MANAGING DIGITAL TRANSFORMATION

Per Andersson, Staffan Movin,
Magnus Mähring, Robin Teigland,
and Karl Wennberg (eds.)

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Karyn McGettigan, Language Editor

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STIFTELSEN MARKNADSTEKNISKT CENTRUM

In his central role at the Wallenberg Foundations,
Peter Wallenberg Jr has furthered a broad range of important research and research-led education initiatives at the Stockholm School of Economics (SSE) and its Institute for Research (SIR). This indispensable work has also helped create a fertile ground for research on digital innovation and transformation: a phenomenon currently experienced, shaped, and managed in and between organisations and throughout society.

This is the topic of this book, which we dedicate to him.

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Acknowledgements

Every year since 1992, the Stockholm School of Economics Institute for Research (SIR) has published an Annual Research Anthology, and this year SIR is publishing the book in cooperation with MTC (Stiftelsen Marknadstekniskt Centrum). The purpose of the SIR Annual Research publication is to enable managers and practitioners better understand and address strategically important challenges by showcasing SSE research on a selected topic of importance for both business and society.

This year's book, *Managing Digital Transformation,* features authors from academic areas across SSE together with representatives outside the institution. The book's eighteen chapters show the strength and breadth of SSE's research within the area of digitalization and reflect the importance that SSE places upon closely linking research to practice and on investigating the leadership challenges and their implications in order to support value creation in society.

Participating in the many ongoing research projects at SSE and the multitude of aspects of digital transformation addressed in the various chapters has been very rewarding for the editors. We would like to thank all the authors for their hard work and cooperation throughout the project. In finalising this book, we have relied upon the expert work of Karyn McGettigan for language editing, Petra Lundin for layout and graphic design, and Marie Wahlström for digital access to the book. We are, indeed, most grateful for their excellent and diligent work.

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Finally, we would like to thank all the companies and organisations for sharing their challenges and engaging in dialogue and research collaborations with us so that we can produce more solid and relevant research to help better our society.

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Stockholm, January 2018
Per Andersson, Staffan Movin, Magnus Mähring, Robin Teigland, Karl Wennberg

Introduction

One of the hottest research topics lately is digitalization. Many research projects are focusing upon different perspectives. Gone are the days when digitalization or business implications of ICT were just about increasing efficiency. Instead, the ripple effect of digital development can now be felt wider and deeper than ever before. The way in which business is conducted and how it creates value, as well as how corporations can become more efficient and sustainable, are all implications of digitalization. Adapting to new demands and taking advantage of the plethora of possibilities, however, is not always easy.

Managing digitalization and the transformation of business always involves new challenges. The novelty and complexity of the digital age has led to an increased academic interest in the area of digital transformation and a call from companies that seek support in this process.

We take a look at digitalization from the perspective of business research. This creates a better understanding of the challenges that today's businesses are facing. We believe this anthology will serve as a tool to help businesses better understand the force that is digitalization and support these corporations in their digital transformation.

The idea behind this anthology grew as Marknadstekniskt Centrum was taking part in several interesting research projects. Companies were asking MTC to facilitate contact with scholars and supply them with academic insight. Vinnova came on board, by supporting the project *Progressiv digital utveckling förutsättningar för framgång (Progressive Digital Development: Pre-Requisites for Success)* of which this book is a part: its aim to stimulate business to become more progressive in digital change. At last, this book and the website www.digitalchange.com have become a reality.

This joint venture between Marknadstekniskt Centrum and The Stockholm School of Economics Institute for Research follows the SIR tradition of publishing an annual yearbook to showcase its vital research contributions. The book begins with an overview of digitalization, then moves to understanding the new digital customer, and ends by exploring re-organisational effects, business models, and ecosystems. We hope this year's anthology will be useful for managers by facilitating their digitalization processes.

PART 1: DIGITALIZATION – DIFFERENT PERSPECTIVES

The role of digital technology in business and society is rapidly shifting from being a driver of marginal efficiency to an enabler of fundamental innovation and disruption in many industrial sectors, such as media, information and communication industries, and many more. The economic, societal, and business implications of digitalization are contested and raise serious questions about the wider impact of digital transformation. Digitalization affects all private and public operations, as well as the internal and external workings of any operation. Digitalization is the major driving force behind sweeping large-scale transformations in a multitude of industries. Part 1 includes various perspectives on digitalization and digital transformation.

PART 2: THE NEW DIGITAL CUSTOMER

Digitalization has resulted in more user-centric business and user-centric systems. The changing behaviour of the digital consumer/customer is discussed here as it connects to new forms of customer involvement and engagement, as well as analysis models of what creates customer value in this digital context.

PART 3: THE RE-ORGANISATION IN ORDER TO CONNECT WITH THE DIGITAL CUSTOMER

How can companies connect with digitalized consumers and non-digitalized customers? This is a central issue in managing digital transformation, as it draws attention to the emerging intra-organisational, marketing, and customer interaction challenges associated with digitalization: for both the consumer and the supplier. Another aspect of this is the internal handling of new forms of organizational ambidexterity; that is to say, companies and organizations engaged in digitalization processes often require an internal re-organisation in order to handle the demands that digitalization brings, and to explore new digital opportunities while promoting their existing business and operations.

PART 4: BUSINESS MODELS AND ECOSYSTEMS

How do companies change, adapt, and innovate their business models? Given that digitalization leads to a convergence of previously unconnected or loosely connected markets, the digitalizing company and organisation is analysed in its systemic and dynamic context. This part draws attention to business models

and business model innovation. Incumbent firms need to adapt and change business models while competing with digital start-ups based upon new scalable business models, accessible ventures, and rapid processes of intermediating. These chapters discuss completely new co-operative business models: processes that need to be developed as companies shift from products to digitally based services.

The Ecosystem places digitalizing organisations and companies into their broader and systemic context. This includes discussions on digital disruption, industrial convergence processes, and shifting patterns of competition and cooperation. Digital technologies cause markets to converge in many new and sometimes unexpected ways. The result is the emergence of new roles and market positions of technical platforms.

Staffan Movin, Stiftelsen Marknadstekniskt Centrum

Reaping Value From Digitalization in Swedish Manufacturing Firms: Untapped Opportunities?

MAGNUS MÄHRING, KARL WENNBERG, AND ROBERT DEMIR[1]

Introduction

Digitalization has emerged as one of the hottest management buzzwords of the past few years. Media and industry experts forcefully argue that broad-ranging digitalization is a competitive must and that speed is of the essence (Kiron et al. 2016). This prompts several key questions for companies: for example, are we "at peak trend"; that is to say, at the summit of inflated expectations? And, will the next developments move firms through the "trough of disillusionment" (Burton and Barnes 2017)? Or are we, in fact, not in a trend cycle at all, but in a massive adoption phase instead: where transformation of companies and industries will continue and even accelerate (Brynjolfsson and McAfee 2014)? If so, what are firms actually doing? What influences them? And, is there a gap between talk and action when it comes to digitalization?

In a cross-national survey conducted in 2015, we asked executives in 400 large firms in Scandinavia, Europe, North America, and the Asia-Pacific region about their perceptions and respective strategies regarding digitalization (Andersen et al. 2015). We found that Scandinavian firms appeared less concerned with and less active in, pursuing digitalization than did their North American and Asian counterparts. Top management devoted relatively less time to digitalization in their strategic dialogue and companies devoted less attention to acquiring and deploying potentially disruptive technologies.

1 The authors are grateful for financial support from the Peter Wallenberg foundation. Jonas Yakhlef and Kristina Karlsson provided excellent research assistance. All conclusions and interpretations are our own.

Correspondingly, chief information officers (CIOs) predominantly had a traditional view of competition: for example, not being very active in technology monitoring and focusing their activities on providing IT services rather than supporting or driving business innovation.

A lot has changed since then. As digitalization became a buzzword in the Swedish business press in 2016, many large corporations expressed their intentions to become "digital leaders" in their respective industries. Experience from digitalization and service transformation is scarce and highly sought-after in the recruitment of executives and directors (Carlsson 2016; Karlsson 2016). In many firms, developing strategies that incorporate the challenges and benefits of digitalization is seen as a pressing need.

In this chapter, we take a fresh look at what is actually happening in the area of digitalization, with a particular focus on the Swedish manufacturing sector. We sent out surveys by email during the winter of 2016–2017 to 1250 CIOs and Chief Technology Officers (CTOs) at companies in Sweden that have been active in a wide range of manufacturing sectors: such as road construction equipment, gear motor production, agricultural production systems, precision components, water monitoring and management instruments, and wood processing equipment. We received 206 completed surveys from the firms, of which the average grosses approximately 135 million SEK in revenue. The firms in our dataset are distributed across revenues in the following way: 45 per cent with 500+ million SEK, 40 per cent with 50–500 million SEK, 10 per cent with 10–49 million SEK, and 5 per cent with 1–9 million SEK. In order to shed further light upon the patterns we see in the survey data, we also draw upon interviews and focus groups conducted with 18 key decision makers involved in digitalization projects and initiatives in manufacturing firms.

Our data provides a recent snapshot of digitalization activity levels, practices, and strategic readiness in Swedish manufacturing companies. We particularly focus upon patterns in the ways in which they seek to develop innovations and explore new business models from their activities related to product sensors and wireless data, cloud-based data warehouses, computer-aided manufacturing and 3D printing, big data technologies, and application programming interfaces (APIs). Our findings suggest that while many Swedish industrial firms have developed a strong edge through a combination of high-quality products, international presence, and decentralization, the latter

in particular poses challenges when it comes to digital transformation. Digitalization may necessitate large investments across business segments, standardisation, and knowledge sharing regarding both customers and digital solutions in order to create new customer offerings. Points for reflection are then discussed, along with recommendations for scholars that are seeking to develop new and relevant knowledge by studying the transformation of Swedish industry, as well as for managers seeking to benchmark their digitalization activities to others.

How do Firms Assess the Strategic Importance of Digital Opportunities in Their Processes and Offerings?

The future is already here – it's just not very evenly distributed (William Gibson)

We begin our exploration of digitalization activities and strategies among Swedish manufacturing firms by providing an overview of the overall strategic importance of digital technologies. We posed questions regarding the opportunities related to both digital processes and digital offerings. Digital process-related opportunities capture how firms run their operations, including logistics and manufacturing processes. These opportunities include connected and digitally (or remotely) controlled production equipment, data transfer within and across factories to optimise process flows, and the use of data to analyse and improve processes. Digital offering-related opportunities capture digital capabilities in products and associated services. Such improvements include the embedding of sensors and software in "smart" products, enabling the capturing of customer use patterns and product performance, thus, new kinds of services, new pricing models and, ultimately, new business models (Porter and Heppelmann 2014). We asked how respondents perceived their firms to be active in both sets of opportunities during the past two years, and what they saw as their main foci during the next two years.

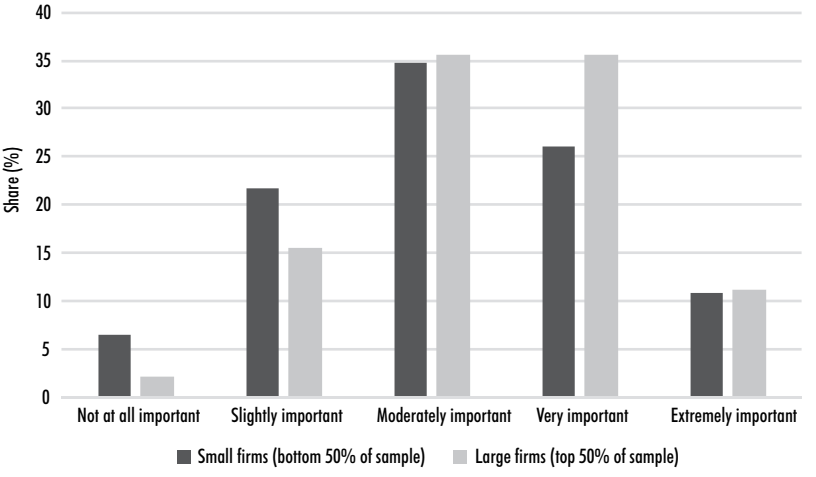

Figure 2.1: Strategic importance of digital process-related opportunities.

Figure 2.1 depicts the strategic importance of process-related opportunities, as per the 206 responding companies. The black bars display the answers from the smaller firms: those that gross less than the average 135 million SEK in revenue; the grey bars represent the answers from the larger firms: those that gross more than the average 135 million SEK in revenue. Two important insights can be gleaned from this figure: first, it is apparent that larger firms are more active in digitalization; secondly, the distribution of responses highlights that digitalization is of high strategic importance to many of the Swedish manufacturing firms, and that more than half of all respondents rate digital process-related opportunities as being "not at all", "slightly" or "moderately" important. For half of the industrial firms surveyed, the digitalization of processes is simply not the top priority. Apparently, many firms either do not perceive the risk of digital disruption in their industry, or they do not think that developing digital opportunities drives new business opportunities. Of course, we do not know whether or not this perception is accurate. What we do know, however, is that over the past few years progressive industrial firms in Sweden have addressed the challenges of digitalization in their strategies. For example, one of the firms in our sample stated: "The ability to be connected to the product has been a strategy since 2010".[2] Conversely, a

2 Director, Strategy & Business Development, large industrial firm.

breakdown of the respondents' answers to our question regarding the strategic importance of offering-related opportunities is depicted in Figure 2.2:

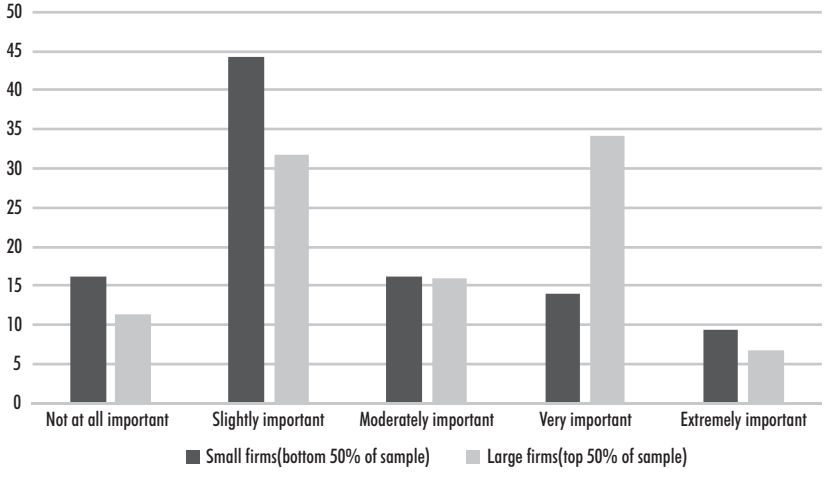

Figure 2.2: Strategic importance of digital offering-related opportunities.

A few insights can be gleaned from Figures 2.1 and 2.2 and illustrated with our qualitative data. Digitalization affects not only the processes; it also affects the products and services of a majority of firms in our survey. The challenges are not only – or even primarily – about technology itself; they are more about how to generate continuous revenues from digital solutions (Autio et al. 2017). As one of the interviewed executives noted: "It's not the technology in itself that's interesting; it's the ecosystem and business model that you can create around the digital content that's interesting"[3].

A common key to creating new business models is to exploit digital offering-related opportunities: that is to say, those that relate to the firms' potential to generate new solutions for their customers. Therefore, we also asked our respondents about the strategic importance of digital *offering-related* opportunities (Figure 2.2) in their firms. As aforementioned, the black bars display the answers from the smaller firms: those that gross less than the average 135 million SEK in revenue; the grey bars represent the answers from the larger firms: those that gross more than the average 135 million SEK in revenue. On

3 CEO, large Scandinavian industrial firm.

average, the firms in our sample reported digital offering-related opportunities to be somewhat less important compared to process-related opportunities (cf. Figure 2.1). Consequently, this indicates that Swedish manufacturing firms perceive current opportunities from digital technologies to lie, to a greater extent, in process innovation rather than in the potential to produce new types of products and services to their customers.

In addition to firm size, several other factors contribute to the firm's perceived importance of digital process-related and offering-related opportunities. Two plausible reasons are "whether managers have the willingness and commitment to spend the time and effort on pursuing those opportunities", and "whether the firm's IT department (where a great deal of digital competency tends to reside) is involved in the digitalization efforts". We posed both of these questions in our survey, finding a weak yet statistically significant correlation between the strategic importance of digital process-related opportunities and the willingness and commitment to spend time and effort on pursuing those opportunities ($r=0.28$ and $p<0.05$). We found no correlation, however, between the strategic importance of digitalization and the extent to which the IT department is involved in exploring digital opportunities ($r=0.01$). This raises an important question concerning whether internal expertise on digital technologies–specifically in the IT department–is not being sufficiently leveraged in developing digital process-related opportunities and, correspondingly, whether some IT departments do not possess the proper capabilities for digital transformation efforts. The quality of existing resources, technology, and data assets may also be poor, forcing firms to explore new and different avenues in their digitalization initiatives. As one executive told us:

"The data quality of the ERP systems is so substandard that you could not build anything reliable on that data without first sanitizing the information. But, then you have destroyed the whole idea of digitalization."[4]

From Where do the Influences to Pursue Digital Opportunities Come?

Without a strong willingness and commitment to spend the time and effort on exploring digital technology's business implications, there is a risk that technologies are being deployed in ways that do not create strategic value. Our focus group discussion with decision makers in six companies suggests

4 CEO, large Scandinavian industrial firm.

that a key aspect of committing to digitalization in manufacturing firms might stem from the ways in which external and internal parties influence the shaping of a firm's strategic agenda. Therefore, we now explore what kind of internal and external actors influence Swedish manufacturing firms when it comes to developing process-related and offering-related opportunities enabled by digital technologies. We asked our respondents about the relative importance of various influences on their efforts to develop digital processes and offerings (see Tables 2.1 and 2.2).

Table 2.1: Important Influences on Manufacturing Firms' Efforts to Develop Digital Processes

	Not Important At All	Slightly Important	Moderately Important	Very Important	Extremely Important
Owners and Board Directors	5,6%	12,8%	23,2%	40,0%	18,4%
B2B Customers	11,2%	9,6%	29,6%	38,4%	11,2%
Non-Management Employees	4,0%	12,8%	36,8%	36,0%	10,4%
Middle Management	4,8%	10,4%	38,4%	39,2%	7,2%
Subcontractors / Suppliers	6,4%	24,8%	32,0%	32,0%	4,8%
B2C Customers	34,4%	16,8%	22,4%	21,6%	4,8%
Existing Competitors	17,6%	23,2%	35,2%	20,0%	4,0%
Start-ups / New Entrants From Other Industries	25,6%	32,0%	32,8%	6,4%	3,2%
Consultants	16,0%	32,8%	25,6%	21,6%	4,0%
Media and Public Debate	30,4%	40,8%	16,8%	10,4%	1,6%
Government Institutions	37,9%	29,8%	19,4%	11,3%	1,6%

Table 2.1 displays that the most important influences on industrial firms' efforts to digitally transform processes come from owners and the board of directors, followed by corporate (B2B) customers. The emphasis upon owner influence highlights the importance of corporate governance in setting not only the strategic agenda in general, but also in articulating the role of digitalization in the strategic development of the company (Benaroch and Chernobai 2017; Mähring 2006). The patterns for development of digital offerings (new, digitally enabled products and services) are quite similar (Table 2.2);

however, respondents were less likely to rate three of the major influences on firms' efforts to develop digital offerings (B2B customers, non-management employee, and middle management) as being "very" or "extremely" important, compared to the same three influences on their efforts to develop digital processes.

Table 2.2: Important Influences on Manufacturing Firms' Efforts to Develop Digital Offerings

	Not Important At All	Slightly Important	Moderately Important	Very Important	Extremely Important
B2B Customers	18,6%	16,1%	25,4%	24,6%	15,3%
Owners and Board Directors	12,7%	11,0%	28,0%	38,1%	10,2%
Non-Management Employees	13,7%	18,8%	29,9%	30,8%	6,8%
Middle Management	11,9%	17,8%	31,4%	34,7%	4,2%
Subcontractors / Suppliers	17,9%	28,2%	21,4%	24,8%	7,7%
B2C Customers	35,9%	22,2%	17,1%	20,5%	4,3%
Existing Competitors	20,3%	22,0%	33,1%	19,5%	5,1%
Start-ups / New Entrants From Other Industries	29,7%	33,9%	22,9%	11,0%	2,5%
Consultants	23,9%	30,8%	27,4%	13,7%	4,3%
Media and the Public Debate	33,1%	41,5%	16,1%	8,5%	0,8%
Government Institutions	46,4%	28,8%	12,7%	9,3%	2,5%

Clearly, the influence from the top in many firms also includes digital leadership of the CEO:

"The godfather of everything regarding digitalization has been our Group CEO, who has challenged the organization by saying: 'This thing with digitalization, you need to dig it; whether you like it or not, but that's how it's going to be'".[5]

5 CEO, large Scandinavian industrial firm.

In many companies, digitalization initiatives are started, guided, and supported by senior executives (Gregory et al. 2015). Other external and internal stakeholders are also important:

"If we disregard the customer as being naturally the largest stakeholder in all of this, it is the service organization and those responsible for service organizations. Then we have those who actually perform services in different ways, such as field technicians, sales people, all who are out there… those who manufacture the goods… those who develop new services"[6]

Digitalization initiatives are challenging due to their often wide-ranging and partly emergent impact upon organisation structures, work processes and work content, as well as due to their challenging project dynamics. For example, extensive knowledge sharing and knowledge recombination is often required, as are repeated changes in goals and shifts in the initiative priorities. Boundary spanning activities are needed that may or may not result in sustainable working groups supported and resourced by unit and division level managers. As one executive said: digitalization "requires extensive collaboration and formation of new cross-functional groups… to take the full benefit of creating an organization that supports big data and IoT services".[7]

This suggests that "upper echelons" are important for the activity level in digitalization; the interests of owners, directors, and executives, which can be partly driven by trend sensitivity and "copying" behaviours, also need to be matched by in-depth knowledge amongst lower-level employees and middle management involved in digitalization efforts. This knowledge needs to encompass both areas ripe for internal innovation and opportunities that can be captured in collaboration with customers, suppliers, and entirely new "third-party" collaborators (Autio et al. 2017).

Both demand side and supply side influences are important. On the demand side, business-to-business customers are particularly important sources of influence for manufacturing firms' digitalization efforts. On the supply side, empowering employees seems to carry extensive potential for bottom-up innovation initiatives, though companies also need to be prepared for some of these initiatives to take the form of "bootlegging" projects hidden from managers and executives (Criscuolo et al. 2013; Globocnik and Salomo 2015). As one firm reports:

6 Program Manager for Connectivity, large industrial firm.

7 Senior IT executive, large water technology firm.

"It all started just over a year-and-a-half ago. I was working as a product development manager and ran a few smaller pilot projects revolving around the electronics of our control systems. Initially, I was doing this on my own but, after a while, I tried to prompt others' interest around [digitalization]: acting as an ambassador, trying to get people's [management's] attention".[8]

A notable difference between processes and offerings is that B2B customers are seen as having a less important influence on digital offerings than do subcontractors. A widely known fact is that innovation and knowledge exchange activities may take place across organisational boundaries, thus, including buyer-supplier interactions and even strategic alliances with competing firms. For example, Toyota developed an organisational unit to better exchange knowledge within its wide network of suppliers; Nestlé collaborated with Coca-Cola to develop a distribution model for its hot canned drinks using Coca-Cola's expertise in distribution and vending machine network (Dyer and Singh 1998). One possibility might then be that firms are dependent upon the digital capabilities of suppliers in developing digital offerings, as well as on the extent to which components supplied by upstream partners can be digitally enabled.

Alternatively, companies might consider locating digitalization activities in business hubs. For example, one company we studied gathered their analytics and digitalization activities in a specific location where most of this expertise was both internally and externally located:

"Here are our consultants and partners... We could not have attracted employees if we had not been here…"[9]

This quotation also leads us to consider the influence patterns that are *not* seen as being very important. Firms in our sample pay considerably less attention to outside influences, and even less to influences outside of their existing business relationships. Start-ups and new entrants from other industries have little influence, and even existing competitors are considerably less important than B2B customers and internal stakeholders. This can be understood as a natural consequence of organisational structure and interaction patterns; it also suggests a vulnerability to disruptive forces and a lack of intelligence activities extending into other sectors (Dyer et al. 2011). Yet, we know that Uber did not come from the taxi industry, and that Tesla was not an incumbent automotive company. This means that incumbent firms need to keep an

8 Senior IT executive, large water technology firm.

9 Program Manager for Connectivity, large industrial firm.

eye on new entrants who may take advantage of new digital technologies that help them overcome the entry barriers that incumbents have set. In other words, digitalization might lower the barrier to entry for new entrants, thereby, increasing the threat to incumbents should they ignore the fact that actors outside of the traditional industry or strategic group boundaries may use new technologies more advantageously.

A specific domain of internal influence relates to the IT department that traditionally has been responsible for digital technologies. Our 2015 cross-national survey revealed that Scandinavian CIOs have a rather "traditional" view on competition: for example, they choose to focus their activities upon "IT services" rather than on facilitating business development (Andersen et al. 2015). Thus, we posed a question to the managers in the surveyed Swedish manufacturing firms regarding the extent to which their IT department is involved in the formulation of the firm's strategy. The result for this question is illustrated in Figure 2.3.

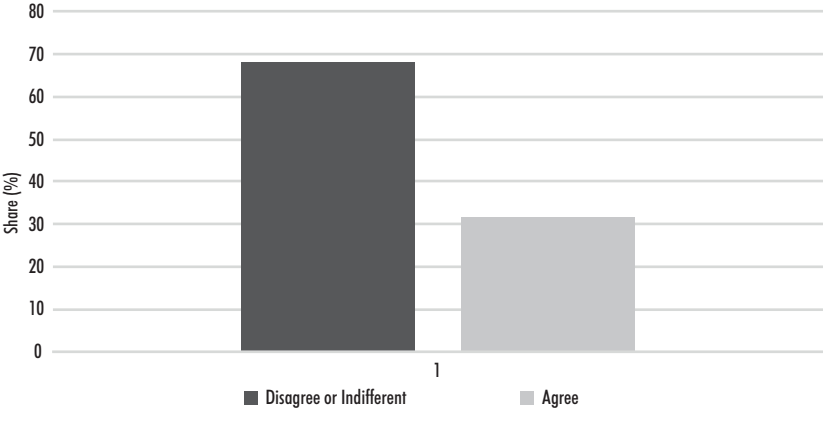

Figure 2.3: Our IT department is closely involved in formulation of organisational strategy

Figure 2.3 shows that 32 per cent of all IT departments in our survey are closely involved in the formulation of the firm's strategy. Compared to the rather negative results in our previous study two years ago (Andersen et al. 2015), this suggests that Swedish manufacturing firms do value the role of IT departments. In fact, it is remarkable that a comparatively large proportion of IT departments take an active role in the formulation of strategy, which is traditionally the domain of TMTs and income generating units. A plausible interpretation is that IT departments are shifting in focus from internal

efficiency (business process improvement) to supporting external/competitiveness aspects (strategy, digital opportunities). This would suggest a shift from IT as service delivery toward business process improvement. Such a shift is likely required to establish credibility for IT to be involved in innovation and strategy work (Mark and Monnoyer 2004).

However, while some IT departments seem to be actively engaged in strategy formulation, it begs the question to what extent are they involved in exploiting digital opportunities? As previously discussed, there is a common lack of capability to effectively generate knowledge from information: that is to say, to store, manage, and mine all of the data generated by products and production processes in Swedish manufacturing firms.

Which Technologies Underlie Digitalization Initiatives at Industrial Firms in Sweden?

The specific type of technologies a company uses is a key source of opportunity for enhancement in both the processes and customer offerings using digital technologies. Thus, we asked respondents to report what kinds of technologies are currently being used in their respective firms. We asked for a large set of different technologies, and categorised the answers in the four groups: 1) Products (sensors in products, wireless data transfer in products, and 3D printing), 2) Manufacturing (computer-aided manufacturing, computer-integrated manufacturing process, and APIs), 3) Analytics (statistical analysis tools, cloud base data warehouse, and big data) and 4) Other (computer-aided design and publication technologies). The results from these questions are reported in Table 2.3.

Table 2.3: Types of Digital Technologies Currently Used by Swedish Manufacturing Firms

Which of the following digital technologies or practices is your firm currently using?	No	Not Sure	Yes
Products (sensors in products, wireless data transfer in products, and 3D printing)	59,8%	4,2%	35,9%
Manufacturing (computer-aided manufacturing, computer-integrated manufacturing process, and APIs)	45,1%	19,1%	35,0%
Analytics (statistical analysis tools, cloud base data warehouse, and big data)	51,2%	14,6%	35,1%
Other (computer-aided design and publication technologies)	46,7%	42,2%	11,1%

What do these scores tell us about the type of digital technologies currently used by Swedish industrial firms? As indicated by the relatively high answers to "No" and "Yes" across companies, there is clearly a significant heterogeneity between firms. Furthermore, as indicated by the relatively high answers on "Not Sure" for these two categories, the CIOs and CTOs surveyed do not possess complete knowledge regarding the use of digital technologies in manufacturing processes or for data analytics purposes in their firms. When it comes to the specific sub-questions, the most common categories within "Products" are wireless data transfer and sensors in products. A surprisingly high number of companies also report they are using 3D printing. Many of the companies surveyed are obviously very advanced in what they do. However, as a group, they appear to be lagging on big data as part of their analytics. Current Swedish industrial firms are perhaps struggling in the analytics domain since the resources and capabilities needed to store, manage, and mine all the data they generate are often lacking.

These types of technologies are important since they are intimately related to specific firms' digitalization strategies and their potential to develop innovations and explore new business models from their activities. However, corresponding customer-facing idea generation activities are also essential to create a match between technology adoption and related knowledge acquisition, and customer engagement in the innovation process. For example, in order to reap the benefits of digitalization, one company has initiated and engaged in "research projects around the world… and we have jams and hackathons and have lots of such fun stuff"[10]. This suggests that digital innovation is inherently emerging in interaction with the customer. In order to make this happen, the company has sought to rapidly increase digital service functionality vis-à-vis customers, as well as initiating collaborations with leading smartphone handset manufacturers. Their hope is that internal and external developers will be better equipped to develop new services and apps related to the product itself. Customers will also benefit by being able to personalise connected services to their needs, thereby, generating user information that feeds back to the company. Through the expertise of external actors for developing digital solutions that speak to customers' needs, the company seeks to create a recursive flow of proprietary data that continuously helps improving, adapting, and innovating services (Svahn et al. 2017).

10 Senior IT executive, large industrial firm.

Future Digital Ambitions of Swedish Manufacturing Firms

We now turn to the firms' assessments of their respective ambitions and plans concerning digitalization during the coming two years. Here, it is first notable that the projection of future digitalization activity is quite ambitious: as much as approximately 75 per cent of companies expect changes in customer interaction patterns and relationships to be somewhat or extremely likely (Figure 2.4). This suggests a rather widespread belief that digital innovation in the industry will trigger changes in the relationships between manufacturing firms and their customers. For the individual company, this might be either caused by own first-mover initiatives or by the need to catch up with competitors' initiatives. In either case, the distribution of responses suggests that many firms view the competitive impacts of digitalization as potentially disruptive for their industry and clearly beyond incremental changes and adjustments.

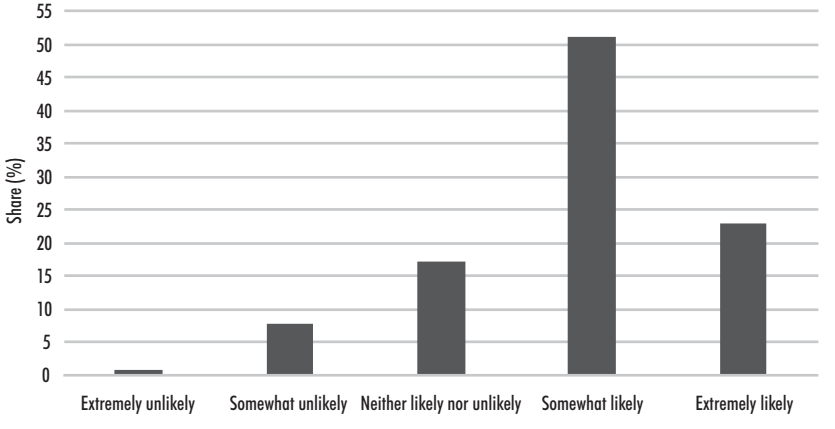

Figure 2.4: How likely is it that you will introduce new ways to interact with customers and manage relationships in order to meet the changes in the market caused by digitalization?

We next show in Figure 2.5 respondents' assessment of the likelihood that their firms will use digitalization to reduce costs from their internal processes and operations. As is apparent, further cost reductions from the digitalization of processes are seen to be even more likely to occur than does new ways to interact with customers and manage relationships. This reflects aspects of digitalization that are less disruptive, essentially focusing upon cost savings from process efficiency improvements. This most likely reflects both a wide-

spread expectation that regular productivity gains are necessary to remain competitive and profitable. As such, the responses to this question are not surprising since productivity improvements to a considerable extent are driven by IT investments (Brynjolfsson and Hitt 1998). What is perhaps more interesting is that the percentage of respondents who believe in disruptive strategic changes involving key external actors is about as large as the percentage that expects "business-as-usual" improvement work.

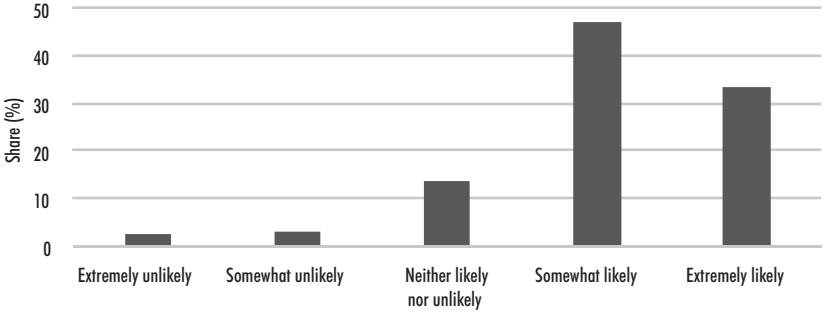

Figure 2.5: How likely is it that you will reduce costs from your internal processes and operations in order to meet the changes in the market caused by digitalization?

Interestingly, the correlation between the responses to the two questions in Figures 2.4 and 2.5 above is quite low ($r = 0.28$). This suggests that companies either plan to focus upon changing customer interaction and relationships, which suggests introduction of new services: for example, through the introduction of digital capabilities in products that allow automated monitoring and servicing of the installed base at customer sites, or they see themselves as focusing upon increasing process efficiency. In turn, this suggests that companies are at different stages of maturity, with the assumption that process improvement often comes before more advanced rethinking of how the company delivers offerings to customers (Mark and Monnoyer 2004). As aforementioned, the future might have arrived – but not for everyone.

Managerial Attention to Digitalization: are Firms Willing and Able to Walk the Talk?

Knowing that expressed ambitions are high in the firms and that owner and board involvement is important for digitalization efforts, it becomes important to ask to what extent management is seen as willing and able to engage

in digitalization. We measure this in several ways: we assess the time spent by respondents (CIOs/CTOs) scouting for input on new digital opportunities (see Figure 2.6); we look at their commitment of resources to cross-functional teams (see Figure 2.7); and we focus upon the CEO's change of leadership, particularly as it pertains to questioning the status quo and rethinking how things are done (see Figure 2.8).

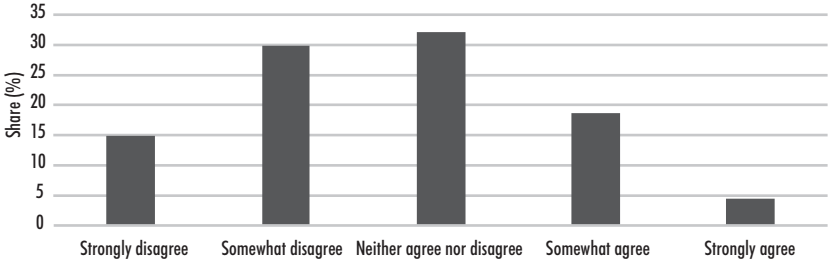

Figure 2.6: Managers at our firm will devote a large share of their time to searching for information about digital opportunities.

Figure 2.6 shows that, for a majority of firms in our sample, managers are unlikely to actively devote a major portion of their time to scout for digitalization opportunities (the responses "somewhat agree" and "strongly agree" summarise to about 25 per cent). However, managers' willingness to devote resources to cross-functional teams and to provide leadership for digitalization initiatives by challenging the status quo represent approximately 45–50 per cent of firms. This coincides very closely with the percentage of firms that are more active in their digitalization efforts (cf. Figures 2.1 and 2.2). One way to interpret these figures is that executives in the surveyed firms seek structural organisational solutions to digitalization (cross-functional teams and widespread activity increase) rather than addressing digitalization through a radical reprioritisation of their personal agendas. A more critical interpretation of Figure 2.6 would be that it puts into question whether managers are willing to put their time where their mouth is: that is to say, whether they are willing to "walk the talk". Since top-down influences are important, it might well be that a shortage of managerial attention can hamper the level of digitalization activity and/or lead to insufficient managerial guidance of the efforts that are undertaken. Two of our respondents in large industrial firms note:

"There are some people in top management who appreciate the future importance of digitization, because they are on the boards of other more digitized companies. One must consider that these are people who mostly meet other engineers whose focus is on the functionality of the product itself, and not how do the company work: business people, organisational structure, communication, and all these other issues where digitization has a very, very big impact. For these people, digitalization is limited to automation issues."[11]

"The CEO is extremely central. Replacing a major part of the top management team might be necessary to push through the huge cultural change that is required."[12]

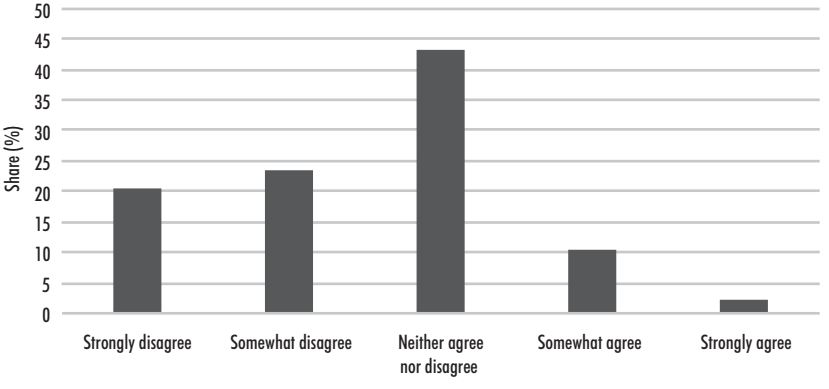

Figure 2.7: When searching for information about digital opportunities, our managers will make looking for new information a top priority for how they will spend their time.

The answers shown in Figure 2.7 call into question whether top managers are willing to put their time where their mouth is, so to speak. These findings relate to our interviews that indicate decision makers might be cognitively and habitually bound to their existing practices and practice domains, thus, limiting them from exploring opportunities beyond their core competencies and areas of personal interest. They also reflect the hectic, issue-packed, and often response-driven nature of managerial work (e.g., Stewart 1982): where new domains might be difficult to incorporate into an already full agenda, particularly when there are knowledge gaps that raise the threshold for, and cost of, initial engagement (Loch et al. 2017).

11 Program Manager Connectivity, large industrial firm.

12 Director, Strategy & Business Development, large industrial firm.

On the other hand, one could argue that the key to successful digitalization efforts might not be strongly correlated with time spent by top management; rather, it is by the priority they assign to the task compared to other tasks, as well as to how they allocate resources to address complex challenges. In particular, we know that complex and novel challenges often need to be tackled by teams that break the boundaries of functional silos, thus, potentially enabling problem solving and solution development to be more creative and innovative (Love and Roper 2009). We, therefore, asked managers in the surveyed firms about the extent to which they allocate resources to forming and deploying cross-functional teams (see Figure 2.8). Here, we see a level of activity, which is much higher than it is for direct top management time allocation.

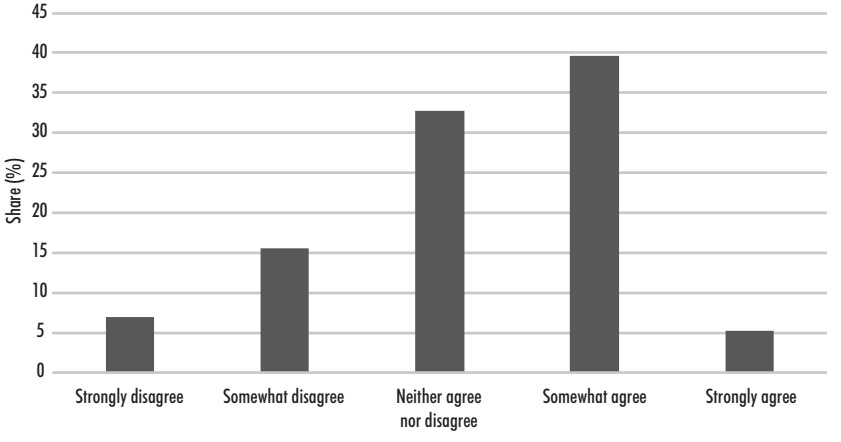

Figure 2.8: Our managers formally allocate resources to the use of cross-functional teams.

Lastly, as a way of exploring whether technical and managerial staff are actively involved in the implementation of digital solutions, we also asked respondents to gauge the percentage to which time in executive meetings is devoted to digitalization, as well as the percentage to which time in research and development (R&D) is designated to the implementation of digital solutions (see Figure 2.9). Looking at the light grey line, we see that the majority of Swedish industrial firms in our study – about 87 per cent – spend approximately 20 per cent or less of their time in management meetings discussing issues related to digitalization. The dark grey line shows us that 80 per cent of

firms use approximately 30 per cent of their R&D time on digital solution development and implementation.

To summarise, relatively limited time in executive meetings is typically devoted to digitalization; somewhat more time in R&D is devoted to implementing digital solutions. Our data does not suggest that top executive attention is undergoing a major shift towards digitalization. Rather, the agenda of top executives is likely to remain broad and diverse, while also allowing to focus upon new trends and strategic shifts. The challenge for corporate boards and executive teams will be to assess how much attention to digitalization is appropriate, given the current level of, and future potential for, transformation and disruption in the specific industry within which the company is active.

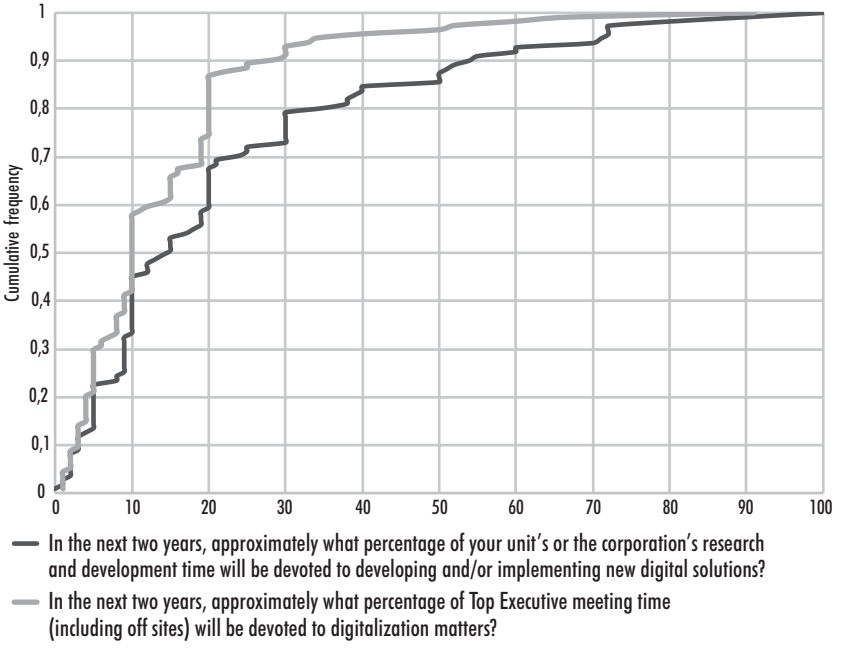

Figure 2.9: Percentage of R&D time devoted to the implementation of digital solutions (dark grey) and executive meetings time devoted to digitalization matters (light grey)

Concluding Discussion

In this chapter, we have sought to provide a snapshot of digitalization in Swedish manufacturing firms and to display how these firms seek to develop

and explore business opportunities from digital technologies. Our survey of CIOs and CTOs in Swedish manufacturing firms – with 206 firms responding – suggests that, while digitalization is of strategic importance to many Swedish manufacturing firms, more than half of the firms in our sample do not rate opportunities for value creation from new digital processes or digital offerings as being very important. The finding that digitalization is simply not a top priority for many firms poses some interesting questions for future studies and also some challenging questions for corporate decision makers.

Our analyses suggest that the Swedish manufacturing sector currently experiences a somewhat "digital divide"[13] among manufacturing firms. As digital transformation continues to be driven by the increased attention and activity of many progressive firms, the digital laggards in the manufacturing firms risk being left behind; knowledge acquisition and capability development may be compromised, and competitiveness could simply slip through their fingers. As aforementioned, it appears that management in these firms does not perceive a large risk of digital disruption in their industry and/or they do not see new business opportunities as being driven primarily by developing digital opportunities. The future has clearly arrived, yet it is not evenly distributed. Furthermore, most CIOs and CTOs responding to our survey perceived current opportunities from digital technologies to lie primarily in their companies' processes, rather than in the potential to produce new types of offerings for their customers. This goes against the current international discourse to a certain extent: where, along with the servicification of current products, digitalization is heralded as facilitating the developments of new revenue-generating products (Brynjolfsson and McAfee 2014; Porter and Heppelmann 2014). This raises the question whether the firms in our sample underestimate the risks for disruptive forces as well as the opportunities of digital offerings. Moreover, those who responded to our survey may have been more focused upon internal issues rather than market offerings, compared to those that did not respond.

Our analyses also illustrate that, while digitalization is quite high on the corporate agenda, the actual time spent discussing digitalization in top executive meetings is limited. Correspondingly, prioritised efforts over the next two years appear to include using digital technologies to lower costs and

13 Originally, the "digital divide" denoted the risk that underprivileged individuals would be left behind in the digital era, due to lack of access to IT resources and knowledge (see e.g. Kvasny & Keil, 2006).

streamline production and process efficiency, rather than to develop new customer offerings.

Our survey also shows that managers perceive their current portfolio of digital technologies to be primarily within manufacturing and in technologies embedded in products sold to customers. When it comes to technologies related to analytics (big data, statistical tools, and so on) there is still a relative dearth.

Summarising, while digitalization seems to have changed from a buzzword to something of real importance for a large portion of Swedish manufacturing companies, our study suggests there might still be a discrepancy in terms of "talking the talk" and "walking the walk" regarding the actual time and effort spent on developing business opportunities from digital technologies. We interpret this from the perspective that many Swedish industrial firms have, thus far, managed to develop a strong edge by focusing upon high-quality products, an international outlook and footprint, and decentralised decision-making that concentrates upon serving customer needs wherever they are. However, the key focus on physical products and decentralised decision-making also poses challenges when it comes to digital transformation, which may necessitate large coordinated investments across business segments, standardisation, and knowledge regarding both customers and tools for managing and using digital information to drive business processes and create new customer offerings.

For managers seeking to develop and benchmark their digitalization activities to others, we believe that the global nature of digitalization makes it necessary for Swedish manufacturing firms to also keep a keen eye on studies of digitalization processes and advancements in other regions, such as North America and Asia. Finally, generating value from digitalization often demands that firms are able to work across departments and avoid thinking in silos. Knowledge and resources to collect and manage digital data may reside in IT departments, while customer contacts and ideas for new products and services are often developed elsewhere in the organisation. Efforts to improve the customer journey typically require lateral and integrative approaches. We believe that firms best able to successfully reap the value from digital technologies will be those that actively avoid departmentalising questions and, instead, see digitalization as an overarching strategy for their business processes and business development.

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