, 2012, 2014; Teece et al., 1997; Wadhvani & Jones, 2016). While I discuss dynamic capabilities specifically in the paper about the RWS-case (chapter six), I believe the capability to (intentionally) create rooms represented a new dynamic in the Kongsberg Group’s market orientation that went beyond that single case. Indeed, it might seem that the new dynamics emerging with the RWS-project was gradually applied to other parts of the organization. The RWS-paper demonstrates how the top management in the Kongsberg Group differentiated between segments of the organization when this was necessary,

providing room for innovation emerging from the bottom up. It also shows a willingness to 'step up' on behalf of the organization to claim opportunities, for example taking the US Army to court to settle a dispute concerning the opportunity to compete for the new CROWS program on equal terms.

The paper on the Nasams-case (chapter five) shows how a new form of tactical commitment to the strategic alliance with Raytheon also created a new room for commercial breakthrough. This process, however, evolved gradually and over time in KDA. It was given a considerable push through the government intervention that secured the first strategic alliance in the mid-1990s. Nevertheless, KDA had to change focus from demonstrating advanced technological capabilities to demonstrating complementary technological capabilities before the alliance became deep enough to have an effect. This change came in the early 2000s, after the company acknowledged that to compete as a small (in international terms) product systems integrator it had to commit to the alliance with its prime integrator. Perhaps was the experience from the RWS-development important here because it had taught the company that there is 'room' to adapt.

In 'The Full Picture' case (chapter seven), one of the most significant aspects was the recognition that systems technology was subordinate to the product solution, and by acknowledging this, the top management in Kongsberg Maritime opened a room for product development that had previously not been there. By defining the core capability of the organization as the capability to integrate complex systems, The Full Picture opened for a new understanding of how existing resources, i.e. technologies, could be used to build new or improved products. Moreover, by placing previously separate departments together under the same corporate umbrella, incremental innovations were developed across and between company departments and units that had previously been confined to separate markets.

Across the three cases, new rooms for innovation was thus created after 2000. Importantly, the new dynamics that emerged from these rooms built on established capabilities and technologies stemming from the old defense segment of KW, as well as the mature maritime milieus of Albatross and Norcontrol. The inherent historical element in a firms' capacity to "create, extend or modify its resource base" (Helfat et al., 2009, p. 4), has led previous scholarship to argue for more research on dynamic capabilities to elucidate the evolutionary character of this phenomenon (Lazonick, 2002; Suddaby et al., 2020; Teece, 2012; Wadhvani & Jones, 2016). An important reason for this is that in spite of abundant research

on the topic, it has proved difficult to depict the nature of how these capabilities emerge and operate in firms. By means of their historical foundation, the three papers in this thesis clearly demonstrate the evolutionary element in how product lines or specific technologies initially developed under KW were brought forth under the Kongsberg Group and then redefined to fit new market demands. When put together, the empirical findings from the three Kongsberg-cases illuminate how a top management can operate in subtle, yet tactic ways to establish ‘rooms for innovation’, as an important step in the process of creating opportunities for dynamism in mature firms.

Table 8.1 How the Kongsberg Group created rooms for innovation in its subsidiaries

Cases	Room for innovation
Nasams (chapter five)	A new ‘room for innovation’ was created when KDA and Raytheon engaged in a deep alliance to develop and sell Nasams together.
RWS (chapter six)	A new ‘room for innovation’ was created in the Kongsberg Group (between Kongsberg Protech, KDA and the corporate level) when the RWS-project was allowed to develop and evolve within the organization.
The Full Picture (chapter seven)	A new ‘room for innovation’ was created in Kongsberg Maritime when the previously separate entities of Norcontrol, Albatross and Navia were united to conduct product development based on the Full Picture concept.

The next section explains how a microfoundational perspective has contributed to the findings of this thesis, and furthermore, how specific microfoundational processes are related to the overall synthesis.

Uncovering ‘rooms’: The value of a microfoundational perspective

By means of historical methodology, I have applied a microfoundational perspective on innovation in this thesis. This means that I have chosen a few cases and explored these in depth, through people, processes, structures, and product systems. Generally, studying innovation from a micro perspective is nothing new, on the contrary, studying innovation in depth is by many considered necessary to capture the complexity of the phenomenon (Garud

et al., 2013). I have chosen to use the concept of microfoundations specifically because I believe it can provide a bridge between the fields of business history and strategy in the study of innovation, aligning theoretical ideas with empirical findings on how innovation is accomplished in mature high-tech firms. This perspective enabled me to follow the interplay between what goes on at the top management level and what goes on in the decentralized product areas. Furthermore, by going in depth and by following the processes as they have emerged from the material, I have traced interesting patterns across from the three cases.

According to Foss and Linder, it makes little sense to argue that managers can intervene directly on the level of capabilities in a company (Foss & Linder, 2019, p. 7). If the top management influences the capabilities of its organization, it is because it influences the motivations, abilities, and opportunities of organizational employees. This dissertation shows that one way to influence the capabilities of an organization is by creating rooms for innovation. The cases further demonstrate that these rooms were initiated and created through different people, practices, processes, or structures—what we can describe as microfoundations of innovation. I do not believe I would have discovered these ‘rooms’ by approaching the study of the Kongsberg Group in a different way or by relying on more homogenous source materials.

Microfoundations are by definition less visible, and therefore not necessarily seen as important processes. It is specifically by looking for the micro processes of macro phenomena that we as researchers are open for these types of discoveries and insights from the materials we study. Essentially, one of the methodological contributions of this thesis is that I demonstrate how microfoundations can be detected by constructing narratives based on in depth case studies, and detailed information from archive material, interviews, and secondary data. By reconstructing detailed narratives about specific product areas and their path to commercial innovation, I am able to outline what these microfoundations are, how they shape the innovation path of the product in question, and thereby how they are important for the outcome.

Previous research has noted that systems companies tend to change their organizational boundaries quite often to respond to challenges in their markets, but has mainly pointed to clearly observable responses like mergers and acquisitions (Bonaccorsi et al., 1996; Gurca et al., 2021; Hobday et al., 2005). By means of a microfoundational perspective, the Kongsberg-cases shed light on some of the less visible sides of CoPS innovation strategies, insights that

might be important outside of this specific context as well. Applying a microfoundational perspective on the Nasams-case (chapter five) meant that I needed to dig deep into not just the product system, but also the *strategic alliance* that enabled its sale in international markets. This brought insights on how strategic alliances can evolve into deeper alliances based on complementarity and trust (Panico, 2017), what kind of trade-offs this involve, and why this is an important key to innovation in the defense industry.

In the RWS case (chapter six), I discovered how a new opportunity not initially anchored in the organization was given the room to grow through a practice that I have referred to as *shifting organizational ownership*. This enabled the RWS opportunity to evolve from being a single project (between Kongsberg Protech and KDA), to become a division (KDA), then its own subsidiary (Kongsberg Protech Systems), and then back to a division again (KDA). In the end, this flexibility in the corporate structure enabled the growth of a completely new product and business venture in the Kongsberg Group. The case is peculiar because it shows how innovation processes can be both detached from—and at the same time supported by—the corporate structure of an organization, and why this is an essential part of how firms operate dynamic capabilities (Teece, 2007).

In Kongsberg Maritime (chapter seven), I found that The Full Picture was not simply a new brand strategy, but the result of a *sensemaking process* initiated to develop a narrative that could strengthen both the strategy *and* the organizational identity of the company (Suddaby & Foster, 2017; Weick, 1995). The case illuminates how strategic processes can involve historical and emotional aspects and shows that these can be used for both internal organizational and external commercial purposes at the same time.

Moreover, the three papers in this dissertation demonstrate how the new rooms that were created across different places in Kongsberg Group became crucial arenas for innovation because they represented spaces where creative engineering capabilities could meet specific and ongoing market demands within a new and long-term corporate horizon. This tells us something about the duality necessary for the enactment of dynamic capabilities, and that tactic maneuvers from top management must be pursued by creative maneuvers further down in the organization. The next section elaborates on what the empirical findings from the three cases tell us about how the new market orientation of the Kongsberg Group played out within the new rooms for innovation, and more specifically, how the engineers worked to create

advantages for their customers by leveraging long established systems integration capabilities in new and strategic ways.

Reorienting from technology to market in a CoPS context

Previous CoPS research points to systems integration as a key modern strategic capability in these types of industries and indicates that this capability is relevant for discussions about dynamic capabilities (Davies & Brady, 2000; Hobday et al., 2005; Prencipe et al., 2003). Hobday et al. argue that systems integration can be used to create competitive advantage in at least two different ways; 1) to design and redesign new products and product families, and 2) to decide where and how a company situates itself in a market, including who it competes and collaborates with (Hobday et al., 2005, p. 1127). These two ways of deploying systems integration has arguably made this an important strategic business activity far beyond its original engineering character (Hughes & Hughes, 2000), and existing research has demonstrated this by pointing to how these activities are conducted separately across a number of different firms and industries (Hobday et al., 2005; Prencipe et al., 2003). By showing how systems integration capabilities were leveraged by the Kongsberg Group to accommodate specific market demands, this thesis contributes to an increased understanding of how these capabilities are used in different ways, and how these forms of appliances can be combined to create new dynamics for firms.

In similar ways to Hughes' descriptions from the US context after world War II, systems integration emerged over time in KW as a technical capability and a core element in the systems engineering process necessary to facilitate the production and eventually also design of complex weapon systems like missiles and command and control systems (Hughes & Hughes, 2000; Hughes, 1998). As a functional capability (A. D. Chandler, 1990; Davies & Brady, 2000), it constituted the collective and broad competence across the organization that enabled KW to integrate different components into complex systems. While this capability in systems integration opened for creativity and several new product areas in KW between the 1960s and 1980s, it did not lead to the market breakthroughs necessary for new products to become huge commercial successes (Øyangen, 2014). This only happened several years later, under the Kongsberg Group, and not immediately either.

The three papers show that it was first after 2000 that the Kongsberg Group began to cultivate its role as a product systems integrator, which coincided with a reorientation from a focus on

technology development to a focus on market adaptation. This does not imply that the Kongsberg Group developed less advanced or less complex products after 2000, or that the company did not develop new technology. It meant that developing new technology was no longer an independent goal, as it had been in KW (Sogner & Petersen, 2014; Øyangen, 2014). It also meant that the Kongsberg Group was no longer dependent on developing competence in new technological areas as a way of seizing emerging opportunities. The RWS-case (chapter six) is a good example of this. Instead, the Kongsberg Group continued to build on the technological foundations of KW, present in the company's existing product categories and in the capabilities of its engineers.

However, in terms of product development, the Kongsberg Group distinguished itself from KW by the change during the 1990s from a focus on building hardware components to integrating, and innovating, software-dependent systems. This shift was important. Through its new software-dependent and modular system solutions the Kongsberg Group could not only customize product systems for different customers, but also provide modular solutions that could increase the opportunity for the customers themselves to choose and combine different solutions—even involving different suppliers. It is interesting to note that the driving forces behind these new modular solutions came from deep within the organization in both defense (a new generation software engineers that started their careers in KW in the mid-1980s) and maritime segments of the former KW (Albatross and Norcontrol).

During the early 2000s the Kongsberg Group continued its development towards modular software solutions, but in different ways for the maritime and defense market. This essentially depended on the company's position in the market, whether, as with Kongsberg Maritime, the advantage lay in selling complete automation packages, or whether it lay in selling components that were compatible with different systems, as with KDAs Nasams. Either way, the cases show that the subsidiaries of the Kongsberg Group increasingly made strategic decisions regarding technology based on the overall recognition that its use was dependent on the role it played in providing the company with a competitive advantage in relevant markets. This also concerned the corporation's attitude towards questions of ownership of software technology.

It turned out, in some cases, competitive advantage could be achieved by securing ownership over important technology. The experience that KDA and Kongsberg Protech acquired from working on the Stryker RWS-contract and later the CROWS-contract (chapter six), increased

the understanding in the Kongsberg Group that its role as a product systems integrator had important tactical, judicial and financial implications that needed to be considered. These were especially important for securing control over key component designs. As innovation was also performed through software, ownership of system design could be key to market advantage—in some cases even market dominance. Control over component design was also important because components from one product could be used in new product development, even outside the original industry.

In other instances, such as the Nasams-case (chapter five), the solution was sharing sensitive technology with an alliance partner. Decisions made by KDA and the Kongsberg Group in this regard reflect how core technology became means to an end; to sell complex (niche) product systems in a global defense market. One could say that by choosing to share its core technology in order to strengthen the alliance with Raytheon, KDA accepted the role of product systems integrator. In Kongsberg Maritime, this reality had a different, but not unrelated outcome, turning technology into means for achieving a desirable system, instead of being the end product itself. However, providing integrated solutions from established technologies, Kongsberg Maritime became more flexible towards customer demands and could target a broader market.

Scholars have previously pointed out that we know little about the exact strategies that product systems integrators use when competing within the hierarchy of CoPS industries (Bergek et al., 2008; Hobday et al., 2005). Systems are composed of many interrelated parts. The composition of a system is dependent on how it can be constructed technologically, as well as the functionality demanded by the customer. This thesis shows how the engineers across the subsidiaries of the Kongsberg Group worked consistently to find this balance in the design and development of different types of CoPS, by means of systems integration capabilities. One way they did this, which contributes to fill the gap noted above, is the way in which the subsidiaries of the Kongsberg Group built advantages from undertaking prototyping, both systematically over time and in certain cases almost overnight (rapid prototyping). The paper on strategic renewal in Kongsberg Maritime (chapter seven) describe how the engineers began to work systematically on prototyping under ‘The Full Picture’ strategy, combining technologies from the different units of the company to develop new products. One example being the prototype for a completely new integrated offshore bridge solution, developed prior to the Offshore Northern Seas trade fair in August 2004.

For KDA, a practice of rapid prototyping turned out to be a strong asset when the company was trying to build an alliance with Raytheon (chapter five). The new type of fire distribution center designed swiftly by KDA engineers to fit the needs of US Army Humvee vehicles, is an example of this. The new prototype was far from ready, but sufficient to demonstrate its functionality. After seeing the demonstration, representatives from Raytheon agreed that the new component could work in a joint air defense system between Raytheon, Hughes and KDA. The emerging RWS business is another example of how rapid prototyping provided Kongsberg Protech and KDA with an advantage (chapter six). When the customer requested adjustable RWS' so that the American tanks could fit the size of the relevant military airplanes, engineers working on the RWS-project designed a new adjustable solution almost overnight. The Kongsberg Groups continued dominance in the RWS market, as well as feedback from the customers, confirmed that the capability to develop and industrialize prototypes quickly was a strong asset in that particular market.

In these examples from the defense industry, the ability to perform rapid prototyping differentiated the Norwegian engineers from their American partners and customers. This was not because the American engineers were not capable of performing fast prototyping, but they were not necessarily in a position to do so without having clarified this operation further up in the hierarchy in advance. This stands in contrast to the empowerment and the autonomous position that characterized the Norwegian engineers working in the Kongsberg Group (Moen, 2011). Being an underdog therefore also had its advantages in specific contexts, when small became synonymous with having the flexibility and agility to get business done.

Previous contributions by Hargadon and Sutton (1997) as well as Garud et al. (2013) have noted that prototyping play a crucial role for innovation, serving as proof of a concepts viability and because it provides an opportunity to implement customers' feedback. The empirical examples from the three papers elucidate this notion, showing how engineers in KDA, Kongsberg Protech and Kongsberg Maritime were able and willing to design new solutions within existing product categories that fitted customer requirements and feedback. By implementing these changes rapidly through prototypes that demonstrated the product's new performance, engineers across the Kongsberg Group ensured prototyping became an essential part in seizing market opportunities, thereby building upon and supporting the room for innovation provided by the top-management. This was an asset both in terms of showing

customers the agility and capabilities of the company and important for continued product development within existing product areas.

Final remarks

By comparing the findings of the three papers, this final synthesis reveals interesting insights into how the Kongsberg Group succeeded with innovation in different CoPS markets in the years after 2000. While these findings are heavily dependent on the empirical context of the Kongsberg Group, I believe that they have a broader and more general value outside of their contextual origin, which should be considered in future research on innovation.

First, by demonstrating how the corporate management of the Kongsberg Group created new rooms for innovation across its different subsidiaries, this thesis provides an important empirical contribution to the discussion about the nature of dynamic capabilities, showing how these can emerge on the basis of both historical assets and market driven changes.

Second, the thesis shows that business history, through its methodological approach, can contribute with valuable insights into microfoundational processes of innovation, especially with regards to in-depth historical case studies. By explaining how and why a microfoundational perspective was necessary to gain this insight, and how this was conducted by the means of business historical methods, the thesis provides a possible common ground for historians and strategy researchers to continue to search for links between organizational micro processes and broader macro level phenomena.

Third, by concentrating on three product areas within one large, high-technology company, this thesis illuminates how different aspects of systems integration capabilities are linked at the firm level and explains how this is related to successful innovation in CoPS industries. As described in the synthesis above, while the corporate management made intentional, tactical decisions regarding the Kongsberg Group's role as a system company to create new rooms for innovation, either by engaging in a stronger collaboration, opening the organization for a new venture or establishing a new organizational structure, the engineers across the subsidiaries applied their technological knowledge and experience with systems to design, redesign and integrate components into new products systems within these rooms. In the end, the result of this interaction was market-informed complex product systems that proved highly competitive in global markets.

The table on the next page illustrate these findings by showing how different deployments of systems integration capabilities were connected to and leveraged within the corporation's new rooms for innovation.

Table 8.2 How the Kongsberg Group leveraged systems integration capabilities across the three cases and the microfoundational processes involved.

Cases:	What are the activities, processes or structures that open for commercial innovation?	How are new ‘rooms for innovation’ created?	How are systems integration capabilities leveraged in different ways?
Nasams (chapter five)	<i>Strategic alliance</i>	A new room for innovation was created when KDA and Raytheon engaged in a deep alliance to develop and sell Nasams together.	When acknowledging that the company was best positioned as a component/product systems integrator in the international defense market, KDA began to focus more on adapting its technology to fit the alliance with Raytheon rather than the market as a whole.
RWS (chapter six)	<i>Shifting organizational ownership</i>	A new room for innovation was created in the Kongsberg Group (between Kongsberg Protech, KDA and the corporate level) when the RWS-project was allowed to develop and evolve within the organization.	Systems integration capabilities are leveraged in different ways at different stages in the process. Functional capability in systems integration enabled the engineers in the Kongsberg Group to industrialize the RWS-project and deliver results rapidly, while a strategic capability in systems integration was important when top management decided to go for market dominance.
The Full Picture (chapter seven)	<i>Sensemaking for strategic and organizational purposes</i>	A new room for innovation was created in Kongsberg Maritime when the previously separate entities of Norcontrol, Albatross and Navia were united to conduct product development based on the Full Picture concept.	After recognizing the capability to conduct systems integration as a core functional capability across different units, Kongsberg Maritime used this capability strategically to conduct new product development and symbolically to establish a mutual identity for the organization.

9. References

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