MANAGING DIGITAL TRANSFORMATION

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

Managing Digital Transformation

Managing Digital Transformation

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

Karyn McGettigan, Language Editor

SSE INSTITUTE FOR RESEARCH

Stockholm School of Economics Institute for Research (SIR)
is an independent research foundation established in 2010. The Institute's purpose is to conduct high quality academic research in the economic sciences with an ambition to combine scientific rigor with empirical relevance. Its board includes professors and other representatives of the faculty at the Stockholm School of Economics. The Institute encourages and assists its researchers to communicate their research findings to both the scientific community and society at large.

Address:
Stockholm School of Economics Institute for Research (SIR)
Box 6501, SE-113 83 Stockholm, Sweden
Visiting address: Sveavägen 65, Stockholm City
Phone: +46(0)8-736 90 00
www.hhs.se/en/Research/Institutes/institute-for-research/
publications@hhs.se

Keywords: digital innovation, organizational transformation, digitalization trends, customers, business models, platforms, eco-systems, analytics, information technology, change management, Internet of Things

Managing Digital Transformation
ISBN: 978-91-86797-31-7

First edition

Art Direction and Design: Petra Lundin, Manifesto
Production: Manifesto, www.manifesto.se
Cover photo: Westend61/Getty Images

Distributed by:
Stockholm School of Economics Institute for Research (SIR)

Printed by: BrandFactory, Göteborg, 2018

PROJECT SPONSOR

Stiftelsen Marknadstekniskt centrum, MTC
The Foundation MTC promotes value-creating interaction and learning between business and research in the areas of market, service development, digitalization and ecosystem development. The foundation was established by the Royal Swedish Academy of Engineering Sciences (IVA) and the foundation of the Swedish Institute of Management (IFL) in 1974. MTC is a non-profit organization, thus the projects are financed primarily by major corporations and government agencies.

mtc
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.

Contents

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.

The Director of SIR, Johan Söderholm, and the Chair of SIR, Professor Richard Wahlund, have provided important support, for which we are deeply grateful. We would also like to thank Vinnova for its financial support for the research project *Progressive Digital Development: Pre-Requisites for Success* of which this book is part. Hopefully, the book will become a reference for future research and funding areas.

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.

The authors and the editorial team would like to express their gratitude to the following for generously contributing to this valuable research:

• European Union's Horizon 2020 research and innovation programme: Grant Number 688670
• Forte: Grant Number 2014-1502
• Hakon Swenson Foundation
• IIS: The Internet Foundation in Sweden
• Infina Foundation
• IoT Sverige: Internet of Things Sweden
• Jan Wallander and Tom Hedelius Foundation
• Marianne and Marcus Wallenberg Foundation
• Peter Wallenberg foundation
• SMHI: Sveriges meteorologiska och hydrologiska institut,
• Sveriges Riksbank
• Tore Browaldh Foundation
• Torsten Söderberg Foundation
• Vinnova

And to the Swedish retailers, executives and other research participants, and all others who kindly helped make this book a reality.

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

Digitalization: Different Perspectives

Strategic Challenges of Digital Innovation and Transformation

PER ANDERSSON AND CHRISTOPHER ROSENQVIST

Introduction

Digitalization has reached all industries and all sectors of society. Companies and industries are currently facing challenging transition processes; the future appears to be less predictable for many, which threatens existing competitive position. Meanwhile, digitalization opens up for many new options, thus, shifting companies' and organisations' opportunities to re-position their business and operations. Digitalizing incumbents and new digital start-ups both face a number of strategic challenges associated with digital transformation and digital innovation processes. Our focus in this chapter is on these strategic challenges. We will extract, present, and discuss a set of common strategic challenges that are associated with digital transformation and innovation processes, while drawing upon insights from cases in fifteen different sectors and digitalizing arenas. Larger incumbents are under pressure to transform their business while acting in a short-sighted quarter-to-quarter perspective. The rapid pace with which new start-ups are creating strong market positions sometimes leaves the incumbents with no choice but to collaborate – or be left behind. One major strategic challenge stemming from digitalization is the development of business models based upon new forms of cooperation and partnerships. One report expresses this new competition and the resulting strategic challenges:

> "The current generation of entrepreneurs is unlike any other. Empowered by digital technologies and unencumbered by legacy structures, they are unleashing fundamentally new business practices at a pace that was almost unthinkable just a couple of decades ago... inventing new business models and monetization strategies all along the way." (Source: *Ericsson Digital Disruption Report*)

Digitalization poses strategic challenges for both incumbents and for the new digital disruptors. Major challenges concern business development, including business model changes. Building upon a broad set of case studies in a variety of industries, the purpose of this chapter is to provide an empirical overview and a discussion of the recurrent strategic challenges that are associated with digital transformation. To set the scene for this discussion, we introduce three short introductory illustrations from three completely different sectors.

Our first example comes from the automotive industry. The increased demand on behalf of car users for "car access as a service" requires new business models and a strategic shift from product to service orientation in the automotive industry. Meanwhile, the digitalization associated with the launching of connected vehicle strategies enacts another strategic challenge, which appears to be part of the digitalization process: the creation of new cooperative business models across previously weakly connected business networks. When launching various types of "connected vehicle" concepts, companies in the automotive and the ICT industries report similar experiences. When Ericsson presented its connectivity platform for connecting the car, thus, directing attention to business model challenges, the ITC company argued that business modelling and new forms of partnerships could be an area for innovation: "It… enables new profitable innovative business models for the industry where new actors – government and third party players – are able to share revenues. Several stakeholders share the growing interest in being connected on the road: Governments want to enhance road safety and collect road tolls and congestion charges. Insurance companies want to be able to offer insurance based on how you drive; media and content companies want to be present in the vehicle." (Ericsson: Connected Vehicle Cloud). This leads to challenges in establishing completely new business models across industries. One of the anticipated obstacles relates to the vast differences between the automotive industry and the mobile communication industry, as expressed by one mobile operator: "The automotive and mobile industries have been drawn together by the unstoppable rise of the Connected Car. As with any partnership, there will inevitably be teething problems, but both sides are aware of the importance of making the relationship work as the demand for connectivity in cars grows." (Telefonica: *Connected Car Industry Report 2013*, p.9)

Our second example is from the medical technology industry. A business unit manager in a global medical technology company was interviewed about his and the company's main challenges with regard to directing attention and resources to digitalization:

> "The biggest challenge is to grasp the complexity of the strategic challenges that we are facing when taking the next steps into digitalization. We had an idea of what to start with, but soon we experienced that there were many strategic issues that required our attention. And they seemed to be strongly connected. We experienced some difficult delimitation problems quite early when starting to work with this…"

The company thought it could do something about the masses of machine and patient data that was being generated from the company's machines when used globally in intensive care rooms. Thus, big data issues captured the company's early attention. A first mover advantage was expected in relation to competing global medical technology suppliers that had (connected and complementary) intensive care machines placed in the same rooms in different parts of the world. However, creating a new business around the analyses of big data aimed for intensive care professionals and their hospitals would require a shift in business orientation: from selling products, associated hardware, and services to also becoming a service and consultancy provider. Intensive care staff would have limited use of data analyses from only one supplier; much more value would be created if analysed data from complementary medical technology suppliers were included in the service package. This would require some radical re-thinking on behalf of the medical technology suppliers of their present, competition-based business models, as well as technical integration. New cooperative business models would be required with patients as the focus of value creation. The initial and delimited big data was difficult to separate from other main strategic issues: moving from products to services, shifting toward more user-centric business operation, and handling completely new cooperative business models.

Our third example is from the education sector and the emerging education technology industry. Sensavis is a Swedish company that offers high quality 3D visualisation software for the K12 education sector. Sensavis' vision is to improve learning outcomes by making it easier to understand complex and abstract phenomena, particularly within STEM: science,

technology, engineering, and mathematics. The small company's mission is to provide educators all over the world with tools that enable them to reach and include all students in the learning process. Headquartered in Sweden, the company operates in 36 countries and serves over 550 schools, thus, reaching more than 220,000 students. Sensavis and the education technology industry face a unique challenge: the public education sector is characterised by fairly high levels of bureaucracy, risk-aversion, and slow technology adoption (2014 OECD Conference: *Innovating the Public Sector: From Ideas to Impact*). This often stands in stark contrast to the innovation-driven education technology industry, which presents multiple barriers to entry for education technology companies. In addition, investor impatience to show returns puts more pressure on education technology companies, such as Sensavis. Although education technology companies have the opportunity to transform learning, the potential impact of their digitalized services often depends upon their ability to develop a viable business model. In the case of Sensavis, as the small education technology start-up successively learned more about the customers, the users and the other stakeholders in the local networks, it altered and adapted its business model four times during its first years of existence: "We had the ability to spark interest and got the traction of people who were early adopters and visionaries, but we lacked the understanding of what people really needed..." And considering this was a situation where digitalization was difficult due to existing structures and institutions, "we are trying to change 100 years of tradition in schools and that is the biggest challenge."

The three examples indicate that digitalization processes often enact radical new forms of business and industry change. The same complexity emerges regardless of the digitalizing industry or sector. During these digitalization processes, previously unconnected or weakly connected industry networks become connected (for example, automotive and telecom industries). As with these first two examples, many incumbents in different industries have begun their digitalization journeys; one over-arching experience is that digital transformation processes often embrace big strategic challenges. And, one strategic challenge does not come alone; it is often connected to other bigger issues. Hence, the guiding question is the following:

What are the general, strategic, and managerial challenges associated with digitalization?

Companies report on a set of major strategic challenges when engaging in digital transformation. This seems to be general in the sense that they appear in many different business (and public) contexts. When starting the process of digital transformation, these strategic challenges do not come alone. For example, business model challenges can often become intertwined with technical challenges associated with the introduction of a new technical platform. Companies show different behavioural patterns in terms of how they deal with this inter-connectedness of digitalization challenges. We will describe and elaborate upon these general strategic challenges. First, let us say a few words about how they have been extracted.

About the Underlying Research

The digital transformation challenges are collected from a longitudinal comparative research project focusing upon in-depth studies of companies in 15 different contexts engaged in digital transformation processes (see Table 1.1). The discussion here builds upon a broad set of ongoing case studies, and secondary sources on digitalization. The strategic managerial challenges were extracted from ongoing cases of digitalization processes listed in the table. The cases all share the fact that the effects of digitalization are apparent/considerable (a transformation) and are of central strategic importance for the organisations involved; this includes the role of various technical platforms. In many of the represented sectors, digitalization is associated with an overlapping between sectors and networks, which sometimes includes tension between different "industrial logics". Thus, the processes in most cases open up for considerable changes and re-positioning of companies: where business development and business model innovation become part of the digitalization changes. The strategic challenges discussed in this chapter provide a snapshot of ongoing digitalization processes that have been extracted from both secondary sources (digitalization reports from different industries, government reports, companies' annual reports, and business press) and from a set of ongoing case studies that occurred between 2015–2017 (see Table 1.1.) The main case studies (from areas 2, 5, 7, 8, 11, and 15 in the table) are based upon interviews in the case organisations and workshop sessions. These focus upon internal and external organisational challenges associated with ongoing and future steps in the case companies' digitalization processes. In broad terms, the digitalization challenges were initially discussed along a set of different

themes, which included the following issues: technical, customer exchange and value, external partnership and business ecosystem, economic and financial, and other business models. With these as guidelines, a set of ten general strategic issues was finally extracted from the cases and the secondary sources from the fifteen digitalization areas. (The research is ongoing as of 2017; therefore, no claim is made that the list is exhaustive or that all issues are equally relevant for companies in all fifteen areas.)

Table 1.1: Cases of Digital Transformation Processes: Studied in 15 Different Areas

Digitalization Area	Start of Empirical Studies	Focal Sector (and Business and Societal Issues)	Main Ongoing Case Studies and/or Empirical Collection During 2016–2017
1 "The Smart Home"	2016	Building construction and digital homes	Mainly ongoing data collection from secondary sources
2. "The Connected Vehicle"	2014	Automotive industry	Volvo-Ericsson: The connected vehicle case (reported In: Andersson & Mattsson 2015)
3. "The Big Media Event"	2014	Media and entertainment industries	Mainly ongoing data collection from secondary sources, including case of a major sporting event
4. "The Mobile Enterprise"	2010	Administration and office operations	Mainly ongoing data collection from secondary sources
5. "The Remotely Monitored Patient"	2014	Healthcare sectors	Getinge: ongoing case study of integrated patient care and big data challenges
6. "The Beyond-the-Pill Solution"	2016	Pharmaceuticals and healthcare	Mainly ongoing data collection from secondary sources, including reports on pharmaceutical companies buying health care digital support companies
7. "The Connected Farm"	2015	Farming and food industries	Vertical Farming: ongoing case studies of the digitalizing of supervision in farming, including vertical farming
8. "The Networked University"	2016	Public and private sector education	Sensavis: ongoing case study of a new start-up company in the education technology sector
9. "The Smart City"	2015	City planning and sustainability issues	Mainly ongoing data collection from secondary sources, including reports from Stockholm and Dubai
10. "The Monitored Environment"	2015	Sustainability and issues of environmental monitoring	Mainly ongoing data collection from secondary sources

11. "The 'Mobility -as-a- Service' System"	2015	Transportation and logistics	Nobina: ongoing case study of public transportation supplier ("Public transportation as 'mobility-as-a service")
12. "The Automated Production System"	2016	Manufacturing, industry automation and production	Mainly ongoing data collection from secondary sources
13. "Digitalizing Finance"	2017	Banking, finance institutions and new FinTech start-ups	Mainly ongoing data collection from secondary sources
14. "The Networked Public Society"	2017	Public safety, social welfare organisations, and elderly care	Mainly ongoing data collection from secondary sources
15. "E-com 3.0: Consumer Centric Retailing"	2015	Retail sectors: music, food, and fashion	Universal Music Sweden: ongoing case study of management of big data in music consumption

Ten Digitalization Challenges

What are the major managerial challenges experienced by managers in different sectors? We have extracted ten general strategic challenges taken from discussions and meetings with both global suppliers of digital technology solutions for transforming sectors and with companies engaged in digital transformation. We can still say that while the composition of problems under each of the ten strategic issues can differ, it appears as though several issues are common, based upon a first exploratory step of analysis and the given empirical limitations. In addition, the centrality and importance of certain challenges can differ between industries and sectors, partly depending upon the stage of digitalization in which a company or sector finds itself. For example, the issues facing media companies is often at the forefront of digitalization – such as, in the music industry – yet they do not fully mirror those of companies in other more traditional types of manufacturing and construction industries. We will now summarise these companies by giving short descriptions of them. We begin by addressing the challenges associated with the technologies, explore the challenges of increased user-centrism, and then move toward business model issues; , lastly, we will end with more systemic challenges. We focus upon the broader strategic issues, and end the list with linking these to important internal organisational challenges.

1. MANAGING THE IMPORTANT ROLES AND MARKET POSITIONS OF TECHNICAL PLATFORMS

Platform management research in general – and more specifically, information management – tends to draw attention to the growing importance of technical platforms, as well as their organisational and technical complexity. The emergence of industry-wide technical platforms sparks profound changes – and challenges – in industrial structures. This blurs industry boundaries, reshapes markets, and impacts firms' strategies, structures, and management processes (Yoo et al. 2010). This transformative impact of digitalization is often connected to the growing importance of technical platforms. As Gawer & Cusamano (2014) argue, the concept "platform" has become almost ubiquitous; their definition of "external platforms", however, draws attention to the external strategic dimensions: "We define external (industry) platforms as products, services, or technologies that are similar in some ways to the former, but provide the foundation upon which outside firms (organized as a "business ecosystem") can develop their own complementary products, technologies, or services…" (ibid, p.418)

A technical platform's eco-system can refer to one or several platform owners and a more or less explicit platform leader. The way in which technical platforms emerge and how their ecosystems evolve is of great importance in management. Platforms are "manageable objects" (Gawer & Cusumano 2014), purposefully managed to bring multiple parties together: primarily users and 'complementors'. Platform leaders and their competitors, as well as suppliers, complementors, and users are involved in both competitive and cooperative interaction: that is to say, in co-opetition. This creates new managerial challenges. In digitalization processes, a complementor might become a platform leader that is in competition with the incumbent leader. Moreover, from the perspective of layered modular technology, there appears to be many loosely coupled layers of devices, networks, services, and contents when it comes to technical platforms that are central in many digitalization processes. Yoo et al (2010) describe the strategic challenges of this: "Because of the dynamic nature of the layered modular architecture, the same firms can compete on one layer and peacefully coexist on other layers" (p.729). Many of the identified management implications come back to the fact that digitalization and the new technical platforms upset old industry structures and require new types of "frameworks" for analysing and understanding competition. Digital

technologies and platforms require actors to create new "meanings" to products, competition, customers, etc. (Yoo et al 2010, p.729).

Part of the managerial issue concerns the important role of technical platforms as new *intermediaries* in service innovation. That is, the technical platforms take on and/or are given a central role between a set of complementary suppliers (complementors) and a set of customers. The intermediating role seems to be associated with new complex patterns of cooperation and competition, thus, creating important strategic challenges for involved companies, including platform leaders. Intermediation in the digitalization processes seems to be associated with dynamic network processes and changes in network connections.[1]

2. MANAGING BIG DATA: CREATING NEW VALUE BASED SERVICES FROM DIGITALIZATION

Quotes from three managers interviewed in 2016 in an ongoing research project[2] on digitalization processes in different sectors of the networked society, illustrate the problem area. This is the focus of our second strategic challenge connected to digital transformation:

"We are working hard right now to try to figure out a strategy for big data – one important question is if we should build our own internal big data analytical capabilities, like some leading companies that have created specific units and business focused on this, or if we should outsource parts of big data operations to partners." (Interview with product manager at engineering company engaged in IT and industry automation, Jan 2016.)

"One of the strategic issues that we are struggling with in our ongoing digitalization concerns our future approach to big data. There is a business opportunity in this, but one of the tricky issues concerns the fact that our products are strongly connected to a number of competing companies' products. Big data analyses for the end user of these systems is of less value if the analyses do not involve data from all products. This is a new situation of competition and cooperation emerging…." (Interview with marketing manager at high-tech medical device company, Dec 2015.)

1 In an article published within our ongoing research, Andersson & Mattsson (2015), argue: "We find it useful to introduce elements from methodology, specifically including material objects as actors and to acknowledge the performative role of technology for overlapping and intermediating in industrial networks." (p.92)

2 A three-year research project on digitalization processes ending in 2017: *Renewal of the Service Society* ("Det mogna tjänstesamhällets förnyelse", Wallanderstiftelserna)

"The first issue is of course to understand if and how our big data analyses can be actually turned into value creating services for our customers and other partners. The second issue concerns our own role in this and what our business model should be when creating new business value for ourselves." (Interview with marketing manager at a media company, Feb 2016.)

Recurrent questions in the contacts with managers concern the experienced challenges associated with big data (BD), now and in the future. As the above quotes indicate, these challenges concern both strategic and practical operational issues around BD: What role should the company and other organisations have in BD, including specialised BD analytic companies? What value can actually be developed from BD, and for whom in these stakeholder networks? And what are the various practical challenges when taking a step into BD operations: translating accessed, structured, and analysed data into value creating services? A number of emerging question marks concerning data sharing, privacy, and ethics around BD are also added to this. Practitioners' concerns regarding BD, thus, circle around three broad issues: 1) strategic, which includes the (external) distribution of work and control over various BD related activities; 2) value and business models, regarding the actual output value from BD analytics and associated business models; 3) operations and practices, including the processes of translating BD analyses into value creating services, and how to internally re-organise in order to manage BD-related operations. Edelmann & Singer (2015) are in line with the last point; they describe how companies draw upon large amounts of customer data in order to analyse and build effective "customer journeys" that, in turn, require new internal organisational structures and innovative types of management.

3. COPING WITH USER-CENTRIC SYSTEMS: MEETING THE POWER OF CONSUMER NETWORKS

One common observation in digitalization reports is that the 4th Industrial Revolution leads to increased user-centric orientation in companies (World Economic Forum). A consequence of this shift, for example, is that marketing and its bridging role are placed right at the centre of this development. Consumers buy and use products and services in new ways, sometimes sharing products and services as part of what collectively has been labelled "the sharing economy" (Frenken & Schor, 2017). Companies' existing product and product sales-based business models become challenged when large networks

of consumers or organisational customers start sharing products and begin demanding "access to product use", rather than ownership, which is often based upon digital support systems.

This general shift has also been associated with changes in connectivity, advances in analytics and artificial intelligence, and the growing profusion of smart devices and sensors. The experience concept, customer value, and outcomes receive special attention as consumers' set of daily digital activities grows: they search and buy, download, stream, access, connect and create, do peer reviews, and so on. Since the growing digital ecosystems are becoming increasingly digital and more user-centric, companies strive to meet the number of new challenges. One such challenge is how companies should connect in the best way possible to these digitalizing, and sometimes cooperating, consumers: directly, via platforms, in aggregated marketplaces, via connected objects, products, and services, in digital information systems, and so on. A wide range of new digital marketing technologies, systems, and solutions are implemented to support back-office analyses of customers' digital journeys and new digital behaviour, and also to support new digitalized interactions with customers. Together, these new marketing technologies are beginning to shape newly emerging marketing platforms, thus, connecting the digitalizing company with its digitalizing customers. The challenges of this digitalization for companies' marketing operations include the speed and pace of the responses to, and reactions from, customer actions. Interaction processes are becoming more continuous with ongoing customer contacts; deep and ongoing insight into customer journeys, and marketing planning processes are being radically affected. For example, long-term product life cycles and marketing planning is changing, as digitalization enables continuous experimentation and product testing. In turn, this also affects and creates challenges for the strategies as well as the total business of companies.

4. GO-TO-MARKET AND SCALABILITY: GOING FROM DIGITAL PILOTS TO THE SHAPING OF NEW MARKET

Digitalization processes include the development, production, implementation, and use of new digital solutions and offerings. A recurrent managerial issue in many business sectors is how digital solutions in pilot tests can be translated into scalable business models to target larger markets. Going from single successful pilot projects to market launch of new targeted digital offer-

ings is often experienced as being challenging due to the uncertainties regarding which parts of the associated business model can support scalability. An example is a global ICT supplier and incumbent in its ICT business, which considered a new business opportunity. The company tested new digital infrastructures with sensors and Internet of Things technology, which also included mobile phone applications aimed for the audience and spectators at a world sport championship. The managerial issue in focus was how to turn a successful digitalization pilot into the next commercial step by creating a viable business model that could support the sales of the system on the global market for "big events" (sports, music festivals, and so on.) Which parts of the business model for this particular "digital solution" could be stabilised, if any, and which parts needed to be kept agile and adaptable? The business model scalability issue turned out to be essential. In order for the company to find a way to go to market and continue providing these types of solutions, it needed to find a scalable way to transform the ideas tested during the pilot project into new revenue streams as part of the business model. One of the first issues to solve became which central partners to target in the (global) stakeholder network as part of the business model, as well as finding out also the value in which different stakeholders were seeking from the large-scale digital solution. A central issue in the digitalization project then became determining how to transform the value created by new digital big event solution into real cash flows based upon a new revenue model. Similar large-scale digital infrastructure projects in other industries indicate similar scalability challenges.

5. MANAGING DIGITALIZATION AND SERVICE TRANSFORMATION: SHIFTING FROM PRODUCT TO SERVICE-BASED BUSINESS MODELS

In many sectors, digitalization has become connected to transitions from product to service provision or, in the words of Vargo & Lusch (2004), shifting toward a service dominant logic. This has also become one of the major managerial challenges in digitalization processes: one that often requires new organisational principles, structures, and customer interaction processes. Business models change from transaction to relationship-oriented, which means that new sets of capabilities will have to be developed: such as organisation structures, metrics, marketing and sales incentives, and more. Three possible service innovations can be seen in the following examples: Philips launching its concept of "lighting as a service"; Volvo marketing its "connected

vehicle" based upon new digital infrastructures; and, public transportation company Nobina moving toward "mobility-as-a-service" for city travellers instead of bus operations. These innovations involve many knowledge areas, new digital technologies and platforms, and actors from several industries in new partnerships. Such digital service innovations may be new, in terms of how individual services are connected to each other (bundled or unbundled), the role of different actors (including the users), the organisation and the distribution of services (as well as the price and payment for services). We have seen and reported (Andersson & Mattsson 2015) how cooperative and competitive relationships in business practice change when different knowledge areas and industries are involved in such digital service innovations. Shifting from product to service-based business models when going through a digital transformation means that uncertainty and complexity need to be acknowledged. Moreover, the value of the new digitally-based service for a user may be more or less difficult to perceive and evaluate during the transformation.

6. SHAPING NEW CO-OPERATIVE BUSINESS MODELS

Digitalization opens up for network interdependencies that cross industry borders. An individual company in such a context cannot independently develop and implement a sustainable digital transformation, including business model change (Berman 2012; Westerman & Bonnet 2015; Ehret & Wirtz 2017) For example, implementing the ideas of "smart cities" based upon new digital infrastructures, means that different private as well as public actors may prefer other designs of the model. Conflicts between actors with different business models need to be addressed. For a digital service innovation of this magnitude, many uncertainties will emerge, thus, challenging traditional roles and positions. And, these are challenges that both young digitalizing firms and established businesses face when they seek to collaborate with one another in order to engage in digital transformation processes. However, such cross-industry collaborations also enable firms to accelerate innovation and create more competitive market positions. Therefore, there are two kinds of challenges associated with the digitalization and the creation of new cooperative partnerships and new business models: first, as in the case of Volvo and Ericsson around the Connected Vehicle Cloud, there is the challenge of creating new types of bilateral cooperation. Secondly, such as in the case of "smart cities", there are the many challenges of establishing functioning

partnerships associated with broader sets of cooperating organisations. This type of wide form of digitalization challenging innovation connects to Vargo et al (2015): for example, they propose an ecosystem approach for considering different types of technological and market innovations as being driven by new forms of institutionalisation processes.

7. MANAGING THE NEW DIGITAL ENTREPRENEURS AND THEIR RAPID PROCESSES OF INTERMEDIATING

There is a tendency to draw a great deal of attention to the steps and moves of the so-called Unicorns and successful digital start-ups when discussing and analysing digital transformation. In reality, digital transformation processes in all sectors involve a wide array of different relationships between both young and established incumbent firms being dependent upon each other and being part of the same transformation. Digital transformation is a collaborative innovation process in which small and large companies create joint strategic partnerships. The small digital start-ups may take advantage of the fact that many of them are digital from the start and may also possess a scalable business model from the outset. They are often in need of access to the established incumbents' advantages, however: in terms of financial resources, established cooperation networks, experiences, regulatory knowledge, and so on. In some cases, they can rapidly scale successful digitalization experiments across multiple markets.

An example can be seen in the service sector. New digital actors, such as Booking.com and Tripadvisor, have created new intermediate positions in a short period of time between hotels (including big global hotel chains) and customers: where the former struggles to attract hotel customers back to the hotels' own web/booking sites. As a result of digitalization processes, similar intermediation can be seen in other service industries, thus, challenging the incumbents regarding who is going to have most of the direct contact with the customers. As a previous study stated:"… service innovation processes might require, or stimulate, changes in intermediation – sometimes also the entry of new actors as intermediaries" (Andersson & Mattsson 2015). One company expressed the process as going in both directions: that is to say, embracing both dis-intermediation and re-intermediation processes: "Increased usage of ICT has led to a complex and dynamic process of 'disintermediation,' as producers are able to generate direct sales and creators can directly distribute their work online. Telecom and IT players, meanwhile, create a move toward

're-intermediation,' allowing smaller companies that may not have large marketing budgets to participate in the market."[3] The challenge of managing the new digital entrepreneurs and their rapid processes of intermediating has a mirror effect; the digital start-ups need to embed their business in established network settings by relating to incumbents. No business is an island.

8. CREATING NEW BUSINESSES ACROSS INDUSTRY BOUNDARIES AND INDUSTRY LOGICS

Digital technologies cause markets to converge in many new and sometimes unexpected ways. The previous wave of convergence between the sectors for information, communication, media, and household appliances is being replaced by much more radical forms of convergence (Hackling, 2013). And, digital technologies are at the centre of these processes: pulling different and sometimes distant industries and markets toward each another. Previously unrelated sectors become dependent upon one another. Connectivity and interdependence between networks change with digitalization, due to technical and market convergence: for example, between the ICT sectors, the automotive industry, and in various public spheres (road authorities, and so on) when launching more integrated connected vehicle concepts. Following these processes of overlapping between industrial networks, unexpected new patterns of cooperating and competing companies emerge and create new market situations. Such overlapping between digitalizing industrial networks implies the need to consider and address new relationships, changes in old ones, and closer indirect contact. Overlapping confronts actors with uncertainties and tensions, and sometimes threatens established network positions (Andersson & Mattsson 2015). Through digitalization, companies that were not previously considered competitors are pulled closer together; categories of firms that were once distinct begin to converge, and build new cooperative business models. Processes of technical and industrial convergence create new digitalized markets: for example, through the proliferation of technical platforms. In the emerging smart home ecosystem, a good example is Google's acquisition of Nest (thermostat, smoke detector, and alarm system hardware). With these two companies, players as wide-ranging as telecoms, energy corporations,

3 From official presentations made by the ICT company Ericsson under their label The Networked Society. These presentations are listed and are made available at: http://www.slideshare.net/Ericsson/industry-transformation-in-the-networked-society

gaming systems, and home appliance manufacturers form new Smart home constellations of both cooperating and competing firms. This includes Google, thus, positioning itself in relation to operating system or cloud service providers for smart products and digital selves. And, beneath it all is digitalization, which enables new potential contributors to enter these emerging networks. A general implication for management is to develop a preparedness to act upon unexpected new actors entering these networks; this becomes the new normal situation in many industrial areas.

9. RE-ORGANISATION OF DIGITALIZING CUSTOMERS: MANAGING ORGANISATIONAL BUYER ALLIANCES

The digitalization of companies and industries also affects the buyer side. Purchasing power moves to executives outside of regular purchasing and IT departments and functions. Digitization brings a more permanent change to the ICT investment and buying processes. In turn, this creates a more complex sales environment for technology providers engaged in their customers' digitalization processes. Furthermore, large-scale digitalization processes – such as investments in "Smart cities" – create new and very complex buying situations. Complex constellations of both public and private organisations need to engage in the creation of functioning buyer constellations in order for large-scale digitalization processes – such as smart city projects – to move from idea to pilot, and then to large-scale implementation. Successful examples, such as the city of Dubai, can be explained by the fact that constellations on the buyers' side have been created and engaged in the process. The growing influence of joint business and public buyer constellations in purchasing decisions when digitalizing also constitutes a major challenge for the supply side. Providers of digital solutions will need to support the creation of functioning buyer constellations, thus, creating new go-to-market models that meet these organisational challenges on the buyers' side.

10. MANAGING THE POLITICAL AND INSTITUTIONAL CHALLENGES OF DIGITALIZATION

Digitalization, in general, and the access to and use of big data, in particular, pose a number of challenges for both companies and policy makers. As one manager in health care expressed it: "One of the biggest challenges for us right now is how to relate to policy makers and policy making – often (the) lack of

policy making – when it comes to digitalization, in general, and issues concerning patient data, in particular. Understanding how to handle these new strategic issues and how to influence politicians and policymakers are two of our major concerns…." Addressing privacy and security issues will become paramount as more data increasingly travels across boundaries for various purposes and as a result of increased digitalization.[4] Security issues and intellectual property issues are becoming part of companies' data strategies, yet it is perhaps becoming more importantly a privacy and trust issue when it concerns customers and other stakeholders. Meanwhile, one of the strategic challenges for companies in many digitalizing sectors is how to influence policy makers, so the choices they make also help individual firms in their quest to capture value from using big data. For digitalizing companies, it is a matter of complying with the role that policy makers have of developing policies that balance the interests of companies that want to create value from data and citizens who wish to protect their privacy and security. This new situation for companies is often accentuated by the fact that one of the most important enablers of value creation from big data combines data from multiple sources. This is a new situation in many sectors and digital data policies are still often lacking or need to be adapted. Still, this has become one of the major strategic challenges for many companies: the way in which to relate to – and sometimes influence – new policy-making. The ownership, access, collection, storage, use, and dissemination of information require rules and policies; companies and public organisation tend to become highly involved in these processes.

Digitalization Challenges are Connected

The focus of the ten challenges of digital transformation is different: some are more closely connected; some are not. Those that are concern technology: for example, platforms and big data management and user orientation – such as big data analyses, user-centric and user-network driven actions. Several managerial challenges are business-model related: creating new cooperate business models and shifting to service-based business models; some of these also connect to broader ecosystem-related challenges for digitalizing companies;

4 For example, both public and private organisations need to interpret and relate to various new principles: for example, OECD's eight Privacy Principles, which concern: Collection Limitation, Data Quality, Purpose Specification, Use Limitation, Security Safeguards, Openness, Individual Participation, and Accountability.

thus, creating new business across industry boundaries and managing new forms of buyer/user constellations.

A digital transformation challenge for an incumbent firm seldom comes alone. The medical technology company to which we referred in the introduction began one part of its digital transformation with a delimited interest in how to manage the big data generated from the use of its intensive care machines. Successively, major business model issues emerged: cooperation or competition with other machine suppliers and users: doctors, hospital administration units, and other related issues. Seeing how firms in various sectors take different initiatives into digital transformation, we can see that digital transformation steps often lead to new digitalization challenges.

Managers need to cope with the fact that digitalization challenges do not come alone. We can assume by building upon our first insights into this issue when going into the fifteen business areas of digital transformation, that companies take different paths in their digital transformation processes. There are differences with regard to initial drivers and managerial problems, as well as when and the way in which these connected challenges are handled. Hence, the emphasis shifts over time. Technical platform issues in this digital transformation might dominate a certain period; more attention could be given to user-centric issues and the processes of business modelling or creating functioning cooperation between involved stakeholders in the emerging ecosystems might dominate the other stages. Incumbents in many industries have begun their digitalization journeys; the starting point creates different digital transformation paths in different industries and in different organisational contexts.

The management of digital transformation should not be seen as purely an intra-organisational or operational issue. Instead, it is a strategic and societal issue, which is often a challenge of highest priority. As seen in Table 1, the studies and cases of digital transformation, however, all reveal that the ten strategic challenges are connected to big internal challenges and tensions within the organisations.

Implications: Pressures on Internal Organisational Structures, Processes, and Resources

Digitalization is becoming a dominant driver of internal change: both in private and public organisations. For incumbent companies as well as public

organisations, digitalization often requires administrations to explore new opportunities while still operating with mature technologies in mature markets. Many incumbent organisations experience profound changes in organisational structures, daily operations, and in other modes of doing business. Thus, dual forces affect internal operations and organisations in profound ways. Keeping the digitalized business or operations separate or integrating them with current traditional ones is but one of the organisational challenges that needs to be managed.

We conclude this chapter by discussing the demands upon internal organisational structures, processes, and resources when entering a digital transformation. Interviewees have forwarded these issues that were taken from reports, which represent all fifteen digitalization arenas listed in Table 1 and have also been compared with other studies: for example, Soule et al, 2016. Many of the issues described are structural and concern new principles for organising digitalized operations, as well as internal resources and capabilities. Many of the mentioned internal challenges are change related. The focus of internal organisational challenges includes managing and leading digital innovation and transformation processes. Comments from managers centred around seven general areas: 1) leadership challenges; 2) new skills, resources, and internal capabilities; 3) customer orientation and customer oriented work practices; 4) internal organisational structures and responsibilities; 5) internal processes for continuous experimentation and user orientation; 6) internal cultural challenges; and 7) change management challenges.

A LEADERSHIP CHALLENGE

A common view among managers in all sectors is that digitalization can only be successful if top management support is ensured. The presence of a dedicated CEO and a central team to propel the new digital development is central in achieving successful transformation. This is not a back office or an IT department problem. Some firms and organisations hire a new chief digital officer to spearhead the changes in a digital transformation. Few, however, believe that installing a new chief digital officer or one in a similar position is a guarantee for success. One can argue that digital transformation is a big challenge, and that support for the process needs to be driven from top management, thus, fostering a (new) corporate culture. That is to say, the responsibility of creating a corporate culture that effectively drives digital transformation ultimately

rests with the CEO.[5] There is a strong common belief that top management is responsible for setting the digital vision and strategy of the company or organisation. Some also argue that a new type of leadership is needed, thus, moving away from hierarchical autocratic top-down approaches and looking instead to create more open collaborative environments, powered through digital collaboration tools.[6]

NEW SKILLS, RESOURCES, AND INTERNAL CAPABILITIES

Many argue that, apart from the many technological resources that are required to ensure a digital transformation, there is also a need for new human skills. Interviewed managers often come back to various workforce-related issues. There is a need for people with skills and experiences with different digital technologies (cf. Soule et al 2016). When digitalizing, desired employment skills will include technological experience with social and mobile technology, artificial intelligence, big data analytics, internet of things, and more. The competition for such skills and capabilities is expected to increase. The ways in which to apply these technology skills operationally, tactically, and strategically will also be part of the skills that will be needed when going digital. Furthermore, the increasing importance of networked and connected resources and capabilities means that platforms and skills for such networking will have an increasingly important role in digitalizing organisations.

CUSTOMER ORIENTATION AND CUSTOMER-ORIENTED WORK PRACTICES

A central recurrent idea among interviewed managers about the new internal requirements for digitalizing organisations is the fact that organisations with digitalization are coming closer to end users: that is to say, customers, patients, clients, and so on. Digitalizing organisations are becoming more and more user centric. Actively participating and closer connected users require internal skills and capabilities – as well as processes and organisational structures – that support new user empowerment. The challenge for existing marketing and customer operations includes understanding, following, analysing, and trying to influence customers' "digital and analogue journeys"

5 WEF Report: *World Economic Forum White Paper: Digital Transformation of Industries: Digital Enterprise*, January 2016

6 WEF Report: *World Economic Forum White Paper: Digital Transformation of Industries: Digital Enterprise*, January 2016

(Edelman & Singer 2015) across various channels, platforms, and physical settings.

INTERNAL ORGANISATIONAL STRUCTURES AND RESPONSIBILITIES

During the transition, organising the new digitalized operations in relation to the old established operations sometimes create "ambidexterity problems" for incumbents (O'Reilly & Tushman 2004; Birkinshaw et al 2016). That is to say, the new digitalized operations need to be organised and handled in relation to existing traditional business operations. How this should be managed in practice is often challenging and requires organisational skills. In addition, new organisational processes based upon changed internal and external connectivity often require new digital platforms in order to enable new forms of cooperation. Some argue that digitalization and platforms for cooperation might lead to a shift toward flatter hierarchies. One of the new internal challenges is creating structures that enable organisations to draw upon networks both within and beyond traditional organisational boundaries.

INTERNAL PROCESSES FOR CONTINUOUS EXPERIMENTATION AND USER ORIENTATION

Leadership and organisations in general need to adapt to two central shifts in operations; the first concerns the need for less focus on long-term planning, thus, moving toward more continuous development. Traditional internal roles and responsibilities need to be adapted, including leadership and CEO roles. Some reports[7] argue that, as a consequence of internal digitalization, leadership needs to embrace the role of moving to shorter data-driven predictive analytical planning cycles with greater focus on experimenting. Digitalization leaders need to embrace the role as drivers of new forms of development, thus, becoming promoters of continuous innovation processes. The second challenge concerns the new role of end users; internal organisational processes and operations need to be changed and coordinated in new ways to adapt to this new orientation. Understanding and organising in relation to end users' digitalization processes is a challenge that requires new leadership orientation, new internal processes, structures, interactions, and capabilities.

7 WEF Report: *World Economic Forum White Paper: Digital Transformation of Industries: Digital Enterprise*, January 2016

INTERNAL CULTURAL CHALLENGES

Creating an effective digital strategy is critical, as is fostering a corporate culture that is open to innovation and will be supportive of the new strategy. Digital transformation processes equate cultural challenges, which are often a part of the new demands facing CEOs and leaders of the transformation.

CHANGE MANAGEMENT CHALLENGES

Many incumbent organisations are not prepared for digital transformation. A big challenge is the actual change process. One report[8] describes three ways in which organisations seem to approach the change management challenge when digitalizing. The first is a direct approach: that is to say, transforming existing business processes. Initiatives can come from, and within, various parts of an organisation: marketing, supply chain, production, and operations. They can also be connected to a number of partnerships of the organisation. One of the many challenges with the direct approach is how to coordinate different initiatives and how to engage the entire organisation. The second approach starts by creating an autonomous "digital unit" free from corporate legacy and standardised business processes. When it works, the separate unit ("skunk works" unit) functions as a start-up with no learning barriers or aversions to risk. The second approach has a niche focus upon building new digital models. The third change approach builds a parallel digital business, which is a parallel business aimed at repositioning the existing enterprise as a start-up geared towards digitalization. This becomes a sort of incubator aimed at delivering new business models and insights that can be leveraged by the traditional organisation. Overall, there are multiple ways to begin removing barriers to digitalization and to learn from the change processes within organisations. Irrespective of the change management principle, one of the major challenges is how to digitally transform the entire organisation and how to coordinate different change initiatives. Traditional mindsets, practices, and resources can be difficult to adapt. Developing new (digital) mindsets, practices, and resources on every level, and within every function, is often perceived as being a difficult and long-term change management issue.

8 From official presentations made by the ICT company Ericsson under its label *The Networked Society*. These presentations are listed and are made available at: http://www.slideshare.net/Ericsson/industry-transformation-in-the-networked-society

WHAT CHARACTERISES A DIGITAL ORGANISATION?

Our interview findings can be compared to those of Soule et al (2015), who investigated organisations' modes of becoming digital and state that the characteristics of a digital organisation could be summed up in four critical areas concerning mindset, practices, workforce, and resources. First, Soule et al state a distinguishing feature of a digital organisation is a (digital) mindset: an attitude that reflects a broad tendency to initially seek digital solutions, use technology as a tool for advantage, and approach enterprise data in a systematic fashion. Secondly, as concerns practices, they argue that four fundamental behavioural norms are present in a digitalized organisation: first) digitized operations based upon extensive use of data and information exchange; second) a readiness for boundary-crossing collaborative learning, problem solving, and the discovery of new insight, and data-driven decisions; third, digital organisations view their workforce in broad terms, thus, acknowledging the contributions of all when it comes to technology experience, digital skills, and high engagement in digitalization issues; and fourth, digital tools and data are critical inputs to the functioning of the digital organisation, and the main resources are often real-time customer data, accessibility to integrated data about internal operations, and digital collaborative tools to support communication, collaboration, and rapid feedback within the organisation.

Conclusion: Connecting External Strategic and Internal Operational and Organisational Challenges

As aforementioned, digitalization challenges do not come alone. In this chapter, we have elaborated on one broad question: What are the general, strategic, and managerial challenges associated with digitalization? We described different general paths of digital transformation building upon our insight from the fifteen areas of digital transformation, arguing that there are strong overlaps between them: in terms of the accompanying managerial issues that are involved and managed. For example, big data problems and issues appear in many of the studied business contexts. There are also differences with regard to initial drivers and managerial problems, as well as when and the way in which external strategic challenges and internal operational challenges are handled. In these terms, the digital transformation paths are always unique, while the overall external and internal digital transformation challenges are very similar across industries and organisations.

References

Andersson, P., Markendahl, J. and Mattsson, L.G. (2011). Technical development and the formation of new business ventures – the case of new mobile payment and ticketing services. *The IMP Journal*, Vol. 5 No. 1: 23–41.

Andersson, P. and L-G. Mattsson, (2015). Service innovations enabled by the 'internet of things'. *IMP Journal*, Vol. 9 Iss 1: 85–106.

Berman, S.J., (2012). Digital transformation: opportunities to create new business models. *Strategy & Leadership*, Vol. 40 Iss 2: 16–24.

Birkinshaw et al (2016). How Do Firms Adapt to Discontinuous Change? Bridging The Dynamic Capabilities And Ambidexterity Perspectives. *University Of California, Berkeley* Vol. 58, No. 4 Summer 2016

Edelman, B. and Singer (2015). Competing on customer journeys: you have to create new value at every step. *Harvard Business Review*, Vol. 93 Issue 11: 88–98.

Ehret, M. and J. Wirtz (2017). Unlocking value from machines: business models and the industrial internet of things. *Journal of Marketing Management, 33*:1-2: 111–130.

Frenken, K. and Schor, J. (2017). Putting the sharing economy into perspective. *Environmental Innovation and Societal Transitions, 23*: 3–10.

Gawer, A., and Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management, 31*(3): 417–433.

Hackling (2013). Strategic Choices in Converging Industries. Fall MIT *Sloan Management Review*, Fall: 64–73.

O'Reilly, C.A. and Tushman, M.L. (2004). The ambidextrous organisation. *Harvard Business Review*, April: 74–83.

Soule, D., Puram, A., Bonnet, D. and Westerman, G. (2016). Becoming a Digital Organisation: The Journey to Digital Dexterity. *MIT Center for Digital Business*, Working Paper #301, January 5 1016.

Vargo, S.L. and Lusch, R.F., (2004). Evolving to a New Dominant Logic for Marketing. *Journal of Marketing,* Vol. 68 (January): 1–17.

Vargo, S.L., Wieland, H., and Akaka, M.A. 2015. Innovation through institutionalization: A service ecosystems perspective. *Industrial Marketing Management, 44*: 63–72.

Westerman, G and Bonnet, D. (2015). Revamping Your Business Through Digital Transformation. *MIT Sloan Management Review*, Spring 2015: 2–5.

Yoo Y., Henfridsson O. and Lyytinen, K. (2010). The new organizing logic of digital innovation: An agenda for information systems research. *Information Systems Research, 21*(4): 724–735.

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.

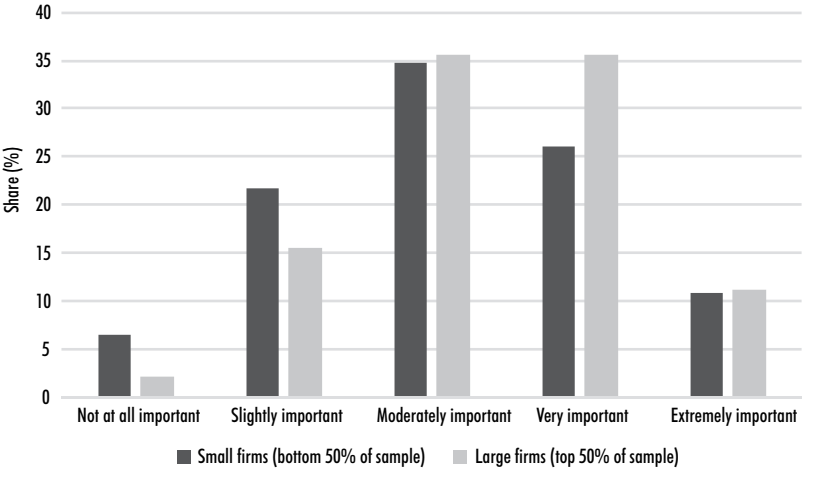

Figure 2.1: Strategic importance of digital process-related opportunities.

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:

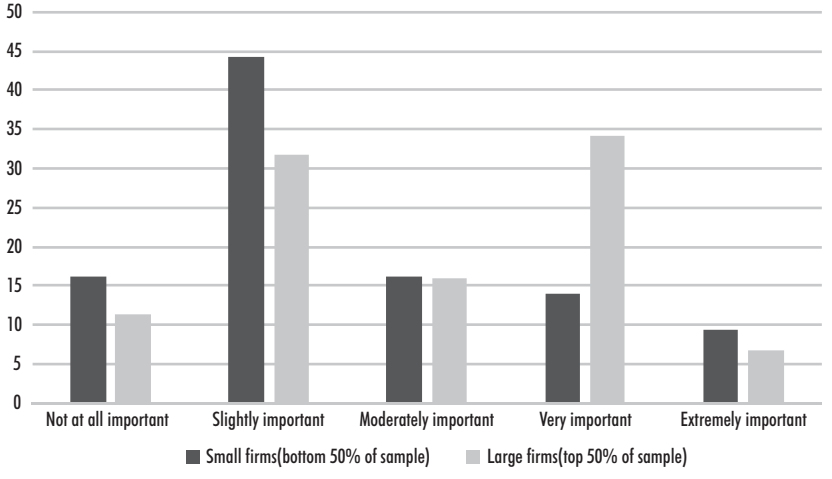

Figure 2.2: Strategic importance of digital offering-related opportunities.

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.

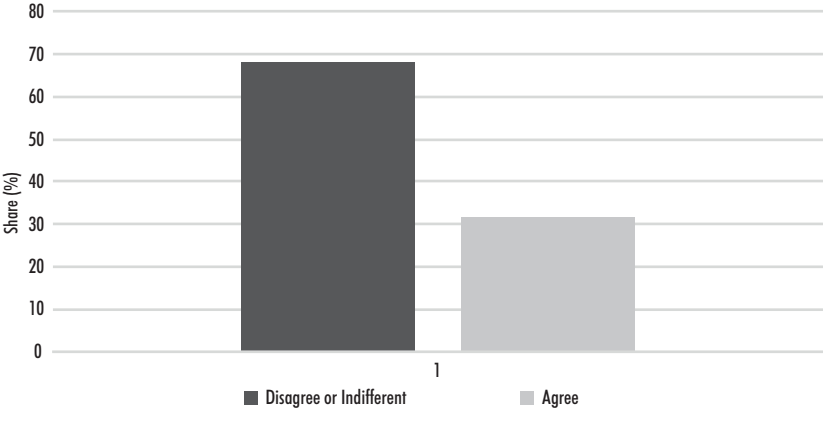

Figure 2.3: Our IT department is closely involved in formulation of organisational strategy

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.

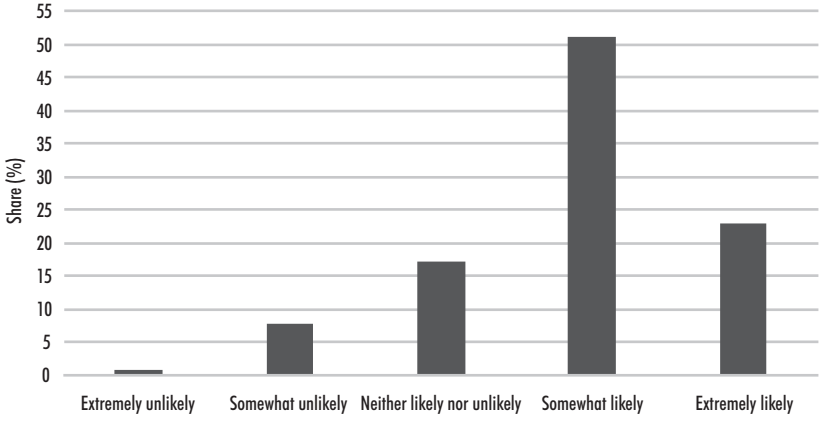

Figure 2.4: How likely is it that you will introduce new ways to interact with customers and manage relationships in order to meet the changes in the market caused by digitalization?

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.

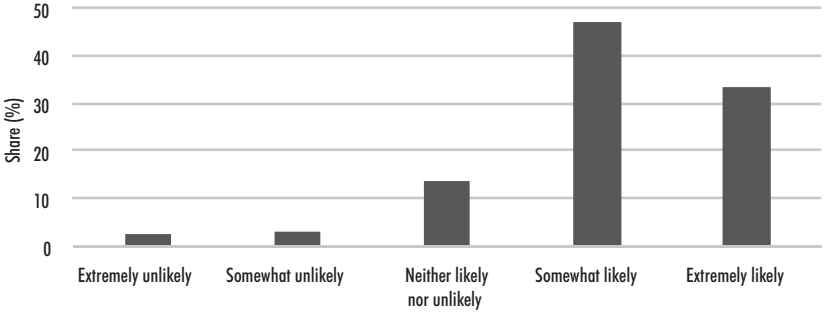

Figure 2.5: How likely is it that you will reduce costs from your internal processes and operations in order to meet the changes in the market caused by digitalization?

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).

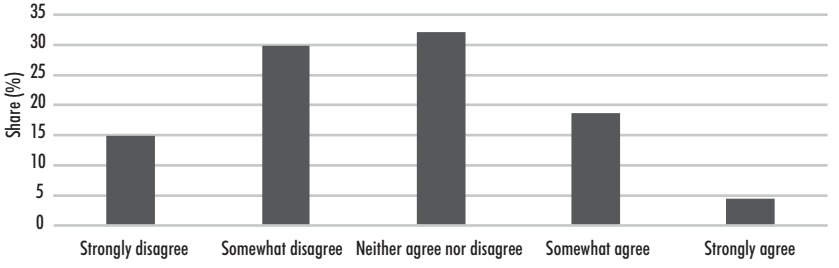

Figure 2.6: Managers at our firm will devote a large share of their time to searching for information about digital opportunities.

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]

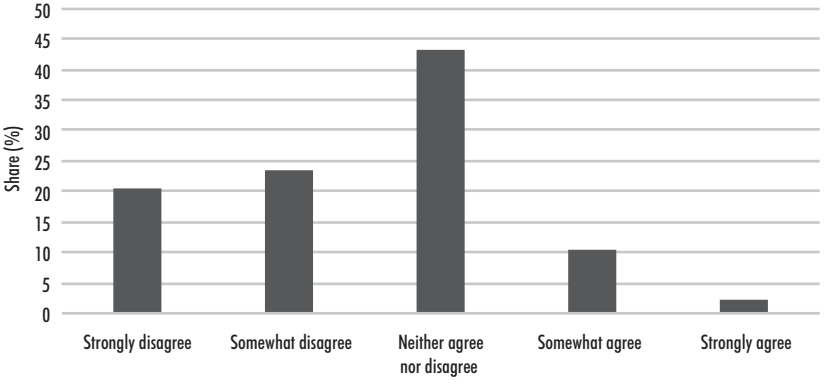

Figure 2.7: When searching for information about digital opportunities, our managers will make looking for new information a top priority for how they will spend their time.

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.

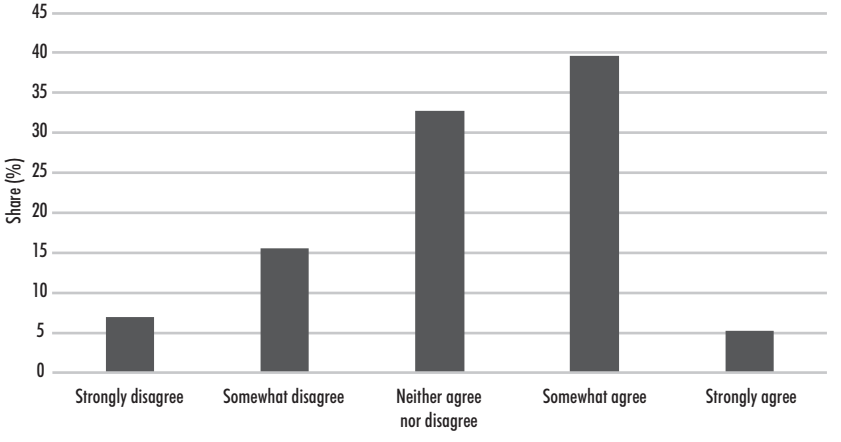

Figure 2.8: Our managers formally allocate resources to the use of cross-functional teams.

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.

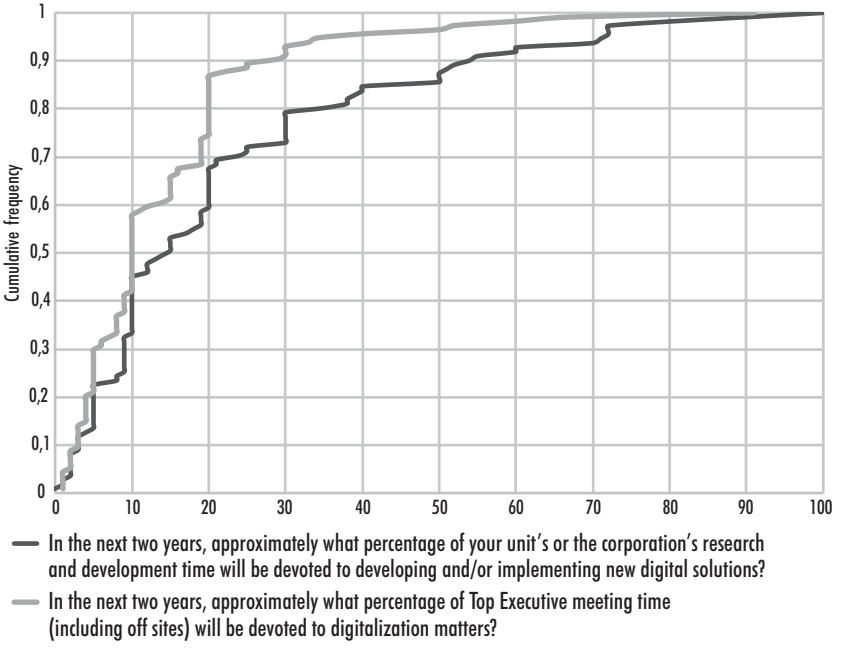

Figure 2.9: Percentage of R&D time devoted to the implementation of digital solutions (dark grey) and executive meetings time devoted to digitalization matters (light grey)

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.

References

Andersen, E. S., Demir, R., Mähring, M., Sannes, R., Wennberg, K., & Woerner, S. L. (2015). Organizing for digitalization – A cross-country study of CIO attention to digital technology. Working paper: Ratio Institute.

Autio, E., Nambisan, S., Thomas, L. D., & Wright, M. (2017). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, Forthcoming.

Benaroch, M., & Chernobai, A. (2017). Operational IT failures, IT value-destruction, and board-level IT governance changes. *MIS Quarterly, 41*(3) 729–762.

Brynjolfsson, E., & Hitt, L. M. (1998). Beyond the productivity paradox. *Communications of the ACM, 41*(8), 49–55.

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*: WW Norton & Company.

Burton, B., & Barnes, H. (2017). *Hype Cycles Highlight Enterprise and Ecosystem Digital Disruptions: A Gartner Trend Insight*. Stamford, Connecticut: Gartner Group.

Carlsson, S. (2016). Åtta av tio styrelsemedlemmar saknar digital kompetens. *DI Digital, February 21*. URL: https://digital.di.se/artikel/atta-av-tio-styrelsemedlemmar-saknar-digital-kompetens, Accessed: Nov. 12, 2017.

Criscuolo, P., Salter, A., & Ter Wal, A. L. (2013). Going underground: Bootlegging and individual innovative performance. *Organization Science, 25*(5), 1287–1305.

Dyer, J., Gregersen, H., & Christensen, C. M. (2011). *The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators*: Harvard Business Press.

Dyer, J., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review, 23*(4), 660–679.

Globocnik, D., & Salomo, S. (2015). Do formal management practices impact the emergence of bootlegging behavior? *Journal of Product Innovation Management, 32*(4), 505–521.

Gregory, R. W., Keil, M., Muntermann, J., & Mähring, M. (2015). Paradoxes and the nature of ambidexterity in IT transformation programs. *Information Systems Research, 26*(1), 57–80.

Karlsson, P. (2016). *Rekryteringsenkäten 2016: Rekrytering – när teknikutveckling och digitalisering förändrar jobben*: Svenskt Näringsliv, URL: https://www.svensktnaringsliv.se/migration_catalog/Rapporter_och_opinionsmaterial/Rapporter/rekryteringsenkaten-2016pdf_642897.html/BINARY/Rekryteringsenkäten%202016.pdf, Accessed: Nov. 12, 2017.

Kiron, D., Kane, G. C., Palmer, D., Phillips, A. N., & Buckley, N. (2016). Aligning the organization for its digital future. *MIT Sloan Management Review, 58*(1), 3–26.

Kvasny, L., & Keil, M. (2006). The challenges of redressing the digital divide: A tale of two US cities. *Information Systems Journal, 16*(1), 23–53.

Loch, C., Mähring, M., & Sommer, S. (2017). Supervising projects you don't (fully) understand: Lessons for effective project governance by steering committees. *California Management Review, 59*(2), 45–67.

Love, J. H., & Roper, S. (2009). Organizing innovation: complementarities between cross-functional teams. *Technovation, 29*(3), 192–203.

Mark, D., & Monnoyer, E. (2004). Next-generation CIOs. *McKinsey on IT, 2*, 2–8.

Mähring, M. (2006). The role of the board of directors in IT governance: A review and agenda for research. *AMCIS 2006 Proceedings*, 3104–3112.

Porter, M. E., & Heppelmann, J. E. (2014). How smart, connected products are transforming competition. *Harvard Business Review, 92*(11), 64–88.

Stewart, R. (1982). *Choices for the Manager*. Englewood Cliffs, N.J.: Prentice-Hall.

Svahn, F., Mathiassen, L., Lindgren, R., & Kane, G. C. (2017). Mastering the digital innovation challenge. *MIT Sloan Management Review, 58*(3), 14–16.

Digital Platforms: A Critical Review of the Core Concepts

HENRIK GLIMSTEDT

The Inverted Smile

Remember the *smile*?

Comments on the economics of computer manufacturing in 'new economy' in the 1990s often referred to a U-shaped curve, which illustrated the uneven distribution of profitability between the different kinds of actors in the personal computer industry. Both manufacturers of branded personal computers and the manufacturers of PC clones operated in the shadows of two specialized component suppliers: Microsoft and Intel. These two businesses organizations provided most of the value added, whilst they also captured the lion's share of the profit pool. Hardware components and software applications lived somewhere in between those two polar positions, depending upon degree commoditization.

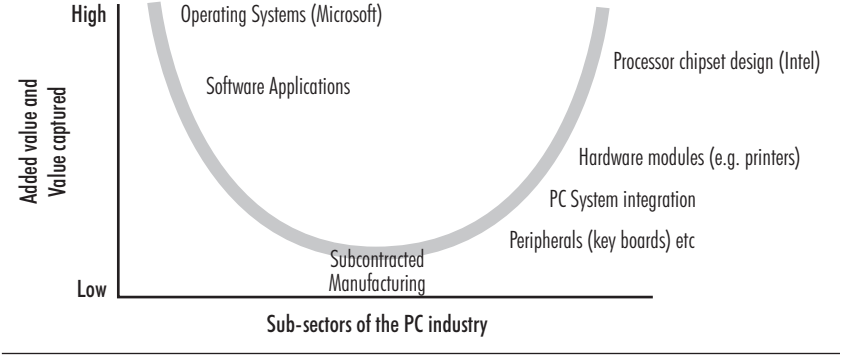

Figure 3.1. Wintel: The Smile Shaped Curve

Recent developments in the contemporary digital economy have turned the concept of the smile into a less useful template. In particular, system integrating device manufacturers have risen from rags to riches; successful device integrator manufacturers, such as Apple, sees profit margins far superior to those of even the more component suppliers. The economic value of operating systems – once the stellar performers of the digital economy – seems to have eroded definitively, especially since Google released its free of charge open source OS for mobile devices[1]. How about software applications? What about software? The growth in terms of software output has been staggering since the smartphone revolution, especially in the app markets that Apple and Google/Android have organized. Apple likes to talk about its AppStore, in terms of a booming business. A little more than 0.7 billion customers/users can now choose from 2.1 million different apps, accounting for 100 billion accumulated downloads (Reisinger, 2017). While growth, in terms of output of software, is striking. The independent software developer's revenue figures tell us a different story. Game apps, with market leading Clash of Clans, absorb 85% of the profit pool. For most developers, the App Store resembles a lottery: for every hit like Candy Crush, hundreds or even thousands of apps languish in obscurity. In 2016, Apple paid approximately $50 billion to app developers (Perez, 2016), indicating that app developers offer a substantial part of all apps for free or at very low cost (e.g. $1). Forbes already flagged in 2013 that no less than 55% of all for-profit apps failed to even fetch $1,000 in revenue; only a fraction of the more successful app development companies reporting revenues above $5000 per month, thus, concluding that "a hard-working developer on iOS will eventually be able to get a new car, while Android and Microsoft developers will be forced into the used car market, if they plan to take those earnings on the road."(Louis, 2013) As for hardware, the sector suffers from exposure to concentrated demand: for example, Apple and Samsung. Steep investments in the latest sub-22 nanometre technologies must also be made at prohibiting costs to all who remain viable as suppliers. Leading chip vendors, such as Qualcomm and Broadcom, respond in the same fashion as low margin contract manufacturers have done for decades: mergers in search of control of even greater production

1 According to numbers released officially by Redmond, Windows mobile operating system dropped from a 1.2 per cent market share at the end of 2015 to a new low of 0.3 per cent by the end of Microsoft's third financial quarter in 2016. Those numbers show that the business of selling operating systems as a standalone product for profit is dead.

volumes to amortize sky-rocking manufacturing costs for the latest generations of chip technologies. According to Handel Jones, a semi-conductor industry analyst, only five companies are making sufficient investments to support leading edge manufacturing capabilities today: down from nearly 20 a decade ago. Lesser chip vendors either make their exit, or stick with older generations of processor node technologies: that is to say, >32nm. Whereas software and hardware companies find themselves entangled in intensive competition and "price taking", the major platform companies capture the largest chunk of the profit pool of the digital economy. Tech strategist Wos Ahmed[2] (2016) writes: "Today, the consumer captures a lot of end use value. The functions in my iPhone are a testament to this. Nearly all the economic value goes to Apple: from the application processor through to retail, apps, and services. Foxconn earns low single-digit operating profit margins and the rest of the value system – vendors of IP, semiconductors and display panels, etc. – fights over the rest."

In 2016, the top 15 public platform-based companies represented no less than US$2.6 trillion of the world market capitalization. Some platforms are household names: such as Microsoft, Amazon, Apple, Google, and Alibaba. Others have emerged more recently or hail from parts of the world that get less attention: such as ARM (Great Britain), Rakuten (Japan), Delivery Hero (Germany), Naspers (South Africa), Flipkart (India), or Javago (Nigeria). Thus, a new general orthodoxy has emerged as a "strategy of last resort" for tech companies. Writing for Accenture, the global advisory, Lacy, Hagenmueller, and Ising (2016) offered the following view to prospective customers:

"Players across industry clusters are entering existing platforms or collaborating to build new products, services, and customer experiences on enabling platforms. Or businesses are expanding into other industries by using existing platforms–or creating their own. Previously 'independent' products and service suppliers are now part of one large competitive set. This leads to a new landscape where former competitors are now working closely together, and former collaborators become competitors. And while this expanded competitive circle may seem a threat, it is also an opportunity."

Observations of value creation and value capture in platform economies bring business strategies to the forefront, as well as governance of networks and industry architecture. The billion-dollar question concerns whether the

2 https://www.linkedin.com/pulse/business-semiconductor-part-one-what-happened-woz-ahmed/

actions in which a firm takes may, indeed, shape the industry architecture: with the intent to skew to their advantage capacity for capturing value from innovations along the value chain.

Executives, consultants, and academics are armed with showcase examples ranging from personal computers in the 1990s to the contemporary case of Uber. They push hard to support the idea that modular platform will change industrial architecture, bringing massive productivity gains, and even contribute to the collapse of old established incumbents. In the late 1990s and early 2000, a widely believed notion was that modular platforms would change the architecture of the global automotive industry: shifting the capacity for innovation from incumbents' OEMs to "first tier mega-suppliers", thus, servicing the OEMs with modules the way that Microsoft and Intel innovated on behalf of HP and other manufacturers of personal computers[3]. More recently, loud voices including those at PwC, Accenture, McKinsey & Co, and KPMG (the list is long) all advocate that "open platform banking" collectively organized by ecosystems of innovative FinTech companies, or some version thereof, will disrupt the giant incumbents. And, as the argument runs, that will be the end of banking as we know it (e.g. deJong, Little and Gagliardi, 2016). The numbers are certainly suggestive. Europe anticipates banking regulations that require incumbent banks to share proprietary data through open "application interfaces"[4]. Uncertain if they have the right ideas for open platform banking and financial innovation, incumbent banks and investors congregate around the new generation of FinTech start-ups. Global venture investment in FinTech grew by 11%: up to $17.4 billion in 2016; it is the first time China – with its $7.7 billion of investment in FinTech – outpaced the US with its $6.2 billion. Ant Financial, formerly Alipay and a subsidiary of Alibaba, led 2016 with a whopping $4.3 billion venture round: the largest in FinTech's venture history (Wintermeyer, 2017). Yet, the jury for open platform banking is still out, leaving us to question whether investments in open

3 According to a Bain & Company report by Donovan (1999), "The new giant suppliers will quickly move to designing vehicle systems that can be 'standardized' within and across OEMs–in other words, used in multiple models of an OEM and eventually by multiple OEMs." According to some academics, autos would mirror IT: "Chrysler has played the role of the Compaq of the automotive industry. Chrysler's strategy allows suppliers–even Ford's and GM's internal suppliers–to strengthen their capability to develop whole automotive subsystems, thereby, pushing the entire structure of the industry from vertical toward horizontal (Fine, 1998, p. 62)."

4 Regulation PSD2 in the European Union, and Open Banking Standard in the United Kingdom.

platform banking will be as futile as the billion dollars invested in automotive modular mega-suppliers around the new Millennium.

Emergence: The Basic Enabling Technologies and Definitions

In a sense, today's digital platforms are just the more complicated cousins of two 19th-century innovations: the self-playing piano and Joseph Marie Jacquard's famous silk loom from 1801. Both innovations separated pre-programmed instructions (punctuated paper music rolls and silk patterns stored in sets of punch cards) and the machinery execution that, in turn, enabled the formation of rudimentary ecosystems of composers and silk pattern designers[5]. Modern platforms, of course, support more elaborate forms of integrations. Generally speaking, we define this by comprising three elements: a core technology that serves as a foundation, additional modular technologies that integrate or connect with this core, and the interfaces in-between (Baldwin and Woodard, 2008; Tiwana, Konsynski and Bush, 2010). According to the loosest possible depictions, the term "digital platform" simply points to a set of online digital arrangements whose algorithms serve to organize and structure economic and social activity (Kenney and Zysman, 2016). The core technology is typically formed around a specific standard (for example, GSM, VHS, and Ethernet) or the arrangement of standards compiled into an operating system: such as Microsoft Windows (David, 1985; Farrell and Saloner, 1985; Cusumano, Mylonadis and Rosenbloom, 1992; Besen and Farrell, 1994; Von Burg, 2001) Especially in business, these arrangements also point to a set of digital frameworks for social and marketplace interactions. Therefore, platforms tend to build upon the formation of digital ecosystems. In sharp contrast to the sequential and linear notion of value creation of Porter's infamous value chain model (Porter, 1985), the general thrust in later conceptualizations of value creation has revolved around the idea of horizontal linkages and concurrent co-specialization between independent value network participants or "value constellations" and "value co-creation" as famously proposed

5 Joseph Marie Jacquard's loom was indeed the first binary information processor. At any given point, the thread in a woven fabric can be in one of two states or positions: on the face of the fabric or on the back. Pattern cards were punched or cut according to the required fabric design. A hole in the card signified that the thread would appear on the face of the fabric, while a blank meant that the end would be left down and appear on the back of the fabric. The Jacquard head was used on the weaving loom or machine for raising and lowering the warp threads to form desired patterns based upon the lifting plan or program embedded in the cards. Thus, the Jacquard mechanism set the stage for modern day binary information processing.

by (Normann and Ramirez, 1993; Vargo and Lusch, 2004). Indeed, a substantive subset of the literature proposes platforms as the coordinating artefact that a hub firm uses or the services, tools, and technologies that other members of the ecosystem can use to enhance their own performance (Gawer and Cusumano, 2002; Iansiti and Levien, 2002, 2004b, 2004a; Li, 2009)[6], [7].

Product Platforms: Internal and Supply Chain Platforms

Product development researchers generally see modular product platforms as the final answer to the question of how to develop and offer a greater variety of products to different market segments at a reduced cost. Their thinking starts with Herbert A. Simon's theory about hierarchies of interdependent problem having dynamics that are approximately independent to those of other subsystems (Simon, 1965). Herbert Simon famously said: "Every problem-solving effort must begin with creating a representation for the problem" and "solving a problem simply means representing it so as to make the solution transparent" (Simon, 1996: pp. 108 and 132). In other words, good representations can help to illuminate important dimensions of a problem. Simon's basic inclination was to differentiate between two approaches to solving problems in complex systems:

- *Integral systems* where the sub-system are tied together through a large number of technical interconnections with un-specified 'interface rules' for how different sub-systems work together, and

- *Modularized* systems where sub-systems are decomposed and tied together through a reduced number of technical interconnections with clearly defined interfaces between the different sub-systems.

6 As Jansen and Cusumano (2012) point out, the field of digital ecosystems is evolving. Originally, the concept of ecosystem was applied to study how traditional monolithic software service-oriented software architectures evolved into collaborative architectures: processes in which innovation by autonomous agents, self-organization, and sustainability were the main topics, More recently, this previous application of the concepts has faded into the background, giving way to a more strategic definition. Increasingly, the term digital ecosystem is being used as strategic behavior in digital business ecosystems.

7 The comparison to biological and natural ecosystem is easily made, but analogies only stretch so far. The main difference between digital and natural ecosystems is that biological ecosystems are mainly studied to observe influences from external factors, whereas software ecosystem dynamics are mainly analysed with the aim of growth and success. Software ecosystems are also made up of participants harboring intentionality, whereas the beings in a biological ecosystem have no means to consciously be part of the ecosystem. The largest difference between participants in software ecosystems and those in natural ecosystems, however, is that participants can consciously decide to exit the ecosystem or even destroy it in software ecosystems.

Simon suggested that problem solving in integral systems will be always cumbersome and time consuming because modifications to one part of the system may result in deleterious side effects elsewhere in the system. By contrast, Simon's research suggested that modularization of complex systems into nearly independent modules allow engineers to modify and improve subsystems independently, with limited unintended side-effects in other parts of the system. Hence, the idea about modular problem solving and the re-use of modules in ever-increasing ranges of product configurations to meet diversified demand is simple and powerful. Wheelwright and Clark (1992) famously introduced the concept of product platforms to describe a framework "for new products that meet the core customer requirement, but are designed for *easy modification* into derivative products through addition, substitution or removal of features" (p 73). Apart from the reduction in complexity (Simon, 1965; Parnas, 1972), the advantages of modular product platforms involve *economies of substitution* (Garud, Jain and Kumaraswamy, 2002), *enhanced customer flexibility* (Baldwin and Clark, 2000), and *organizational agility* in responding to changing environmental conditions (Galunic and Eisenhardt, 2001). Moreover, many have argued that modularity increases innovation (Baldwin and Clark, 2000). Because many firms are involved in the design and production of a modular system, there are more opportunities for innovation as there are potential innovators. Further, several firms are involved in the design and production of a product; its modules increase competition which, in turn, also spurs experimentation and innovation. Not only are there more potential experimenters who face increased competition; the costs of experimentation are also lower, given the fact they are split among multiple firms. Thus, modularity results in an elevated rate of trial-and-error experimentation, and in increased competition and innovation on the module-level (Langlois and Robertson, 1992).

Within the discussion on internal product platforms – particularly in research on the development of product platforms in machine tools, consumer electronics, and the automotive industry – product platforms have been defined by its degree of modularity. Most definitions of product platform focus upon re-using and sharing common elements – or use-cases – across complex products. The focus has been placed, to a large extent, on four dimensions: architecture, platform, modules and design rules (Ulrich 1994; Baldwin & Clark, 2000).

- *Platform:* The collection of bundled technological [physical] assets that are shared by a set of related products.
- *Architecture:* The [abstract] scheme by which the functions of a product is allocated to physical components, also defined as *modules.*
- *Module:* A unit whose internal structural elements are powerfully and integrally connected among themselves and relatively weakly connected elements in other modules.
- *Design Rules [or interfaces]:* The principles that govern the relationship between modules.

The general established criteria are that a platform embodies certain constraints or design rules, in terms of interfaces (or crossing points) between components; these govern the relationship between components. At these points, the interdependencies between components are defined by the interfaces, whilst other forms of interdependencies are ruled out by the design rules Therefore, internal product platforms refer the to modularization of complex system in which the platform itself remains stable, while modules are encouraged to vary in a cross-section or over time. The most stable element in a platform is the interfaces that control the mediation and point of interactions between modules. In turn, this defines the degree of modularity.

This product-oriented definition emphasises commonality of the systematic re-use of components across different products within a product family, which allow economies of scope in production to occur. Hence, the systematic creation and harnessing of economies of scope and mass-customization in innovation can be seen as one fundamental principle of platform-based new product development. Led by these inclinations, empirical studies within the product engineering studies have identified that these kinds of economies of scope can occur in a variety of industrial contexts (such as semi-conductors, machine tools, commercial aircraft manufacturing, automotive manufacturing, aerospace engine manufacturing, and consumer electronics). Expanding the focus from internal product platforms, such as Black & Decker's successful operation of its much-discussed internal platform for consumer electrical hand tools, empirical research has also documented how manufacturing platforms were increasingly being shared across firms within supply chains. (Helper and Sako, 1995; Helper, MacDuffie and Sabel, 2000; Brusoni, Prencipe and Pavitt, 2001;

Sturgeon, 2002; Zirpoli and Caputo, 2002; Becker and Zirpoli, 2003; Doran, 2003; Berger, 2005; Brusoni, 2005; Huang, Zhang and Liang, 2005; Park et al., 2009; Sako, 2009; MacDuffie, 2013; Jacobides, MacDuffie and Tae, 2016).

Industry Ecosystem Platforms (Product Innovating and Transactional)

Parallel to the evolution of platform thinking in product engineering, various scholars and industry observers began to discuss the networking of personal computing technologies' "industry-wide platforms" for information technology; these include Michael Bourrus & John Zysman (1997); William Lazonick (Lazonick, 2005, 2009); and, Michael Cusumano & Anna Gawer (2002). Zysman and Bourrus, coined the phrase *Wintelism*, to describe the rise of a new industry platform, competing against the vertically integrated computer manufacturers. The aforementioned research originally drew upon insights from business history on how the policies and processes (e.g. anti-trust) led to the raise of independent software companies a new generation of merchant chip manufacturers, epitomized as *the Fairchildren*. Eventually, this new generation American tech firms experienced the rise of Japan's successful semi-conductor manufacturers, which fiercely competed upon both price and quality in the late 1970s and early 1980s. This cut-throat context in semiconductor technologies, such as memory chips, lead tech firms in Silicon Valley-based pioneers to more advanced technologies in personal computing, which they identified as way of diversifying into new and less competitive segments. Hardware specialists such as Intel, however, lacked the competence to develop and market complex consumer electronics products. While the initial attempts to diversify into computers and other consumer products failed (for example, calculators), Intel and other Silicon Valley tech firms purified their specialisation strategies. They particularly embraced the idea of platforms linked together with sophisticated and less advanced components, thus, according principles of "open-but-owned" systems of standards[8]. The making of a new Wintelist era enabled a dramatic shift in the character of electronics production, moving away from

8 Key product standards under Wintelism, especially the interface specifications that permit inter-operability with the operating system or system hardware, are owned as intellectual property, yet are made available to others who produce complementary or competing components, systems or software products. Hence, the systems are "open-but-owned". The relevant technical standards are licensed rather than published, with either the universe of licensees, the degree of documentation of the technical specifications, or the permissible uses restricted in some fashion.

the dominance of vertically-integrated organizations that were built upon a closed-proprietary standard over to a decentralized value chain that both collaborated and competed within platforms, such as the PC.

More recently, platforms have been found to operate within even larger networks of firms that are not necessarily linked through buyer–supplier relationships. This is also known as "innovation ecosystems" (Adner and Kapoor, 2010; Nambisan and Sawhney, 2011) or "ecologies of complex innovation" (Dougherty and Dunne, 2011). *Such industry platforms* are then defined as ' …a building block, providing an essential function to a technological system, which acts as a foundation upon which other firms, loosely organized in an innovation ecosystem, can develop complementary products, technologies, or services (Tee and Gawer, 2009).

At the end of 2016, four of the top five public firms by market capitalization used platform business models. An open platform business model offers distinct economic advantages since it allows a firm to harness external innovation as a complement to internal innovation (Chesbrough, 2003a). While prevalent in information intensive industries such as search (Google), operating systems (Microsoft), and video games (Sony), open platforms have emerged in aerospace (Lockheed Martin), food spices (McCormick), T-shirts (Threadless), 3-D printing (MakerBot), and shoes (Nike). Thus, industry platforms are mainly viewed by a research hub or a central point of control within a technology-based business system (Gawer and Cusumano, 2002, 2008; Huang et al., 2013). Cusumano (2010) has argued that that an industry platform differs from product platforms in two ways:

- While similar to an internal product platform in that it provides a common foundation or technological system that a firm can reuse in different product variations, the industry platform defines a more or less "open" technological system whose components are likely to come from different companies (or maybe different departments of the same firm), which we call "complementors."

- The industry platform has relatively little value to users without these complementary products or services.

As an example, Cusumano maintains that the Wintel PC or a smartphone are just "boxes with relatively little or no value without software development tools and applications or wireless telephony and Internet services" (ibid, p.

33). The company that makes the platform is unlikely to have the resources or capabilities to provide all the useful applications and services that make platforms such as the PC or the smartphone so compelling for users.

Hence, in order to allow their technology to become an industry wide platform, companies generally must have a strategy to open their technology to complementors and create economic incentives (such as free or low licensing fees, or financial subsidies) for other firms to join the same "ecosystem" and adopt the platform technology as their own. A third key point is that, as various authors have noted, the critical distinguishing feature of an industry platform and ecosystem is the creation of *network effects*. These are the powerful feedback loops, which also are referred to as *demand-side economies of scale* (Katz and Shapiro, 1986), that can grow at geometrically increasing rates as adoption of the platform and the complements rise.

Central to industry platforms, by the way of summary, appear to be the combined logics of platform leverage and architectural openness. As its most basic definition, platform leverage refers to a process of generating value and market impact that is disproportionally larger than the input required in other types of value chains: for example, integral (non-modular) architectures. In the area of strategic management, platform leverage is directly linked to the organization's sustainable competitive advantage. Following Thomas, Autio and Gann (2014):

- *Production leverage* is based upon the (re) use of a collection of assets and the interfaces and standards that enable sharing these to drive economies of both scale and scope. In the case of product families, the reuse of production assets and product components helps to realize both scale and scope economies through reduced manufacturing costs and improved design quality, such as better product architecture.

- *Innovation leverage* is similarly based upon the (re) use of a collection of assets and the interfaces and standards that enable sharing. However, instead of sharing to achieve economies of scale and scope, the goal is to drive economies of innovation and complementarity and, hence, facilitate the creation of new goods and services. When the product family is extended to supply chains and the platform system is decoupled from the focal firm, potential innovation benefits also emerge in the form of com-

ponent innovation, enhanced by the distribution of self-interested decision making across the ecosystem among competing complements.

• *Transaction leverage,* in contrast, is based upon the manipulation of the market pricing mechanism and market access, which drives transaction efficiency and reduces search costs in the exchange of goods and services. In the same manner as a conventional market intermediary, a platform ecosystem extracts the surplus value generated by leveraging its position as a value hub linking multiple sides of the market. In this sense, the platform ecosystem leverages its position within industry architecture to benefit from the economies of transactions and search.

Given the critical importance of complements and network effects, the key ways of defining industry platforms revolve around concepts of degree of *platform openness* and the *governance of complements*. Before discussing the theme of governance, we will briefly touch upon the economics of platforms, combining demand-sided economies of scale (or network externalities) with forceful lock-in effects.

Value Capture in Digital Platform Ecosystem

Demand-side economics of scale is widely held as constituting the driving force of digital platforms. Researchers have developed an explicit platform theory to explain how, despite interdependence in technologies and complementary assets, some technology firms can control an industry's value chain and capture a disproportionate share of the total value. This draws primarily upon the literature on technological standards (David, 1985; Katz and Shapiro, 1985; Besen and Farrell, 1994), network economics (Katz and Shapiro, 1985; David and Bunn, 1988) (David Bunn, 1988; Katz & Shapiro, 1985 and 1994) and multi-sided markets (Evans, 2003b, 2003a; Rochet and Tirole, 2003; Evans and Schmalensee, 2010). As many have observed, a first key point is the critical distinguishing feature of an industry platform and ecosystem is the creation of critical mass and network effects: for example, (e.g. Molina, Bremer and Eversheim, 2001; Evans and Schmalensee, 2010; Prasarnphanich and Wagner, 2011). These are positive feedback loops that can grow at geometrically increasing rates as adoption of the platform and the complements rise. Thus, the network effects can be very powerful.

TWO-SIDED-MARKETS

Digital platforms serve as integrators and bottlenecks in two-sided markets (Roson, 2005; Hagiu and Hałaburda, 2014). They can take many guises and provide infrastructure and rules that facilitate the two groups' transactions. In some cases, platforms rely upon physical products, as with consumers' credit cards and merchants' authorization terminals. In other cases, they are places that provide services, such as shopping malls or websites: Monster, eBay, and so on. Two-sided networks differ from other offerings in a fundamental way. Value moves from left to right in the traditional value chain,: cost is to the left of the company; revenue is on the right. Since the platform in two-sided networks has a distinct group of users on either side, cost and revenue are both found on the left and on the right: for example, as is the case of Google Search, which is subsidized by revenues from the advertising business: Google Ad.). In this case, the perspective shift goes from supply-side economics to demand-side of economics.

In two-sided markets, the number of agents on the other side determines the value that an agent derives from joining a platform: that is to say, the cross-group network effects. Examples include payment systems such as PayPal or Visa, videogame systems such as PlayStation 3 and Xbox 360, smartphone platforms similar to Apple's iPhone or Google's Android, and so on. According to Parker and van Alstyne (2005), two-sided markets require the interaction of three groups of actors: a group of technology buyers, a group of sellers, and an intermediation "platform", which creates tools or mechanisms for helping both parties strike a deal[9]. It works like this: a company quickly enters a new market and attracts customers, and those customers attract more customers, and so on. In turn, the first mover experiences explosive growth and assumes a dominant market position while earning wonderful profits. The most important aspects of the network effect are that the more external adopters in the ecosystem that create or use complementary innovations, the more valuable the platform (and the complements) become. This dynamic, driven by direct or indirect network effects or both, encourages more users to

9 More precisely, according to Rochet and Tirole (2006, pp. 664-665)"*a market is two-sided if the platform can affect the volume of the transactions by charging more to one side of the market and reducing the price paid by the other side… The market is one-sided if end-users negotiate away the actual allocation of the burden; it is also one-sided in the presence of asymmetric information between the buyer and the seller, if the transaction between buyer and seller involves a price determined through bargaining or monopoly".*

adopt the platform, more complementors to enter the ecosystem, more users to adopt the platform and the complements, almost ad infinitum.

NETWORK EFFECTS: DIRECT AND INDIRECT

Economists developed the theory of network effects in the 1980s, and burnished it in the 1990s. Business gurus, entrepreneurs, and the tech media cherished it as one of the guiding lights of the new economy. Two concepts are central here: critical mass and "indirect" network effects; it is widely recognized that sufficient value from the use of products such as the telephone, fax machine, or other networked services is closely associated with 'critical mass' (Rohlfs, 1974). Without such a critical mass (defined as "a minimum network size that can be sustained in equilibrium") users will not receive sufficient value, and growth will not continue (Oren and Smith, 1981; Economides and Himmelberg, 1995).

Strong direct network effects builds upon the number of users. A telephone becomes more valuable to an individual as the total number of telephone users increases. Following the received wisdom of *Metcalf's Law,* the value of a platform is attributable to the size of the network: that is to say, the number of nodes (Gilder, 1993; Metcalfe, 2013)[10]. Companies or platforms compete through creating "bandwagon" among the users that make the outsiders to those bandwagons experience a loss of value, and even an extra cost of remaining outsiders. Therefore, network industries often involve 'tipping' at a certain point at which the joint existence of two incompatible products may be unstable, with the possible consequence that a single product and standard will dominate. Given the idea that the numbers of nodes – that is to say, complements and users – determine the value of a network, economists see markets with strong network effects as being prone to a "winner-takes-it-all-outcome" (Katz and Shapiro, 1985; Boschma and Lambooy, 1999).

Strong indirect network effects arise when critical mass of complementary products – for example, hardware and software – enable users to receive sufficient value from the use of the networked technology. As the variety of avail-

10 Research in industrial economics introduced the concept of network externalities (popularized as Metcalf's Law) to describe a situation in which "the utility that a user derives from consumption of the good increases with the number of other agents consuming the good" (Katz & Shapiro, 1985: 424). The "number of other agents consuming the good," often referred to as total network size, is defined in a straightforward way: "The network size is simply the total number of consumers owning units of hardware that are compatible with the individual's unit" (Katz & Shapiro, 1992: 59)

able DVDs increases, a DVD player becomes more valuable through indirect network effects, and this variety increases as the total number of DVD users increases. A major stream in the literature on indirect network effects demonstrates how the value of ownership of core products – for example, phones, VHS and DVD players, game consoles, and other networking technologies – increases with the number of complement products. Standardisation, therefore, is a likely outcome (Gandal, Kende and Rob, 2000; Dranove and Gandal, 2003; Gandal, Salant and Waverman, 2003; Rohlfs, 2003; Clements and Ohashi, 2005). Theory also suggests that such effects should drive faster market growth due to the bandwagon effects (Shapiro and Varian, 1998; Rohlfs, 2003). Shapiro and Varian (1999) first attributed network externalities to positive feedback and then suggested that "if a technology is on a roll…positive feedback translates into rapid growth: Success feeds on itself" (p 176).

Research also point to the opposite effect of slowing growth in what is sometimes labelled "excess inertia" (Srinivasan, Lilien and Rangaswamy, 2004; Goldenberg, Libai and Muller, 2010; Peres, Muller and Mahajan, 2010). Early in the product life cycle, most consumers see little utility in the product, as there are few adopters; therefore, they may take a "wait-and-see" approach until there are more adopters. Hence, diffusion early on may be very slow and occur among the few consumers that see enough utility in the product even without adoption on the part of other consumers. Therefore, the process may be characterized by a combination of excess inertia and excess momentum: that is to say, slow growth followed by a surge (Rogers, 2003).

Managing the Degrees of Openness

Governance of platforms and strategizing within platforms gradually becomes relevant for companies that are trying to establish themselves in the digital economy. Decentralization of value chains is not without its ambiguities. First, the building of decentralized value chains for a more or less permanent innovation economy invites free riding and opportunism, thus, raising questions about governance of management of networks. (Piore and Sabel, 1984; Jarillo, 1988; Dyer and Singh, 1998). The central dilemma of growth lies in reconciling the demands of learning with the demands of monitoring (Sabel, 1994). In this view, there is a contradiction between openness to attract and coordinate learning for innovative product or services with the control over value capture and the distribution of the gains from the collaboration

within the ecosystem. Here, it is easier to write contracts between partners within the ecosystem that cover contingencies associated with transactions between them when the market conditions are stable and economies of scale are, thus, predictable. Innovations undermine stability because they disrupt the regularity of markets. Hence, the dilemma is that learning and innovation within the ecosystem undermines the stability that is normally required for value capture and monitoring insofar as each transacting party in the collaboration fear possible hold-ups: that investments will not be matched and the terms of value capture from the investments remain uncertain.

With concepts such as *system integrators* (Hobday, Davies and Prencipe, 2005), *architectural capabilities* (Henderson and Clark, 1990; Galunic and Eisenhardt, 2001; Roy and McEvily, 2004; Jacobides and Winter, 2005; Jacobides, Knudsen and Augier, 2006; Baldwin, 2015; Jacobides, MacDuffie and Tae, 2016), *architectural knowledge control* (Henderson and Clark, 1990) and *platform leadership* (Gawer and Cusumano, 2002, 2014), *iterative pragmatic collaboration* (Helper, MacDuffie and Sabel, 2000; Gilson, Sabel and Scott, 2009) research tries to describe that decisive capacity to coordinate collaborative knowledge creation and simultaneously manage value capture.

Gawer and Cusumano (2002, 2008) argued that the main problem of platform leaders[11] can be identified in two key features of contemporary platforms: the increasing interdependency of products and services and the increasing ability to innovate by more actors, especially in the high-tech sectors. The combined effect of these two elements determines that the evolution and improvement of one element in the product/service/organisation of the platform is complementary and interdependent to the development of all other elements. Furthermore, they focus upon how firms can drive industry innovation and "architect" or influence competition through four particular "platform levers":

- *Firm scope:* The choice of which activities to perform in-house versus what to leave to other firms. In particular, this decision is about whether

11 Iansiti and Levien (2004) also differentiate between two types of platform leaders: "keystone" and "dominator" leaders. In particular, the keystone leader has developed capabilities from which to benefit and, at the same time, generate significant externalities within the platform in order to sustain the collective performance. Keystone leaders strike a productive balance value appropriation and value sharing between platform's partners. By sharp contrast, the "dominator" leaders integrate vertically and horizontally this in a predatory way, seeking to appropriate most of the value produced by the network.

the platform leader should make at least some of its own complements in-house.

• *Technology design and intellectual property:* This refers to what functionality or features to include in the platform, whether the platform should be modular, and to what degree and at what price the platform interfaces should be open to outside complementors.

• *External relationships with complementors:* This is the process by which the platform leader manages complementors, and encourages them to contribute to a vibrant ecosystem.

• *Internal organization:* This regards the way and the extent to which platform leaders should use their organizational structure and internal processes to give assurances to external complementors that they are genuinely working for the overall good of the ecosystem. This last lever often requires the platform leader to create a neutral group inside the company, with no direct profit-and-loss responsibility, as well as a Chinese Wall between the platform developers and other groups that are potentially competing with their own complementary products or services.

Gawer's and Cusomano's highly influential book has created a bandwagon of related research, converging on a general theory on platform leadership. Essentially, there is a general agreement on the critical role of establishing an "optimal degree of openness", which ensures wide ecosystem participation and positive network externalities, while still leaving the control of the core element of the platform firmly in the hand of the platform leader in order to ensure the disproportionate distribution of value captured. First, the literature indicates that platform owners face a key challenge in designing the structure of their platform, such that they maintain ownership and control over the critical elements that deliver value. For example, platform owners must determine the optimal "openness" of the platform in terms of interoperability, disclosure of IP, and collaboration with complementors that will spur innovation and network effects (Chesbrough, 2003a; West and Gallagher, 2006; Parker and Alstyne, 2008). Secondly, the firm must balance these requirements with the need to maintain control of the platform in a way that allows it to capture value in a sustainable fashion (Boudreau, 2010; Eaton et al., 2015). This tension is present in strategies for day-to-day governance, which include

determining the boundaries of innovation and value capture by the platform owner and complementors (Eaton, 2012; Tilson, Sorensen and Lyytinen, 2012; Ghazawneh and Henfridsson, 2013), as well as pricing and other revenue generation strategies for each side of the market (Rochet and Tirole, 2003).

Research on "industry architecture" takes a more structured approach to the analysis of platform governance. Jacobides, Knudsen and Augier (2006) say firms attempt to strategically develop architectural competencies to determine the firm's vertical and horizontal specialization, as well as influence the institutions that shape markets. Thus, researchers explore how firms shape and redefine the strategies and templates that determine "who does what" in a sector, because they appreciate that this will affect "who takes what" (Jacobides, Knudsen and Augier, 2006). Departing from a structural view on agency, the industry architecture literature suggests that a platform firm can intentionally construct the value network in such a way as to create barriers of entry for its own position, while increasing competition in other nodes around its network location, thereby positioning itself as the "bottleneck" or "control points", which is defined as the location in the platform that extracts most value while locking-in customers most forcefully (For a revew, see: Ballon et al., 2008).

In the PC industry and other related sectors, the OS and application layer have famously been the locus for value capture (for example, Microsoft)[12]; with the advent of the Internet, however, the recent opportunities for control and profitable growth have migrated upward, away from the operating system layer and into the software application layer, which is higher in the IT stack (for example, Google's search function and other online applications[13]).

12 Though most persons attribute Microsoft's dominance to its control of the Window's OS, equally, or perhaps more important, is the Microsoft Office productivity suite, which is the consumers' connection to Microsoft and is likely more important for the mindshare lock-in than the desirability of Windows. More precisely, each new improved generation of Microsoft Office package also involves up-graded file formats (e.g. docx for Word). Once users start upgrading –they might be universities, large companies, parts of the government, or public institution–all users with older versions will find that sharing and opening of the new files will be more complicated (for example, they might save in older formats with a loss of functions and formats) unless they also upgrade to the latest version of MS Office. In that sense, Microsoft's position in the computing depends upon the proprietary file format rather than the operating system.

13 As Jonathan Murray, Microsoft Worldwide CTO, revealed in a private conversation with the present author, Microsoft's concern of course is that large public sector customers start pressing for support of widely recognized non-proprietary formats, such as XML for Excel, which would reduce the pressure on up-grading and increase the capability between MS products and free software offered by, say, Google as cloud services.

Research on Android shows that Google's launch of its open source operating system diluted the existing OS-based bottlenecks in general – particularly, Microsoft's position – whilst also generating a shift in the locus of control points. Pon, Seppälä and Kenney (2014) demonstrate, based upon case studies of evolution of control points and gate keeper roles in Google's Android, Amazon and Xiaomi, that Amazon and Xiaomi have built new bottlenecks by designing complementary services on top of Google free OS to create new bottlenecks and find ways to lock-in customers. Google's open source OS allowed Amazon and Xiaomi to tap into Google's massive installed base and offer a significant short-cut, meaning they could forego the massive investments in attracting users into a two-sided market and, instead, allow them to focus their resources upon providing value-adding services for two-sided markets. Amazon builds its own versions of Android application interfaces to offer unique services that other Android-powered platforms cannot match. In this fashion, Amazon extends, for example, its popular AWS cloud services into its line of Kindle and Fire-tablets, thus, creating strong incentives for developers to focus upon Kindle and Fire-tablet applications while locking in customers at the other end of this two-sided market. Pon, Seppälä, and Kenney (2014) follow this same logic by also revealing that Google responded by raising the bar for mobile OEMs that seek to implement Android without adding Google Mobile Service apps: for example, Maps, Gmail, Google Drive, Calendar, and Search. Thus, Google quietly adds the highest value-adding innovations to a proprietary version known as "certified" Android. Mobile phone OEMs that aim to offer its own version of added-value services on top of the open source Android will find the "bare" open source OS becomes less and less competent compared to the certified version, thus, increasingly demanding more and more resources to turning the open source version into a competitive offering.

General Caveats

In this chapter, I attempt to provide a first impression of some of the more central ideas that guide our understanding of the evolution of the digital economy. These generalizations must, however, be taken at face value – at least partially. Some of the cornerstones – particularly, advantages from modularity in design and production, and network effects, may be weaker than often agreed. As for management implications, the consequences might be

significant. If the digital platforms strongholds of monopoly power are weaker than presumed, the chances of dethroning digital platforms in various sectors of the economy are not as bleak as we may think.

NETWORK EFFECTS: HOW STRONG IS EXPLANATORY POWER?

First, the existing conceptualisations of network effects do not fully explain observable market outcomes, especially when it comes to technology adoption. If consumers would have based their decision on network size, it could be hard to explain market outcomes in wireless standards. Take cellular standards as an example: by the early 1990s, the AMPS systems ranked, by far, as the most successful standard in the world. By 1991, wireless operators in 21 countries had adopted AMPS, accounting for approximately 75% of the world subscribers (Garrard, 1998). Even if AMPS originally outnumbered European standards in terms of connected phones, the European GSM standard gained traction in the 1990s and the first decade into the millennium. Two decades later, the GSM family of standards (GSM, UMTS, LTE) became the dominant global standard.

In a similar way, we must also ask how well does network theory really explain why Symbian and Blackberry did not win against iOS and Android in the race for dominance in smartphone operating. By 2009 – that is to say, two years after Apple's introduction of iPhone and Google's decision to offer Android for free – Symbian's global market share was at 60%, whereas the second network in terms of size (RIM/Blackberry) had captured 20% of the global market through its dominating position in the US market. At 60% dominance, the market should have tipped in the favour of Symbian. Yet, Android and iOS stormed in. If the number of nodes determines the value of a network, then Google's Android arm, or Samsung's mobile phone business, would be valued higher by investors than Apple's. What is noteworthy is that Apple's 75% market share of the global MP3-player fell apart the moment entrants such as Nokia, Samsung, and Sony-Ericsson entered the music platforms with music phones, even though their initial platforms lacked the strong network externalities, such as Apple's iTunes services, which connected the music industry to Apple's platform product. Similarly, in videogames, several competing platforms fight for dominance; however, smaller players still hold strong in profitable pockets of the market. The deviations from predicted outcome are significant in all cases. What anomalies such as

these suggest is that other factors in network externalities theories besides network effects are at play. Network effects might, indeed, explain market outcomes *cetris paribus*. But then again, how often is everything equal in the innovative platform economies?

THE LIMITATIONS OF MODULARITY

Closely related to the above, we need to also treat the concept of modularity with analytical care, which explains the seamless integration of positive network externalities (or complements) into the platform environment. Following Simon's notion of nearly decomposable systems, modularity has been a key concept in system design as well as in the discussion on the rise of highly specialized supplier networks. Modularity allows firms to apparently respond more quickly and flexibly to shifts in product markets since modular architecture reduces the cost of providing a greater variety of product and services because the standardisation of interfaces drastically reduces the volume of information required for inter-firm coordination. Since the modules themselves can serve many purposes, they can be produced in high volume and combined to yield a variety of customized goods matched to differentiated consumer demand (Langlois, 2004). In modularity literature, the implicit assumption is that supply-chain can be 'virtualised'. Langlois (2003) introduced the concept of the "vanishing hand" to illustrate how platform technologies, such personal computers and stereo equipment systems, emerged as a consequence of perfectly modularised product architectures under the liberalisation *slash* globalisation of trade and manufacturing in the 1980s and 1990s.

The stabilisation of technical interface standards, however, constitutes a two-edged sword (Glimstedt, 2001; Chesbrough, 2003b; Sabel and Zeitlin, 2004). Some standardisation is obviously necessary to allow specialists to focus upon the complex subsystems in which they have distinctive capabilities. Too much standardisation, however, can just as obviously become a barrier to systematic innovation, thus, locking component manufacturers into a potentially obsolete product architecture. Excessive commitment to a particular product architecture and accompanying interface standards can, thus, lead to a *modularity trap,* with the following two associated risks: loss of innovative capacity and loss of product distinction.

Henry Chesbrough writes: "Within the firm, the focus on developing products to compete within the standard eventually erodes the amount of

system-level knowledge. While focused firms are effective in linking to the established architecture, they lack the knowledge to envision how to connect to a new architecture. Within the industry, the collection of focused competitors that modularity enthusiasts celebrate . . . now lack the collective knowledge of how to evolve the system. They may also lack the ability to take collective action, necessary to coordinate a shift from one system of highly interconnected parts to a new system of connections" (Chesbrough, 2003b, p 181)

The far-reaching delegation of modules' R&D diminishes organisation's absorptive capacities (Cohen and Levinthal, 1990), with firms losing their ability to evolve their product and to innovate (Hobday, Davies and Prencipe, 2005).

If architects of a product no longer control inter-module interactions and no longer understand the technological and functional opportunities offered by module-related innovations, they will be unable to design radically new architectures. The product will then freeze in its current state, which will weaken the manufacturer who has taken the outsourcing decision, thus, affecting its ability to make radical innovations: especially in comparison to more integrated competitors. For these very reasons, firms in most industries seek to avoid risky and irreversible commitments to a single product architecture and technical specifications.

While having embraced the concept of *modular mega suppliers* in the 1990s, major automotive OEMs backed away from modularisation as a key path for the creation and capture of value. Automotive executives feared that modularisation and outsourcing to 1st tier (mega) suppliers would lead to the *hollowing out* of OEMs, that is shifting the capacity to innovate from OEMs to the suppliers (MacDuffie, 2013; Jacobides, MacDuffie and Tae, 2016). Takeishi (2002)has also shown that the quality of suppliers' developments depends strongly upon the degree of carmakers' technological prowess, notably when it regards architectural knowledge. Carmakers that have substantially reduced the scope of their ancillary (non-core) competencies are less successful in innovation terms than carmakers that have maintained and continue to achieve significant learning regarding detailed module architecture. Managers and technology strategists in the automotive sectors understand the problem: "It is naive to believe you can integrate a system without having in-depth and detailed knowledge of the components that are going to affect the performance of the whole car. Managing each system performance does

not, in fact, automatically result in effective system integration. The performance is the ultimate objective, not systems... We realised you cannot integrate the performance of components you know very little about... if you have never designed a component or a system it will be very difficult to understand the subtle interactions with the rest of vehicle" (FIAT Director of Vehicle Concept and Integration: 2006, quoted in (Becker and Zirpoli, 2011)[14].

While reporting on modular networks in the electronics industry, Timothy Sturgeon (2002) acknowledges that "as contractors seek new sources of revenue by providing additional inputs to lead firm design and business processes, and new circuit-board assembly technologies appear on the scene, such as those for boards with optical components, the hand-off of design specifications is becoming more complex and less standardized, making it harder for lead firms to switch and share suppliers," while requiring "closer collaboration in the realm of product design". Thus, Sturgeon also concedes contract manufacturing of modular design accounted in 2000 for just 13 per cent of the global market for circuit-board and product level electronics (Sturgeon, 2002). Concerning loss product distinction through far-reaching modularity, Joakim Ingers, a smart phone veteran and Apple's expert witness in Samsung versus Apple over patent rights, noted:

"Any entrepreneur can hire a team of 10 engineers to create a new smart phone based on standard modules, such as Qualcomm Snapdragon [hardware platform] and Android [operating system] and a slew of other standards components. In a year so, it would actually work. But it would be a very mediocre device without features that make it stand out in the competition. As such, it would compete in Asia's rock-bottom division of mediocre white-box phones, catching minimal attention and minimal revenues per sold phone."

14 Statements of this kind echo the insight from research on system integration in complex systems: that is to say, "firms need to know more than they make" (Brusoni, 2001). Task and knowledge boundaries will not always coincide (Takeishi, 2001). Firms that have historically integrated the components of a complex product risk a competency trap if, from outsourcing, they lose their systems integration capability (Zirpoli and Becker, 2011). Thus, firms that no longer produce certain components may still need to retain the knowledge of how to make them; as Brusoni et al. (2001) had it, such firms need to "know more than they make". Indeed, given risks of imitation from modularity (Pil and Cohen, 2006), firms may benefit from preserving the interdependencies of a near decomposable product design– even when more decomposition is possible– to maintain the tacit knowledge associated with managing those interdependencies (Ethiraj and Levinthal, 2004).

Conclusion

There is widespread consensus among management consultants on digital platforms with a new pillar of profitable growth or even a fourth industrial revolution. These ideas are trickling down into business schools and into buzzword-driven academic business research. While citing more or less fanciful examples of digital platforms to illustrate the potential for innovative value creation concerning value capture, the literature tends to be less distinct, or even conceptually misleading.

References

Adner, R., & Kapoor, R. (2010). Value Creation in Innovation Ecosystems: How the Structure of Technological Interdependence Affects Firm Performance in New Technology Generations. *Strategic Management Journal, 31*(3), 306–333.

Baldwin, C. Y. (2015). Bottlenecks, Modules and Dynamic Architectural Capabilities *Harvard Business School Working Paper, No. 15-028, October 2014. (Revised May 2015.).*

Baldwin, C. Y., & Clark, K. B. (2000). *Design Pules: The Power of Modularity* (Vol. 1). Cambridge, MA: MIT Press.

Baldwin, C. Y., & Woodard, C. J. (2008). *The Architecture of Platforms: A Unified View*. Working Paper (03-030), Harvard Business School: http://www.hbs.edu/faculty/Publication%20 Files/09-034_149607b7-2b95-4316-b4b6-1df66dd34e83.pdf

Ballon, P., Walravens, N., Spedalieri, A., & Venezia, C. (2008). *Towards Platform Business Models for Mobile Network Operators*. Paper presented at the 19th European Regional ITS Conference, Rome, Italy.

Becker, M. C., & Zirpoli, F. (2003). Organizing New Product Development: Knowledge Hollowing-out and Knowledge Integration–the Fiat Auto Case. *International Journal of Operations & Production Management, 23*(9), 1033–1061.

Becker, M. C., & Zirpoli, F. (2011). *Beyond Product Architecture: Division of Labour and Competence Accumulation in Complex Product Development*. SSRN Working paper, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1031931:

Berger, S. (2005). *How We Compete: What Companies around the World Are Doing to Make It in Today's Global Economy*. Danvers, MA: Crown Business.

Besen, S. M., & Farrell, J. (1994). Choosing How to Compete: Strategies and Tactics in Standardization. *The Journal of Economic Perspectives, 8*(2), 117–131.

Borrus, M., & Zysman, J. (1997). Globalization with Borders: The Rise of Wintelism as the Future of Global Competition. *Industry and innovation, 4*(2), 141–166.

Boschma, R. A., & Lambooy, J. G. (1999). Evolutionary Economics and Economic Geography. *Journal of Evolutionary Economics, 9*(4), 411–429.

Boudreau, K. (2010). Open Platform Strategies and Innovation: Granting Access Vs. Devolving Control. *Management Science, 56*(10), 1849–1872.

Brusoni, S. (2005). The Limits to Specialization: Problem Solving and Coordination in 'Modular Networks'. *Organization Studies,* 26(12), 1885–1907.

Brusoni, S., Prencipe, A., & Pavitt, K. (2001). Knowledge Specialization, Organizational Coupling, and the Boundaries of the Firm: Why Do Firms Know More Than They Make? *Administrative Science Quarterly, 46*(4), 597–621.

Chesbrough, H. (2003a). The Logic of Open Innovation: Managing Intellectual Property. *California Management Review, 45*(3), 33–58.

Chesbrough, H. (2003b). Towards a Dynamics of Modularity: A Cyclical Model of Technical Advance. In A. Prencipe, A. Davies, & M. Hobday (Eds.), *The Business of Systems Integration*. Oxford: Oxford University Press.

Clements, M. T., & Ohashi, H. (2005). Indirect Network Effects and the Product Cycle: Video Games in the Us, 1994–2002. *The Journal of Industrial Economics, 53*(4), 515–542.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly, 35*(1), 128–152.

Cusumano, M. (2010). Technology Strategy and Management the Evolution of Platform Thinking. *Communications of the ACM, 53*(1), 32–34.

Cusumano, M. A., Mylonadis, Y., & Rosenbloom, R. S. (1992). Strategic Maneuvering and Mass-Market Dynamics: The Triumph of Vhs over Beta. *Business History Review, 66*(1), 51–94.

David, P. A. (1985). Clio and the Economics of Qwerty. *The American Economic Review, 75*(2), 332–337.

David, P. A., & Bunn, J. A. (1988). The Economics of Gateway Technologies and Network Evolution: Lessons from Electricity Supply History. *Information Economics and Policy, 3*(2), 165–202.

deJong, B., Little, M., & Gagliardi, L. (2016). Open for Business. *Accenture Strategy*. Retrieved from https://www.accenture.com/t20170629T215524Z__w__/us-en/_acnmedia/PDF-56/Accenture-Strategy-Digital-Open-Banking-POV.pdf

Doran, D. (2003). Supply Chain Implications of Modularization. *International Journal of Operations & Production Management, 23*(3), 316–326.

Dougherty, D., & Dunne, D. D. (2011). Organizing Ecologies of Complex Innovation. *Organization Science, 22*(5), 1214–1223.

Dranove, D., & Gandal, N. (2003). The Dvd-Vs.-Divx Standard War: Empirical Evidence of Network Effects and Preannouncement Effects. *Journal of Economics & Management Strategy, 12*(3), 363–386.

Dyer, J. H., & Singh, H. (1998). The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage. *Academy of Management Review, 23*(4), 660–679.

Eaton, B., Elaluf-Calderwood, S., Sorensen, C., & Yoo, Y. (2015). Distributed Tuning of Boundary Resources: The Case of Apple's Ios Service System. *Management Information Systems Quarterly, 39*(1), 217–243.

Eaton, B. D. (2012). *The Dynamics of Digital Platform Innovation: Unfolding the Paradox of Control and Generativity in Apple's Ios.* (PhD Thesis), The London School of Economics and Political Science, London.

Economides, N., & Himmelberg, C. P. (1995). *Critical Mass and Network Size with Application to the Us Fax Market*. Working paper, NYU Stern School of Business EC-95-11. Available at SSRN: https://ssrn.com/abstract=6858 or http://dx.doi.org/10.2139/ssrn.6858:

Evans, D. S. (2003a). The Antitrust Economics of Multi-Sided Platform Markets. *Yale Journal on Regulation, 20*, 325–342.

Evans, D. S. (2003b). Some Empirical Aspects of Multi-Sided Platform Industries. *Review of Network Economics, 2*(3).

Evans, D. S., & Schmalensee, R. (2010). Failure to Launch: Critical Mass in Platform Businesses. *Review of Network Economics, 9*(4).

Farrell, J., & Saloner, G. (1985). Economic Issues in Standardization.

Galunic, D. C., & Eisenhardt, K. M. (2001). Architectural Innovation and Modular Corporate Forms. *Academy of Management Journal, 44*(6), 1229–1249.

Gandal, N., Kende, M., & Rob, R. (2000). The Dynamics of Technological Adoption in Hardware/Software Systems: The Case of Compact Disc Players. *The RAND Journal of Economics,* 43–61.

Gandal, N., Salant, D., & Waverman, L. (2003). Standards in Wireless Telephone Networks. *Telecommunications Policy, 27*(5), 325–332.

Garrard, G. A. (1998). *Cellular Communications : Worldwide Market Development*. Boston, MA: Artech House.

Garud, R., Jain, S., & Kumaraswamy, A. (2002). Institutional Entrepreneurship in the Sponsorship of Common Technological Standards: The Case of Sun Microsystems and Java. *Academy of Management Journal, 45*(1), 196–214.

Gawer, A., & Cusumano, M. A. (2002). *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation*. Boston: Harvard Business School Press.

Gawer, A., & Cusumano, M. A. (2008). How Companies Become Platform Leaders. *MIT Sloan Management Review, 49*(2), 28.

Gawer, A., & Cusumano, M. A. (2014). Industry Platforms and Ecosystem Innovation. *Journal of Product Innovation Management, 31*(3), 417–433.

Ghazawneh, A., & Henfridsson, O. (2013). Balancing Platform Control and External Contribution in Third-Party Development: The Boundary Resources Model. *Information Systems Journal, 23*(2), 173–192.

Gilder, G. (1993). *Metcalfe's Law and Legacy*. Discovery Institute, Technology and Democracy Project. Availible at: http://www.discovery.org/a/41.

Gilson, R. J., Sabel, C. F., & Scott, R. E. (2009). Contracting for Innovation: Vertical Disintegration and Interfirm Collaboration. *Columbia Law Review, 109*(3), 431–502.

Glimstedt, H. (2001). Competitive Dynamics of Technological Standardization: The Case of Third Generation Cellular Communications. *Industry and innovation, 8*(1), 49–78.

Goldenberg, J., Libai, B., & Muller, E. (2010). The Chilling Effects of Network Externalities. *International Journal of Research in Marketing, 27*(1), 4–15.

Hagiu, A., & Hałaburda, H. (2014). Information and Two-Sided Platform Profits. *International Journal of Industrial Organization, 34*(May 2014), 25–35.

Helper, S., MacDuffie, J. P., & Sabel, C. (2000). Pragmatic Collaborations: Advancing Knowledge While Controlling Opportunism. *Industrial and Corporate Change, 9*(3), 443–488.

Helper, S. R., & Sako, M. (1995). Supplier Relations in Japan and the United States: Are They Converging? *Sloan Management Review, 36*(3), 77.

Henderson, R. M., & Clark, K. B. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly, 35*(1), 9–30.

Hobday, M., Davies, A., & Prencipe, A. (2005). Systems Integration: A Core Capability of the Modern Corporation. *Industrial and Corporate Change, 14*(6), 1109–1143.

Huang, G. Q., Zhang, X., & Liang, L. (2005). Towards Integrated Optimal Configuration of Platform Products, Manufacturing Processes, and Supply Chains. *Journal of Operations Management, 23*(3), 267–290.

Huang, P., Ceccagnoli, M., Forman, C., & Wu, D. (2013). Appropriability Mechanisms and the Platform Partnership Decision: Evidence from Enterprise Software. *Management Science, 59*(1), 102–121.

Iansiti, M., & Levien, R. (2002). The New Operational Dynamics of Business Ecosystems: Implications for Policy, Operations and Technology Strategy *Working Paper 03-030:* Division of Research, Harvard Business School.

Iansiti, M., & Levien, R. (2004a). *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability*. Boston, MA: Harvard Business Press.

Iansiti, M., & Levien, R. (2004b). Strategy as Ecology. *Harvard Business Review, 82*(3), 68–81.

Jacobides, M. G., Knudsen, T., & Augier, M. (2006). Benefiting from Innovation: Value Creation, Value Appropriation and the Role of Industry Architectures. *Research Policy, 35*(8), 1200–1221.

Jacobides, M. G., MacDuffie, J. P., & Tae, C. J. (2016). Agency, Structure, and the Dominance of Oems: Change and Stability in the Automotive Sector. *Strategic Management Journal, 37*(9), 1942–1967.

Jacobides, M. G., & Winter, S. G. (2005). The Co-Evolution of Capabilities and Transaction Costs: Explaining the Institutional Structure of Production. *Strategic Management Journal, 26*(5), 395–413.

Jarillo, J. C. (1988). On Strategic Networks. *Strategic Management Journal, 9*(1), 31–41.

Katz, M. L., & Shapiro, C. (1985). Network Externalities, Competition, and Compatibility. *The American Eeconomic Review, 75*(3), 424–440.

Kenney, M., & Zysman, J. (2016). The Rise of the Platform Economy. *Issues in Science and Technology, 32*(3), 61.

Lacy, P., Hagenmueller, M., & Ising, J. (2016). Platform Strategies: *How the Rules of Competitiveness Have Changed in the Era of Ecosystems*. Accenture Strategy, availible at https://www.accenture.com/t20160916T010708Z__w__/us-en/_acnmedia/PDF-27/Accenture-Strategy-Platform-Strategies.pdf:

Langlois, R. N., & Robertson, P. L. (1992). Networks and Innovation in a Modular System: Lessons from the Microcomputer and Stereo Component Industries. *Research Policy, 21*(4), 297–313.

Lazonick, W. (2005). Evolution of the New Economy Business Model. *Business History and Economic History OnLine*(2005:3), 1–60.

Lazonick, W. (2009). *Sustainable Prosperity in the New Economy?* Kalamazoo, Michigan: WE Upjohn Institute for Employment Research

Li, Y.-R. (2009). The Technological Roadmap of Cisco's Business Ecosystem. *Technovation, 29*(5), 379–386.

Louis, T. (2013, Aug 10). How Much Do Average Apps Make? *Forbes*.

MacDuffie, J. P. (2013). Modularity-as-Property, Modularization-as-Process, and 'Modularity-'-as-Frame: Lessons from Product Architecture Initiatives in the Global Automotive Industry. *Global Strategy Journal, 3*(1), 8–40.

Metcalfe, B. (2013). Metcalfe's Law after 40 Years of Ethernet. *Computer, 46*(12), 26–31.

Molina, A., Bremer, C. F., & Eversheim, W. (2001). Achieving Critical Mass: A Global Research Network in Systems Engineering. Foresight, 3(1), 59–65.

Nambisan, S., & Sawhney, M. (2011). Orchestration Processes in Network-Centric Innovation: Evidence from the Field. *The Academy of Management Perspectives, 25*(3), 40–57.

Normann, R., & Ramirez, R. (1993). From Value Chain to Value Constellation: Designing Interactive Strategy. *Harvard Business Review, 71*(4), 65–77.

Oren, S. S., & Smith, S. A. (1981). Critical Mass and Tariff Structure in Electronic Communications Markets. *The Bell Journal of Economics,* 467–487.

Park, Y., Ogawa, K., Tatsumoto, H., & Hong, P. (2009). The Impact of Product Architecture on Supply Chain Integration: A Case Study of Nokia and Texas Instruments. *International Journal of Services and Operations Management, 5*(6), 787–798.

Parker, G., & Alstyne, M. V. (2008). Managing Platform Ecosystems. *ICIS 2008 Proceedings,* 53.

Parnas, D. L. (1972). On the Criteria to Be Used in Decomposing Systems into Modules. *Communications of the ACM, 15*(12), 1053–1058.

Peres, R., Muller, E., & Mahajan, V. (2010). Innovation Diffusion and New Product Growth Models: A Critical Review and Research Directions. *International Journal of Research in Marketing, 27*(2), 91–106.

Perez, S. (2016). *Apple's App Store Hits 2m Apps, 130b Downloads, $50b Paid to Developers*. TechCrunch (June 23, 2016). Available at: https://techcrunch.com/2016/06/13/apples-app-store-hits-2m-apps-130b-downloads-50b-paid-to-developers/ https://techcrunch.com/2016/06/13/apples-app-store-hits-2m-apps-130b-downloads-50b-paid-to-developers/

Piore, M., & Sabel, C. (1984). *The Second Industrial Divide: Possibilities for Prosperity*. NYC, New York: Basic Books.

Pon, B., Seppälä, T., & Kenney, M. (2014). Android and the Demise of Operating System-Based Power: Firm Strategy and Platform Control in the Post-Pc World. *Telecommunications Policy, 38*(11), 979–991.

Porter, M. E. (1985). *Competetive Advantage: Creating and Sustaining Superior Performance*. New York: Free Press.

Prasarnphanich, P., & Wagner, C. (2011). Explaining the Sustainability of Digital Ecosystems Based on the Wiki Model through Critical-Mass Theory. *IEEE Transactions on Industrial Electronics, 58*(6), 2065–2072.

Reisinger, D. (2017). Here's How Many Iphones Are Currently Being Used Worldwide. *Fortune*.

Rochet, J. C., & Tirole, J. (2003). Platform Competition in Two-Sided Markets. *Journal of the European Economic Association, 1*(4), 990–1029.

Rochet, J. C., & Tirole, J. (2006). Two-Sided Markets: A Progress Report. *The RAND Journal of Economics, 37*(3), 645–667.

Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.

Rohlfs, J. (1974). A Theory of Interdependent Demand for a Communications Service. *The Bell Journal of Economics and Management Science,* 16–37.

Rohlfs, J. H. (2003). *Bandwagon Effects in High-Technology Industries*. Cambridge, MA: MIT Press.

Roson, R. (2005). Two-Sided Markets: A Tentative Survey. *Review of Network Economics, 4*(2).

Roy, R., & McEvily, S. K. (2004). Incumbent Survival During Market Fusion in Matured Industries: The Influence of Component and Architectural Capabilities on the Survival of Us Machine Tool Manufacturers During 1975–1995. In J. A. C. Baum & A. M. McGahan (Eds.), *Business Strategy over the Industry Lifecycle (Advances in Strategic Management, Volume 21)* (pp. 199–224): Emerald Group Publishing.

Sabel, C. F. (1994). Learning by Monitoring. In N. J. Smelser & R. Swedberg (Eds.), *The Handbook of Economic Sociology*. Princeton, N J Princeton University Press.

Sabel, C. F., & Zeitlin, J. (2004). Neither Modularity nor Relational Contracting: Inter-Firm Collaboration in the New Economy. *Enterprise & Society, 5*(3), 388–403.

Sako, M. (2009). Technology Strategy and Management Globalization of Knowledge-Intensive Professional Services. *Communications of the ACM, 52*(7), 31–33.

Shapiro, C., & Varian, H. R. (1998). *Information Ules: A Strategic Guide to the Network Economy*. Boston, MA: Harvard Business Publishing.

Simon, H. A. (1965). The Architecture of Complexity. *General systems, 10*(1965), 63–76.

Srinivasan, R., Lilien, G. L., & Rangaswamy, A. (2004). First in, First Out? The Effects of Network Externalities on Pioneer Survival. *Journal of marketing, 68*(1), 41–58.

Sturgeon, T. J. (2002). Modular Production Networks: A New American Model of Industrial Organization. *Industrial and corporate change, 11*(3), 451–496.

Takeishi, A. (2002). Knowledge Partitioning in the Interfirm Division of Labor: The Case of Automotive Product Development. *Organization Science, 13*(3), 321–338.

Tee, R., & Gawer, A. (2009). Industry Architecture as a Determinant of Successful Platform Strategies: A Case Study of the I-Mode Mobile Internet Service. *European Management Review, 6*(4), 217–232.

Thomas, L. D., Autio, E., & Gann, D. M. (2014). Architectural Leverage: Putting Platforms in Context. *The Academy of Management Perspectives, 28*(2), 198–219.

Tilson, D., Sorensen, C., & Lyytinen, K. (2012). *Change and Control Paradoxes in Mobile Infrastructure Innovation: The Android and Ios Mobile Operating Systems Cases*. Paper presented at the 2012 45th Hawaii International Conference on System Science.

Tiwana, A., Konsynski, B., & Bush, A. A. (2010). Research Commentary–Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics. *Information Systems Research, 21*(4), 675–687.

Vargo, S. L., & Lusch, R. F. (2004). Evolving to a New Dominant Logic for Marketing. *Journal of marketing, 68*(1), 1–17.

West, J., & Gallagher, S. (2006). Challenges of Open Innovation: The Paradox of Firm Investment in Open-Source Software. *R&d Management, 36*(3), 319–331.

Wheelwright, S. C., & Clark, K. B. (1992). *Revolutionizing Product Development: Quantum Leaps in Speed, Efficiency, and Quality*. NYC, New York: Simon and Schuster.

Wintermeyer, L. (2017, Feb 17). Global Fintech Vc Investment Soars in 2016. *Forbes Magazine*.

Von Burg, U. (2001). *The Triumph of Ethernet: Technological Communities and the Battle for the Lan Standard*. Palo Alto, CA: Stanford University Press.

Zirpoli, F., & Caputo, M. (2002). The Nature of Buyer-Supplier Relationships in Co-Design Activities: The Italian Auto Industry Case. *International Journal of Operations & Production Management, 22*(12), 1389–1410.

The Digital Customer

Catering to the Digital Consumer: From Multichannel to Omnichannel Retailing

SARA ROSENGREN, FREDRIK LANGE, MIKAEL HERNANT, AND ANGELICA BLOM

Introduction

Digitalization has a long history in retailing. In fact, is has been a driving force since the 1960s with developments being made, for example, in terms of electronic cash systems, barcodes, point-of-sale data, and electronic data interchange (EDI) with suppliers (e.g., Hagberg et al, 2017). Since the early 2000s, however, digitalization driven by operations and supply-side concerns has been complemented by digitalization following changing consumer behaviours and demands. The way consumers search and shop for products has changed dramatically during this period and, consequently, retail offers have changed with it. Although this change has affected retailing in general, it has been especially disruptive in service retailing (such as travel and banking) and for retailers focusing upon products that have been digitized: such as, for instance, music and books (Verhoef et al, 2015). The intangibility of these offers has made them highly suitable for online transactions that, in turn, make physical stores more or less obsolete.

Still, the shift in consumer behaviour is increasingly being felt in other retail sectors. A clear indication is the many recent store closings and bankruptcies of large retailers in US. As is the fact that online retailing comprised all growth in Swedish non-grocery retailing in the first half of 2017. With increasing use of mobile, tablets, social media and technological advances in analytics, the integration of channels in online and offline retailing continues to develop; as a result, the retail landscape continues to change. As a consequence, it has been argued that digitization of consumer behaviours will

fundamentally change retail as we know it (Grewal et al, 2017; Verhoef et al, 2015).

This chapter discusses contemporary research on digital shopper behaviour and its implications for retailers to better understand this development; it does so by reporting on two ongoing research projects at the Center for Retailing at Stockholm School of Economics: more detailed descriptions can be found in Hernant and Rosengren (2017) and Blom et al (2017). While previous research has primarily focused upon the growth of online retailing (Hagberg et al 2017) we focus upon the integration between online and offline retailing, which is often referred to as omnichannel retailing (Verhoef et al 2015). The question raised in this chapter is not whether an omnichannel strategy should be implemented; rather, what should be the omnichannel strategy. We particularly focus upon the importance of understanding, managing, and evaluating consumer behaviour across channels and touchpoints when crafting an omnichannel retail strategy.

In our first project, we use customer-level data of actual customer purchases offline and online to track changes in consumer behaviour over time (Hernant and Rosengren, 2017). The data comes from three Swedish retailers that operate in three different retail industries: pharmacy, grocery, and beauty. This project contributes to omnichannel retailing by offering a way to understand changes in customer behaviours over time. In the second project (Blom et al. 2017), we use experimental methods to test the effectiveness of efforts to integrate consumers' digital traces (for example, online browsing history) with promotional offers from a retailer. This project contributes to omnichannel research by examining digitalization related to individual shopping trips and shopper reactions to omnichannel-based promotions that are created for short-term sales effects. In both projects, we adopt the perspective of an established retailer adapting their offer to increasingly digital shopper behaviours. Still, it should be noted that the challenges in combining the online and offline retail offer is equally pressing for pure online players trying to grow, as indicated, for instance, by more and more online retailers opening physical stores (for example, Amazon buying Whole Foods or Zalando adding outlets and pop-up stores to their online offers).

From Multichannel Retailing to Omnichannel Retailing

Although interest in digital consumers dates back to the 1990s, it is in the past decade or so that digital consumer behaviour has become mainstream.

According to eMarketer (n.d.), a leading source of statistics on digital retail, over 2.14 billion people worldwide are expected to buy goods and services online in 2021, which is up from 1.66 billion global digital buyers in 2016. In 2016, 58.3 percent of global internet users had purchased products online. By 2019, this figure is expected to grow to 63 percent. This development clearly shows that retailers need to cater to consumers who are constantly online via smart phones and tables and for whom social and digital media are an ever-present part of everyday life and, thus, the buying process.

Verhoef et al (2015) discuss in their seminal article how digital consumer behaviour has led retailers to move from multichannel retailing: that is to say, offering their products in several different online and/or offline channels, to omnichannel retailing: offering customer experiences that are integrated across different channels and touchpoints. Whereas multichannel retail management focuses upon "the design, deployment, coordination, and evaluation of channels to enhance customer value through effective customer acquisition, retention, and development", they argue that omnichannel retail management should be concerned with "the synergetic management of the numerous available channels and customer touchpoints, in such a way that the customer experience across channels and the performance over channels is optimised" (p. 175). The main differences in perspectives lie in the focus upon synergies rather than coordination, on holistic customer experiences rather than conversion (customer acquisition, retention, and development), and on combining sales (channel) and brand (touchpoint) perspectives. Table 4.1 provides an overview of the different perspectives.

Table 4.1: Differences Between Multichannel and Omnichannel Management in Retailing (Adapted from Verhoef et al, 2015)

	Multichannel	**Omnichannel**
Focal channels	Interactive (transactional)	Interactive (transactional) and mass communication channels
Channel integration	Channels separate	Channel synergies
Focal interactions	Customer, store	Customer, store, brand
Management	Per channel	Cross-channel
Performance measures (KPI)	Sales	Sales and brand equity

The literature on multichannel retailing is vast; however, Verhoef et al (2015) points to the need for more research on omnichannel issues Such research has, indeed, emerged over the past couple of years as illustrated, for instance, in special issues coming out in several of the leading academic retail journals dealing with omnichannel issues (for example, Grewal et al, 2017; Hagberg et al, 2017).

From a retailer perspective, the move to omnichannel retailing seems inevitable. Consumers are digital shoppers and, thus, retailers need to offer experiences that cater to their demands. Still, there is plenty of room for variations, in terms of what the omnihchannel strategy should be. We will now discuss three key issues to consider in developing this strategy: namely understanding, managing, and evaluating movements between channels and touchpoints.

UNDERSTANDING MOVEMENTS BETWEEN CHANNELS AND TOUCHPOINTS

Previously, researchers discussed channel migration, as consumers were thought to switch from offline stores to online stores. Nowadays, there is a general understanding that most consumers move back and forth between channels and use them interchangeably. There is a vast literature documenting different tools for understanding consumer behaviours and decision journeys in order to create strong customer experiences (for a review: see Lemon and Verhoef, 2016). Customer experience is a multi-dimensional construct focusing upon cognitive, emotional, behavioural, sensorial, and social responses to a firm's offerings during the entire purchase journey (Lemon and Verhoef, 2016: p. 71). This means the overall customer experience is created in interactions before, during, and after a specific purchase has been made. The interactions are not all controlled by the retailer; they also comprise touchpoints created by brands and partners as well as other consumers, influencers, and media (see Figure 4.1 below).

Pre-purchase customer experiences are created through interactions taking place as the consumer recognises a need and begins to search for ways to fulfil it. In order to serve these effectively, retailers should consider different types of shopping needs. For example, it is often fruitful to distinguish between utilitarian (also refered to as task oriented or problem solving), and hedonic (also refered to as recreational, or experiential) shopping needs, as they lead to different decision journeys. From a retailer perspective, it is also vital to understand where the need occurs and whether it will lead consumers to

search for information. In this regard, a distinction can be made between planned (the need occurs prior to purchase and typically leads to information search) or unplanned (the need occurs at the point of purchase without much previous information search).

Considering the interplay between online and offline channels in the pre-purchase stage in an omnichannel context is especially important. Key behaviours to consider are the extent to which consumers use webrooming (that is to say, searching online and then moving in to physical stores to make a purchase) and showrooming (searching offline and then moving to digital stores to make a purchase).

Purchase customer experiences cover all interactions with the brand and its environment during the actual purchase. From a retailer perspective, key behaviours to consider at this stage are how choice, ordering, and payment are facilitated. Shopping experiences can also be created during the purchase stage.

Traditionally, the focus in retailing has been on the offline store as the arena for purchase (sales), whereas online platforms have been used as touchpoints to convey messages and provide information (brand). However, this logic can easily be turned around today: as indicated by novel showrooming concepts, such as the Samsung concept store in NYC (where consumers are not able to leave the physical store with a product) and American department store retailer Nordstrom's new concept: small neighbourhood stores without inventory. In addition, all retailers need to be sensitive to the fact that shoppers may look for the same product in competing online stores while shopping in a specific online or offline store.

Post-purchase consumer experiences comprise interactions that consumers have with the brand and its environment following the actual purchase. These interactions are usually related to usage and consumption; important behaviours from a retailer perspective deal with service and loyalty. Thus, the focus in this step has been on issues related to the brand rather than to sales.

In omnichannel retailing, however, this stage of the decision journey is more complex. Whereas the shopping experience in traditional physical retailing typically stopped with the purchase, the purchase and delivery of products is typically extended in time when an online purchase is made. This means that omnichannel retailers need to be more concerned about the experience offered in delivering the product to customers. This has led to an increased focus upon different delivery options: such as click-and-collect

(where products purchased online are picked up in offline stores) and last-mile delivery as part of the customer decision journey.

Understanding how consumers make decisions, mapping the use of different touchpoints in different stages, and identifying trigger points that lead customers to continue or discontinue in their purchase journey is crucial for understanding how to manage an omnichannel retail offer. Shoppers today may use a retailer's digital channels and touchpoints on the path to purchase and, thereby, disclose information to the retailer about, for instance, the types of products in which they are interested. This behaviour produces digital trace (for example, from website browsing with the mobile phone) about shopping goals that may be a valuable source of information for retailers that they can use in order to analyse movements between channels and touchpoints, which they are able to manage them over time.

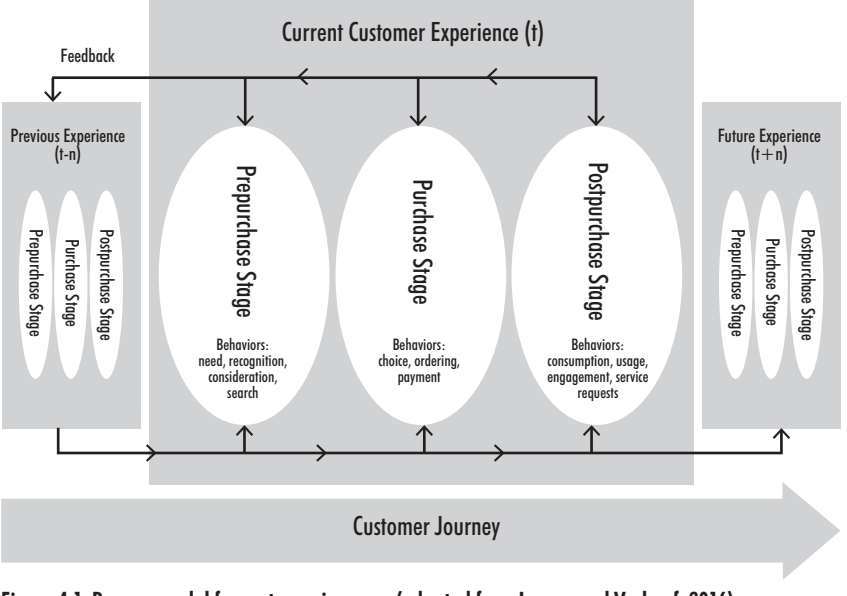

Figure 4.1. Process model for customer journeys (adapted from Lemon and Verhoef, 2016)

MANAGING MOVEMENTS BETWEEN CHANNELS AND TOUCHPOINTS

Based upon thorough analyses of the consumer decision journey, retailers are better equipped to come up with strategies on how to manage movements

between channels and touchpoints. A review of existing literature on omnichannel retailing highlights that integration between channels and touchpoints needs to be managed differently depending upon the type of product being offered and the type of decision journey used by consumers (Blom et al 2017).

We investigated in a recent research project how consumers respond when retailers offer a promotion in the physical store that is based upon pre-purchase digital data. We compared such tailored promotions (that is to say, promotions that are adapted based upon the customer's pre-purchase behaviour online before entering the store) with a generic promotion (see Blom et al, 2017 for a more detailed description). The results reveal that shoppers are more responsive to tailored promotions compared to generic traditional promotions. We also found the advantages of using tailored promotions vary depending upon the type of product (utilitarian versus hedonic motivation) and decision process (planned versus unplanned) of consumers.

In terms of product categories, our study found that, although tailored promotions have a positive effect on both sales and brand, this effect is attenuated for hedonic compared to utilitarian product categories. Since a tailored promotion evokes benefits that are more valued by those shopping for utilitarian rather than hedonic products, consumers who are shopping for a utilitarian product category redeem the promotion to a greater extent and have a more positive attitude towards the retailer after being offered such promotions. The tailored promotion facilitates the shopping trip, thus, enabling the consumers to satisfy their shopping goal in an effortless manner. Conversely, consumers seek exploration, variation, and enjoyment when shopping for hedonic product categories. In order to be relevant in promotions targeting such consumers, promotions that satisfy their shopping goal in an experiential fashion is required, as the shopping experience is part of the shopping goal. The tailored promotion is, therefore, of less relative importance since consumers shopping for hedonic products also perceive the shopping trip experience as such as part of their shopping goal.

In terms of consumer decision processes, our study found that, although tailored promotions have a positive effect on both sales and brand, the effect is attenuated when consumers make an unplanned versus a planned purchase. Consumers that have made a planned purchase have previously identified a problem. This typically means they engage in a more rational shopping process with clearly defined shopping goals. In contrast, unplanned purchases

correspond to more irrational, emotional, affective, hedonic, experiential, and variety seeking aspects of shopping. An unplanned purchase occurs without much thought or consideration and is less rational, thus, meaning that it is made with relatively little cognitive control and is usually linked to abstract shopping goals. A tailored promotion is more helpful for consumers that have planned their purchase. Since consumers that have made a planned purchase have engaged in cognitive effort, thought and involvement, and have formed a concrete shopping goal, a promotion that is congruent with this goal is more valuable. As a consequence, consumers who make a planned purchase are more likely to redeem the promotion and become more positive toward the retailer.

Overall, the results from the Blom et al. (2017) study indicate that examining different types of shopping situations is important to better understand omnichannel promotional initiatives and how to manage movements between channels and touchpoints in an omnichannel setting. We also found that integration is less important in hedonic (versus utilitarian) product categories and for unplanned (versus planned) purchases.

We also explored the benefits to consumers that drive these effects. The use of digital traces in promotions may produce both utilitarian and hedonic benefits and value for shoppers; these benefits and values are linked in different ways to purchase behaviour and brand perceptions. The results reveal that integration is more important for omnichannel performance (sales) than for omnichannel experience (brand). If retailers are interested in short-term effects on sales (promotion redemption), they should strive for designing omnichannel promotions that provide benefits and shopping value, which are primarily utilitarian. However, a retailer should offer both utilitarian and hedonic benefits and experiential values if the main purpose of omnichannel promotions is to create long-term effects on perceived omnichannel experience (that is to say, brand building).

The results from our study suggest that omnichannel promotions are more effective if they are designed with in-depth knowledge about the shopping goals of specific shopping trips. Based upon an analysis of the customer journey for different customers it is, thus, possible to come up with more tailor-made strategies to manage customer movements between channels and touchpoints. This implication is not restricted to promotions; rather, it could

be used to guide other decisions related to managing consumer movements between channels and touchpoints. For example, the other study discussed in this chapter (Hernant and Rosengren, 2017) found an asymmetric effect of converting customers from online to offline compared to converting them from offline to online, in the context of pharmacy retailing (which can be characterised as driven by utilitarian products and planned consumer behaviours). Whereas online customers buy more as they convert offline, existing offline customers mainly switch channels. This implies that a retailer should target customers recruited online with offers that will help converge them offline; while it should market its online channel to current customers more as an information channel or a complement to the existing store. As illustrated thus far, there is a lot to gain by analysing and managing movements between channels and touchpoints. These activities also need to be matched with a clear understanding of how to evaluate these movements.

EVALUATING MOVEMENTS BETWEEN CHANNELS AND TOUCHPOINTS

Retailers must also come up with a system for evaluating movements between channels and touchpoints in order to fully understand omnichannel retailing. Such measures play a key role in making insights actionable for the firm (for example, Lemon and Verhoef, 2016). The omnichannel literature points to the importance of integrating customer experiences, sales, and brand perspectives; thus, these three aspects must be included when evaluating movements between channels and touchpoints (Verhoef et al, 2015).

In practice, it is difficult to find a single set of measures that adequately captures customer experience across different retail sectors and different channels. This means that firms typically rely upon a set of different measures (such as satisfaction, net promoter score, or similar) for different parts of the omnichannel offer. There ideally should be proven measurement approaches for the overall customer experience at each stage in the customer journey (pre-purchase, purchase, and post-purchase) and for all touchpoints. This measure should then be complemented with measures of sales and brand perceptions. However, there is not yet agreement on robust measurement approaches to evaluate all aspects of customer experience across the customer journey. Lemon and Verhoef (2016, p. 81–82) conclude the following in their review of customer experience research:

- Long-tested approaches, such as SERVQUAL (reliability, assurance, tangibles, empathy, and responsiveness) may offer a good starting point.
- Customer satisfaction and NPS (net promoter score) perform equally well in predicting firm performance and customer behaviour, although the predictive performance differs between specific contexts.
- Transformations of metrics are useful to account for potential non-linear effects due to notions such as customer delight.
- Customer feedback metrics focusing upon a specific domain of the customer are not strong in predicting future performance.
- Multiple customer feedback metrics predict customer behaviour better than a single metric.

Lemon and Verhoef (2016) recommend crafting dashboards that combine different measures to evaluate customer experience across channels and touchpoints, based upon this review. Such dashboards also need to consider retailer performance, in terms of both sales and brand, to provide a comprehensive evaluation of omnichannel performance. For example, as a way to facilitate integration between online and offline sales performance, Ikea and Åhléns attribute additional sales in the online channel to the offline stores in geographical areas where the product is delivered. This way, store employees can focus upon customer experience and satisfaction rather than direct conversion in stores. Similarly, it is important to examine simultaneously the effects on both purchase behaviour (sales) and brand image (see Blom et al., 2017) when evaluating omnichannel promotions.

From a customer journey perspective, it is also important to track how multiple touchpoints encountered throughout the journey affect purchase (or other behavioral) outcomes. This is often done through attribution or path-to-purchase models. Although such analyses can be valuable, a general problem with modelling such behaviours is that touchpoints tend to be used in different phases of the decision journey and, as a consequence, touchpoint effects can be endogenous, thus, leading to erroneous conclusions and resource allocation (Lemon and Verhoef, 2016). What is more, tools are available in an online context for tracking shopper behaviour in real time. Offline, however, these tools typically comprise satisfaction, and sales and are not measured as frequently as are online measures. As a consequence, there is a risk that too

much weight is given to aspects of customer behaviours that are easily measured in relation to what should be measured and what really drives customer experience, sales, and brand effects.

A Framework for Analysing Buying Behaviour Across Channels

Although the overall customer experience is multi-dimensional, retailers typically have quite elaborate and readily available data in terms of behaviours in their CRM (customer relationship management) systems or loyalty programs. This data can be valuable in developing an understanding of consumer behaviour in different channels, thus, providing a point of departure for analysing, managing, and evaluating behaviours across channels. In our second recent project discussed here, we use this type of data to develop a framework that provides a comprehensive understanding of the implications of retail digitalization for sales in physical stores and of how to manage customers across channels (for details, see Hernant and Rosengren, 2017). Our framework illuminates how customer behaviours of individual customers change when a new online channel is added to an existing network of physical stores. Thus, our focus is upon the purchase step of the consumer decision journey and the extent to which buying behaviours of individual customers change when they also start using an online channel.

To analyse movements between channels for individual customers, our framework disentangles overall buying behaviors of each customers into amount, frequency, and regularity.

Table 4.2: Definitions of Variables (from Hernant and Rosengren, 2017)

Purchase amount	Total amount of all purchases the customer has made.
Purchase volume	Total number of all products the customer has purchased.
Purchase visits	Number of occasions the customer has made purchases.
Purchase months	Number of different months for the customer's purchase visits.
Customer months	Total number of months the customer has been a customer.
Monthly amount	Purchase amount per customer month, (i.e. the total amount of purchases divided by the number of months since the first recorded visit in the database).
Monthly volume	Purchase volume per customer month, (i.e. the total volume of purchased products divided by the number of months since the first recorded visit in the database).
Amount per visit	Purchase amount per purchase visit (i.e. the total amount of purchases divided by the number of purchase visits).

The variables used in our study are summarised in Table 4.2. All measures refer to the aggregate behaviour during the time period for which the customer has been a customer, and were used to describe overall behaviour as well as behaviour for the online and offline channel, respectively (for further details regarding the variables: please see Hernant and Rosengren, 2017).

The variables facilitate a comparison of customers purchase behaviour (in totalm, as well as online and offline) after they have become online customers. The monthly amount (volume) can be calculated by multiplying the amount (volume) per transaction, the purchase frequency, and the purchase regularity. Mathematically, the monthly amount (volume) can be expressed by multiplying the amount (volume) per transaction, the purchase frequency, and the purchase regularity (see Figure 4.2).

$$\frac{\text{Purchase amount}}{\text{Customer months}} = \frac{\text{Purchase amount}}{\text{Purchase visits}} \bullet \frac{\text{Purchase visits}}{\text{Purchase months}} \bullet \frac{\text{Purchase months}}{\text{Customer months}}$$

(Monthly amount) (Amount per visit) (Purchase frequency) (Purchase regularity)

$$\frac{\text{Purchase volume}}{\text{Customer months}} = \frac{\text{Purchase volume}}{\text{Purchase visits}} \bullet \frac{\text{Purchase visits}}{\text{Purchase months}} \bullet \frac{\text{Purchase months}}{\text{Customer months}}$$

(Monthly volume) (Volume per visit) (Purchase frequency) (Purchase regularity)

Figure 4.2: Calculations of monthly revenues and sales volumes using the variables (from Hernant and Rosengren, 2017)

UNDERSTANDING MOVEMENTS IN PHARMACY RETAILING

Our framework was developed in the context of pharmacy retailing, using the CRM system of a Swedish pharmacy retailer, and capturing data for a total of 12,139 online customers. Each sales receipt shows detailed information on an actual purchase: that is to say, the (anonymised) customer's identity, the products purchased, and the date and time of purchase. Furthermore, all purchases in the retailer's physical stores in a time period from one year before the online store opened were identified for all customers who made at least one purchase in the online store. In all, this dataset enabled us to analyse customer purchase behaviour for a full year prior to, and 15 months post-introduction of the online store at the specific retailer (for a more detailed description: see Hernant and Rosengren, 2017).

The analysis using the framework showed that going online facilitated customer acquisition. A total of 2,954 (24%) of the 12,193 customers who patronised the online store made their first purchase online. Most of these (1,798 or 61%) made no purchases offline. The remaining 1,156 (39%) online customers also became offline customers. The latter customer group provided twice as much sales every month as online-only customers; this was primarily due to their higher purchasing regularity. From the retailer's perceptive, this difference clearly indicates that it is crucial to convert customers acquired online to also become customers of the physical store.

We also found that existing customers buying online (9,239 or 76%) were primarily shifting their purchases from one channel to the other. These customers showed only minor increases in total purchasing after their first online purchase; identical number of products purchased per month, and monthly amount increased by 2%. However, the average transaction size among these customers increased (most notably in amount spent per visit, which rose by 13%) after their first online purchase. The purchase frequency of this customer group increased by 2.4%; purchase regularity decreased by 5%. The net effect, therefore, was the larger average transaction translated into only a small increase in monthly amount. Overall, the online buying by existing (offline) customers represented a switch from offline to online. After their first online purchase, existing customers changed their offline behaviour, as illustrated by lower average transactions, lower frequency, and lower regularity.

Based on these analyses we found an asymmetry in channel migration. Converting online customers into customers at a physical store provided more opportunities for additional sales than the other way around. The results also highlighted the importance of looking beyond average transaction size (see also Pauwels and Neslin, 2015). By using the average monthly sales from individual consumers as the target variable, our study found that, despite the larger online transaction size, the interaction between average transaction, purchase frequency, and regularity for existing customers is a zero-sum game. The effects on the physical stores for the retailer were negative for all variables.

This highlingts how retailers can use our framework to design address various aspects of consumer behaviour (average transaction, frequency, and regularity), as well as describe the offers and their underlying strategies to decision makers and store employees. The framework (Hernant and Rosengren, 2017)

allows for a more insightful discussion of the sales impact of adding an online channel. It can also serve as a basis for targeting different customer groups with tailored offers designed to change the facet of customer behaviour (average transaction size, frequency, or regularity) considered most likely to impact overall sales among that specific group of customers.

While access to this type of customer-level data is rare in academic research, it is typically readily available for retailers, which makes the framework easy to implement. The framework can also be used for continuous tracking and aggregation of individual customers' purchase behaviour between channels, and assist retailers in identifying sales-related problems as well as potential opportunities. For the retailer in our study, the online channel is still small in relation to the total business. Nevertheless, our research provides important insights. In particular, managers should carefully evaluate the effects of going online, based upon the transaction size, as well as the routine or pattern according to which transactions occur. For instance, an increase in average transaction size for offline customers going online can be offset by lower frequency and regularity. Since online channels also cannibalize on physical stores (see further Hernant and Rosengren, 2017), priority should be placed upon marketing activities that encourage customers' cross-channel purchasing: both to benefit more from customers acquired online and to reduce cannibalisation. For example, promotion and reward offers to customers can be based upon their degree of cross-channel purchasing. There is an important trade-off between cost functions online and offline from an operational perspective, as well as between short-term customer responses and longer-term potential effects on customer behaviour and revenues. For managers, our study highlights the importance of considering effects on cost, profit, customer relationships, loyalty, and long-term revenues when considering multi and omnichannel strategies.

COMPARING MOVEMENTS ACROSS RETAILERS

The framework can also be used to gain a better understanding of movements between online and offline channels in different retail contexts. In a second step of the project, we added the same type of data from two additional retailers: one grocery retailer and one beauty retailer. The framework was adapted to weekly behaviours to better fit the purchase cycle of grocery retailing, whereas monthly behaviours were used for the other two.

As buying motives as well as buying processes differ substantially between industries, adding an online channel should have differential effects upon customer behaviour and sales performance between various retail industries. For example, Kushwaha and Shankar (2013) found that customers that buy from more than one channel increase their purchases for hedonic product categories, yet not for utilitarian categories. Their study did not, however, address the effect upon retailers' sales performance. Still, it is reasonable to expect based upon this finding that retailers in industries facing consumers with hedonic motives for their purchases have more to "win" from also going online.

In comparing the changes in behaviour for existing customers also starting to buy online, the three cases reveal the following:

- In all three cases, the average purchases in the physical store are reduced after customers start buying online (range: -22 to -24%). Customers who start to also buy online increase their total spending with the retailer in grocery (+23%) and beauty (+19%). There is no such effect for the pharmacy.

- In all three cases, the average purchase is larger online than offline. When customers start buying online, this means the average purchase in total (considering both online and offline purchases) increases by 13–15%. At the same time, the average purchase offline is lower in all three cases (Pharmacy: -11%; Grocery: -8%; Beauty: -5%).

- In all three cases, the purchase frequency is lower online than it is offline. Customers who start to buy online become less frequent offline (Pharmacy: -10%; Grocery: -5%; Beauty 6%). The overall effect on frequency is positive for Beauty (+7%), yet it is small for Grocery (-1%) and Beauty (+2%).

- The purchase regularity in all three cases is lower online than offline. Purchase regularity increases overall after the first online purchase for Grocery (+17%), yet it decreases for Pharmacy (-5%) and Beauty (-2%).

The results thus support the notion that omnichannel strategies need to be adapted based upon product categories and purchase behaviour (Blom et al 2017). Achieving high online purchase regularity among customers seems to

be most beneficial for overall sales (online plus offline) in the beauty industry. Cannibalisation is brought about to a larger extent in the grocery industry, although overall sales are increasing here too. With its primarily utilitarian motives and planned purchases, cannibalisation on the offline stores is the highest in the pharmacy industry.

Conclusion

This chapter set out to provide a better understanding of digital shopper behaviour and its implications for retailers. Whereas previous research has primarily focused upon the growth of online retailing, we focused on omnichannel retailing: the integration between online and offline retailing. More specifically, we outline the importance of understanding, managing, and evaluating consumer behaviour across channels and touchpoints when crafting an omnichannel retail strategy. We discuss how it is not possible, based upon two ongoing projects, to provide a one-size-fits-all key to omnichannel retailing. Omnichannel strategies must be designed with in-depth knowledge about the type of products and decision processes used by consumers. Therefore, it is possible to come up with more tailor-made strategies to manage customer movements between channels and touchpoints, based upon an analysis of the customer journey for different customers. The chapter also points to the importance of combining measures of customer experience, sales, and brands when evaluating different channels and touchpoints through the use of dashboard approaches. The frameworks presented in the chapter can be used as tool in this regard.

References

eMarketer. (n.d.). Digital buyer penetration worldwide from 2016 to 2021. In *Statista – The Statistics Portal*. Retrieved October 8, 2017, from https://www-statista-com.ez.hhs.se/statistics/261676/digital-buyer-penetration-worldwide/.

Blom, Angelica, Lange, Fredrik, and Hess, Ron (2017), Omnichannel-based promotions' effects on purchase behaviour and brand image, *Journal of Retailing and Consumer Services, 39*, 286–295.

Grewal, Dhruv, Roggeveen, Anne, and Nordfält, Jens (2017), The Future of Retailing, *Journal of Retailing, 93*(1), 1–6.

Hagberg, Johan, Jonsson, Anna, and Egels-Zandén, Niklas (2017), Retail Digitalization: Implications for Physical Stores, *Journal of Retailing and Consumer Services, 39*, 264–269.

Hernant, Mikael and Rosengren, Sara (2017), Now what? Evaluating the sales effects of introducing an online store, *Journal of Retailing and Consumer Services, 39*, 305–313.

Kushwaha, Tarun and Shankar, Venkatesh (2013), Are Multichannel Customers Really More Valuable? The Moderating Role of Product Category Characteristics, *Journal of Marketing, 77* (4), 67–85.

Lemon, Katherine N. and Vehoef, Peter C. (2016), Understanding Customer Experience Throughout the Customer Journey, *Journal of Marketing, 80* (6), 69–96.

Pauwels, Koen and Neslin, Scott A. (2015), Building With Bricks and Mortar: The Revenue Impact of Opening Physical Stores in a Multichannel Environment, *Journal of Retailing, 91* (2), 182–197.

Verhoef, Peter C., Kannan, P.K., and Inman, J. Jeffrey (2015), From Multi-Channel Retailing to Omni-Channel Retailing – Introduction to the Special Issue on Multi-Channel Retailing, *Journal of Retailing, 91* (2), 174–181.

Digital Trace Data: Which Data Should we Collect and What Should we do Once we Have it?

CLAIRE INGRAM BOGUSZ

Introduction

Today, we take for granted the fact that websites and other platforms are optimised to provide different experiences for different people. Individuals' browsing history, location, and device are all bits of important information that help web services provide them with a personalised experience. These personalised experiences are incredibly useful for individuals; someone on a mobile phone no longer has to navigate a complex web-based version of a platform, for instance, because data about the individual's device are received by the website provider. Similarly, advertisements that individuals see are tailored for them, based upon what they have looked at – and read – online. While there is no question that these developments are convenient, some question whether data collection has gone too far.

Whether or not we are aware of it, these practices form the very backbone of some of the largest internet firms. Google, for instance, makes much of its revenue from advertising: in mid-2016, Google's parent company Alphabet made 21.5 billion USD in revenue, of which 89 per cent (or 19.1bn USD) came from advertising (Johnson 2016). Facebook made 8.81 billion USD profit in 2016, exclusively from advertising – with 84 percent of that coming from mobile advertising (Constine, 2017).

While there are ways to avoid generating data while online, most of us do not take the trouble to cover our footsteps. This is despite the fact that everything from how our mouse moves when interacting with a website, to sites

that we visit, to the data that we enter into online forms – even if we never submit the form – can be, and often are, collected.

The data that enable personalisation are generated on a diverse number of websites: from social media to news. And, all of these websites collect these data, whether it is for their own uses or otherwise. When it comes to their own uses, many websites pay for their own existence by selling advertising, and they use our data to match our profiles with the most relevant advertisements. In principle, this should give us the most relevant advertisements online; however, the process also allows websites to charge advertisers more for better targeting. Other actors who make use of these data are third party actors; they bundle data from multiple sources and sell them to other firms: sometimes in raw form, and sometimes as analytical insights. This direct and indirect collection and use of online data has come to be called the *commodification of data*, and it has emerged from our desire to have "free" services on the web, and the fact that digital footprints – or digital traces – are easy to track.

This chapter will define and give boundaries to the collection of what is called *digital trace data*: the data that are generated – and collected – as a by-product of our online activities. This summary then goes on to show how digital trace data are being used for both business and illicit purposes, and zooms in on some examples. Lastly, it discusses how to balance the risks for individual integrity against the opportunities for new businesses, and "free" services on the web.

What are "Trace Data"?

"Big Data" is the popular term for very large volumes of data; it is often used to refer to the volumes of data collected about online activities. However, big data has its origins in scientific inquiry, and internet-generated data is just the tip of the iceberg: information collected about the weather patterns by satellites, to interaction data from so-called "Internet of Things" devices connected to one another, to information about online activities are even more commonplace (McAfee et al., 2012). These large volumes of data have led to more accurate and sophisticated models in areas such as agriculture and weather patterns (using weather data), allowed connected devices to make predictions about when to turn the heating on in our homes, or when to refill the refrigerator (from Internet of Things data), to complex models around human behaviour and preferences.

Large volumes of data allow for automated pattern recognition, the testing of hypotheses at a rate of knots, and automated model development using machine learning. When it comes to online activities, the more gritty "digital trace data" is the most relevant for social – and economic – activities. Individuals typically unintentionally leave digital traces as they browse, shop, and transact online. These data can be used instead of, or as a supplement to, data already willingly given by individuals in order to build a clearer picture of their online activities and preferences.

Most of us are aware, at least peripherally, that we generate data while online. Most websites display, for instance, a "cookie request": they ask for permission to store small amounts of data on our computers. These small files are linked to a particular website; in turn, the files can be accessed both from the user's computer and from the website owner's server. As such, the files carry information that is used to fine-tune the user's online experience by remembering preferences or providing targeted advertising. Often web pages contain scripts that allow data to be carried from one visit (or page) to the next: for instance, to optimise advertising.

Cookies are just the tip of the iceberg: not only are we mostly aware of them; there are limits on what can be shared and are regulated by bodies such as the European Union (Directive 2002/58/EC). Other traces left online are not as tightly controlled. However, to understand why (and how) this is the case, we need to explore what it is that we are talking about when discussing digital traces.

These different ways in which data are collected, the different kinds of data, and the extent to which we have control over the data collected allow us to classify digital traces to some degree. Drawing upon Schneier (2015) and Ingram Bogusz (2018), this chapter describes a taxonomy of digital trace data, and discusses the different ways in which these data are being used commercially, both on their own and in combination with other data. This summary then goes on to discuss the possibilities and pitfalls of data use.

DATA WITH CONTENT, AND DATA ABOUT DATA

Data typically are one of two kinds: data with content or metadata. Data with content are substantial and personal in nature; they say something about an individual, and can easily be identified as being linked to that person. Data with content include not only that which we explicitly share with a firm; they

also include other kinds of trace online data, notably content shared on social media and in forums. When it comes to social media, for instance, photographs on Facebook are data with content, as are the links to news articles that we share.

In contrast, metadata are data about data. For instance, metadata around a Facebook photo might include the size of the photograph, the time it was shared, and the IP address from which the image was shared. While the metadata from a single photograph cannot be used to say much about an individual, the metadata about all of the photographs of you shared on Facebook can. For instance, if you consistently share large files, from the same IP address in Stockholm at the same time on a Friday night, algorithms might determine that you have a high quality camera and therefore are a photography enthusiast, who lives in Stockholm, and prefers not to go club-hopping.

Many companies – and countries – treat the collection of metadata (and other "anonymised" data) as unproblematic. Indeed, metadata are often central to, for instance, a telecommunications firm, which ensures their internet service infrastructure is working as it should. However, depending upon the patterns searched for in the data, it could reveal more about individuals than data with content. Therefore, these data could give firms, and anyone else who can access these data, an unprecedentedly detailed picture of a number of online habits. For instance, the presence of a mobile phone at an anti-government protest in an autocratic country might reveal the identities of individual protestors.

A recent study, for instance, using only the metadata from phone calls and text messages identified that a small sample of individuals were suffering from sensitive medical conditions (Mayer et al, 2016). The amount of data that is currently available about us, combined with advances in data analysis, have significantly increased the likelihood that an individual can be re-identified from anonymised data: whether metadata or otherwise. In fact, removing personal data from digital traces (for instance, by making it illegal to collect personal data) is, therefore, insufficient: identifying an individual depends upon the number of data traces available, and that to which other data a dataset can be linked.

LEAVING TRACES IS ALMOST UNAVOIDABLE

Most of us are familiar with giving some of our data to companies and authorities; it would be impossible to get a bank account, or access healthcare, without disclosing our names, addresses, and other information. We are fully aware of these data, however, and what they say about us. This is not always the case with digital trace data. Although the comparison is imperfect, digital trace data has been likened to the data left behind at a crime scene.

Take, for instance, when a perpetrator leaves behind a strand of hair or fingerprints on a doorknob. Criminals are not the only ones that leave these traces, and neither criminals nor passers-by leave these traces deliberately. Even so, they can be used to identify individuals–whether at face value by their appearance or colour, or after further analysis. Thus, these traces may be said to have "content".

Avoiding leaving these traces in the physical world, while possible, is tricky. A perpetrator could wear gloves to avoid leaving fingerprints, or a hat to avoid leaving hair, but what about footprints or skin cells? It would take considerable effort, if possible, to avoid leaving any traces at all. Leaving these traces in the digital realm is similarly difficult to avoid: online activity can be re-routed through multiple servers, and users can use special web browsers. Few, however, go to these lengths.

For this very reason, online data are readily accessible. While we give explicit permission for some services to make use of our data – for instance, Google and Facebook – data are accessible even to those to whom we do not give explicit permission. We also often give implicit permission for our data to be used and stored, simply by using certain websites: such as forums or news websites.

From Where do They Come?

These two overarching categories are the ones most often discussed in policy documents, for example. However, individual users have different levels of control over data, depending upon who shares them and who controls what is being shared. For this reason, researchers have further characterised data. While there are many taxonomies, we favour Schneier's (2015) in this chapter. Relying upon his framework, we discuss some of the different types of data out there, their source, and who controls the data in various cases.

SERVICE DATA

We are largely familiar with giving our service data to service providers: one's name, age, address or credit card number are common service data. Indeed, these data are willingly given in the offline world to everyone from banks to state actors. However, despite how widely these data are used, they are considered to be very sensitive. Ironically, although we often willingly provide these data, they are the most heavily protected in most countries; for instance in Sweden, other data may not be used to infer these personal details.

These service data, in the digital world, have the least use: they give only the most basic of details about an individual, and information contained in service data can often be inferred from other data. For instance, someone's location could as easily be inferred from an IP address as his or her physical address. Moreover, an IP address can pinpoint where an individual is located at a given time, and not just what their home address is: useful information if, for instance, for a targeted advertisement for coffee at 7am.

Considering how service data has been the backbone of the service industry for decades is also illuminating. Today, other sources of data are more enlightening than this service data. Therefore, it is interesting that individuals (and governments) are protective of these data, when other kinds of data contain the same information: often in real time. Other sources of data often reveal more about an individual than a name and address can.

Theses service data, however, can be combined with other sources of data, and others' service data, to create data that provides more – and deeper – insight.

DERIVED DATA

Derived Data are data inferred from other data. For instance, combining service data from thousands or hundreds of thousands of individuals allows marketers to create segmentations. Offline brokering firms create group profiles that categorise people according to their shared demographic traits, while online information brokers tend to use social media networks, device locations, and online activity.

The creation of these categories is done by individuals or machine learning, with no input from the individuals whose data are being curated. Thus, an individual's membership of a group created based upon either demographics or online activity is not something that they can influence: even if that

categorisation is inaccurate or just plain wrong. Moreover, as third parties create these categories, the individual user has no influence over how these group-level data are used by the brokering company or other third parties.

DISCLOSED DATA

Disclosed data, on the other hand, are data that include content that we as individuals control, according to where we control the platform. This kind of data includes content such as photos, messages, and/or comments that we post on a webpage, blog, and/or website that we control, own, and/or host. While the data are publicly available, we can decide what to share, and for how long. In principle, this should mean that we could limit access to the underlying infrastructure, thus, limiting the collecting of digital trace data by third parties. However, the reality is the "public" nature of these data – even though we control the content – mean that third parties wanting to use it can easily do so as well.

We often think of data that we put up on social media sites as being disclosed and within our control. However, this is not the case. Even data that we flag as "private" can be used by social media giants for third party services, such as advertising targeting. For instance, up until 2016, there was talk of using Facebook data for credit scoring[1].

ENTRUSTED DATA

What we often think of as disclosed is really entrusted data instead. This includes similar content to disclosed data, yet it is data posted on a platform we do not control, such as Facebook, LinkedIn, or our employer's website. As such, someone else decides what happens to these data, and how easy they are to use and collect. We can decide the content and whether or not we chose to post it on these platforms; however, we cannot control what firms subsequently do with our trace data.

Entrusted data has been a goldmine for internet giants. For instance, by making use of entrusted data, Facebook has built some of the world's most reliable facial recognition software. By using photographs online and users' tags of their own friends, Facebook has been able to teach a machine-learning algorithm how to recognise and classify facial features. This algorithm is now

1 http://fortune.com/2016/02/24/facebook-credit-score/

not only better than humans are at facial recognition; its use online has been called "biometric invasion of privacy" in court proceedings that aim to curb its use (Brandom, 2016).

Facebook and other social networks are also renowned for their use of data generated as a result of this entrusted data, namely incidental data.

INCIDENTAL DATA

Incidental Data are data generated as a result of the sharing of entrusted data. For instance, comments on photographs or on shared links are incidental data. The tag on a Facebook photo, which identifies an individual, is also considered incidental data. Incidental data, as with entrusted data, is beyond the user's control: both because of its platform and because it is generated by a third party.

Incidental data in the business world are often used to train machine-learning algorithms or to generate business insights. The example of Facebook's tags is an instance of algorithm training. This data can also be used to generate business insights when analysts use natural language processing to assess whether or not a post or online content has been positively or negatively received – not just whether or not it has been shared.

BEHAVIOURAL DATA

Lastly, there are behavioural data. These data are created while interacting with a computer, mobile phone or tablet. Some examples include how long one spends looking at a particular website or where one clicks. These kinds of data provide insight into what we do, with whom, how often, and where. These behavioural data are among some of the most valuable data to collect: they allow websites to give individuals tailor-made advertisements or special offers.

Behavioural data have even been used to conduct credit risk assessments. Wonga, a payday lender in the United Kingdom, claims that its behavioural data-driven algorithms are so reliable (and quick) that decisions are made within six minutes, and that money is transferred to user accounts in fifteen (Deville, 2013). Wonga does this by tracking how a person uses a sliding credit bar (dragging it straight to the maximum amount is apparently a red flag). Moreover, Wonga seems to offer individuals higher initial loan amounts based upon the device from which they access the site.

Table 5.1: The Characteristics and Kinds of Digital Trace Data, from Ingram Bogusz (2018)

	Deliberately Left	Unintentionally Left	Left by a Third Party
Data with content	Service data Disclosed data Entrusted data		Entrusted data Incidental data
Metadata		Entrusted data Behavioural data Derived data	Incidental data Derived data

Both behavioural and incidental data are typically unintentionally (or unknowingly) shared. This commonly occurs when we allow one service access to data contained in other services; for instance, when we allow the Facebook mobile app to access our phonebook, we ultimately are sharing our friends' phone numbers. The fact that data are unintentionally shared, however, does not affect who has control over when and to whom, data are released.

All of these kinds of data could be either data with content, or metadata: that is to say, data about data. We unknowingly generate this metadata over the long term in an organised format.

Having discussed the volumes of data that we generate, and the differences between them, we now turn to the broader trend of commodifying data, before discussing how to approach the possibilities implicit in these data with privacy in mind.

Patterns in Commercial Trace Data Use

Facebook's average revenue per user in the US and Canada was around $20 in 2016 (Oreskovic, 2017). This revenue is largely a result of the social media giant's access to volumes of data that, at scale, it can use to create insights and new products. These new products include targeted advertisements, news feeds that contain "recommended" posts and new software, such as the aforementioned facial recognition software.

What is key is that individual data sets are not worth this money: data can only be used to build new products and train algorithms when an actor controls and maintains vast quantities. While building and maintaining this infrastructure costs money too, the value of the data is only growing: the European Commission (2016) estimates that, by 2020, the value of European

citizens' personal data is expected to reach 1 trillion EUR, or 8 per cent of the Union's GDP.[2]

DIGITAL INSIGHTS AND RECOMMENDATIONS

Facebook, Google, and other social media giants are, at their very core, data brokers. They use entrusted and incidental data to build profiles of individuals for various purposes. They also access other data to know where we are, such as our phones' GPS position. These profiles and physical world indicators allow them to create some of the following business and service innovations.

Consumer Segments

Segmentation helps retailers online and offline identify potential customers: for instance, "under 40 without a mortgage" or "young mothers in the Uppsala region". These profiles can then be sold to other companies for advertising or marketing – whether through the data broker's platform or otherwise. The media giants with whom we are familiar, however, are just the tip of the iceberg. There are even more data brokers of whom we have not heard: US–based company ID Analytics has information on more than 1.4 billion consumer transactions. The data to which they have access goes far beyond what Facebook or Google control; instead, they can offer third parties detailed pictures of consumer browsing and purchasing practises, their interests, habits, hobbies, communities and opinions.[3]

Consumer Behaviours

Knowing whether a visitor to a site is a "first time visitor" or "everyday browser (who never buys)" can be vital information for an online retailer. These categories help online platforms optimise their appearance – and offerings – for different people, depending upon their internet profile and browsing history. This information, and the resulting personalisation of platforms, is both useful for individuals and for retailers: it allows the platform to better meet the consumer's needs that, in turn, increases its own income.

2 http://ec.europa.eu/justice/data-protection/files/data-protection-big-data_factsheet_web_en.pdf

3 Federal Trade Commission (2014) 'Data Brokers: A Call for Transparency and Accountability.' Washington DC: Federal Trade Commission. p.iv.

NEW PRODUCT DEVELOPMENT

Training Algorithms

Algorithms using machine learning are increasingly common online and offline. Google and Uber's self-driving cars, for instance, are steered by algorithms that have been "trained" using environmental feedback. Other kinds of algorithms are often designed – and trained – using online data: for instance, ones that automatically calculate credit risk, set prices or recommend products.

These algorithms are given initial instructions, often in the form of experiments, which rely upon one set of data to complete. Based upon initial data and instructions, a machine-learning algorithm builds a model of some sort. This model is then tested using either additional data ("supervised modelling") or user feedback (usually "unsupervised modelling"). Therefore, being able to build these kinds of algorithms requires access to large volumes of data. And the larger the volumes, the more accurate the algorithm is likely to be. In a study by US credit assessor FICO, using machine learning was said to improve the accuracy of a credit assessment by 10-25 per cent, depending upon the methods used.[4] One caveat to this is that only the right kind of data can generate these results: not only are some data not inherently useful; the cost of extracting them may be more than the possible benefit they reap.

Making Processes into Products

Building a credit score today is something that is based upon transaction and financial activities, as well as service data. Individuals build up credit scores by borrowing and repaying progressively larger amounts of money: by consistently having their salaries paid into a single account, and by paying bills on time. Financial institutions can lend a consumer money at a given interest rate, based upon these and other consumer-disclosed or service data: with higher interest rates correlating to high-risk lending. However, these data points provide only the broadest frame for assessing an individual's creditworthiness.

Moreover, behavioural and incidental data can provide a clearer picture of an individual's disposition to repay a more accurate credit score. Third parties

4 http://www.fico.com/en/blogs/analytics-optimization/how-to-build-credit-risk-models-using-ai-and-machine-learning/

– including data brokers – have, therefore, turned the calculation of these scores into new products. The ability to screen potential borrowers more accurately and possibly more quickly than competitors is, indeed, a source of competitive advantage. The provision of these kinds of products can draw new potential customers into the credit ecosystem. In China, for instance, the use of digital traces has meant that people who were once ineligible began to get credit, which served to the benefit of the economy at large (Bateman 2017).

Discrimination and Profiling

While creating consumer profiles for the purposes of providing personalised services may seem sensible, these methods can sometimes be used to "profile" individuals for nefarious purposes. As a test, a research team at Stanford University recently created an algorithm that, by using public images of faces, could identify the sexual preference of the person in the image. Moreover, the algorithm was more accurate than the average human.[5] The abundance of public data has meant that, while algorithms can be created to do commercially and socially valuable things – such as track weather patterns and identify health risks–the data that are out there are use-agnostic. Therefore, it is possible for data to be used to support immoral and even dangerous developments.

An algorithm that identifies homosexual men or women is just the tip of the iceberg. Given how digital traces are increasingly used to train machine-learning algorithms, even the creators of algorithms lose control of what it is their creations do with the data – and what kind of heuristics they create. Algorithms used in hiring decisions have been observed to adopt human biases because the data upon which they rely contains these biases.[6] One price-setting algorithm has been known to use race as a proxy for academic achievement.[7]

What is more, these algorithms often self-teach ("unsupervised modelling"), making it unlikely that a human would notice and figure out how to reverse discrimination.

5 https://www.wired.com/story/ai-research-is-in-desperate-need-of-an-ethical-watchdog/

6 https://hbr.org/2016/12/hiring-algorithms-are-not-neutral

7 https://www.propublica.org/article/asians-nearly-twice-as-likely-to-get-higher-price-from-princeton-review

Implications for Businesses

Most businesses today have a digital presence of some sort – whether through their website, digital advertising, or online customer service (often all of the above). This means that most businesses have the potential to benefit from the data that is being generated, which is close to their brands, products, and services. A few things to think about include the following:

OBTAINING THE DATA MAY COST MORE THAN THEIR WORTH

Data from existing products and services can be hard to access, largely because online services built in the past did not prioritise data in the same way. Thus, data are often not collected; they may be siloed or only a very limited dataset collected. Business owners may be misled into thinking that all data are gold; however, this is not true. Only data that are accessible, and relevant to a given question, can improve business outcomes.

BUILD A NEW SERVICE OR PRODUCT WITH DATA IN MIND

Although there are vast troves of data out there, accessing them can be messy and expensive. For this reason, businesses building new digital services are advised to construct them a little more slowly, and think about the kind of data that might be collected – and the way in which they might be used as part of the service or product innovation process. Collecting and structuring the data in a useful way right from the beginning makes it easier to work with later; this maximises its potential.

INFORM YOUR CUSTOMERS

Not only does informing your customers that you are collecting their data build trust, it is currently required by a myriad of laws. However, telling them what you are using it for is not yet required. This will shortly become mandatory as a result of the European General Data Protection Regulation (GDPR), which comes into force in Sweden in 2018. However, even if it were not required, it makes business sense to be transparent about the way in which you use your customers' data: in order to avoid a backlash.

DATA PROTECTION BY DESIGN

The GDPR also encourages what consumers are increasingly demanding anyway: what is known as "data protection by design". This principle encourages

architects of data services to use techniques such as anonymisation, pseudonymisation, encryption, and other protocols for anonymous communications. The European Commission encourages the use of these techniques as *ex ante* protection from data violations, and has offered to support member states in the technical implementation of such measures.

Moreover, these laws have also tried to avoid lax data security by making more severe penalties for data breaches; the GDPR prescribes a fine of up to 20 million EUR or 4 percent of a firm's global turnover (whichever is higher) for companies who misuse personal data or fail to take proportionate steps to prevent data breaches. This protection also helps to deal with some of the problems previously identified around metadata.

Policy Considerations

Although the abundance of digital trace data allows for the creation and optimisation of large numbers of new services, using these data runs the risk of infringing on individual integrity. In examining digital trace data and legislating around its collection, storage, and use, regulators must find a balance between the commercial imperative to support new business creation and the social necessity to support individuals' data integrity. This section is devoted to some of the important elements that data legislation should – and increasingly does – include for the purposes of individuals' protection.

INFORMED CONSENT

While consumers are often told that their data are being collected, it is not always clear for what purpose – or exactly for which data – they are giving their consent. In fact, the use of machine learning may even mean that corporate data scientists are not always sure themselves what it is that their algorithms are prioritising.

In 2008, researchers at Stanford University estimated that it would take 7.6 days per year for the average person to fully read all the privacy statements they encountered in their lives (Symons & Bass, 2017). In practice, the "take it or leave it" of most online service terms and conditions means that people have no choice but to grant access to their data to a large number of compa-

nies. That is to say, there is no option to make use of, for instance, Google's services without permitting them to analyse and sell the data they collect.[8]

Moreover, most of us barely acknowledge (and seldom read) notices around how our data are collected online. In fact, the norm when using a website is often just to "accept" the terms and conditions of its use, without reading what they entail. This means that users often do not know that their digital traces are being collected, and do not know what are the ways in which the data are being used nor to whom they might be sold.

Users typically make use of services without being able to limit the extent to which data are collected and used, even if they were aware of it, which many are not. Moreover, even if individuals were aware that their data was being used, they would be hard-pressed to understand how its use would affect the financial (and other) services they receive.

The GDPR requires that individuals give specific and informed consent to how their data are used and collected. While this is a move in the right direction, the complexities of algorithms and the fact that individuals seldom read online terms of service means there is still more to be done.

While it is hard to legislate or avoid over-use of user data when consent is given, GDPR has also promoted better safety measures to prevent the theft of data, and the non-consensual identification of individuals.

CREATION OF "DIGITAL COMMONS"

While the GDPR goes a long way toward protecting individual data, it has been suggested that individuals should have control over digital traces about themselves online: for instance, in the European Court of Justice's 2014 ruling on the "Right to be Forgotten".[9] In the UK, one proposal has been to create a registry of data used by firms (Downey, 2016). In Australia, draft legislation has proposed a National Data Custodian body to allow individuals to have greater control over the data collected about them by both public and private sector actors (Bindi 2016). Germany, known for the importance it places on privacy, treats data protection as a consumer protection issue, with breach offenses under the law.

8 Some uses of the data can be limited, but users seldom know that these limitations exist—or how to make use of them

9 ECLI:EU:C:2014:317

Pentland (2013) suggests that our digital trace data should be managed by data controllers in a way akin to how our banks manage our money. He highlights the tenets of possession, use and disposal, arguing that these are the three areas of digital trace data leverage that should be regulated and overseen. He describes these tenets as follows:

> *You have the right to possess data about you. Regardless of what entity collects the data, the data belong to you, and you can access the data at any time. Data collectors, thus, play a role akin to a bank, managing the data on behalf of their "customers.*
>
> *You have the right to full control over the use of your data. The terms of use must be opt-in and clearly explained in plain language. If you are not happy with the way a company uses your data, you can remove the data–just as you would close your account with a bank that is not providing satisfactory service.*
>
> *You have the right to dispose of or distribute your data. You have the option to have data about you destroyed or redeployed elsewhere. (2013:37)*

An experimental project called DECODE (DEcentralised Citizen-owned Data Ecosystems) is currently underway with partners in Spain and the Netherlands; it aims to develop technology to facilitate this "data commons". The intention is to put people in control of their personal data, and give them the ability to decide how it is shared. The technology will include an architecture for controlled and, if desired, anonymised data sharing. Crucially, this project also explores whether there are viable alternative revenue generation models in an internet economy, which finances itself predominantly through monetising personal data

Conclusion

As more economic activity has moved online, records of our activities have improved and are routinely collected: both with and without our consent. Much of the activity that precedes an economic transaction is also recorded: individuals' attitudes to brands, online habits, and even decision-making processes can be captured through the things they say and do online. This personalisation of online experiences extends beyond just how and what we see online, to what we are offered, by whom, and under which terms.

This chapter has explored the kinds of data that have been made available as a result of improved – and more determined – data collection by internet giants and data brokers. However, while this abundance of data has made

way for new products, services and analytics, it raises concern around individual integrity. While the EU's GDPR goes a long way toward easing these concerns, a push in the direction of a "data commons" would give consumers more control over their data. This is important and, thus, should be discussed in the long term.

References

Brandom, R. (2016, May 5). Lawsuit challenging Facebook's facial recognition system moves forward. *The Verge*. Retrieved from https://www.theverge.com/2016/5/5/11605068/facebook-photo-tagging-lawsuit-biometric-privacy

Constine, J. (2017, February 1). Facebook beats in Q4 with $8.81B revenue, slower growth to 1.86B users. *Techcrunch*. Available online at https://techcrunch.com/2017/02/01/facebook-q4-2016-earnings/

Deville, J. (2012). Regenerating Market Attachments. *Journal of Cultural Economy, 5*(4), 423–439.

Downey, P. (2016). Registers in a digital ecosystem. Available online at https://data.blog.gov.uk/2016/09/12/registers-in-a-digital-ecosystem/

Ingram Bogusz, C. (2018). Digital Traces, Ethics and Insight: Data-Driven Services in Fintech in Teigland,R; Siri, S; Larsson, A; Moreno Puertas, A; and Claire Ingram Bogusz (Eds), *The Rise and Development of Fintech: Accounts of Disruption from Sweden and Beyond* (forthcoming). London: Routledge.

Johnson, L. (2016, July 22). Google's Ad Revenue Hits $19 Billion, Even as Mobile Continues to Pose Challenges. *Adweek*. Available online at: http://www.adweek.com/digital/googles-ad-revenue-hits-19-billion-even-mobile-continues-pose-challenges-172722/

Lorenzetti, L. (2016, February 24). Lenders Are Dropping Plans to Judge You by Your Facebook Friends. *Fortune*. Available online at http://fortune.com/2016/02/24/facebook-credit-score/

McAfee, A., Brynjolfsson, E., Davenport, T.H., Patil, D.J. and Barton, D. (2012). Big data: The management revolution. *Harvard Business Review, 90*(10): 61–67.

Oreskovic, A. (2017, February 20). Facebook generated almost $20 from each of its US and Canadian users last quarter. *Business Insider*. Retrieved from http://nordic.businessinsider.com/facebook-almost-20-per-user-us-and-canada-q4-2017-2?r=US&IR=T

Pentland, A. (2013, October). Data-driven society. *Scientific American*.

Schneier, B. (2015). *Data and Goliath: The hidden battles to collect your data and control your world*. New York: WW Norton & Company.

Symons, T., & Bass, T. (2017). *Me, my data and I : The future of the personal data economy*. Retrieved from https://decodeproject.eu/file/158/download

Case C-131/12, Google Spain SL, Google Inc. v. Agencia Española de Protección de Datos (AEDP), Mario Costeja González, 2014 ECLI:EU:C:2014:317, 100(3) (May 13, 2014).

Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector. *Official Journal L 201, 31/07/2002 P. 37 – 0047*.

Managing Digital Media Investments

ERIK MODIG AND MARTIN SÖNDERGAARD

In this chapter, we discuss the possibilities and the challenges that come with moving from traditional to digital media investments. In line with popular opinion, we discuss whether digital media offers opportunities that are not available in the more traditional stream. Or whether digital media investments simply seem more attractive due to people's mentality that the "grass is always greener on the other side." The way in which companies adapt to digital media is likely to impact company success, it is crucial to understand the rules for these media investments, especially as these investments continue to increase. We begin this chapter by highlighting how digitalization has led to new principles for planning, designing, and evaluating media investments, and how companies must work in new ways to handle this change. We then discuss each area of research and summarise the valuable implications.

NEW MEDIA PRINCIPLES

There has been a dramatic increase in the total spending on digital media in Sweden since 2010, with the numbers more than doubling in the last six years. This is in line with international trends. Digital media investment is undeniably increasing, and starting to become a norm in which to invest. One of the largest changes due to this media digitalization is that it is now possible to target advertisements down to the single customer. We can customise ads and let algorithms determine the best way to distribute them to audiences. This potentially increases marketing effectiveness, as every company can become more relevant for each customer. This is nothing new: the segmentation and targeting of different media audiences is one of the cornerstones of media planning. However, the usefulness of doing this has increased significantly due to digitalization, which has led media planners to rethink how to work with reach and frequency: the two traditional parameters of media effect.

There are potential winnings in a new way of optimising; however, findings also suggest that it might be harmful for companies to rely too heavily upon the power of targeting and small target audiences.

NEW TYPES OF EXPOSURE

Besides new ways of evaluating and thinking about media planning, digitalization has also led to several changes in the kind of media exposure that companies can buy for their advertisements: from traditional TV and print to a plethora of different digital formats. This offers many new possibilities; however, advertisers really need to be aware that digital media exposure is usually smaller and shorter, and users tend to process it with lower motivation. We see a shift from desktop to mobile within the digital channels, and this increase in mobile spending is mostly what has led to increases in digital marketing. Banner advertising is disproportionately more prevalent in the mobile format than on desktops. This means there will be even more of an increase in smaller ads with shorter exposure time in the future. Advertisers need to understand and optimise their advertisements based upon these insights into a different kind of exposure.

NEW METRICS

The transformation into digital media has created the possibility of measuring behaviour in the form of a click rather than through changes in thoughts or emotions. The click-through rate (CTR) is the standard measure used to determine whether a potential customer has clicked on any digital marketing element: such as a link, advertisement, social media post, and so on. This has led to the possibility of connecting certain marketing activities with company performance, as clicks can lead to specific transactions that marketers can trace to specific investments. In this way, marketers can evaluate certain investments based upon their performance. In digital media channels, 64% of the budget is spent using a revenue model basing the cost upon the performance of the ad, thus, focusing upon the exposure of the ad (measures per impressions or views) and the number of clicks (Silverman, 2017). As aforementioned, large digital players emphasise the importance of so-called click-attribution. This, of course, is natural since these players sell clicks. Advertisers must be aware that, although evaluating a media investment

based upon clicks may seem the perfect way to account for its effects, several findings suggest this is not a good strategy for all media investments.

NEW WAYS OF WORKING

The change in the digital media landscape also has implications for the structure of the marketing department. As more channels emerge, new competences become necessary; this means that companies need to both recruit new talent and educate existing employees. The digital landscape in particular has given marketing departments new opportunities to test and measure their work. This has opened a more agile way of working, and companies that can utilise these new opportunities and combine them with older approaches that still work will increase their chances of winning.

We will now discuss how companies should think regarding reach and frequency. Firstly, we examine the new kind of media exposure the digital environment offers and the implications for the kinds of ads that companies can use. Secondly, we look at how companies should best evaluate initiatives in this new environment. We will end by going through the implications this has for the approaches of marketing departments. We would like to emphasise the importance of these issues for people other than the CMO. Since it is absolutely necessary for the marketing department to stay relevant and competitive, the CEO and top management should also know about these changes in order to better understand the transformation and have the capability to manage it.

Media Planning: Questioning Reach and Frequency

The general opinion among marketers is that new digital possibilities allows for the smartest to win rather than the one with the largest media budget. Although a larger media budget will of course still allow for reach and frequency, smart decisions in media planning can offset this to a certain extent, by asking the right questions when buying access to target groups from publishers and communicating strategically with the right consumer at the right time with the right frequency.

SEPARATING REACH AND FREQUENCY

The media industry has previously discussed impressions, in terms of gross rating points (GRP) and target rating points (TRP), which generally stands for audience reach multiplied by the frequency of the advertisement. With the

advent of digital media, we can break up reach and frequency into two independent metrics instead. Depending upon the strategic objectives for a specific campaign, the point where the marginal returns diminish will differ, thus, leading to different optimal frequencies. Obtaining a higher frequency on digital media might even cancel the possible benefits of previous exposures if the consumer becomes irritated or gets tired of seeing the same ad. Thus, getting the right exposure frequency and interval of sending a certain ad to an individual can have a great impact upon marketing metrics. If a low frequency is the aim for a given strategic objective, then it is better to spend the money on reach. This leads to two types of strategies when media planning: either goes for wide reach/low frequency or narrow reach/high frequency. Low frequency might be the way to go if one is trying to increase brand metrics; if one is trying to generate sales or communicate a new message, higher frequencies might be necessary.

Table 6.1.

	Wide Reach	**Narrow Reach**
High Frequency	Strong media impact: High investment with a risk of over-investing.	Targeted sales focus: The key challenge is to find the right target audience.
Low Frequency	Non-targeted brand building: The key challenge is to have relevant and good advertisements that can attract a wide audience.	Weak media impact: Low investment, with the risk that the low impact has little or no effect.

Since no impressions are expended to increase the frequency for a few people, using digital platforms to obtain greater reach can be cheaper than using traditional media. Nielsen (2016) found that, when buying TRP, increased spending was no guarantee of reaching more people. Instead, it often reached the same people: just with a higher frequency. The bigger the campaign gets, the harder it becomes to reach new people; however, actually communicating with these people who are difficult to reach can prove very valuable. This is because those in the target group who are generally not accessible through traditional media do not receive communications from competitors to the same extent, meaning that your message does not have to compete in the same way.

The ability to separate reach and frequency provides CMOs with another lever to optimise the marketing campaign, thus, creating an even bigger difference between unskilled and skilled marketers in the results they achieve. Since no unnecessary spending on the other variable is necessary, campaigns can also achieve higher reach or frequency with the same budget as before.

Unfortunately, marketers cannot take at face value the numbers publishers quote regarding target audiences and reach, since many use dubious methods to obtain these conclusions.

QUESTIONING REACH

Different actors within the digital media industry have claimed a greater reach than is possible: for example, saying they reach more people within a certain demographic than actually exist. Therefore, with regard to reach, it is important not to take at face value the numbers publishers provide since they can be fraudulent. Not only have they overstated reach; they have also claimed to hit certain target groups that they, themselves, have compiled using questionable methods. The same is true for traditional media; however, due to the possibility of tracking everything on digital platforms, many target groups that publishers compile seem to obtain greater credibility from advertisers.

There are great differences in the target groups available for purchase, depending upon which data and assumptions publishers have used to compile the specific groups. The main differences fall into two categories: how the publisher identifies and tracks the user through a cookie or by being logged in, and how the publisher segments the audience, based upon audience, context or behaviour. We begin by discussing how to identify the user, and then we will dive into how to segment the audience.

The advent of the cookie, which can track what a user has been doing, raised certain possibilities; its promises, however, go beyond what it can actually deliver. Many users today have several devices, meaning that it is not possible to reach those people who have allowed us to gather information on a single unit or to use the data on their other units to target information to them using cookies alone. Also, many different people may use the same computer, meaning consumers may see advertisements that marketers did, indeed, intend for someone else as they are targeted using cookies. In addition, many cookies disappear over time; the advertiser will only be able to reach the consumer for a certain period of time after the consumer engages in

behaviour that is relevant to that specific advertiser. Services that let the user log in instead or use their specific app instead of a website can track users over many devices, as well as store information for a long period of time. This can also give marketers better control over ad frequency, as one person will not be counted as two different people and, thus, will not receive the ad twice as often as intended.

There are three different types of target group segmentation: audience, contextual, and behavioural. These follow in the order of least to the closest to a specific purchase.

The basis of audience segmentation lies in knowing which people are using publishers' services; thus, demographic variables are very informative. These types of segmentation are usually possible when users log in and give marketers information about themselves. This is obviously more accurate than, for example, using the traditional way of first doing a study of who reads a certain newspaper and then assuming everyone that reads said paper is a member of this demographic group. Most readers or viewers of a specific media outlet are not that homogenous; therefore, we also pay for impressions of people outside our intended group and cannot target certain individuals of the reader base; rather, we reach everyone that uses that media. Audience segmentation in the digital era can be much more specific than traditional media regarding whom it targets: instead of having a goal of reaching 24–39 year-olds, we can focus instead on 26–29 year-old men who also have certain kind of education, for example. Using geo-targeting, we can also target people who are in a certain area with a specific message. This can be very useful when we are trying to push for a sale.

The basis of contextual segmentation is the fact that the information the publisher is providing to the visitor has to do with a certain topic. This type of segmentation is very similar to what we have long since been doing in traditional media: for example, posting ads about a new car in a car magazine. The difference here, however, is that we can use information in digital media that we have gathered later. For example, if a visitor reads an article about cars, we may conclude the reader is interested in cars. Therefore, we might later send the visitor an ad for a car. Thus, it is important to keep in mind here that, although the consumer might be interested in cars, it does not necessarily mean the consumer is interested at that specific time. An ad for a car at that time might not be as relevant as when it appears together with an article

about cars. On the other hand, we get the benefit here that we can re-target the same person multiple times, which is not possible to the same extent when the ad has a unique connection to the specific article.

One thing to keep in mind here is that some systems that sell ads online automatically classify what type of topic the specific site discusses, as marketers can post ads on separate forum threads. Since no human is necessarily involved, it means this classification can sometimes be incorrect. Another thing to keep in mind is that customers can look for information about a certain topic; however, that does not necessarily mean they are ready to buy. They may just find it emotionally rewarding to read about the topic. This issue is of course relevant in traditional media as well: just not to the same extent as it is online, as it is much easier to do, and consumers incur no extra cost by visiting an automotive site compared to buying a car magazine.

The basis of behavioural segmentation is the user behaviour the publisher has observed; it is often not as accurate as many advertisers believe it to be. The type of behaviour can vary in relevance to an advertiser; it of course can be of especially high interest if the search was very specific. Before purchasing or using any kind of consumer data, one should ask oneself from where does this data come and what are the underlying assumptions. For example, how many times must a consumer engage in a certain kind of behaviour in order to fit into a given segment? Perhaps one kind of behaviour is more telling than another, meaning that it is worth more to you as the advertiser. Before using any data, it is important to take into consideration its source, how old it is, and how often it is updated.

Some publishers are trying to offer specific audience segmentations by learning how a certain demographic behaves, thus, inferring that anyone who acts in the same way must also be a member of this group. Depending upon the degree of behavioural overlap, the quality of this segmentation differs; however, it is of course not on par with logged-in users' information. The logic might be as follows: We have observed that many executives are interested in soccer; therefore, anyone who shows an interest in soccer is probably an executive; therefore, we should advertise to him or her services for companies that would appeal to executives. That is to say, the behavioural overlap is not related to the specific advertised product; it is a source of demographic information instead and a way of deciding what kind of a person he or she is.

Advertisers need to question both size and nature of the target audience, which different media houses say they can provide. In several cases, they are overpromising when it comes to the number of real people they can reach as well as the potential increase in relevance based upon their segmentation method. Huge benefits are possible if one can find the right audience; however, it is up to the advertiser to find the right match among the large range of solutions that are available in the digital landscape.

Industry actors have used questionable methods for achieving reach and communicating with certain target groups, which is why it is important to ask the right questions. Has the publisher done the identification and tracking using cookies or logged-in users? What kind of segmentation has the publisher done and what assumptions does it underlie? Is it based upon audience, context or behaviour? Not only have critics raised questions regarding whom the advertisement reaches; they also wonder what should count as an exposure and how we can guarantee the ad was shown the number of times that it should have been.

QUESTIONING FREQUENCY

Reach is not only the victim of too ambitious promises of delivery; it is also of frequency, since it can be hard to know how many times and to whom a certain ad has been shown. To combat this, different technologies have emerged to detect possible ad fraud regarding frequency to ensure that real people – and not bots – are the actual viewers of the ads. This technology is constantly evolving on both sides: as we get better at detecting fraud, they become better at faking views.

To better understand what type of ad exposure we are purchasing, it is important to understand the numbers and reports that publishers return to us: something that can be rather confusing, since the terms and definitions they use can differ. Has the ad only been loaded, yet never in-screen; has it been in-screen, yet only very briefly or has it been in-screen for a longer period of time? There is still discussion about how long an ad should be in-screen for it to have the desired effect on the consumer. The time will most likely differ depending upon the objective of the specific ad. If it is only to increase familiarity, it will need less time than if the objective is to inform consumers about a new product. The important thing here is that it is not fair to say one impression equals another. For example, this is true for viewing

time; an ad that has been in view for one second on a desktop is most likely not as valuable as an ad that has been in view for one second on a mobile, which has to do with the degree of attention the consumer gives to the ad. As an impression on one platform might not have the same effect as an impression on another; it is important to go back to the original goals in the form of metrics in order to understand their different relative values: for example, by offering a survey of how the ad has affected the attitude toward the brand.

With the advent of digital media, how we think of reach and frequency has fundamentally changed. We can now focus upon either reach or frequency: the implication is good choices can lead to an actor with a smaller budget but better choices, thus, outperforming one with a larger budget who has not thought through the way he or she is using the ad. Not only must the CMO understand which variables to focus upon; the CMO must also ascertain the actual reach and frequency that he or she has purchased, rather than what seems at face value to be the case. To conclude, digital media investments offer new possibilities to optimise reach and frequency. However, marketers need to stay alert and aware to avoid being fooled when media companies publish both their own measures and targeting tools.

Media Design: Rethinking Media Exposure

The digital transformation not only has implications for how the public sees advertisements; it is also true for how marketers design advertisements. The rules for what makes a good advertisement in the digital media are different from those of traditional linear television or print. This area is still under development; some guidelines have already emerged that can help with creative production. Following these insights will give marketers a better understanding of the fundamental principles of digital advertising.

SHORTER EXPOSURE TIME

The change in what works in digital media may come from differences in attitudes across generations, as well as the context and how the content is delivered. Since the viewer often has the option of skipping the ad after a certain number of seconds or scrolling past it whenever he or she wants, it is important for the commercial to hook the viewer instantly. The user spends approximately 1.7 seconds for any type of content on a mobile, which gives us an idea of the timeframe that we are talking about; often decisions on what

content with which to engage takes even shorter times than that (*Capturing Attention in Feed*, 2017). This decrease in time spent on ads does not necessarily mean that the effect of the advertising decreases as well. Ads can generate recall even with very short exposures. We should be able to transmit the viewer a message or a feeling in a short timeframe, within which, we must hook viewers to ensure they want to continue watching. This is a paradigm shift from the way TV commercials generally work: by building up a linear story, and revealing the brand in the end. Since consumers can click away from the ad, we must hook them so that they want to see more. We must reverse the general structure of TV commercials, starting with the most intensive and attention-grabbing visuals at the beginning, and then building a context around it. The aspect ratio should differ from that on TV to increase the likelihood of the ad getting attention when presented in a feed, such as Facebook's newsfeed, since we want it to cover as large an area as possible in order to make it as hard as possible to ignore (*Tips for Your Facebook Video Ads,* n.d.). Even when we have caught the viewers' attention, we should not have ads that are any longer than absolutely necessary; consumers are much more likely to watch an entire ad if it is 15 seconds or less.

There is currently a discussion in the media about whether or not it is possible to get 30 seconds' of exposure that users cannot skip, as was and is the case with television. This is a big problem, since many no longer know where to put the main messages of their campaigns. Perhaps they should rethink instead the underlying assumption that they actually need this type of exposure: it is quite possible to do the same job with a five-second video ad if they rethink the general structure of the video ad according to the viewpoints presented herein.

Advertising presented online needs a different design to what works in traditional media. Since the attention span is much shorter here, it must offer the right feeling, thought, association, and so on much quicker than ads on linear television. This does not necessarily mean the advertising is less effective because consumers spend less time on it; it just means that a different design is necessary to influence the consumer. For example, marketers must invert the logic they use for constructing commercials for television: saving the best for last. Since consumers can now skip ads or just open another tab and wait for the ad to end, we must immediately pique their interest. As we will see in the next section, ads not only need to be shorter; they must also be

easier to understand, as ads that consumers see many times are shown in a context, where consumers take in many other impressions at the same time.

NO SOUND

Even though digital offers possibilities to communicate with sound, only a limited portion of the audience consumes digital media with sound: such as news or social feeds. We cannot assume that all viewers have their audio turned on, and they may be in a loud environment; therefore, video ads cannot rely upon audio to make sense: they should still have an impact even without sound; the audio should only be an extra possibility to spice up the ad even more. One way of doing this is to utilise captions or subtitles, or to make sure the visual cues the ad uses are easy to interpret.

COGNITIVE LIMITATION

An ad is presented many times in a context where consumers are not prepared for a new message, meaning that it can take the viewer some time to understand what is going on in the ad. In one way, this is different from the way television presents commercials: where many are clustered together, so the viewer is somewhat prepared for the presentation of an entirely different concept. This means that it is essential for the ad to be easy to understand, not only since viewers' attention is limited; it is also because viewers are generally not very motivated to understand. Since the viewer is often unengaged in the ad itself and not paying much attention, it is also more effective if the product is present in at least half of the ad. Ads with lower cognitive loading have a more positive effect on ad recall (*Closing the Creative Loop,* 2016), as well as other traditional marketing metrics. To keep the cognitive loading low, we cannot work on all the important variables in the same ad, as this will lead to cognitive overload and, thus, no improvement upon any of the variables. We should instead use one ad specifically to increase its appeal and another one to inform about a new aspect of our products.

To a certain extent, these guidelines go against what many creators strive for in their ads: namely an awareness that requires thought to understand, and once the viewer grasps the point, the concept makes sense. Instead, a good ad should be short, attention grabbing, and as easy to understand as possible.

Ads in the digital age need to be easy to comprehend due to decreased motivation and attention, so we need to simplify the ads and focus upon specific

variables. In turn, this requires a re-definition of a good marketer. This is not about making the cleverest ads; it about understanding how to make them short, attention grabbing, and easy to understand. One way to increase the motivation for viewers to process an ad is to increase its relevance, which is where digital media offers new possibilities as well as pitfalls.

RELEVANCE

Relevance can be discussed in relation to the media platform as well as to the individual. Realising that different platforms satisfy different needs within the viewer is important to consider, meaning that what is relevant and valuable in one context might not be so in another one (*Why Creativity Matters in the Age of Mobile,* 2017). Different platforms offer value to the consumer in a variety of ways. For example, many use Facebook to feel a sense of belonging and to show others who they are, whereas Instagram is more a source of inspiration. The same difference occurs in the traditional media, such as print: for example, the difference between lifestyle magazines and newspapers. Not only are consumers looking for different things in different channels; they might also perceive an ad differently depending upon the context in which they see it. For example, an ad on Instagram might seem to have a higher aesthetic value (*Why Creativity Matters in the Age of Mobile,* 2017). Not only should brands adapt their ads depending upon the exact channels in which they are presented; they could also utilise the possibility within digital media to offer different ads depending upon the segment to which they believe the consumer belongs; in doing so, they can increase the perceived relevance for the individual further. Large differences are not required: for example, it can be a good idea to show products that are actually relevant to the viewers when advertising a second-hand portal on which people can sell and buy whatever they want, in order to ensure they make the connection that they can buy and sell what interests them. This is of course obvious once they think about it; however, we must make this job as easy as possible for them since we cannot expect great viewer engagement.

As advertisers, we need to think about digital not as one unified channel, but rather as many different platforms that satisfy many different needs. To be relevant in relation to the customer, we must consider what benefits customers seek in different outlets as well as try to personalise the ad using the available data.

Due this new form of advertising, ads must communicate their messages more quickly than traditional media. When done well, this does not mean that the shortened exposure reduces the effectiveness of ads. Not only does the viewer process the ads more rapidly; they also use less attention and require fewer cognitive resources. The bottom line is that ads must be easy to understand. One way to increase the cognitive resources and the time consumers spend processing the ad is to make it more relevant, which involves understanding why the consumer visits a certain media outlet, as well as utilising the methods previously described to target certain variants of the ad to specific customers. Even though much remains to be explored within digital marketing, these are some established ways of thinking about ads in this new context, which can lead to more effective advertising. Overall, marketers need to pay more attention to the specific design requirements for digital exposure. Today, several marketers spend money on ads that perform much worse than they would if only marketers prepared them properly for the digital landscape.

Media Evaluation: Questioning Click Metrics

When the internet was a new phenomenon, consumers had a completely different attitude to digital ads, and they clicked on ads to a much greater extent than they do now. Many digital companies, such as Google, were driving forces behind this logic, as they themselves profited from the focus on CTR. This new currency was easy for other actors within the industry to adopt, since it is easy to understand intuitively and to measure. These factors together explain why the issue is in focus today.

Over time, however, the general CTR dropped due to changed attitudes and increased ad density. This did not mean that the effectiveness of banner advertising dropped; just that instead of driving a direct behaviour such as a click, it led to more traditional effects, such as changed attitudes toward the brand or increased purchase intention. Despite this, many are still evaluating ads in the digital media on how many clicks they receive. Most people understand the problem of solely focusing on clicks, but they still choose to continue. What are the underlying reasons for this, and how can they be changed?

TOO EASY TO MEASURE AND UNDERSTAND

The explanation you usually get when asking why marketers evaluate a campaign by clicks is usually one of the following: It is a universal measure with a

clear standard. It does not require additional bets on panels or surveys to get an answer. It is easy to communicate upwards, as it is a clear behaviour that everyone can understand. It often happens close to a purchase. With all these arguments available, one can still understand why the measure is tenacious, since all these arguments describe valuable things. The problem lies in the fact that if the metric does not tell us anything of value, all the above-mentioned arguments become irrelevant.

THE CLICK'S SIGNIFICANCE IS OVERRATED

It is partly the nature of the metric that makes CTR problematic. Instead of measuring how the average has changed, through a survey for example, you measure those who have been influenced so much that they are very interested right now in buying or knowing more about the product, which is a very small percentage. Not only is it problematic just to measure those who actually engage in behaviour at the moment of exposure, but it is also the case that many of these clicks are mistakes. If we look at the difference between measures of a good and a bad campaign, 0.15% and 0.05%, we see that they differ by 100 clicks per 100,000 impressions. In addition, many clicks on the phone are mistakes. The intentional clicks are not even an even a proportionate sample of the people marketers target. Many times, a small percentage of all visitors make the majority of the clicks, and these visitors tend to be younger and have lower incomes than average. With this in mind, one can really question how valuable a click is to the brand.

OTHER BEHAVIOUR VARIABLES ARE MORE IMPORTANT THAN CLICKS

Already in 2003, research showed that the number of clicks was a bad measure of the effectiveness of a banner (Drèze & Hussherr, 2003). What instead should be used is the classic brand-equity metrics that have been in use for a long time in many other media outlets. Even before choosing the channel and designing the ad, one should decide on the exact goals of the campaign and how to evaluate the results. If the goal is to increase the brand awareness, it is important to keep in mind the negative relationship between classic brand equity measurements and CTR shown in Schibsted's study of mobiles in collaboration with Lund University (Olivensjö & Sundberg, 2015), showing that clicking on the ad led to a worse view of the brand.

There is evidence that classic brand-equity metrics have a greater correlation with actual conversion than CTR has. For example, one study has shown (Pretarget & ComScore, 2012) that the correlation between having the mouse over the ad and actual conversion was 0.49, whereas the same correlation for CTR was 0.01. Not even in the cases where we want the consumer to carry out an action directly on the mobile phone is CTR the preferred option, as we would rather look at how many have performed the action and then use cost per action.

If we want to make a fair measurement and evaluation of the investment, there is unfortunately no single measure that can capture all possible dimensions that are relevant to our brand. Instead, it is necessary to reflect on and understanding what different metrics in marketing measure.

Consumers' attitudes toward ads on the internet have changed significantly since ads began; yet the ways many brands evaluate their media investments online have not. Using CTR became the standard for evaluating digital ads, as some actors within the industry profited from its focus and because of the ease of measuring and understanding it. The importance of CTR is overrated, as it only measures the small number of people who actually engage directly in behaviour, and neglects the fact that many of these clicks are mistakes. Those who click with intent are not a representative sample of the visitors to the site; instead, many who do are younger people with below average incomes. To better measure the effectiveness of online ads, marketers should use traditional brand-equity metrics and, when they are not available, other measurements that can be collected automatically can prove better: such as clicking a mouse over ad or an action that has been taken.

The New Marketing Department

A new way of organising the marketing department is required in order to capture all these new possibilities and to cut costs using the new technology. These new ways of marketing require new processes and the modification of old ones. For these processes to run smoothly and to generate the maximum value, employees need new competencies and skills. Since we are still in the early stages of this development, it is not yet clear which systems are the best; with no established standards, it is hard for the CMO to know in which new initiatives to invest. Many CMOs feel they face never-ending possibilities; they are fearful of the possibility that their competitors might be making better use of them than they are. When there are no established solutions, big

media spending is no longer the concern; instead, it is hiring the best talent to capitalise on these new opportunities. Having the right employees will become even more important to identify the processes companies that can standardise and upon which they should prioritise and focus, as staff understands and learns the appropriate skills.

RE-EVALUATION OF MARKETING PROCESSES

Some processes require an entirely new division, such as search engine optimisation; creating ads for digital platforms require modification of existing processes. Some jobs or processes require entirely different kinds of people, whereas others require re-educating existing employees. The number of different processes, however, will increase; therefore, it is crucial for the marketing department to handle a larger number of different procedures. Some methods should become more automated than many believe is possible. In many cases, this does not require new technology; rather, it is the standardisation of some processes is vital for companies, so they do not repeat them unnecessarily. Marketing departments need to sort out which processes they can standardise, and focus upon those that require the greatest effort. In doing so, they can experiment more in the more relevant areas, thus, finding the recipe for success that will allow employees to be even more creative at work, and experiment with new concepts.

SET UP EXPERIMENTS FOR CONTINUOUS LEARNING

With the possibilities that the new digital environment offers, it will be possible for companies to try things out to a larger extent without incurring much extra cost. They might run some ads simply to see if a certain hypothesis is correct regarding what drives growth, and later use that information to improve other campaigns. The emerging technology of machine learning can automatically test different layouts and combinations of elements in digital channels and find the combination that works best. The principle of continuous learning through experimentation and incremental improvements year after year will become even more relevant as the professionalisation of the marketing trade continues. The starting point should be that a large majority of the marketing budget and campaign will stay the same, spending most of the budget upon what already works quite well, while using a smaller portion to try out new ideas. By instilling a culture of slow but steady improvement using feedback, the marketing

efforts will improve over time. Reacting more quickly to the things that matter when most of the processes are stable will also become easier to do.

MOVING FAST

Information moves more quickly in the new marketing environment; therefore, it is even more important to be fast in order to capitalise upon opportunities and to negotiate threats. Information is also more spread out and more democratised than it was in the past. A portion of the marketing department for many companies should focus upon interactions with customers in real time: skills that are similar to what customer relationship management divisions have been doing for a long time. The possibility for people to interact with each other in real time is something in which companies should partake as well. This means another type of marketing material is necessary. In these contexts, it is no longer about a small amount of content of high production quality, but rather a lot of continuous content at a lower production quality. The content can be more personal, and it does not require the same professional feeling, as the goal here is to build a more intimate relationship with the customer. This requires not only a new type of marketing department; different structures in other parts of the organisation are also necessary, as is a quick clearance to respond to events in real time. A media budget specifically for capitalising upon current trends might be necessary to create awareness, which is a great way to obtain more attention for your brand, as it increases the perceived relevancy: very useful when consumers receive floods of new messages. A risk voiced by CMOs about restructuring their marketing departments in accordance with these suggestions is that they will have difficulty communicating one uniform message. This will not necessarily have as much of a negative impact as they believe. Being in tune with campaigns that run in the traditional media is, therefore, not as important for new departments or those that have recently increased in size.

DO NOT DROWN IN THE WRONG NUMBERS

Decisions in marketing departments are increasingly being made using the new possibilities of measuring marketing impact. However, just because we can measure something does not mean that it is a relevant number that can tell us something useful. A structured approach based upon consumer psychology and research methodology is necessary in order to discern the relevant measurements and the type of decision for which they are required. A quantitative

rapport is not worth much if the underlying assumptions and data upon which it builds is not of high quality. When we need to measure the initiatives in different media outlets against each other, we must look at what they have in common: the person who is actually receiving and responding to the communication. An understanding of consumer psychology is necessary to grasp what types of metrics are relevant to a specific brand or initiative and how they compare with each other. Having good knowledge of research methodology is necessary to measure these metrics in the fairest way. When focusing upon measurement and data, it is important to keep in mind that just because a variable is easy to measure, does not mean that it is relevant; in fact, the relationship between the two might actually be the opposite. Many of the most important variables in success are hard to quantify, yet are still very important to marketing: such as unconscious emotions toward the brand. By forgetting about these more abstract and esoteric metrics, brands can easily destroy their brand equity by only looking at the variables they can easily affect, that are easy to measure, and that lead directly to sales.

The new opportunities and threats in digital marketing require a restructuring of marketing departments to adds new processes and skills. This rapidly changing environment makes it hard for the CMO to know upon which areas to focus. Companies should standardise other processes and marketing investments to a greater extent in order to allow for the allocation of time and resources to the respective focus areas. They should reinvest the larger part of the marketing budget in what already works to allow for a smaller part of the budget for experimentation and to discover new initiatives that might work. They should reserve another part of the budget to capitalise upon emerging trends, as this will allow the marketing of the company to stay relevant. When evaluating all these new initiatives, the focus should be on the most relevant numbers rather than those that are the easiest to measure.

Surviving The Shift

Transforming to the digital media landscape will not be easy for companies. They will have to adapt. What we see now, however, is that many companies are running much faster than their marketing department can handle, and probably much faster than is necessary. This new technology offers as many opportunities as it does ways of going in the wrong direction. We have highlighted four of the concepts companies need to understand in the digital

media landscape in order to optimise their media investments: questioning reach and frequency, rethinking media exposure, the new marketing department, and questioning click metrics.

We began by showing how the separation between reach and frequency has given the CMO more levers with which to optimise the marketing campaign. When utilising this new opportunity, CMOs need to be careful since many of the actors within the industry use dubious methods to determine whether or not someone is a part of the target group. Armed with the right questions, CMOs can avoid many pitfalls. They also need to investigate frequency to ensure the ad has received as much exposure as the publisher claims it has. Before buying exposure, it is also necessary to understand which type of exposure is necessary for the ad to have the desired effect.

We then discussed how companies should design ads for digital media. They need to communicate their message much faster than in traditional media, and to use fewer of the consumer's cognitive resources. They can often construct ads more effectively, yet this sometimes requires focusing upon only one thing, rather than many different ones. Ads should be relevant for them to be effective. Marketers need to consider the platforms on which they will publish ads and the benefits of using these media outlets, as well as personalising the ads using information garnered from the user.

The standard of using CTR to measure the success of ads has arisen not because of its effectiveness in measuring ad impact; rather, it is gathered automatically, thus, it is easy to understand intuitively and the big actors within the industry have pushed it. To evaluate initiatives in digital media, the CMO cannot rely upon click metrics, traditional brand-equity metrics should be used instead.

Discussing the new opportunities and threats due to digital media for the brand, we saw that the marketing department might have to restructure to accommodate for these new needs. They must standardise some processes to a greater extent, whereas others will benefit from more experimentation. The marketing budget should match these structural changes, with the main part going to reinvesting in what works and a smaller part to experimenting and to following up on trends.

We hope this information will arm forward-looking CMOs with insights that will enable them to survive one of the largest shifts in paradigms since marketing's inception.

References

Capturing Attention in Feed: The Science Behind Effective Video Creative. (2017, April 20). Retrieved from https://www.facebook.com/iq/articles/capturing-attention-feed-video-creative

Closing the Creative Loop: Informing Art With Science. (2016, June 13). Retrieved from https://www.facebook.com/iq/articles/closing-the-creative-loop-informing-art-with-science

Drèze, X., & Hussherr, F. X. (2003). Internet advertising: Is anybody watching? *Journal of Interactive Marketing, 17*(4), 8-23.

For Display Ads, Being Seen Matters More Than Being Clicked. (2012, April 24). Retrieved from https://www.comscore.com/Insights/Press-Releases/2012/4/For-Display-Ads-Being-Seen-Matters-More-than-Being-Clicked

Nielsen. (2016, July 28). *Bigger is Not Always Better: Using Reach Efficiency to Run Smarter Digital Campaigns*. Retrieved from http://www.nielsen.com/us/en/insights/news/2016/bigger-is-not-always-better-using-reach-efficiency-to-run-smarter-digital-campaigns.html

Olivensjö, A., & Sundberg, G. (2015). *Evaluating the Effect of Mobile Display Advertising—Guidelines on How to Advertise in the Mobile Channel*. Retrieved from URL

Silverman, D. (2017). *IAB Internet Advertising Revenue Report*. Interactive Advertising Bureau. Retrieved from URL

Tips For Your Facebook Video Ads. (n.d.). Retrieved from https://www.facebook.com/business/m/facebook-video-ads

Why Creativity Matters More in the Age of Mobile. (2017, March 28). Retrieved from https://www.facebook.com/iq/articles/why-creativity-matters-more-in-the-age-of-mobile

Re-Organisation in Order to Bridge the Gap to Digital Customers

Digitalization of Professional Services: The Case of Value Creation in Virtual Law Firms

TALE SKJØLSVIK, KARL JOACHIM BREUNIG, AND FRIDA PEMER

Introduction

> *Virtual firms are already here, and are proving to be successful. These firms provide an opportunity for independent practising lawyers to act as large law firms without giving up their autonomy...* (Lawyer, Virtual Law Firm, US)

From simple information and communication technology (ICT) to advanced artificial intelligence (AI), using digital technologies is becoming an increasingly integrated part of everyday life in organisations. The use of digital technology can provide significant business opportunities, yet can also potentially undermine firms' business models and competitiveness (Christensen, Wang, & van Bever, 2013). Furthermore, digitalization could change organisations and their value creation strategies more fundamentally and faster than any other technological change we have previously witnessed (Jesuthasan, Malcolm, & Zarkadakis, 2016). So far, the use of digital technologies has largely influenced work-intensive firms in production, leading to the automation of standardised and routine tasks (Frey and Osbourne, 2013). Recently, the emergence of new digital technologies may also lead to far-reaching changes for professional service firms, which offer expertise-based and tailor-made knowledge-intensive services (Davenport & Kirby, 2015). In fact, professional services are thought to be one of the industries in which the effects of digitalization will be most prominent (Manyika, Chui, Bughin, Bisson, & Marrs, 2013). So far, however, very few empirical studies supporting this statement exist, and we do not know the way in which professional service firms

will change or what consequences digitalization will have for them. Therefore, we present findings in this chapter from an interview and a media study of the effects of digitalization on a particular type or professional service firms: virtual law firms[1]. Our aim is two-fold: First, we take a processual view and describe how virtual law firms have developed over time. Second, we discuss the consequences of digitalization for professional service firms operating within the legal sphere.

The chapter is structured as follows: After describing the characteristics of professional service firms and our methodology, we provide an overview of how virtual law firms have emerged. We then discuss consequences of digitalization, before concluding the chapter by looking ahead and outlining what the future might hold for professional service firms and their clients.

Characteristics of Professional Service Firms

Professional service firms are characterised by being highly dependent upon the professional employees they attract (Malhotra & Morris, 2009). These employees contribute with competences, experiences, relations, professional judgment, and networks to their clients (Greenwood, Li, Prakash, & Deephouse, 2005), and follow professional norms (von Nordenflycht, 2010) while considering their clients' specific needs and interests (Løwendahl, 2005). Employees in professional service firms generally prefer autonomy in their work and dislike control, standardisation, and formal organisational processes (Alvesson & Karreman, 2006). The basic deliverable in this type of organisations has been characterised thus far by offering tailor-made services, based upon a professionalised knowledge base and trustful client relations.

ICT has increasingly become an integral part of the work professional service firms perform over the past 25 years, and tasks previously performed by humans are being computerised (Chui et al., 2012; Manyika et al., 2013). As part of this development, the understanding for how technology can be integrated in knowledge-work has deepened (Christensen et al., 2013; Susskind & Susskind, 2015). Today, it is difficult to imagine a lawyer or consultant working without access to important information on the internet, or performing analyses or presentations without using computers. Documents are shared on

1 A virtual firm is an organisation that involves dispersed entities that need ICT to support joint work and communication (Hedberg, Dahlgren, & Olve, 1997).

servers and communication with colleagues and clients take place via email, Skype, and social media.

In addition to using technology as support in the daily work, digital technology can also impact how professional services earn money, organise their work, and collaborate internally and with their clients. Thus far, the technological development has revolutionised how individuals communicate and share knowledge across national and organisational borders (Breunig, 2016). The emerging AI technologies are likely to influence value creation by being used to mass-produce or productify knowledge-intensive and professional services (Sawhney, 2016).The use of AI is suggested to be a potential source of increased productivity (Chui et al., 2012), as increased economies of scale and possibilities to standardise services can lead to innovation of new value creation models (Breunig, Kvålshaugen, & Hydle, 2014), and new organisation types, such as virtual firms (Breunig & Skjolsvik, 2016).

VALUE CREATION IN PROFESSIONAL SERVICES

The concept of value creation is often used to describe what an organisation produces, what it wants to achieve, and what it is achieving by delivering the best customer value at the lowest use of resources possible (Skjølsvik & Voldsund, 2016). While it is often described as a function of what the customer perceives to be valuable, measured in monetary terms (Hoopes, Hadsen, & Walker, 2003), value creation is not restricted only to the customer. Rather, firms also create value: for example, to their current employees, potential employees, potential customers, investors, and owners. Thus, value creation can be thought of as aiming to create perceived value among the firm's stakeholders and, in doing so, using its resources in a most efficient manner and at a cost competitive level. The value creation in professional service firms is linked to tailor-made services and problem solving based upon professional expertise. The business model underpinning the service deliverable has changed very little over the last century, and is based upon bundled services billed by the hour (Christensen et al., 2013). The role of professional service firms has also been linked to other stakeholders, as this type of firm have been described as knowledge disseminators that leverage important knowledge among several actors in society (Starbuck, 1992).

Methodology

We have chosen virtual law firms in order to study how digitalization influences value creation in professional service firms. Virtual law firms is an internationally established type of organisation (Gordon, Shackel, & Mark, 2012) that forms an illustrative example of how digitalization impacts an industry that traditionally has been conservative and knowledge-intensive. The results discussed below build upon an explorative interview study with 20 informant related to virtual law firms, and a longitudinal media study of news articles on virtual law firms, published in the Factiva Dow Jones database: 2006–2017.

The interview study aimed to provide contextual information and insights into how virtual law firms use digitalization to improve their value creation. Our identification of relevant cases and informants started quite broadly and followed a snowballing logic (Noy, 2008). Initially, we contacted two high-tech industry specialists based in Silicon Valley with whom we had previous relations. The first was a COO of a major internet corporation and the second was an Intel retiree with a 40-year history in Silicon Valley. Subsequently, we also approached two individuals that work with, invest in, and facilitate scalability of new web-based ventures. We approached these venture capital and innovation incubator communities to learn more about the market conditions and latest trends of the high-tech innovation industry within the context of law firms. In addition, we contacted two professors at the Stanford Law School and were introduced to their initiative CodeX: The Stanford Center for Legal Informatics, with particular emphasis upon the intersection between new ICT and organisational developments for the law firms of the future. Our first interviewees also introduced us to a former mayor of Palo Alto, now working as an advisor to tech start-ups, and to the leader of the Palo Alto Bar Association. During these initial interviews, we were able to identify several different firms using new technology to innovatively offer legal services that had started within the last 10 years. Subsequently, eight of these firms based in the US and UK were contacted and interviewed via Skype in 2015 and 2016. Each interview lasted between 1-2 hours. Those interviewed also provided us with internal documents and information about their firms, which was used as background information to better understand the organisations. An overview of the type of interviews conducted can be found in Table 7.1.

Table 7.1: Overview of Participants in the Semi-structured Interviews

Informants	#
High-Tech Industry specialists	2
Venture capitalists/Innovation incubators/local municipality officials	3
Silicon Valley based researchers with knowledge of the legal industry	2
Legal professionals related to high tech start-ups	5
Attorneys/Partners in virtual law firms	8
Total	**20**

The interviews were recorded, transcribed, and analysed in several steps. In particular, the collected data was analysed using data reduction methods and an inductive approach (Gioia, Corley, & Hamilton, 2013). First, an inductive approach was taken to develop relevant first order categories that, in turn, were compared to existing theory. In turn, these categories were grouped into larger subsidiary and main dimensions of the business model framework (as shown in Table 7.2). Memos in Word were used as core properties of the exploratory categorisation emerged. Subsequently, we chose a more deductive approach re-coding our data comparing it with different core dimensions of business models (Osterwalder & Pigneur, 2010), especially with attention business model innovation in professional service firms (Christensen et al., 2013).

We used the database Factiva Dow Jones in the media study and the search term "virtual law firm" to identify articles published in 2006–2017. The search resulted in 182 relevant articles (see Table 7.2). The findings from the two studies will now be described in more detail.

Table 7.2: Overview of Articles per Year in Factiva Database. *Only for Half of 2017 Included.

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Number of total articles	16	18	10	20	21	32	21	21	24	34	23	18
Duplicates/ beyond scope	5	4	2	2	5	10	4	3	6	23	5	7
Final number of articles	11	14	8	18	16	22	17	18	18	11	18	11

The Development of Virtual Law Firms: 2006–2017

A close analysis of the articles revealed that the emergence of virtual law firms had moved through three phases: 1) virtual law firms as competitive equals: 2006-2010; 2) dissemination: 2011-2014; and 3) transformation: 2015-2017. The three phases will now be described in more detail. As the development gained momentum – particularly in the third phase – and, as we are witnessing a large variety of virtual law firms today, we will give extra attention to this phase.

2006–2010: VIRTUAL LAW FIRMS AS COMPETITIVE EQUALS

Following the financial crises, thousands of lawyers and support staff lost their jobs (see, for example, *The Legal Intelligencer:* October 16, 2007). Many law firms also had to cut down employee salaries to survive. In such a market, the traditional business model was increasingly regarded as being "overweight" (ibid.) and virtual organisations became a means to realise cost savings.

Previously, the virtual law firms had been small and local, mainly focusing upon private law. After the financial crisis, however, many large virtual law firms were established, having extensive geographical reach and directed towards large client companies. Virtual Law Partners (VLP) and Rimon are examples of such large virtual law firms that were established during this period. The business model in this type of firms was to hire lawyers at partner level in traditional law firms who had an established client base. These firms aimed to provide both clients and employees with better offers than traditional law firms in order to reduce costs, offer reasonable services, and let the lawyers keep the main part of the revenues. The lawyers were not physically present in the virtual law firms, yet were assisted by invoicing systems, IT support and marketing and recruitment, and collaborated via software solutions and. The offering of new technologies supported this development for law firms (see, for example, Directlaw and Virtual Law Office Technology).

2011–2014: DISSEMINATION AND EXPERIMENTATION

In the second phase, an increasing number of law firms realised the possibilities that the use of available digital technology could bring, and the traditional law firms started to mimic the virtual law firms. For instance, they

started to offer more flexible work hours and alternative career paths to their employees (see, for example, The Guardian: July 2, 2011). An important new technological development in this period was the automation tool for documents (see, for example, Epoq Legal, LegalZoom and Rocket Lawyer). New management tools for smaller firms were also developed: such as Total Attorneys, Clio, Rocket Matter, and MyCase. Yet another important development was the use of apps and software enabling the law firms to better tailor their services to their clients and support the development of client relations[2].

Virtual law firms were mostly an American or British phenomenon up until 2010. A game-changing event was when Axiom entered the Financial Times' list of the best European law firms. In the end of the second phase, the phenomenon spread steadily to several cities and countries, and simple virtual law firms such as Axiom sought to build a global presence. This development illustrates how organisational advantages associated with the virtual model enable fast internationalisation.

2015–2017: TRANSFORMATION

The large number of new virtual law firms was described in the articles during this period, as being challenging the legal industry. A first reason was that lawyers at large law firms started to view virtual law firms as an attractive employment alternative. As was illustrated in the *Australian Financial Review* on 12 August 2016:

> *So a lot of lawyers are now saying, 'You know what? It's just not worth it'. With technology, you can go and set up your own business, make a name for yourself and do financially better.*

Secondly, there was also an increased interest in the legal industry in LegalTech, and awards were instigated for technology-related legal innovations, thereby, contributing to improving the status of virtual technology-based law firms.

Third, new technology related to AI and cloud base computing was disseminated among law firms. During this period, even traditional legal firms started to explore digital solutions, such as The Robot George tested out by The Conveyancing Shop Lawyers in New Zealand:

2 See e.g. https://blog.highq.com/news/new-swedish-firm-synch-advokat-selects-highq-for-extranets

> *George is a tele-presence Robot from Double Robotics that includes a tablet screen as a "head' and Segway like "feet' to get around. George can move, back, up, and turn. This is all directed by his controller – one of the Conveyancing Shop's specialist lawyers, a client, or a management team member.* (Scoop, 30 July 2015)

The dissemination of the virtual law firm as a business model across geographies continued during this period, particularly in Australia. While larger firms in the US, such as FisherBroyles, Potomac Law Group, Rimon and VLP Law Group were prospering and growing extensively, and the value proposition of virtual law firms was increasingly recognised (*Daily Breeze:* 26th March 2015). Media and experts suggested that the virtual platform could enhance and support the client-lawyer relationship (*Business Wire:* 28th August 2015), and that the client-lawyer relationships had become a key focus of these firms:

> *Many virtual attorneys go out of their way to be more responsive to their clients to counteract any concerns that a virtual attorney is ephemeral or transitory. This renewed primacy of the attorney-client relationship in many ways marks a return to very traditional values of the practice of law.* (Inside Councel, December 2nd, 2015)

However, difficulty was also recognised in establishing and running a virtual law firm (for example, *American Lawyer:* November 1st, 2016). Failed virtual law firms, such as the faulter of virtual law firm, Clearspire caused this (*ABA Journal,* 1st July 2017). Larger virtual firms were also likely to dominate the legal service industry and take market shares from medium-sized and small virtual firms.

We witness a decrease today in the use of the term "virtual law firm". This is partly caused by an increased discussion of alternatives to the traditional law firm model, of which in-house counselling and outsourcing are two extreme alternatives. Axiom is leading this transformation, which is recurrently described as being a key player in offering client advice. There also seems to be an interest in shifting the terminology away from the notion of a "virtual" to a "cloud" based firm. This indicates that law firms want to associate themselves with more modern, up-to-date, cloud-based technologies that augment their value offerings to their clients (for example, the collaboration between the Swedish law firm MAQS Advokatbyrå and the legal technical solutions firm Virtual Intelligence, VQ[3]). The companies also seem to want

3 https://maqs.com/en/news/news/maqs-vq-develop-pioneering-artificial-intelligence/

to communicate to their clients that they are not just virtual; they also have a physical presence. In turn, this suggests that, while technology is an important enabler for improving efficiency and accuracy, the personal client-lawyer relationship is still regarded as important for value creation.

Consequences of Digitalization in Professional Service Firms

In developing a better understanding of digitalization in professional service firms, we further use the interview data together with the media study to focus on three main areas: the nature of the digitalization, the organisation of the virtual law firm, and the impact of digitalization on value creation in this type of firms.

THE NATURE OF DIGITALIZATION IN PROFESSIONAL SERVICE FIRMS

A main finding from the interviews was that the technology used in many cases was not particularly sophisticated or unique. An interviewee explained this in the following way:

> "The systems we use really are on-the-shelf systems. The important thing is (to) find out what is already out there and take advantage of it. We don't need expensive, fancy, or tailor-made systems. We use The Cloud for sharing documents, online video conferences, social networks to collaborate, and LinkedIn for marketing."

Thus, it does not seem that becoming a more digital or virtual firm necessarily implies extensive investments. Only a decade ago, only large firms could afford investments in advanced ICT tools. Currently, we witness that digitalization provides opportunities for small and medium-sized firms as much of the applied technology is inexpensive and standardised solutions. As many of the firms combine technology, they develop themselves with existing openly available technology, and success seems to stem more from their business model and their willingness to apply technological tools than from the tools themselves. cloud computing, automation and AI were key technologies that were emphasised in the interviews and in the examined news publications. Each of these will be discussed in the following section.

Cloud Computing: The increased use of cloud computing offers many benefits to law firms and is one explanation to the growth of virtual law firms:

> *The rise of cloud computing in particular has made it possible for attorneys to keep all the technology tools they need to practice on hand at all times and eschew direct client contact and office space if so desired.* (Broward Daily Business Review, 31st January 2017).

Many firms have particularly developed internal platforms that rely upon cloud-based solutions. The platforms form the backbone of the virtual firms and support communication and collaboration. As one of those interviewed explains:

> "…The entire firm is built in the cloud. We log into the platform that forms the basis for the internal social network; it resembles Twitter and makes it possible for us to post information on new clients or legal updates. We can see who is logged in, and in order to communicate with each other, we can just click and then immediately have a chat or a video conference."

Automation and AI. Technological developments in AI and automation are the second main influencer in the legal services industry. There are a number of AI programs targeted to the legal industry. Examples are ROSS, which is built upon IBM's Watson: a software focusing upon AI and machine learning and Luminence, which is used in due diligence. Having access to AI currently demands large investments from law firms, since it takes time before the AI has been trained to work well within different legal areas. Despite the costs, most of the larger law firms are using resources to develop AI solutions. As costs decrease and the software becomes easier to use; however, it is likely that it will become more accessible for more law firms, with far-reaching consequences for the industry. In a Swedish setting, the language will probably delay this development as it takes additional time for the software to learn to decipher Swedish legal texts. In 5–10 years' time though it may be possible that AI will perform many of the tasks that law firms do today. Some informants, however, argue that technology would not change the core of what lawyers do. They claimed new technology will not influence the professional knowledge, and that the assignments they were given would not change, although the way in which they were performed would be somewhat different. This is illustrated in the following quote:

> "Technology won't replace anyone; it is a tool that makes it possible for us to do things differently and (be) more efficient. Individual professional expertise cannot be replaced by technology."

After having seen what tasks AI can perform in relation to searches for previous legal cases and court decisions, an interviewee expresses his concerns:

> "...It may well be that, in the future, one gets sued for misconduct if one doesn't use this type of systems when preparing cases."

Thus, it might be that the use of technology might not only be a source of effectiveness; it may also become a prerequisite over time. Also, the fact that outsourcing of law services seems to be of increasing interest to clients, the application of AI might happen more rapidly than if law firms were to do it themselves, as illustrated in *ABA Journal:*

> *Most importantly, outsourcing providers can use technology that a law firm cannot afford. That might include artificial intelligence, contract management, process mapping and workflow technology.* (July 1, 2017)

This takes place not only through innovation in the business models – as is the case for the virtual firms; it is also related to basic tasks previously performed by junior lawyers. As *The Straits Times* illustrates:

> *Artificial intelligence (AI) is shaking up the law and accounting sector, as companies embrace the use of increasingly smart machines to perform mundane tasks that have traditionally been the preserve of junior employees.* (September 28, 2016)

Machines with equally good or even better results can now can perform many of the tasks that was once performed by juniors as well as administrative staff in the past: anything from analytical tasks, data gathering or assessments in individual cases. While the use of AI and automation might improve value creation by helping to reduce costs, for example, it is also believed to have drawbacks. The application of AI to routine tasks for junior associates means that they miss important opportunities to learn how to perform more basic searches and analyses, as well as get experience and become socialised into important professional values and norms. As one of the informants describes:

> "…. If robots can perform tasks we normally let junior associates do, then I find it difficult to see how we will develop the knowledge necessary, and also provide our new employees with norms and values that are fundamental to become a good lawyer."

THE ORGANISATION OF THE VIRTUAL LAW FIRM

Interviewees described that the virtual law firm differs in many ways from the traditional law firm. While the physical building is regarded as being highly important in traditional law firms, - not the least from a marketing perspective - this is not so in virtual law firms. One interviewee explains:

> "Nowadays having a large library or support staff is highly redundant, and I find it more efficient to do my searches online myself. The physical office has become irrelevant. We used to need a large office to share resources, libraries, and administrative staff – in fact, one of the main motivators for becoming a member in a large law firm was to get access to these resources. In our company, it is very different, now it is the web site that is the law firm, not a fancy office building. The large law firms are ignoring these changes."

The lack of physical presence was even described as an advantage for the virtual law firms, as it made them more flexible and reduced their fixed costs. As explained in *ABA Journal*:

> *The virtual law firm-an office has no mahogany-walled waiting room, no expensive downtown location and no expensive overhead? Well, how about ditching the office altogether and using technology to communicate, share information and service clients? That's the idea behind the rise of the virtual law firm…* (June 1, 2015).

The digital technology was also said to enable law firms to develop networks that enable them to access research and information previously inaccessible to them. This influences both how law firms can work with better resource allocation and lower their costs through a cost-efficient organisation. For instance, the virtual law firm is built upon a network model that connects dispersed lawyers, allowing them to portray themselves as being part of a larger firm, communicate with peers, leverage up-to-date technology and support administrative needs: such as billing and accounting. As the network model has many advantages, many large law firms are currently experimenting with tying up resources in external networks: for example, via Upwork or Freelancer in order to access new expertise and complement their internal resources. While using network-based resources might not change how the core tasks of lawyers are performed, it certainly affects the context of value creation within legal services. Those interviewed emphasised that the new digital technology enables firms to organise their work in new ways. They

also described how the key to successfully creating value in law firms has changed due to the introduction of digital technology:

> "If technology changes our practices? But of course! We would not be able to take advantage of the new possibilities the technology brings unless we changed the way we organised our work".

As aforementioned, professional service firms are defined by the professional autonomous role the employees have in their work. This ideal has been under pressure in many professions as professional service firms have tried to professionalise their management and move toward more business-oriented organisations in combination with the traditional partnerships. However, the virtual organisation allows the professionals to maintain their autonomy. As one interviewee described:

> "The effects [of virtual organisations] on the professional autonomy? It improves it. The technology frees us from hierarchic and bureaucratic structures".

In a virtual organisation, the structural features are of less importance. Rather, culture is described as being central for how to organise the firm, the practices, and for internationalisation. This is also regarded as important glue, as well as selecting which persons to recruit and retain. Another interviewee explains:

> "We aim to build a culture in which respect for each other and knowledge-sharing are important values. A central tool to achieve this is to give your co-workers as much freedom as possible. An important focus in recruitment is to get on board competent people with a viable portfolio, but who also want to collaborate closely with colleagues. This requires both basic IT competence and an extrovert personality. We need people who can contribute to building a company by sharing and collaborating with colleagues. "

THE INFLUENCE OF DIGITAL TECHNOLOGY ON VALUE CREATION

The costs and value that is offered to the customer and other stakeholders of the firm is at the core of value creation. The virtual organisation forms the basis for the realisation of the value creation potential. Improvements in value creation relate to how virtual law firms are organised; it is their way of organising, which

enables them to save costs. A virtual structure also enables them to deliver better services. As *The Daily Breeze* explains:

> *We have three major value propositions: top quality work; we're extremely responsive, and people can save up to 50 per cent on their legal bills…* (March 26, 2015)

This illustrates how the virtual organisation has had a large impact on the value creation by removing structures and making redundant much of the traditional resource base such as libraries and support staff.

Reputation was another important feature strongly emphasised by the informants. While it used to be common to build a reputation through personal contacts, a new trend among law firms seems to be focusing more on the internet to build a reputation online. One interviewee explains how the online presence could create value for the clients, as it gave them quicker and better access to information:

> "Visibility and building reputation on the internet has become very important. Most well known lawyers now have weekly blogs, or they retrieve information from other lawyers' blogs or LinkedIn updates. This increases the speed: you can now read online about new legal updates every morning."

In addition to contributing locally with value creation, the virtual organisation also enables much faster the international scaling of its operations. One interviewee explains this in the following way:

> "Having an international presence is steadily becoming a more important competitive factor. We hire specialists from all over the world. So we have a distributed model, which takes advantage of the benefits of having partners in the cities where our clients work. Our virtual model enables us to establish our firm internationally much faster. I would say that international expansion occurs when a client asks for a long-term representation in a specific geographic area. We saw an example of this in Tel Aviv recently. We could open an office there in one week's time. First, we identified a lawyer running his own practice there, who was interested in being part of a broader international collaboration. So, we just connected the lawyer to our platform. Geographic distance is not as important as time zones or languages. For me, only 50% of my clients are located nearby – 30 years ago that would have been totally impossible."

Internationalisation has traditionally been associated with high capital commitment limited to large firms. However, the increased digitalization also

enables small and medium-size firms to internationalise and utilise "off-the-shelf" and inexpensive technology to obtain competitive advantages. This change is important, and emphasises how a clever use of inexpensive new digital technology in many situations can be more valuable to firms than merely focusing upon the high end of technological complexity.

Apart from creating value for their clients, virtual law firms also create value for their employees. The way of organising the work makes it possible for lawyers to find a better work-life balance: for example, having time for one' family, especially with young children, or taking up a hobby. This type of value is important for the virtual law firms when recruiting highly competent employees, and it also appeals to potential clients:

> "Our employees are our most important resource. Our clients don't hire the firm; they hire the people working here. If we are able to recruit the right people, well, then we will earn good money. So it is important to us to create a good and attractive place to work. One way of doing so is to encourage flexible work hours and the possibility of working from home. We want to create a better work-life balance and make it attractive for our lawyers to work here."

Looking Ahead: The Future of Professional Service Firms

The study indicates several broader future potential changes in general to professional and knowledge- based services, particularly to the legal service industry. A first observation is that the digitalization of the legal industry is not predominantly driven by increased technological complexity. Rather, it is concerns how the new digital technology is applied and utilised by law firms to improve their competitiveness. As we previously discussed, law firms are adopting and integrating systems based upon AI. The media has discussed how software with AI might influence how the very core of legal tasks is performed, thus, fundamentally challenging the industry. The legal industry is also apparently under strong price pressure, and one strong incentive to automate tasks is cost reduction. The following quote from a virtual law firm operating in the US market illustrates this:

> *The US is a legalistic society, however only 20% of its population can afford legal services. This is a market ripe for disruption. The ones that manage to provide affordable services at a quality that suffice – will take the grand prize.*

Based upon our findings, we suggest that the increased use of automation and AI in legal services will have the following consequences:

First, automation of time-consuming tasks related to data collection and analysis can produce organisational slack and pose an opportunity for law firms to engage in more strategic matters, such as market development and expansion. Automation might also provide opportunities for lawyers to focus more upon tasks that machines cannot easily performed – such as representation in courts or negotiations – as they build upon creativity, human judgment, and empathy. However, this might also lead to changes in the value creation process in law firms. Law firms have traditionally offered high-priced bundled services that are billed by the hour. Today, an increasing number of law firms are seeking to identify tasks that are scalable, which can benefit from automation. The automation makes it possible for law firms to unbundle their services, thus, performing them more efficiently. It also opens up a possibility for competitors to invest in technology as an entry strategy into the market of legal services. There are currently several examples of solutions to solve legal issues offered by firms outside the legal industry. These firms do not have the same regulatory requirements, such as being restricted by the equity clause: for example, divorce settlements, real-estate transaction or incorporating a firm are increasingly offered as online services. Other examples are increased in-house legal expertise, software to support certain services such as Due Diligence offered by Luminence, and firms such as Axiom and Burton law providing strategic services to enable more professional purchasing of legal services. Thus, it is plausible that the legal industry will experience more intense competition from actors presently not part of the market for legal services, and that the current core offerings by law firms will be less relevant in the future. One interviewee addressed this accordingly:

> "An analogy could be predictions about self-driving cars and the future of driving instructors. Acquiring a digital strategy will not suffice for the driving instructor if the market for driving licenses are drastically reduced. Within the legal industry there might be several such examples of potential big changes in marketability of certain services – becoming irrelevant: for example, due to blockchain technology predicted to revolutionise contracts and the need for third-party involvement in transactions."

Secondly, the increased use of digital technologies in law firms will create a need for new types of competences. While law firms have built upon the lawyers' strong legal knowledge, they now need to recruit or develop people with technological competences. In turn, this poses new challenges for law firms, relating to questions such as: i) How to recruit and retain highly technologically-competent employees; ii) if new career paths are needed: for example, different paths for lawyers and technical experts; iii) How the power balance and status of lawyers and technical experts will play out internally; and iv) Whether the law firms instead should outsource all technical issues. In addition, law firms need to develop strategies for how to use the new digital technology and transform it into new business opportunities. To do so, law firms might need to complement their legal competence with strategic competence. This, in turn, opens up for changes in the traditional professional partner-structure in law firms, and the development of new managerial levels not necessarily built upon legal competences.

Third, while virtual law firms reveal many advantages, such as being flexible, agile, having low-fixed costs, and the ability to draw upon expertise on an ad-hoc basis, they also have disadvantages. One such potential disadvantage is the lesser degree of collaboration and knowledge development among the lawyers in virtual law firms. While law firms have traditionally played an important role in training through professional apprenticeships, this might not be as common in the future. The fact that virtual law firms mainly recruit lawyers with long experience and do not hire or spend time on training junior lawyers partly indicates this, as does the increased use of automation and AI. Therefore, the legal service industry needs to ask itself how future lawyers will be trained and given the opportunity to develop into experienced and knowledgeable senior lawyers.

Transforming a law firm's value production process into an automated services production flow, however, will require investments, and might require external capital – now prohibited due to the equity clause. This might also have consequences for the clients to law firms. Using automation and AI will make it possible for law firms to deliver better and more tailored expertise faster and easier to their clients. For the clients, this means that they might get more value for their money. The unbundling of services also makes the value-creation process more transparent, and easier to compare between law firms: for example, via online references. The reduced information asymmetry

and opacity of the services' qualities is likely to shift the power balance between lawyers and clients in the clients' favour; it will be interesting to see whether the increased use of automation and AI will lead to the development of new standards in the legal services industry, or if law firms will create models that make them retain some of the value.

References

Alvesson, M., & Karreman, D. 2006. Professional service firms as collectivities. In R. Greenwood, & R. Suddaby (Eds.), *Research in the Sociology of Organizations: Professional Service Firms,* Vol. 24: 203–230. Oxford: Elsevier.

Breunig, K. J. 2016. Limitless Learning: assessing social media use for global workplace learning. *The Learning Organization, 23*(4): 249-270.

Breunig, K. J., Kvålshaugen, R., & Hydle, K. M. 2014. Knowing your boundaries: Integration opportunities in international professional service firms. *Journal of World Business, 49*(4): 502-511.

Breunig, K. J., & Skjolsvik, T. 2016. The Virtual Future of Professional Service Firms. *Academy of Management Proceedings,* 2016(1).

Christensen, C. M., Wang, D., & van Bever, D. 2013. Consulting on the Cusp of Disruption. *Harvard Business Review*(October).

Chui, M., Manyika, J., Bughin, J., Dobbs, R., Roxburgh, C., Sarrazin, H., & Westergren, M. 2012. The social economy: Unlocking value and productivity through social technologies: 1-170: McKinsey Global Institute.

Davenport, T. H., & Kirby, J. 2015. Beyond Automation. *Harvard Business Review,* 2015(July).

Gioia, D. A., Corley, K. G., & Hamilton, A. L. 2013. Seeking qualitative rigor in inductive research notes on the gioia methodology. *Organizational Research Methods, 16*(1): 15–31.

Gordon, T., Shackel, R., & Mark, S. 2012. Regulation of legal services in the e-world: a need to short circuit hot spots in ethics and novel practices? *International Journal of the Legal Profession, 19*(1): 55-87.

Greenwood, R., Li, S. X., Prakash, R., & Deephouse, D. L. 2005. Reputation, diversification, and organizational explanations of performance in professional service firms *Organization Science, 16*(6): 661-673.

Hoopes, D. G., Hadsen, T. L., & Walker, G. 2003. Guest editors' introduction to the special issue: Why is there a resource-based view? Toward a theory of competitive heterogeneity. *Strategic Management Journal, 24*(10): 889-902.

Jesuthasan, R., Malcolm, T., & Zarkadakis, G. 2016. Automation Will Make Us Rethink What a "Job" Really Is. *Harvard Business Review*(October).

Løwendahl, B. R. 2005. *Strategic Management of Professional Service Firms* (3rd ed.). Copenhagen: Copenhagen Business School Press.

Malhotra, N., & Morris, T. 2009. Heterogeneity in professional service firms. *Journal of Management Studies 46*(6): 895–922.

Manyika, J., Chui, M., Bughin, J., Bisson, P., & Marrs, A. 2013. Disruptive technologies: Advances that will transform life, business, and the global economy. San Fransisco, CA, US: McKinsey Global Institute.

Noy, C. 2008. Sampling Knowledge: The Hermeneutics of Snowball Sampling in Qualitative Research. *International Journal of Social Research Methodology, 11*(4): 327–344.

Osterwalder, A., & Pigneur, Y. 2010. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers:* John Wiley & Sons.

Sawhney, M. 2016. Putting Products into Services. *Harvard Business Review, 94*(September): 82-89.

Skjølsvik, T., & Voldsund, K. H. 2016. *Forretningsforståelse* Oslo: Cappelen Damm.

Starbuck, W. H. 1992. Learning by Knowledge-Intensive Firms. *Journal of Management Studies, 29*(6): 713–740.

Susskind, R., & Susskind, D. 2015. *The Future of Professions: How Technology Will Transform the Work of Human Experts*. Oxford, UK: Oxford University Press.

von Nordenflycht, A. 2010. What is a professional service firm? Toward a theory and taxonomy of knowledge-intensive firms. *Academy of Management Review, 35*(1): 155–174.

Robotisation of Accounting in Multi-National Companies: Early Challenges and Links to Strategy

MARTIN CARLSSON-WALL AND TORKEL STRÖMSTEN

Introduction

Multi-national companies are complex organisations (Busco et al, 2008; Bartlett and Ghoshal, 2002). This complexity comes in many different forms. A central aspect is that operations take place in different geographical locations, which leads to challenges when it comes to controlling at a distance. The ways in which activities and behaviour are controlled also differ between companies. Some organisations rely largely upon calculative numbers and control, while others use a norm-based control regime. In this chapter, we are interested in exploring how the finance functions in multi-national companies use digital robots, more commonly referred to as robot process automation.

Robot Process Automation (RPA) is a software that performs administrative tasks and activities that otherwise humans and knowledge workers (such as business controllers) would perform. The reasons why RPA is often referred to as "robots" is because it can take over relatively simple and routine tasks such as moving data from one system to another. As Lacity and Wilcocks (2015, p.2) write:

> "Knowledge workers consistently tell us they want to be liberated from such highly-structured, routine, and dreary tasks to focus on more interesting work. Some are actually getting that wish, thanks to a new approach known as Robot Process Automation (RPA)".

As of the autumn of 2017, many companies experiment with various forms of RPAs. The hopes for robotisation are high since one "robot" (often equal to one software license) can do work that normally takes several individuals.

Still, fear also exists that skilled jobs will be replaced by RPAs. This might start with help doing dull high-routine work; however, as the RPAs get better, we do not know what the future will hold.

Despite the interest in RPAs, there has been surprisingly little discussion about the pros and cons of robotisation in administrative tasks (Isaksson and Wennberg, 2016). The invisible activities of book keeping and paying bills are seldom given much attention when researchers and practitioners discuss digital transformation. To remedy this, we have conducted an exploratory case study of three multi-national companies and how they invest in RPAs within the finance function[1].

Even if the results are preliminary, our empirics indicate that investments in RPA technologies are related to the companies' choice of internationalisation strategy and the challenges that different types of strategies create.

This chapter is organised in the following way: First, we briefly review the literature on accounting and digital transformation. Even though the term *digital transformation* is rather new, it will be shown that current research challenges can be linked to earlier research on accounting and ERP systems and accounting and functional IT. Secondly, focusing upon multi-national companies, we introduce a framework that discusses three types of internationalisation strategies: ethnocentric, polycentric, and geocentric (Perlmutter, 1969; Hedlund, 1986). These strategies differ depending upon the scope and scale of internationalisation and we will use them to explore how the choice of internationalisation strategy is linked to the investment in RPA technologies. We then present three illustrative case studies. Through these cases, we propose some tentative propositions and patterns for how RPAs have been introduced in the finance function. We end the chapter with a discussion and concluding remarks.

Accounting and Digital Transformation: Three Distinct Phases

One can distinguish between three distinct phases when reviewing the literature on accounting and digital transformation. Beginning in the 1970s, we had a first phase called "accounting and functional IT": where the digital

1 In line with an exploratory study, the research process has been highly iterative. Both authors have had formal and informal discussions with CFOs, controllers, and IT-experts around digital transformation for a long period of time. The topic of RPAs started to emerge during the spring of 2016. However, it was not until one year later, in 2017, that we started to do more systematic interviews. This chapter is based upon < total of 30 structured interviews and informal discussions with individuals from telecom, manufacturing, IT, bank, airline, hotel and forestry industries.

transformation focused upon developing specific IT programs to keep track of accounting transactions or to improve the profitability calculations (Newman and Westrup, 2005). This phase gave the accountants a relatively large autonomy, since systems were developed and used within the finance function. As a consequence, there were few tensions and battles with the IT department (Newman and Westrup, 2005).

Tensions with the IT department grew stronger during the second phase, which began during the mid 1990s. This was the era of the ERP systems. These *Enterprise Resource Planning* systems brought a new type of digital transformation to the foreground: integration (Hyvönen et al, 2008). To remedy the large archipelago of functional islands, ERP systems focused upon the integration of different functions within the company to promote a more process-oriented and cross-functional culture (Quattrone and Hopper, 2005). Since the era of the ERP systems occurred at the same time, there was a strong corporate trend toward a shareholder value orientation, and the finance function became a powerful player. In a sense, one can say that many Chief Financial Officers (CFOs) became "captains of the ship" and controlled both the design of the ERP system as well how it should be implemented. In many stock listed companies, it was not unusual that the IT-function became a sub-function within global financial organisations.

Table 8.1: The Accounting Literature on Digital Transformation

	Accounting and Functional IT	**Accounting and ERP Systems**	**Accounting and Digitalization**
Primary Time Period	1970s to mid 1990s	From mid 1990s to 2010	2010–present
Type of Digital Transformation	Digitalize specific accounting tasks within the finance function	Develop large ERP systems	Integration of ERP systems with digital robots, artificial intelligence, and customised CRM systems
Main Accounting Function	Keep track of accounting transactions and do internal calculations	Integrate accounting information with other functional systems to leverage synergies	Integrate accounting information with both internal and external data to leverage synergies, as well as question business model
Power Battle With IT	Limited accounting and IT lived separate lives	Strong; however, accounting strengthened its role since the CFO often became responsible for the ERP system	Potentially strong, where IT could be the winner since many accounting tasks could be automated

During the past years, we have seen the emergence of a third phase of digital transformation (Schäffer and Weber, 2016). This can be seen in the terminology. Instead of talking about accounting and IT, we now talk about *accounting and digitalization* to highlight how this third phase is even broader: focusing upon both front-office digitalization targeting customers and new business models, as well as back-office digitalization with a more traditional focus upon automation and robotisation. From a finance perspective, this third phase entails both opportunities and risks (Quattrone, 2016). On the one hand, line managers have strong needs for controllers to become "trusted business partners" in order to make sense of big data and use new IT tools. On the other hand, with new robots and artificial intelligence, there is a large risk that the finance function will be considerably smaller, in terms of headcounts. Some IT directors to whom we have spoken even foresee that "finance will most likely be there, but they will be part of (my) organisation in the future". Thus, recent developments are very interesting because we do not know what the future finance function will look like, what competences it will have, and where in the organisational hierarchy it will be located.

With this historical background, it is now time to dig deeper into the strategies of multi-national companies. As we highlighted in the introduction, this is important since we have discovered a pattern where the type of robotisation implementation seems to connect to the internationalisation strategy.

Internationalisation: Three Strategies for Multi-National Companies

According to the literature on multi-national companies, there are three fundamental strategies for internationalisation: ethnocentric strategy, polycentric strategy, and geocentric strategy. Howard Perlmutter (1969) coined these concepts, and conducted research on how multi-national companies organise them and how the company headquarters controlled the subsidiaries. In a later article, Gunnar Hedlund (1986) developed the concepts and added a fourth type: *the heterachichal organisation*. We will briefly discuss this type in our concluding section.

Ethnocentric companies are companies with a strong and clear home base. All companies have first started in a home market and then gradually moved into new markets to explore and exploit its specific advantages. The relationship

between headquarters and the subsidiaries in ethnocentric companies can be characterised as a hierarchical one. Subsidiaries' role is to implement the strategy formulated by the headquarters. Following from this, the interdependencies that can be identified in these types of companies are typically sequential. Often production is conducted in the "home country" and then shipped to the subsidiary that is responsible for sales activities. The forms of control used in these companies are characterised by a control that is strongly linked to the parent or home country unit. Since the company originates from a home base, the control is often classified as normative or cultural based. Basically, the company is managed by "home country people". In addition, the technologies in these companies allow for a more calculative and diagnostic type of control.

Polycentric companies are characterised by their independence. These companies have subsidiaries in many foreign markets and, due to the distance as well their operations, will be independent in relation to other parts of the company. Hence, the term multi-national: there are multiple units that independent from each other; therefore not much interaction or transactions takes place between the units. To a large extent, the role of the headquarter will be to create a sense of an organisational belonging. The issue of keeping some activities standardised to draw upon the potential economies of scale will be important; however, the units will continuously challenge this, as they strive for even more independence as long as they do not see the value in standardisation and centralisation.

Lastly, *geocentric companies* are more complex than both ethnocentric and polycentric companies. These companies try to combine the local intimacy with global presence, which means the relationship between headquarters and subsidiaries will be more complex. An important idea with geocentric companies is to develop "centres of excellence" that take advantage of the scale, so less double work is conducted in the group. Hence, there will be, or can be, many centres as well as internal transactions in these types of companies. The forms of control that are exercised in the geocentric companies are often normative and coercive controls.

In the next section, we present our illustrative cases. The focus will be to describe how companies with different internationalisation strategies engage with investment in RPA technologies.

Illustrative Cases

FORESTCO: ROBOTISATION FOCUSING UPON KEEPING TRACK OF SALARIES

Our first case company is ForestCo. During the past years, ForestCo's finance function has received new requirements to become more efficient; "more lean", as one of the interviewees put it. ForestCo has five production units in Sweden and multiple sales units around the world. The company ships products internationally to the different units, where sales offices are located. Technical problems in printing facilities or converting processes can arise in the forest and pulp and paper industries. When this happens, it is appreciated if the supplier can assist. The organisational backdrop in this case is that headquarters decides and the subsidiary follows.

ForestCo has decided to do a pilot with RPAs for two administrative processes within the finance function. The first is foreign payment. This process is administrative-heavy and requires detailed information to be accurate. Hence, ForestCo wants to robotise the task of getting the bank account right and the right IBAN number.

The second process relates to salaries. Both the actual payment as well as the automatised process should create information that shows deviations that management can identify and act upon easier than before. The subsidiaries are often sales offices where administrative processes with customers are handled. Salaries are the main cost element in the subsidiaries. To prevent un-authorised employment and/or unplanned cost increases, the automatisation of salaries will make this process even more transparent than before.

The IT organisation was the department that had the initial say in this robotisation process. They soon realised, however, that this required new thinking and problem solving. For example, one issue that emerged was access to the IT systems. Who should have access? Suddenly, outside partners had access to ForestCo's internal IT system. As soon as this was identified, security issues started to be discussed in the company. The need to identify and define new areas of accountability was also something that came out of the process. As one employee said: "The IT organisation needs an internal counterpart that is not present today. Just like there are systems for HR and production, there is a need for a finance system that IT can speak to and where questions are channelled."

Another consequence of the robotisation of accounting within ForestCo was the identification of new roles and professions. ForestCo had centralised its transactional accounting to a shared service centre. However, it became clear during the robotisation project that there was a need for someone who was responsible for robotisation or *"someone who owned the question"*, as an interviewee described it.

Another challenge that emerged was that employees felt uneasy about becoming redundant. Management had to spend time explaining that this was of no concern to them; no one would be laid off due to the robotisation project. One director said: "What will this lead to? In the end, I am not sure that we will be fewer people working here. But I am rather sure that we will have to replace people, we will need other types of competences."

In relation to the process to implement robotisation in ForestCo, the general impression from the company is that this is a project that has taken longer time than expected. The main reason has been that ForestCo has not specified the processes that it wanted to automatise. "Our processes were not described specific enough", one ForestCo manager said. The implementation of RPAs, therefore, has started to problematise the processes rather than just make them more efficient, which was the initial ambition when the pilot projects began.

MANUCO: ROBOTISATION FOCUSING UPON ACCOUNTS PAYABLE

ManuCo is our second case company. ManuCo has operations in 170 countries and is organised in separate divisions, each with its own financial responsibility and independence. Due to the strong decentralisation and independence, there are very few internal transactions between the different divisions. Headquarters provide some infrastructure for the divisions: such as Global HR, finance, and marketing.

ManuCo has initiated a RPA pilot project that is located in one of the company's units in Warzaw, Poland. This project takes place on the corporate level within ManuCo. The project background is organisational. ManuCo initiated a Shared Service solution in 2000 within the company. All units that were conducting transactional accounting services were then centralised into the Shared Service Center in Warzaw. The operations were later outsourced to a third party in India.

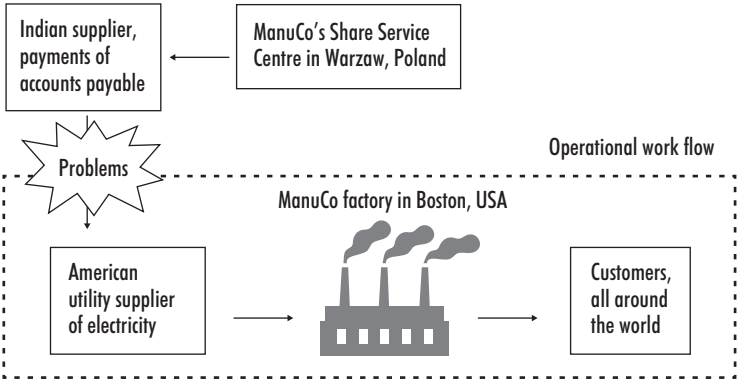

Figure 8.1: Illustration of problems with Indian supplier and American factory.

The robotisation of the accounting transactions focuses upon the company's accounts payable. This might seem like an easy and non-strategic activity; however, ManuCo's experience with the outsourced Shared Service operation in India ended in situation that turned out to be very strategic. One day when management in Boston came to the production facility, it was closed and no lights were on. Nothing worked and the facilities looked abandoned. The Shared Service supplier in India had ultimately failed to pay the bills to the electricity company and had not done so even when the utility company repeatedly had tried to make ManuCo pay the bills.

In the end, electricity was shut down and ManuCo's unit could not run its operations.

The robotisation project of the accounts payable should be seen in the light of this. The plan is now to bring the outsourced transaction services in-house again. Even "simple" transactions could be "strategic"; therefore, the accounts payable will probably follow the decentralised structure of the company and be performed in the different divisions and subsidiaries. This makes this case interesting; not even very standardised transactions can be handed over to the outsourced party since, if they are badly managed, far-reaching and strategic consequences can result.

Furthermore, ManuCo runs a very decentralised business where the divisions make decisions independently and with a strong financial accountability. Hence, the idea with the RPAs is to bring them back into the divisions, so that decentralisation also concerns the transactional accounting activities.

Therefore, the introduction of RPAs seems to facilitate the idea with decentralised decision-making and accountability in ManuCo.

GLOBAL: ROBOTISATION FOCUSING UPON INTER-COMPANY TRANSACTIONS

Global is one of Sweden's largest companies with operation all over the world. The company is active in an industry that was once heavily regulated; however, a wave of deregulation since the 1990s has changed the business landscape for Global and the way its business is conducted.

Global's focus when it comes to RPA implementation has been what is known as "inter-company processes". Since there are significant interdependences between the different units within Global, the internal transactions must be handled with care. The internal transactions amount to over 10 million transactions on an annual basis, which can and, in fact often do, create a headache for management. The reason for this is that there are often mismatches between what an internal unit book as sales and what an internal buyer books as purchased items. For example, the seller invoice can state that goods for 100 items have been shipped. The buyer, on the other hand, receives goods for 80, thus, creating a variance of 20. This happens because of different systems in the buying and selling units, which creates unbalances in Global's accounting system. The local unit's balance sheet and income statement differ in relation to Global's financial reports. Solving these unbalances takes a lot of time and energy. The solution is a robot that looks at the purchasing order that is sent to the other local unit(s) within Global. The purchasing order is cleared in relation to the selling order and ensures that the same amount is ordered and shipped. This will lead to no variances and the orders are cleared on the appropriate level. Payment is accurate and the balance sheet and income statement make sense.

The challenges so far are that Global's local units use different ERP systems, even if the main ERP supplier is the same in the whole company. All the local units have different codes and, in effect, different ERP systems. Another challenge is to give the robot access to the local units' accounting system. When this works, the amount of manual work in the local units will significantly decrease. Head count will decrease as will the risk for errors. For example, sales and the cost of sales will be accounted for in the same year: something that previously was far from clear.

Problems can also occur due to local tax legislation. In some cases, countries have very strict laws and regulation in relation to cross-country payments, especially when the goods that have been bought are an IT-related service. This happens on a regular basis since Global's units in the different countries are dependent upon IT services from another country.

Global has had two Shared Service organisations: one unit has been responsible for accounts payable and another unit for accounts receivables. These units have been working with the financial accounting for external stakeholders; however, the internal accounting has had the same type of organisation. As a consequence of the robotisation, the internal accounts payable and receivables will be moved to the same unit. The external accounting does not have to match in the same way, as the internal transactions need to do, hence, the merger of these transactions.

Discussion and Concluding Remarks

This chapter has explored the use of Robot Process Automation (RPA) in the finance function of multi-national companies. The motive behind the chapter is the relatively silent role that digital robots play in the administrative processes of multi-national companies. During the interviews that we conducted, a pattern emerged that indicated the internationalisation strategy of the company influenced the initial projects that the companies had pursued in relation to robotisation.

First, ForestCo illustrated a company with an *ethnocentric strategy*. Ethnocentric companies often have a clear home base and internally sell their products to sales organisations around different geographical markets. In the case, it was possible to see how ForestCo's finance organisation prioritised to automate salary process in order to streamline this process. A complementary reason was also to keep track of how salaries develop over time and to identify deviations in the subsidiaries early on. Therefore, the control of subsidiaries increased with RPAs; it will be easier to take action if salaries increase for some reason. This control goes hand in hand with the way ethnocentric companies are controlled through a hierarchical governance mode, which also can be classified as coercive.

In our second case, ManuCo illustrated a company with a *polycentric strategy*. In this case, the accounts payable RPA pilot was initiated on a corporate level, yet concentrated on shared activities and resources. Initially, accounts payable

was seen as non-strategic and was outsourced to external parties. However, even a seemingly simple activity created problems. More specifically, due to inadequate control, the Indian supplier did not pay the bills for the factory in Boston. After repeated calls from the utility company, the electricity was shut down and a costly production grinded to a halt. To handle this problem, ManuCo wanted to regain control and in-sourced the accounts payable. However, it decided to experiment with RPAs to ensure a cost-efficient process. This was also a robotisation initiative that made sense from the perspective that ManuCo's divisions were responsible for driving its own digitalization projects. Those projects where the corporate level is involved must be related to less strategic issues for the divisions. As the outsourcing also showed, however, even less important activities – such as account payables – might interrupt and harm important activities, thus, creating problems in critical customer relationships.

Table 8.2: Summary of Illustrative Cases

	ForestCo	ManuCo	Global
Internationalisation Strategy	Ethnocentric	Polycentric	Geocentric
Type of Accounting Function Being Robotised	Keeping track of salaries	Accounts payable	Inter-company transactions
Problem/Solution	Quickly identifying deviation in salaries in order to maintain the headquarter-subsidiary control	From centralised to decentralised handling of accounts payable is facilitated by the use of robots	Managing the internal market through robots in a more efficient way

The Global case shows how a multi-national company with a *geocentric strategy* needs to manage inter-company processes. The amounts of internal transactions make this a natural first step for Global, and the amount of money and energy of the employees that can be saved are substantial. In this case, we could see that the RPAs reinforce this organisational structure and make the structure run much more smoothly with less tension than before.

To conclude, these illustrative cases have shown that the organisational strategy of multi-national companies tends to influence their RPA initiatives. In ethnocentric companies, such as ForestCo, we can see that the robotisation enforces the hierarchical control over the subsidiaries, while in the ManuCo

case, the corporate level initiative to run the accounts payable through a robot will lead in the end to every division having a robot that can be independently used in relation to the specific needs of that division. Lastly, geocentric companies, where Global is a very good example, must handle internal transactions in a smooth way. Here, robots will play a key role in order to create an efficient internal market.

If we go beyond the issue of the robotisation of accounting, it is interesting to return to Table 8.1 and the third phase of "accounting and digitalization". As we described, when digitalization focuses upon both front-end and back-end digitalization, it is unclear how the finance function will develop in the future. On the one hand, an optimistic scenario can be that accountants and controllers will become trusted partners in a world of big data. In this scenario, robots and artificial intelligence are important tools to complement the necessary judgment that most likely is needed to make reasonable business decisions. As was illustrated with the ManuCo case, one never knows when a seemingly standardised activity becomes strategic. On the other hand, we can also see a pessimistic scenario where robots and artificial intelligence becomes substitutes for accountants and controllers. In this scenario, IT directors or perhaps "the Corporate Digital Office" becomes the king/queen. Our talks with IT directors have shown that many seem to believe it is now possible to regain the power that was lost during the ERP-system era. However, the cases – especially the ForestCo case – seem to indicate that some potential organisational tensions arise between the IT department and the finance function. RPA is unchartered territory in some multi-nationals, and it is not clear where the responsibility of the processes will reside.

For us, as scholars in accounting and financial management, an interesting path to follow is certainly the role of the business controller in this new era. What role will the controller play in the digital world? Schäffer and Weber (2016) point out some interesting and potential important areas to follow. The controller community has long aimed to be more of business partners, rather than only "bean counters". In order to be a business partner in the new digital landscape, the digital business model must be translated so it corresponds to the business model of the company; otherwise, the controller risks supporting the wrong processes and, in the end, supporting the wrong decisions as a function will also become obsolete. More than that, Schäffer and Weber point out that controllers need to integrate analytics and, thereby, also need to gain

new knowledge and skills (such as statistics) in order to become valuable for the business.

Still, the limits of systems can be problematised. For example, Professor Paolo Quattrone recently offered a critical view of digitalization in the field of accounting research, remarking upon the consequence it can have, if we are not careful (Quattrone, 2016, p.120):

> *The digital revolution has the opportunity to challenge the tyranny of transparency and this modern divide because the entire edifice of measurement could potentially be disrupted by a tweet or an internal e-mail…. If I had to bet on what big data will do for decision-making, I would say that it will make people take wrong decisions much more quickly than before, with even less room for the exercise of wisdom beyond the increasing compliance that affects various realms of decision-making, from finance to risk management.*

Quattrone pictures a somewhat dark future. We acknowledge that the information will be available to more functions and individuals in large multi-national companies than ever before that will perhaps lead to issues we cannot foresee today. One potential path is that digitalization will create even new organisational forms about which we have little knowledge. One such organisational form could well be the heterarchy that Hedlund (1986) sketched out in an analytical and conceptual article in 1986, where he argued that there would be no clear centre in hierarchies and that the organisation would be comprised with nodes creating a network. In fact, we can see that the digitalization and the RPAs that we have encountered in this chapter might well create the opportunities to go in a heterarchical path. As we could see in one of our cases, is not clear cut that the transactional activities should be centralised to a centre and that the processed information will be sent out to a the organisational periphery (Robson 1992). Instead, digitalization and RPAs will allow for an organisational structure that resembles heterarchies: where power and information (knowledge) can be found more than ever before on the periphery of large multi-national companies.

References

Bartlett, C. A., & Ghoshal, S. (2002). *Managing Across Borders: The Transnational Solution*. Harvard Business Press, Boston, MA.

Busco, C., Giovannoni, E., & Scapens, R. W. (2008). Managing the tensions in integrating global organisations: The role of performance management systems. *Management Accounting Research, 19*(2), 103-125.

Chandler, A. D. (1966). *Strategy and Structure: Chapters in the History of the Industrial Enterprise*. MIT Press, Cambridge, MA.

Deloitte (2015). The Robots are coming.

Hedlund, G. (1986). The hypermodern MNC – A heterarchy? *Human Resource Management, 25*(1), 9–35.

Hyvönen, T., Järvinen, J., & Pellinen, J. (2008). A virtual integration–The management control system in a multinational enterprise. *Management Accounting Research, 19*(1), 45–61.

Isaksson, D., & Wennberg, K. (2016). Digitalization and collective value creation. In Bergström, A., & Wennberg, K. Machines, *Jobs and equality. Technological Change and Labor Markets in Europe*. European Liberal Forum, Brussels, Belgium.

McKinsey & Co. (2016). Digital globalization: The new era of global flows. March 2016. McKinsey Global Institute.

Newman, M., & Westrup, C. (2005). Making ERPs work: accountants and the introduction of ERP systems. *European Journal of Information Systems, 14*(3), 258–272.

Perlmutter, H. V. (1969). The tortuous evolution of the multinational corporation. *Columbia Journal of World Business, 4*(1), 9–18.

Robson, K. (1992). Accounting numbers as "inscription": Action at a distance and the development of accounting. *Accounting, Organizations, and Society, 17*(7), 685–708.

Schäffer, U., & Weber, J. (2016). Digitalization will radically change controlling as we know it». *WHU Controlling & Management Review, 60*(6), 6–17.

Quattrone, P., & Hopper, T. (2005). A 'time–space odyssey': management control systems in two multinational organisations. *Accounting, Organizations, and Society, 30*(7), 735–764.

Quattrone, P. (2016). Management accounting goes digital: Will the move make it wiser? *Management Accounting Research,* 31, 118–122.

Uncertainty and Complexity in Predictions From Big Data: Why Managerial Heuristics Will Survive Datafication

GUSTAV ALMQVIST

Introduction

Target Corporation is the second largest discount store retailer in the U.S. The Company belongs to an industry that constantly craves for more customer information in order to improve marketing effectiveness. To reach this goal as efficiently as possible, merely knowing the past or present is not enough. Data must also enable them to predict[1] the future. When reports broke that Target had managed to use the consumption history of one of its customers, a high school girl, to infer her pregnancy (well before her father knew) it, indeed, stirred some controversy (Sanders, 2014). However, as *The New York Times Magazine* emphasised at the time, it actually came as little surprise to marketers with an interest in predictive analytics. Amazon has since patented anticipatory shipping, to utilise similar abilities on a large scale within its logistics.

Digitalization enables today's marketing professionals to know their digital customers better than ever before. What this really means is that they possess more extensive information about their past and present behaviour. By logical extension, most marketers believe that these *Big Data* will contribute to the realisation of commercial objectives (Erevelles, Fukawa & Swayne, 2016).

The purpose of this chapter is to go beyond the data themselves to illustrate mechanisms in the predictions they generate. The dual function of all

1 Prediction and forecasting will be used interchangeably throughout the chapter.

prediction is to monitor forecast quality and improve decision-making (Winkler & Murphy, 1968). This chapter will address both of these aspects, building upon the forecasting and judgment and decision-making (JDM) literatures, to present a non-technical investigation of the challenges inherent in forecasts from big data.

The *Golden Rule* of forecasting advocates sophisticated prediction models that incorporate all available information (Armstrong, Green & Graefe, 2015). All else being equal, this assumes that having access to more data also lead to better predictions. And yet, at the same time, there is evidence that ignoring part of the information can improve forecasts (Hogarth & Makridakis, 1981; Soyer & Hogarth, 2015) and that simple prediction models often do well (Makridakis & Hibon, 2000). Understanding this paradox will nuance the expectations placed upon predictions from big data. This chapter will argue that forecasts require a good match between the uncertainty of the environment and the complexity of the prediction model.

What constitutes a good prediction? What is meant by big data? Which dynamics determine the predictability of the future? And, are extensive information and sophisticated models really pre-requisites for businesses to anticipate the behaviour of their digital customers? These and similar questions will be answered in the following. The chapter will begin with some comments on prediction, continue with a summary of the literature on big data, then illustrate some mathematical-statistical constraints in forecasting, and conclude by saying that simple *managerial heuristics* (businesses' rules of thumb) may yet survive – even in this age of *Datafication*.

Predictions From Big Data

PREDICTION

Predictions estimate future states of the world when the outcomes cannot be known for sure. Following Hogarth, Lejarraga, and Soyer (2015), prediction involves two populations or settings. In the first setting, data are analysed and interpreted, thus, enabling *learning (L)*. This knowledge is projected into the future in the second setting with the aim of fitting an outcome: the *target (T)*. Predictions can only be effective to the degree that the information in L and T match. They must overcome both *uncertainty* and *complexity*. The former is

the dispersion of the probability density function of T while the latter are the interdependencies among the prediction model's variables (Schoemaker, 2004). As a result, as Nils Bohr, Nobel laureate in physics once said: "Prediction is very difficult, especially if it's about the future."

Predictors and Predictands

Take a music streaming service about to recommend a playlist to one of its users. It cannot perfectly anticipate how it will be received. However, it can make a qualified guess. Certain cues in the past (having just listened to *Oasis*), may have been positively correlated to one criterion (next wanting to hear *The Beatles*), yet negatively to another *(Blur)*. Thus, forecasts extrapolate what is already known into the future and hope that the original relationships still hold. L and T become linked through *predictors* (independent variables) of *predictands* (dependent variables).

Forecasts can be divided into two classes: *deterministic* and *probabilistic*. The former yield a single value ("AC Milan will win the 2017/2018 Europa League") while the latter allocates probabilities to all potential outcomes ("there is a 15 % chance of AC Milan winning the Europa League; there is a 14 % chance of Arsenal FC winning it," et cetera).[2] Predictands can be *binary, categorical, integer, real-valued* or *complex* variables. For example, a prognosis that Gary Oldman will win the Oscar for Best Actor in 2018 is a deterministic forecast of a binary predictand (he either wins it or does not). Table 9.1 below contains some further examples.

For predictions to guide decision-making, these distinctions matter. Deterministic forecasts only project the most likely outcome. Hypothetically, the percentage chance of the most likely outcome can still range between ~ 0 % (think of the person holding the most tickets in the state lottery) and 100 %. For example, weather presenters normally provide temperature forecasts as integers and rain prognoses binary since they do not disclose absolute likelihoods. And yet, the actual probabilities may differ from one day to another; some days are inherently more uncertain than others. Therefore, accepting a deterministic forecast at face value always involves a risk, although it is possible to shift between deterministic and probabilistic forecasts and across predictands through designated transformation rules (Stephenson, 2002).

2 The probabilities were inferred from a bookmaker's betting odds (in September 2017) assuming a margin of 2–7 %.

Table 9.1. Examples of Predictands

Predictand	Scenario
Binary	An e-commerce company wants to infer whether those who have recently purchased product A also will buy product B.
Categorical	A TV production company is eager to know what interest the next season of its main series will attract: massive, average or none (quantified categories).
Integer	An advertising agency tries to anticipate how many followers a particular social media group will have by the end of the week.
Real-valued	An online store hopes to estimate the amount of data traffic its site will experience during the Christmas sales.
Complex	A betting site observes a rapid surge in clicks on a particular team and needs to figure out if and how this will affect the eventual distribution of bets.

What is a Good Prediction?

When the public learns about predictions, these are either the especially good or the particularly poor. Think of the lucky bettors who backed Leicester to win the 2015/2016 Premier League at 1000–1 odds or the unfortunate pollsters who were sure that Bremain and Hillary Clinton would win their respective elections. Meanwhile, the everyday efforts to incrementally improve prediction quality are seldom known.

Prediction quality is assessed through *verification*. This process systematically operationalises, measures, and evaluates predictions in order to enable continuous improvements. Good forecasts are those with high *accuracy* (low *prediction error*). That is, observations *(O)* and forecasts *(F)* that correspond.

Evaluations are sensitive to the choice of accuracy measure (Makridakis & Hibon, 2000). The predominant metric is the *Mean Absolute Error (MAE)* (see equation 1), which measures the average prediction error (Murphy, 1993):

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|O_i - F_i| \qquad (1)$$

BIG DATA

The digital age has enabled Datafication. Where there were once small but tidy sets of information, subjected to deductive analyses by humans, there are now enormous amounts of fragmented data, which computers inductively mine for

correlations (Mayer-Schönberger & Cukier, 2013). This shift is driven by big data. The term Big Data emerged informally in the mid 1990s and would feature in the odd academic publication a few years later (Diebold, 2012).[3]

According to Laney's (2001) *Three V's* framework, big data compiles extensive *(volume)*, multi-faceted *(variety)* data instantaneously *(velocity)*. Indeed, this imaging is there for all to see. Search engine(s) and social media platforms generate enormous amounts of data about their users, of numerous types and origins, and do so in real-time. E-commerce platforms constantly monitor their customers in order to improve segmentation and customise offerings. Streaming services log activities to study preferences in greater detail than ever before. All of the above data are vast, diverse, and immediate.

IBM has since coined another V – *veracity* – to pinpoint data ambiguity (Claverie-Berge, 2012; Scroeck et al., 2012). Others have highlighted how the meaning of data may change *(variability)*, that big data only becomes meaningful once information can be extracted from them *(value)*, and that they must be presented in an understandable way *(visualisation)*. Accordingly, there are actually *Seven Vs* of big data in total (Sivarajah et al., 2017).

The academic literature on big data is still new and mostly discusses data problems or process challenges related to acquisition, cleansing, aggregation, analysis or interpretation (Gandomi & Haider, 2015; Sivarajah et al., 2017). And yet, the key to big data is arguably that they can utilise heterogeneity to improve segmentation. As samples increase, this enables the study of previously marginalised sub-groups of the population (Fan, Han & Liu, 2014).

Big data's predictive potential, however, has attracted the most widespread interest. Be that Google's (in) ability to predict flu outbreaks (Lazer, Kennedy, King & Vespignani, 2014), an airline's improved estimated time of arrivals (Brynjolfsson & McAfee, 2012) or a consultancy's successful forecasts of niche auto sales (LaRiviere et al., 2016). Allegedly, "It's a simple formula: Using big data leads to better predictions, and better predictions yield better decisions" (Brynjolfsson & McAfee, 2012, p. 65).

Unfortunately, the truth of the matter is more complicated. Firstly, due to the novelty of big data, there is a deficit of empirical evaluations. Without systematic verifications of its predictive accuracy in the real world, it is difficult to assess how good predictions big data actually enables, especially across tasks.

3 See Ward and Barker (2013) for further definitions.

Secondly, as highlighted in the introduction, it is well established that simple prediction models may outperform complex approaches. Meanwhile, predictions from big data remain advanced and employ either *regression techniques* or *machine learning* (Gandomi & Haider, 2015).[4] Thirdly, big data implies that the number of variables and dimensions increase, which in-turn results in higher complexity. Taken together, these concerns indicate that predictions from big data remain most difficult. Two explanations for this will be discussed in the following section.

THE BIAS/VARIANCE DILEMMA

The first consideration is the *bias/variance dilemma* (Geman, Bienenstock, & Doursat, 1992), which relates to prediction uncertainty; it stipulates that there are three sources of total prediction error. These are *bias, variance* and a *residual (ε)* (see equation 2). Bias is the systematic deviation from the true score while ε is noise (presumed *exogenous*). This leaves variance. Here, variance could be seen as an important *Eight V* of big data and represents the prediction model's sensitivity data. Assume that L consists of several samples, drawn from the population T, and that each sample yields a unique prediction to fit the true function. Then variance measures the spread over these predictions. An unbiased model could suffer from high variance, or vice-versa. In practice, there is often a tradeoff between the two.

$$Total\ error = Bias + Variance + \varepsilon \qquad (2)$$

Regression techniques are superior at minimising bias within any dataset *(in-sample)*. But this is the easy part. Bias can be reduced from additional parameters alone. As the mathematician John von Neumann jokingly said: "With four parameters, I can fit an elephant, and with five I can make him wiggle his trunk" (see Dyson, 2004). However, similar exercises are susceptible to noise, which can be confused for signal. Statisticians refer to this problem as *overfitting*.

Although predictions should aim to minimise total error, Brighton and Gigerenzer (2015) still find a tendency to "develop, deploy, or prefer models that are likely to achieve low bias, while simultaneously paying little or no

4 This chapter will only discuss the former approach. On machine learning, see Hasan, Shamsuddin and Lopes (2014).

attention to models with low variance" (p. 1772). They use a subset of London temperatures to show the danger of overfitting polynomials to small samples and how this increases total error in prediction (*out-of-sample*).

Similar data will be applied in the following section to illustrate the other side of model complexity – *functional form* – that can have the same adverse effect. A dataset was obtained and analysed, courtesy of the Swedish meteorological and Hydrological Institute's (SMHI). Figure 9.1 contains a 360-temperature observation from Stockholm throughout 2016.

As a first, a linear function along with 2nd (quadratic), 3rd, 4th, 5th and 6th degree polynomials are fit to the observations from January through November (n=329). As expected, increasing model complexity gradually explains more and more of the variance in temperature (in sample).[5] As a second, the same functions are extrapolated to predict (out-of-sample) the December temperatures (n=31). Suddenly, the quadric function has the highest accuracy. Neither the linear function nor the more complex polynomials match the environment equally well. Similarly, although large datasets limit overfitting, the right degree of model sophistication depends upon the uncertainty of the environment (Hogarth & Karelaia, 2007). Different functional forms will find it easier than others to fit some patterns.

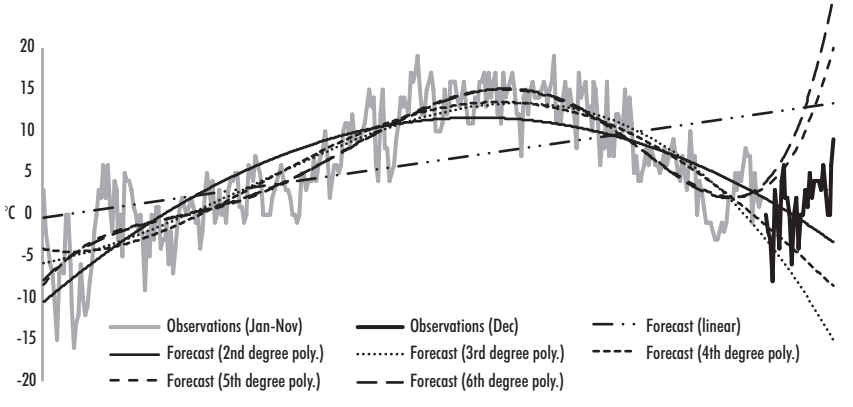

Figure 9.1. Model complexity and prediction accuracy. A linear function and 2nd, 3rd, 4th, 5th and 6th degree polynomials fit to Stockholm temperatures from January-November 2016 (in grey; n = 329) and then extrapolated to forecast December 2016 (in black; n = 31). The quadratic function does best.

5 The respective R2 values read .26, .68, .75, .75, .79 and .79.

THE CURSE OF DIMENSIONALITY

The second issue is the *curse of dimensionality* (Hughes, 1968), which affects prediction complexity. Big data places high demands upon a prediction model, as the number of dimensions per sample increases. Assume a large sample (n) with coordinates throughout an *m*-dimensional space. For instance, say the goal is to predict future purchases among a large group of digital customers about whom extensive information is available. Along with several underlying parameters, the prediction model stipulates independent variables as predictors of purchases. As model complexity increases, however, more correlational relationships involving the independent variables appear. Some are found for a reason, others merely by chance.

Following Fan, Han and Liu (2014), the accompanying risks include *spurious correlations* and *incidental endogeneity*, both of which violate key assumptions of regression methods. The former refers to the fact that the more parameters a prediction model contains, the likelier it becomes that variables incidentally emerge as correlated within the sample. The latter means that independent variables could be correlated with ε (thus *endogenous*). As a result, predictions from big data require analytical and practical tools for variable selection and dimension reduction. Whether more data can be leveraged into better forecasts will partly depend upon which function they are expected to fill within the prediction model.

Consider the following related example from finance. The risk of a portfolio depends upon the covariance of the individual assets' returns. As of November 2017, there have been 361 companies listed on the Nasdaq Stockholm stock exchange.[6] Building a portfolio from these technically requires estimating the entire covariance matrix to maximise the risk-adjusted return. And these elements can be combined in many ways. Here, this translates into having to estimate 65,341 covariance parameters. And even the slightest errors among these estimations could end up having a significant effect upon the portfolio due to *noise accumulation*. Again, model complexity comes at a price.

IMPLICATIONS

There are numerous examples of how forecasts are constrained by the bias/variance dilemma and the curse of dimensionality. Macroeconomists regu-

6 http://www.nasdaqomxnordic.com/aktier/listed-companies/stockholm

larly use extensive data for their predictions. And evaluations undertaken by Sweden's central bank, the Riksbank, indicate that a relatively simple time series[7] remains as good at predicting inflation as its most refined prediction model (Adolfson, Andersson, Lindé, Villani & Vredin, 2006; Sveriges Riksbank, 2017). The rudimentary Basel I framework of the 1970s still outperforms Basel III in predicting financial turmoil; this is also the case when tested against recent data (Aikman et al., 2014). Moreover, in the aftermath of the latest financial crisis, Goldman Sachs' former CFO admitted his complete surprise at having supposedly witnessed 25 sigma events occur several days in a row.[8] The same dynamics are also known to apply in weather forecasting: an application of big data where prediction quality has been the focal point for decades.

This section concludes accordingly that big data forecasts remain susceptible to prediction uncertainty and complexity. Therefore, big data alone does not guarantee better predictions. The natural next step must be more systematic verifications of big data forecasts' quality across a range of real-world tasks. This will require paying equal attention to the prediction models and their performances as to the original data themselves. There can be more to the interaction between a specific prediction model and a particular environment than what first meets the eye.

Managerial Heuristics

Importantly, the alternative against which to evaluate big data predictions are not naïve models of the coin-flipping kind. Businesses already have extensive experience in dealing with an uncertain future and apply managerial heuristics doing so (Artinger, Petersen, Gigerenzer & Weibler, 2015). Managerial heuristics are businesses' rules of thumb for handling specific tasks in their environments. In fact, there is evidence that these remain very much up to the challenge.

In 2008, Wübben and Wangenheimat set out with the ambition to quantify how much businesses would gain from switching to more refined ways to analyse their *customer relationship management* (CRM) databases. Ideally, this would

7 Technically a Bayesian vector autoregression (BVAR) model.

8 Even one such event happening by chance is so incredibly unlikely it practically translates into impossibility; like winning the 1-in-2,500,000 state lottery 21–22 successive times (Dowd, Cotter, Humphrey & Woods, 2008).

have enabled better predictions as to whether or not customers remained active in order to anticipate repurchases. They studied independent sets of CRM data from companies in three different industries: an apparel retailer, an airline, and a CD retailer.

The marketing departments had used a straightforward metric – recency-of-last-purchase together with a cutoff time – whereby a customer who had not made a purchase for a certain number of months was classified as inactive. Wübben and Wangenheimat (2008) put this heuristic to the test and compared its predictions to those made by stochastic models that statistically estimated parameters for customers' purchases and dropout rates. To their surprise, they found "no clear evidence for the superiority of these models for managerially relevant decisions in customer management compared with simple methods that our industry partners used"; instead, they concluded, "the heuristics the firms used worked astonishingly well" (p. 92).

Macroeconomic forecasters have also been found to use intuition and heuristics in their predictions. Additionally, they interpret the task more broadly than merely as a problem of maximising accuracy (Wennberg & Nykvist, 2007).

Some interpret these and similar findings to be counter-intuitive. Brynjolfsson and McAfee (2012) would still insist: "that throughout the business world today, people rely too much on experience and intuition and not enough on data." (pp. 66) But no method, however advanced, can maintain its superiority in face of conflicting evidence. Because in nature and business alike, the pursuit is not maximum sophistication; it is fit: effectiveness in an environment. For as long as prediction remains an empirical issue, managerial heuristics cannot be rejected a priori.

Discussion

In closing, the chapter will briefly discuss what the future might hold for predictions from big data. In an eschatology of sorts, Mayer-Schönberger and Cukier (2013) have suggested that theory and inferential statistics will be replaced, as big data implies $N \sim all$. Correlation will replace causality and a paradigmatic shift from reason to association follow. Given enough data, computers will inductively figure out the world by themselves.

However, big data does not make theory redundant. On the contrary, had it not been for common sense, Google's algorithm would have had people believe that high school basketball games predicted flu outbreaks, as their

seasonality happened to be similar (Lazer et al, 2014). Going forward, this divide will surely cause more debate.

Some consider big data to be a new computational and statistical paradigm (Fan, Han & Liu, 2014); it is fair to assume that the unique characteristics of big data will see to it that certain methods are refined while others are replaced. Tools for analysing high dimensionality data will likely be in demand.

To end on a pessimistic note, the future will tell whether or not big data spirals into an unfortunate man versus machine scenario. In the meantime, ethical issues remain a concern. Ensuring personal integrity and protecting citizens' interests are critical challenges for societies and democratic institutions (Helbing et al., 2017).

Conclusions

The following recommendations are, hereby, provided for businesses considering using big data for forecasts:

- To distinguish between the learning and target population
- To define and operationalise predictors and predictands
- To recognise the difference between deterministic and probabilistic forecasts
- To monitor prediction quality through a systematic verification process
- To beware of the bias/variance dilemma and the curse of dimensionality
- To evaluate prediction models competitively (out-of-sample)
- To avoid overly complex models

Nonetheless, their ability to predict the future will be anything but certain.

References

Adolfson, M., Andersson, M. K., Lindé, J., Villani, M., & Vredin, A. (2006). *Modern Forecasting Models in Action: Improving Macroeconomic Analyses at Central Banks* (No. 188). Sveriges Riksbank.

Aikman, D., Galesic, M., Gigerenzer, G., Kapadia, S., Katsikopoulos, K., Kothiyal, A., ... & Neumann, T. (2014). *Financial Stability Paper No 28: Taking uncertainty seriously-simplicity versus complexity in financial regulation* (No. 28). Bank of England.

Armstrong, J. S., Green, K. C., & Graefe, A. (2015). Golden rule of forecasting: Be conservative. *Journal of Business Research, 68*(8), 1717–1731.

Artinger, F., Petersen, M., Gigerenzer, G., & Weibler, J. (2015). Heuristics as adaptive decision strategies in management. *Journal of Organizational Behavior, 36*.

Brighton, H., & Gigerenzer, G. (2015). The bias bias. *Journal of Business Research, 68*(8), 1772–1784.

Claverie-Berge, I. (2012, March 13). Solutions Big Data IBM. [Presentation]. Retrieved from https://www-05.ibm.com/fr/events/netezzaDM_2012/Solutions_Big_Data.pdf

Diebold, F. (2012). *A Personal Perspective on the Origin (s) and Development of "Big Data": The Phenomenon, the Term, and the Discipline, Second Version*. Penn Institute for Economic Research, Department of Economics, University of Pennsylvania.

Dowd, K., Cotter, J., Humphrey, C., & Woods, M. (2008). How unlucky is 25-sigma? *The Journal of Portfolio Management, 34*(4), 76–80.

Dyson, F. (2004). A meeting with Enrico Fermi. *Nature, 427*(6972), 297–298.

Erevelles, S., Fukawa, N., & Swayne, L. (2016). Big Data consumer analytics and the transformation of marketing. *Journal of Business Research, 69*(2), 897–904.

Fan, J., Han, F., & Liu, H. (2014). Challenges of big data analysis. *National Science Review, 1*(2), 293–314.

Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management, 35*(2), 137–144.

Geman, S., Bienenstock, E., & Doursat, R. (1992). Neural networks and the bias/variance dilemma. *Neural computation, 4*(1), 1–58.

Hasan, S., Shamsuddin, S. M., & Lopes, N. (2014). Machine Learning Big Data Framework and Analytics for Big Data Problems. *International Journal of Advances in Soft Computing & Its Applications, 6*(2).

Helbing, D., Frey, B. S., Gigerenzer, G., Hafen, E., Hagner, M., Hofstetter, Y., … & Zwitter, A. (2017, February 25). Will Democracy Survive Big Data and Artificial Intelligence? [Blog post]. Retrieved from https://www.scientificamerican.com/article/will-democracy-survive-big-data-and-artificial-intelligence/

Hogarth, R. M., & Karelaia, N. (2007). Heuristic and linear models of judgment: Matching rules and environments. *Psychological Review, 114*(3), 733–758.

Hogarth, R. M., Lejarraga, T., & Soyer, E. (2015). The two settings of kind and wicked learning environments. *Current Directions in Psychological Science, 24*(5), 379-385.

Hogarth, R. M., & Makridakis, S. (1981). Forecasting and planning: An evaluation. *Management Science, 27*(2), 115–138.

Hughes, G. (1968). On the mean accuracy of statistical pattern recognizers. *IEEE Transactions on Information Theory, 14*(1), 55–63.

Laney, D. (2001, February 6). 3-D Data Management: Controlling Data Volume, Velocity and Variety. [Research Note]. Retrieved from https://blogs.gartner.com/doug-laney/files/2012/01/ad949-3D-Data-Management-Controlling-Data-Volume-Velocity-and-Variety.pdf

LaRiviere, J., McAfee, P., Rao, J., Narayana, V. K., & Sun, W. (2016, May 25). Where predictive analytics is having the biggest impact. [Online article]. Retrieved from https://hbr.org/2016/05/where-predictive-analytics-is-having-the-biggest-impact

Lazer, D., Kennedy, R., King, G., & Vespignani, A. (2014). The parable of Google Flu: Traps in big data analysis. *Science, 343*(6176), 1203–1205.

Makridakis, S., & Hibon, M. (2000). The M3-Competition: results, conclusions and implications. *International journal of forecasting, 16*(4), 451–476.

McAfee, A., Brynjolfsson, E., & Davenport, T. H. (2012). Big data: The management revolution. *Harvard Business Review, 90*(10), 60–68.

Mayer-Schönberger, V. & Cukier, K. (2013). *Big Data: A Revolution That Will Transform How We Live, Work, and Think*. London: John Murray Publishers.

Murphy, A. H. (1993). What is a good forecast? An essay on the nature of goodness in weather forecasting. *Weather and Forecasting, 8*(2), 281–293.

Sanders, N. R. (2014). *Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence*. Pearson Education.

Schoemaker, P. J. (2004). Forecasting and scenario planning: the challenges of uncertainty and complexity. *Blackwell Handbook of Judgment and Decision Making,* 274–296.

Schroeck, M., Shockley, R., Smart, J., Romero-Morales, D., & Tufano, P. (2012). Analytics: The real-world use of big data. *IBM Global Business Services,* 1–20.

Sivarajah, U., Kamal, M. M., Irani, Z., & Weerakkody, V. (2017). Critical analysis of Big Data challenges and analytical methods. *Journal of Business Research, 70,* 263–286.

Soyer, E., & Hogarth, R. M. (2015). The golden rule of forecasting: objections, refinements, and enhancements. *Journal of Business Research, 68*(8), 1702–1704.

Stephensson, D. B. (2002, October 29). David B. Stephenson's proposed classification scheme for forecasts. Retrieved from http://www.cawcr.gov.au/projects/verification/forecast-types.pdf

Sveriges Riksbank (2017, May 2). Utvärdering av Riksbankens prognoser. [Report]. Retrieved from http://www.riksbank.se/Documents/Rapporter/Riksbanksstudie/2017/rap_riksbanksstudie_170502_sve.pdf

Ward, J. S., & Barker, A. (2013, 20 September). Undefined By Data: A Survey of Big Data Definitions. Retrieved from http://www.adambarker.org/papers/undefined_by_data_ward_barker.pdf

Wennberg, K. & Nykvist, B. (2007). The Psychology of Economic Forecasting. *Global Business and Economics Review, 9*(2), 211–226.

Winkler, R. L., & Murphy, A. H. (1968). "Good" probability assessors. *Journal of Applied Meteorology, 7*(5), 751–758.

Wübben, M., & Wangenheim, F. V. (2008). Instant customer base analysis: Managerial heuristics often "get it right". *Journal of Marketing, 72*(3), 82–93.

Explaining the Behaviour of News Consumption

ADAM ÅBONDE

Brave New(s) World

The way in which people find and consume news[1] and information about the world is changing. As the news industry is facing a textbook example of technological disruption (Küng, 2015), both scholars and industry have been very focused upon *what* is being published (Anand, 2016) in their quest to understand and adapt to the new rules of the game. Another point of departure is suggested in this chapter: I ask *why* news consumers are changing their behaviour. I adopt a behavioural perspective when looking to explain news consumption, thus, arguing that although *content* is important, it is even more critical to understand the *functions* of consuming certain content.

News publishing has been traditionally associated with large fixed costs (Anand, 2016). The costs of producing and distributing content today has greatly diminished and there has been an explosion in the number of news publishers and the amount of content created; fragmented media consumption is a result (Küng, 2015). The internet, smartphones, and social media have all had their profound impact. Indeed, with social media, people have, in a sense, become their own media producers.

In the digital era, money is not the primary currency anymore. Rather, consumers' time and focus are what matters (Goldhaber, 1997; Simon, 1971; Wu, 2017), since this is what brings in ad revenue (Anand, 2016). With the digitalization of media, news must now compete for consumer's attention with virtually all other kinds of information ("How the world was trolled," 2017):

1 The American Press Institute defines news as "that part of communication that keeps us informed of the changing events, issues, and characters in the world outside" (Dean, 2013).

both from other news sources and from completely new competitors providing other kinds of content ("Funnel Vision," 2017).

While some news publishers are succeeding in the digital world; others are not. Various online, mobile, and social media sources are on the rise (Küng, 2015; Wahlund, Rademaker, Nilsson, & Svahn, 2013); while print subscriptions continue to fall. Recent figures show that as many as 85% of Swedes consume news online from time to time: a 66% increase from in 2007 (Davidsson & Findahl, 2016). Social media has become an important news source for many (Müller, Schneiders, & Schäfer, 2016)especially younger, users use Facebook as their primary source for news about political and societal issues. At the same time, research suggests that Facebook use contributes to societal knowledge gaps. Against this background, we investigate the antecedents of using Facebook as a substitute for other news sources. We argue that exposure to news posts on Facebook increases the feeling of being well-informed, regardless of actual knowledge acquisition. This might lead users, especially those with a low need for cognition (NfC. In Sweden, more than every other Facebook user (53%) is using the platform as a news source (Davidsson & Thoresson, 2017). Consuming news is the third most common activity on Facebook, preceded only by chatting through messenger: of which 81% of Swedish Facebook users do, and being part of groups: of which 63% are (Davidsson & Thoresson, 2017).

Recently, some news publishers have actually seen an increase in their number of digital subscribers. For example, both The New York Times and The Washington Post are now bringing in more money through subscriptions – for digital and print combined – than they do with advertising ("Funnel Vision," 2017). Digital sales for news publishers in Sweden are also increasing overall (both subscriptions and ads), yet are still at very low levels and, in most cases, are simply not enough to compensate for the loss in print sales, with only one exception: evening papers (Ohlsson, 2017; Wahlund et al., 2013).

What the future holds for news and journalism is not evident. Nevertheless, understanding the opportunities and threats of digitalization, and how this influences human behaviour (Levitin, 2015) is important not only from a business perspective (Anand, 2016; Küng, 2015); it is also significant for democracy ("How the world was trolled," 2017). While the disruption is largely driven by digitalization and diffusion of new technologies, per sé, a behavioural approach provides a theoretical basis for looking at *individuals' contemporary news consumption behaviours*.

I provide a cursory overview of behaviourist notions of learning. I argue that, as the environment changes, so does the function of behaviours. I further present four examples of news and media companies that are viewed as being successful in the digital sphere and provide a behavioural explanation for why they are successful. I end the chapter by concluding that news publishers must move away from thinking solely about what content they are producing, and begin to primarily focus upon the function the consumption their products offer their consumers.

* * *

The remainder of the chapter is organised in three parts. First, behavioural learning theory is reviewed. Here the role of nature and nurture in human behaviour in general is briefly presented and how it relates to digital technologies. Secondly, I discuss the specific behaviour of consuming news. Different functions of news consumption are considered and examples of news and media companies that are viewed as being successful in the digital sphere are presented in light of this. Third, the chapter concludes with a summary outlining the main points made and I offer some implications for practitioners.

Human Behaviour and Digitalization

NATURE, NURTURE, AND HUMAN BEHAVIOUR

One's behaviour is commonly attributed to nature or nurture – or both. Nature represents inherited capabilities or predispositions that have developed over many generations through evolution: that is to say, it is embedded in the genetic code (Dawkins, 2006). Nurture represents the effects of interacting with the environment: that is to say, one learns from experience (Myers, 2010: p. 291). Nature and nurture are different sides of the same coin; both represent the influence of the environment upon one's behaviour, yet their time horizon differs: nature over the course of evolution of the species, nurture during the lifetime of the individual (Skinner, 1974, via Delprato & Midgley, 1992).

The role of nature is quite easy to grasp (at least on a superficial level). Combinations of genes promote different behaviours. Natural selection favours combinations of genes that foster behaviours that increase the chance of survival of the organism (Dawkins, 2006). That is to say, organisms that behave in ways that increases their survival rate tend to live; organisms that

engage in less successful behaviours tend to die. As a result, certain combinations of genes – and the related behaviours – have a greater probability to survive to the next generation (Dawkins, 2006).

As an example, nature could explain why humans react to sudden noises or movements in our surroundings; the species has evolved to react to novel stimuli, which is why our attention automatically shifts to new things that are happening around us (Dawkins, 2006). Evolutionarily, this behaviour is likely to have been favoured, since it has increased the chance of survival. For example, by acknowledging sudden movements in the corner of the eye, individuals could save themselves from dangerous animals lurking in the bushes. Or by being extra susceptible to strong colors, one might be better suited to avoid poisonous plants. Of course, today's world is different. In large parts of the world, the number of dangers from which humans need to shield themselves has diminished – or at least they are of another kind.

The impact of nature is straight-forward; the principles of learning are less intuitive. Humans learn either by association or by observation (Myers, 2010, p.291-293): learning by doing or learning by watching others do, respectively. Here, the focus will be upon learning by association: that is to say, doing.

Associative learning is further divided into *classical* and *operant* conditioning (Bouton, 2016; Myers, 2010). Classical conditioning is when an organism "learn[s] to associate two stimuli and thus to anticipate events" (Myers, 2010, p.292). The archetypical example of classical conditioning is Pavlov's dogs: a dog learns to associate the ringing of a bell (stimuli 1) with food (stimuli 2); then when the dog hears the bell ring, it begins to salivate (response) regardless whether or not there is any food present (it has learned that the bell usually implies food is coming; therefore, its body starts preparing for digesting it [Bouton, 2016]).

Operant conditioning is when an organism "learns to associate a response [...] and its consequence and, thus, to repeat acts that are followed by good results [...] and avoid acts followed by bad results" (Myers, 2010, p.293). When a behaviour is followed by good results, it is *reinforced*, which increases the probability of the behaviour occurring again (Bouton, 2016). On the other hand, when a behaviour is followed by bad results, it is *punished*, which decreases the probability of the behaviour occurring again (Bouton, 2016). The prototypical example of operant conditioning is known as the Skinner Box: a rat learns to associate the behaviour of pressing a lever (response) with

receiving a food pellet (consequence); and, consequently, presses the lever over and over again (it has learned that the behaviour of pressing is followed by a good outcome: that is to say, the behaviour is reinforced (Bouton, 2016).

In theory, learning can explain all human behaviour (indeed, the behaviour of organisms in general). For example, operant conditioning can explain such things as why people exercise or eat candy: either behaviour is followed by a good consequence (positive reinforcement, in terms of an endorphin rush or a sugar rush, respectively).

According to behavioural learning theory, all behaviours that are not inherited through evolution are caused by external rather than internal factors: that is to say, within the organism. Changes in the environment are consequently bound to influence how an organism acts (Bouton, 2016; Delprato & Midgley, 1992; Simon, 1956) it follows quite naturally that widespread digitalization has had profound impact on the daily lives of millions, if not billions, of people around the world. Two important digital inventions – the smartphone and social media – and their impact upon human behaviour are discussed in the next section, in the light of behavioural learning theory.

THE SLOT MACHINES IN OUR POCKETS

News consumers currently find themselves in a constant state of distraction. Concerns have been raised, warning that the digital world is bad both for individuals (Levitin, 2015) and for society at large ("How the world was trolled," 2017). As information becomes ever more abundant, the new scarce resource has become people's attention. Companies currently must compete for consumers' time and focus, perhaps more than ever before. As a result, new technologies are often designed with the main goal of making its users spend as much time as possible with the technology, regardless of what is the actual value for the user of using the technology (Harris, 2016).

This discussion is not new. In the last fifty or so years, there has been much debate around the increasing amount of information that digital technologies bring with them (see Goldhaber, 1997; Simon, 1971; Wu, 2017). What is new, however, is the mobility and level of engagement of modern technology. More specifically, the little "Swiss army knife-like appliances" (Levitin, 2015) many people carry with them at all times: that is to say, smartphones and the enthralling social networks often accessed through these.

One can think of the many different reasons why people turn to their smartphones in an almost compulsive fashion – and people do. On average, Americans touch their smartphones more than 2,600 times per day: that is, every 33 seconds ("How the world was trolled," 2017). For example, it has been suggested that people are very aversive toward having nothing to do: that is, to be left with their thoughts (Wilson et al., 2014). Smartphones offer a simple escape from the discomfort of boredom.[2]

Smartphones are said to also supplant thinking (Barr, Pennycook, Stolz, & Fugelsang, 2015; Storm, Stone, & Benjamin, 2016)access to the internet and its associated knowledge base is at one's fingertips. What consequences does this have for human cognition? We frame Smartphone use as an instantiation of the extended mind – the notion that our cognition goes beyond our brains – and in so doing, characterize a modern form of cognitive miserliness. Specifically, that people typically forego effortful analytic thinking in lieu of fast and easy intuition suggests that individuals may allow their Smartphones to do their thinking for them. Our account predicts that individuals who are relatively less willing and/or able to engage effortful reasoning processes may compensate by relying on the internet through their Smartphones. Across three studies, we find that those who think more intuitively and less analytically when given reasoning problems were more likely to rely on their Smartphones (i.e.; extended mind. A behavioural explanation for this would be that individuals learn to manage just as well by "outsourcing" their thinking to their smartphones: rather than having to remember things, they have constant and immediate access to the full body of knowledge on the web.

In both of these examples, escaping boredom and outsourcing thinking represents behaviours that are reinforced by the environment through operant conditioning. As users learn that they can get a fresh dopamine kick just by checking their social media feed one more time (Levitin, 2015), or that they manage just as well by relying upon Google to retrieve information rather than trying to remember it themselves (Storm et al., 2016), this is likely to trigger a self-reinforcing spiral of behaviour. This ensures (or at least increases

2 Attempts have even been made to infer when people are bored based upon their mobile phone usage patterns (Pielot, Dingler, Pedro, & Oliver, 2015). The implications are straightforward: if a content producer or advertiser can know when a consumer is bored, they are more likely to grab the consumer's attention by pushing content to the personal device at these specific times than when the consumer has their mind focused upon other things. This would presumably also apply to news, for which attention is sought.

the probability) that people keep coming back again and again. Similar to the rat in the Skinner Box, smartphone and social media users are lured to pull-and-refresh only one more time to see whether there is some new piece of information waiting to be consumed[3]. This is why smartphones have been likened to slot machines (Harris, 2016).

With new contexts, comes new behaviour. Consequently, the function of news consumption inevitably changes, as do the technologies behind it. I will discuss news consumption and digitalization in the next section.

The Function of Consuming News

FROM CONTENT TO FUNCTION

News publishers have typically been concerned with the content they are producing, as this has been assumed to attract consumers and, hence, revenues (Anand, 2016). However, going back to nature and nurture, it is difficult to explain the evolutionary value of news consumption. While behaviors such as reacting to novel stimuli or being extra vigilant toward negative (threatening or dangerous) information can be explained by natural selection, the behaviour of consuming news cannot: for example, under normal circumstances, an individual will not be more or less likely to survive or mate as the result of news reading. Evolution may explain *how* we read (for example, focusing upon certain words, colours or features), yet not *why* we read (for example, picking up the paper to begin with). Thus, the behaviour of news consumption must be a learned one.

From a behaviourist perspective, it is possible to imagine several reasons why an individual learns to consume news. According to the definition provided by the American Press Institute (see the introduction; Dean, 2013), the function of consuming news is to stay informed in general. This, however, does not have any inherent value in itself: it is not evident that there are (directly observable) positive or negative consequences for an individual that "stays informed".

The value of staying informed through news can possibly be explained by cultural practices. As the human species began organising in larger groups (and eventually societies), there may be value for the individual to keep track

3 The fact that there are not rewards to reap every time users check for new content makes them even more likely to become "addicted": Different kinds of irregular reward patterns, called intermittent reinforcement, have been shown to be even more effective in reproducing behaviour than regular: that is to say, continuous reinforcement (Bouton, 2016).

of what has happened: not just in the immediate surroundings, however, in other parts of the community as well. Individuals are better able to make good decisions by staying informed about political developments, threats of war, emergencies, or similar things that may have an effect upon their lives. At the aggregate, a common basis of information also enables public discussion, which is vital for the proper functioning of a democracy.

An even simpler, and perhaps more accurate, explanation since it is directly experienced by the individual, would be to have something to discuss in social situations. Or, rather, to avoid the adverse consequence of being perceived by one's peers as being uninformed when talking about something (an example of negative reinforcement: the individual avoids negative feelings/expectations by consuming the news). In this case, the behaviour of consuming news has a purely social function. The behaviour enables smooth interaction with other members of the species: with colleagues at the coffee machine or at home by the dinner table.

News may also be consumed simply as a means for passing the time. This runs the spectrum of escaping boredom (that is to say, avoiding negative consequences, such as the dreadful "having nothing to do"), to actively seeking entertainment and stimulation (that is to say, pursuing positive consequences, such as reading a witty comic strip).

A counter-argument to the aforementioned functional explanations could be that behaviour depends upon factors within the individual. Say, for example, that an individual is very interested in sports. The argument would then be that this individual perceives joy or some other kind of satisfaction or utility, by consuming news about sports. Many other causes of behaviour residing within the individual, apart from interest, can come to mind as well: for example, cognitive style, personality, norms, self-enhancement, needs or a sense of belonging. From a behaviourist perspective, however, these are not causes of behaviour.

From a behaviourist perspective, news consumption is reinforced due to cultural practices. However, it has no inherent value for the individual: that is to say, survival or mating is not contingent upon it. Consuming news is *reinforced* by such things as enabling decision-making, facilitating social situations or helping the individual escape unpleasant feelings or states. Just as checking social media feeds or looking for new notifications on the smart-

phone, however, the behaviour of consuming news does not promote any other action from the individual apart from continuing to do the same thing.[4]

TOWARD AN UNDERSTANDING OF CONTEMPORARY NEWS CONSUMPTION

Four news and media companies that are viewed as being successful in the digital sphere are The Economist, BuzzFeed, Quartz, and Vice (Küng, 2015). These do not only differ in the content they publish; the function of consuming their products also differs.

The Economist has been almost notoriously slow to adapt to the digital world[5]; yet it has still managed to stay successful in the face of industry digitalization and disruption (Anand, 2016). While the content of The Economist provides its consumers – often busy individuals with little time to spare – with a perspective of the world (Anand, 2016), the function of consuming is something completely different. The Economist have kept their style and form intact; one function of reading The Economist now is an opportunity to stay away from the growing problem of information overload. Their content still provides perspective, yet the function has become the reduction of information.

BuzzFeed and Quartz are both digital news publishers dedicated to understanding virality. These companies have outspoken strategies to target young, smart, and bored-at-work individuals (Küng, 2015). As such, their content is often clever and enticing, accompanied by headlines bordering on click baits[6]. Although they offer interesting or clever news pieces, however, the function of consuming their content is a few moments of distraction.

Vice also targets a young audience, oozing more sex, drugs, and rock and roll than does BuzzFeed and Quartz. While they claim to cover important and current topics – in principle, anything that their audience wants – they tend to focus a lot upon adopting its tone and style to appeal to the audience (Vice's founder has even claimed that it takes young people to address young people, which is why the average age of their journalists is only 25 years old [Küng, 2015]).

4 For an interesting discussion on culture and behavior, see Skinner's (1986)(b paper on how human behavior has grown weak).

5 Although The Economist now complements its weekly magazine with smartphone and tablet apps, audio versions of the paper, and are active on social media.

6 Click bait is not one specific type of formatting. Rather, it refers to a number of methods intended to attract attention and, quite obviously, make news consumers click on published content. Ultimately, the goal with click baits is to make content travel online: that is, to make it viral. Different click bait techniques include tweaking content and wording to vex curiosity, encourage interaction, or engage emotionally (Chen, Conroy, & Rubin, 2015).

Vice is known for its raw and intimate coverage "behind the scenes" on controversial topics. One example is when reporters from Vice visited North Korea with the Harlem Globetrotters: they played basketball against the North Korean national team, and met with Kim Jong-un (Küng, 2015). Another example is when a Vice reporter accompanied white nationalists during the Charlottesville riots in August 2017, interviewing several of the nationalist leaders, and "provid[ing] viewers with exclusive, up close and personal access inside the unrest" (Vice News, 2017). With its Gonzo-style journalism[7] the function of Vice is more entertainment and excitement than it is to inform people.

These news publishers, and others similar to them, have successfully managed to be relevant: not primarily in what they publish, but how they publish it. Although content is important, it comes in second place. The primary focus must be upon what is the *function* of the behaviour of consuming certain news.

By shifting perspective away from content to function, it becomes possible to understand why people act the way they do. From a content perspective, it seems unreasonable that anyone would rather consume news on social media than on a news publisher's website. From a functional perspective, it makes more sense: for example, if the function of the behaviour is to escape boredom rather than to become informed. Many traditional news companies are poorly fit for the digital world: not because they have poor content, but because they do not look to the functions of the behaviour of consuming their content.

Conclusion

In the digital era, people do not pay (directly) with money, but rather with their attention. So, any publisher trying to attract a public online will compete for the attention of the masses (Goldhaber, 1997; Simon, 1971; Wu, 2017). One common way to try to do this is by focusing upon what content to publish (Anand, 2016). In the worst-case scenario, the result is increased sensationalism (for example, click baits) and a degradation of quality. Even if a company succeeds in this new environment, there is always a risk that someone else will enter the playing field and outmanoeuver them: either because they have more money, more brains, or better algorithms with which to fight.

7 "Gonzo journalism" is an approach inspired by the practices of Hunter S. Thompson, for example evident in his book *Fear and Loathing in Las Vegas*, where the writer departs from the journalistic aspiration of objectivity and instead combines subjective experiences with fiction (Küng, 2015).

Another strategy then, which is perhaps controversial for a news publisher, is to focus *less* upon the content that is produced. This does not mean that the things being published are irrelevant; from a business perspective, it is just as (if not more) important to also recognise the function of consuming the content. The behaviour of consuming news has little evolutionary value for humans. Instead, consumers have learned the behaviour through cultural practices, which is reinforced by good consequences. These consequences vary depending upon what function the behaviour serves, and can include things such as enabling good decision-making, facilitating social interaction with other individuals, or escaping boredom. By focusing upon function instead of content, it is possible to explain contemporary news behaviours: such as why consumers migrate from news publisher websites to social media platforms to consume news content.

In conclusion, news publishers should shift focus from *content*: that is to say, what they are producing and distributing, to *function*: for example, what is the purpose of consuming their product. Because digital technologies have changed the function of consumer behaviour related to news in numerous different ways.

References

Anand, B. (2016). *The Content Trap: A Strategist's Guide to Digital Change* (1st ed.). New York, NY: Random House.

Barr, N., Pennycook, G., Stolz, J. A., & Fugelsang, J. A. (2015). The brain in your pocket: Evidence that Smartphones are used to supplant thinking. *Computers in Human Behavior, 48,* 473–480. https://doi.org/10.1016/j.chb.2015.02.029

Bouton, M. E. (2016). *Learning and Behavior: A Contemporary Synthesis* (2nd ed.). Sunderland, MA: Sinauer Associates, Inc.

Chen, Y., Conroy, N. J., & Rubin, V. L. (2015). Misleading Online Content: Recognizing Clickbait as "False News." In *In Proceedings of the 2015 ACM on Workshop on Multimodal Deception Detection. ACM.* (pp. 15–19). https://doi.org/10.1145/2823465.2823467

Davidsson, P., & Findahl, O. (2016). *Svenskarna och internet 2016: Undersökning om svenskarnas internetvanor.*

Davidsson, P., & Thoresson, A. (2017). *Svenskarna och internet 2017: Undersökning om svenskarnas internetvanor.*

Dawkins, R. (2006). *The Selfish Gene* (30th anniv). New York, NY: Oxford University Press.

Dean, W. (2013). What is the purpose of journalism? Retrieved September 20, 2017, from https://www.americanpressinstitute.org/journalism-essentials/what-is-journalism/purpose-journalism/

Delprato, D. J., & Midgley, B. D. (1992). Some fundamentals of B. F. Skinner's behaviorism. *American Psychologist, 47*(11), 1507–1520.

Funnel Vision. (2017). *The Economist, 425*(43), 61–62.

Goldhaber, M. H. (1997). The attention economy and the net. *First Monday, 2*(4). https://doi.org/http://www.firstmonday.org/issues/issue2_4/goldhaber/

Harris, T. (2016). How Technology Hijacks People's Minds – from a Magician and Google's Design Ethicist. Retrieved September 20, 2017, from http://www.tristanharris.com/2016/05/how-technology-hijacks-peoples-minds-from-a-magician-and-googles-design-ethicist/

How the world was trolled. (2017). *The Economist, 425*(44), 21–24.

Küng, L. (2015). *Innovators in Digital News.* Reuters Institute for the Study of Journalism, University of Oxford & IB Tauris. https://doi.org/10.1080/21670811.2016.1153333

Levitin, D. J. (2015). Why the modern world is bad for your brain. *The Guardian,* 1–6. Retrieved from http://www.theguardian.com/science/2015/jan/18/modern-world-bad-for-brain-daniel-j-levitin-organized-mind-information-overload

Myers, D. G. (2010). *Psychology* (9th ed.). New York, NY: Worth Publishers.

Müller, P., Schneiders, P., & Schäfer, S. (2016). Appetizer or main dish? Explaining the use of Facebook news posts as a substitute for other news sources. *Computers in Human Behavior, 65,* 431–441. https://doi.org/10.1016/j.chb.2016.09.003

Ohlsson, J. (2017). *Medieutveckling: Medieekonomi 2017.* Myndigheten för press, radio och tv.

Pielot, M., Dingler, T., Pedro, J. S., & Oliver, N. (2015). When Attention is not Scarce – Detecting Boredom from Mobile Phone Usage. *UbiComp,* 825–836. https://doi.org/10.1145/2750858.2804252

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological Review, 63*(2), 129–138. https://doi.org/10.1037/h0042769

Simon, H. A. (1971). Designing organizations for an information-rich world. *Computers, Communications, and the Public Interest, 72,* 37. https://doi.org/citeulike-article-id:986786

Skinner, B. F. (1974). *About Behaviorism*. New York, NY: Knopf.

Skinner, B. F. (1986). What is wrong with daily life in the Western world? *American Psychologist, 41*(5), 568–574. https://doi.org/10.1037/0003-066X.41.5.568

Storm, B. C., Stone, S. M., & Benjamin, A. S. (2016). Using the Internet to access information inflates future use of the Internet to access other information. *Memory, 8211*(August), 1–7. https://doi.org/10.1080/09658211.2016.1210171

Vice News. (2017). Charlottesville: Race and Terror. Retrieved November 15, 2017, from https://news.vice.com/video/charlottesville-race-and-terror-vice-news-tonight-on-hbo

Wahlund, R., Rademaker, C., Nilsson, P., & Svahn, M. (2013). Mediernas roll i marknadskommunikation. In G. Nygren & I. Wadbring (Eds.), *På väg mot medievärlden 2020*. Lund, Sweden: Studentlitteratur.

Wilson, T. D., Reinhard, D. a., Westgate, E. C., Gilbert, D. T., Ellerbeck, N., Hahn, C., … Shaked, A. (2014). Just think: The challenges of the disengaged mind. *Science, 345*(6192), 75–77. https://doi.org/10.1126/science.1250830

Wu, T. (2017). *The Attention Merchants: The Epic Scramble to Get Inside Our Heads*. New York, NY: Vintage.

Digital Transformation Supporting Public Service Innovation: Business Model Challenges and Sustainable Development Opportunities

PER ANDERSSON AND LARS-GUNNAR MATTSSON

Introduction

Digital transformation is a megatrend as is the widespread concern for sustainable development. In this chapter, we discuss how digital transformation of public services may promote sustainable development. We take the perspective of private business firms that are involved in service innovation processes, focusing upon their business modelling challenges. To a certain and varying extent, public services have become "privatised", yet they are always subject to publicly decided and enforced norms and regulations. We assume that public services are provided with the, admittedly complex, "common good" in mind, which is in line with sustainable development criteria. Therefore, public service innovation, enabled by digital transformation is an important phenomenon subject to development and implementation of both private business models and of public norms and practices. We investigate the nature of these challenges and opportunities, with the help of four cases on digital transformation of public services: City Lighting, Public Transportation, Healthcare, and Education.

The disposition is as follows: first, our analytical framework is presented; secondly, the four cases follow; third, we discuss opportunities for sustainable development based upon the cases; lastly, we identify five business-modelling issues that we suggest should receive increased attention in both practice and research.

Analytical Framework

Our analytical framework is based primarily upon our recent research on ICT enabled service innovations, business models, and dynamics of market networks. (Andersson & Mattsson 2015) This contains three major components, which are all related to digital transformation: business modelling, public service innovation, and market reshaping.

BUSINESS MODELLING

In Andersson and Mattsson (2015), we stressed the importance of development and implementation of new business models (Osterwalder et al. 2005) during digital transformation. In an extensive analysis of the literature on business models, Zott et al. (2011) found that a business model is a holistic system-level perspective that includes both content and processes; it is firm-centric, yet is boundary spanning with a focus upon value creation rather than value capture. Related to this is how the firm will obtain revenues for its value-creating activities and how value is calculated. Ehret et al. (2013) and Mason and Spring (2011) propose a network approach to understand the role of business models. This is in line with the original use of the concept in analyses of how new ventures manage to integrate resources by means of network relationships. Business models of networked firms must, in some way, overlap or be complementary. A general assumption is that a business model expresses the business logic of the firm, what value the company offers to customers and, relating the concept to a business network perspective, the infrastructure and the architecture of the network of partners. Applying a network view, La Rocca and Snehota (2017) stress the limits to autonomy of individual business firms to perform their own business model. They need to observe and adapt to differences across counterparts.

PUBLIC SERVICE INNOVATION

An innovation is a new way to create value. When it comes to public services, an innovation should be hopefully evaluated with reference to aspects of "common wellbeing" and with a focus upon the beneficiaries. Innovations always require some new combinations of resources, yet should also adapt to existing resources: especially in a use context. Resources co-create public service innovations, which are controlled by public and by private actors.

A service innovation must find use in socio-economic technical contexts. This might require added innovative resource combinations or adaptation between existing and new resources.

Digital transformation tends to stimulate and enable service innovation. The "service dominant logic" stream of research associated with Stephan Vargo and Robert Lusch (for example, Vargo and Lusch, 2004 and 2014) has stimulated research on business models and service innovation (Maglio and Spohrer, 2013), business models and service orientation (Kindström, 2010) and digital transformation and service innovation (Araujo and Spring, 2006). Digital transformation is seen to have effects upon the packaging of the service-based value offering, as well as on infrastructures and external partnerships. Vargo et al. (2015) use the concept of "service ecosystem" to also include actors other than market actors.

Little attention in research on service innovation seems to be directed to public service innovation.

MARKET RESHAPING

Market processes are embedded in socio-economic contexts characterised by interdependencies, interaction, and connectedness. Cooperation and competition co-exist in markets. Innovation is crucial to achieve efficiency and effectiveness: that is to say, for the creation of value. This means that *value is co-created* in the market. The *overlapping* of networks and *intermediation* in networks will likely change during innovation processes since new resource combinations develop, as exemplified by converging industries, bundling of services, technical platforms.

SUSTAINABLE DEVELOPMENT

Concern for unsustainable development is widespread: in terms of negative ecologic, social, and economic effects of human activities. This is especially true when it concerns global warming. The UN Agenda 2030 specifies 17 sustainable development goals and some general directions for how to reach them. Public service innovations aimed at promoting sustainable development should be especially important for public actors with an influence upon public services. The World Economic Forum argues that opportunities to develop and implement service innovations based upon digital transformation should be given a high priority (WEF, 2016).

To sum up, digital transformation is associated with challenges to develop viable business models. This chapter will focus upon public service innovation. Service innovations involve market reshaping, especially with shifts in intermediation and overlapping. These three processes are interconnected and associated with business model challenges for the involved private business firms, thus, influencing the achievement of sustainable development.

Four Cases

The cases all describe early stages of applications of digital transformation; they include: city lighting, healthcare, public transportation, and education. The digital transformation challenges are collected from a longitudinal comparative research project that contains in-depth studies of companies in 15 different contexts engaged in digital transformation processes, as described in Chapter 2 of this book. Andersson & Rosenqvist state that digitalization is associated in many of the studied sectors with overlapping between sectors/networks, which sometimes includes tension between different industrial logics. The processes in most cases open up for considerable changes and re-positioning of companies where business development and business model challenges become part of the digital transformation.

The discussion here builds upon a broad set of ongoing case studies, and on secondary sources on digitalization. We employ qualitative methods overall: specifically, a multiple comparative case-study approach, complemented with a rich set of secondary sources (reports and so on).

Of the four case narratives, Philips, is based purely upon secondary sources. Getinge and Nobina were initially part of two master program projects at the Stockholm School of Economics[1] that were performed in 2016. Complementary information was collected in follow-up interviews within the digital transformation research project (Digital Transformation in the Networked Society). Sensavis, was initiated in the research program with a set of interviews in 2016, and completed in a master thesis in 2017.[2]

1 Rosén, A & Lechner, J. (2016), Advanced Market Monitoring. Sensemaking and Strategic Analysis for Medical Device Complementors to Big Data Platforms, Business case research thesis, Stockholm School of Economics, June 2016, Fedrizzi, M. & Liedholm, A. (2016), Nobina and Combined Mobility Services in Sweden. A scenario-based analysis, Business case research thesis, Stockholm School of Economics, June 2016,

2 Badhani, S. & Mut, J. (2017), Business Model Innovation in Edtech. An Exploratory Study of Business Model Innovation in a Complex Market Environment, Master thesis, Stockholm School of Economics.

CASE 1 PHILIPS: LIGHTING AS A SERVICE[3]

Philips launched their strengthened vision for sustainability in 2012: "At Philips, we strive to make the world healthier and more sustainable through innovation. Our goal is to improve the lives of 3 billion people a year by 2025…We have identified three key innovation areas: 1) Improving people's lives; 2) Improving energy efficiency of Philips products; and 3) Closing the materials loop…." The company has embraced a circular economy mindset over the past five years. The transition toward a circular sustainable economy in the Lighting sector is intertwined with both digitalization and a radical business model shift toward service sales: introducing "lighting as a service" and products as service providers. The business model promotes customer access to products and systems instead of customer ownership. Value for customers become performance based. The new concept emerged with a Dutch architectural company.

"In 2009 Rau Architects, an architectural agency specialising in sustainable building design, approached Philips for help to upgrade lighting at its Amsterdam office. They only wanted to buy light, and not the expensive lighting infrastructure (lamps, luminaires, cables, and controls) that it would eventually need to replace and dispose. They wanted the exact amount of light for workspaces and rooms that employees needed, but nothing more. Rau Architects, Philips and an installation partner, CasSombroek, began a co-creation process to design a tailor made, intelligent lighting system maximising natural sunlight, adapting LED light fittings to the building and installing a motion/daylight sensor and controller system. It proved to be an extremely interesting experiment in – and proof-point of – how little artificial light an office actually needs. Since 2010, Rau Architects only pays for the actual amount consumed light (lux), not the equipment or the raw materials used in the products."[4]

By moving from a one-time sale to a 'pay per lux' model, Philips maintains ownership of the materials while Rau pays for maintenance and servicing with the option to adapt or upgrade the set-up. The installation of the LED lamp

3 This case builds upon secondary sources from Philips, see e.g.: https://www.philips.com/c-dam/corporate/about-philips/sustainability/sustainable-planet/circular-economy/light-as-a-service/case-study-circular-economy-lighting-NUS.pdf, http://www.lighting.philips.com/main/services and from other sources, e.g.: "Circular economy snapshot: Philips light as a service" (https://www.issuelab.org/resource/circular-economy-snapshot-philips-light-as-a-service.html) and https://smartcitiesworld.net/news/news/philips-light-as-a-service-offering-1137,

4 Zero Waste Council: "Circular Economy Snapshot: Philips Light as a Service", p.1, see footnote 3.

system saved 35% energy. Digital transformation continued in the next phase when Philips implemented smart energy meters, which provided further insight into the energy consumption per space. The report states that this monitoring and optimisation process saved another 20%. Thus, more than half the energy was saved. At the end of the contract period, Philips lighting products can be taken back into its production process and the raw materials re-used.

Philips argued that the new system provided additional benefits for the development of smart cities, beyond efficiency and reduced carbon emission. With lighting levels that can be adjusted and no compromise in light quality, it can be used to create safer roads and streets, more productive offices, more liveable cities and attractive public spaces, and more patient-friendly hospitals. "… The company developed a commercially successful business model with significant environmental and financial benefits for customers."(ibid)

Managed lighting services extend the lifetime and performance of the lighting products. This allows the customer to take full advantage of the newest lighting solutions, increase energy efficiency, and reduce operational costs. Philips pays the upfront costs of installation and is compensated through a performance contract: the energy savings the retrofit produces. Exploring possibilities from a second-hand market enables Philips to capture new value from used parts and luminaires; co-creation with like-minded companies creates a platform for innovation.

Philips also acknowledges barriers in switching to the new orientation. Lighting is not widely recognised as being the key to energy efficiency. People do not see the electricity costs associated with lighting. They are unaware of new energy-efficient lighting technologies.

Philips' CEO stated: "I don't want to make this sound easy. In our healthcare business, for example, a lot of customers initially thought: 'A second-hand product? We don't want it.' Of course, we are refurbishing it and guaranteeing it as new, but convincing a hospital customer: for example, is challenging and requires a major educational program. We still have much more to do given the size of the market, but as we work with hospitals and establish ourselves as technology partners–and not just sellers of a 'box'–we can more easily convince customers of the mutual benefits of circular-economy principles. Similarly, for municipal-lighting customers, the thinking around the tendering process needs to change. These customers are used to looking at the initial purchase price, not the total cost of ownership and the ecological impact.

Changing the ownership of the lights is also tricky, as it often gets into legislative issues with municipal governments. There are supply challenges in operating in this new way, as well. We need to get our products back. Streetlights are fairly simple because the lights don't walk away, but consumer lamps are another story. Here we work with partners to organise for collection, but even then it's very hard. Currently, in Europe we recover about 40 per cent of our lamps, of which 85 per cent are recycled for reuse."

Still, the company has started the process of fundamentally redesigning its business models and value chains. The basic idea is that, instead of selling products, Philips envisions a future where it retains ownership: selling use as a service so it can optimise the use of resources. Philips is defining new business models, and refining concepts of legal ownership and use, adaptive logistics, and financing strategies. Working with investment models, and finding new potential, has become part of the switch. New business models are developed and tested: utility funding schemes, public private partnership, or creating a new energy service company. This includes private financing alternatives such as instalment payment, bank loan, and financial lease, and also fiscal measures. Public funding issues are brought up including subsidies, economic stimulus measures, and carbon finance.

The LED and digital transformation is both a technology and business model transition: going from analogue and regular lamps, stand-alone and "dumb" products with replacement sales, to digital systems and LEDs that are connected in "smart" systems and services based upon "projects". The transition from analogue to digital is based upon a switch from lighting replacement products to financing and leasing lighting as a service: "This will reap not only the direct economic benefits of lighting, but also the benefits beyond lighting fully in line with the transition from a linear to a circular society."(pp. 26)

Digital transformation is a central part of the big shift, as the CEO states: "We are putting networking capabilities in these lights, as well, essentially making them part of an IT network. This lets the community adjust the lights depending on the circumstances. For example, if there is low traffic density at night, then the lights can be turned further down. But if there is a soccer match one night, the lights can go up. And, of course, we can apply all sorts of algorithms as well to give customers even more control. These kinds of innovations help us move away from selling products and toward selling higher-value solutions.

We believe that customers will increasingly consider natural resources in their buying decisions and will give preference to companies that show responsible behaviour: something we are already seeing. Designing products and services for a circular economy can also bring savings to a company. The first impression people always have is that it adds costs, but that's not true. We find that it drives breakthrough thinking and can generate superior margins."

CASE 2 NOBINA: MOBILITY AS A SERVICE IN PUBLIC TRANSPORTATION[5]

Nobina is an established provider of public transportation in the Nordic countries. Nobina wishes to change its role from "bus operator" to "mobility provider". Digital transformation is said to enable mobility solutions to increasingly pressing urbanisation-related problems, such as traffic congestion and air pollution.

The target of political authorities in Sweden is to double the share of public transportation by 2030 in the following ways: 1) Carbon dioxide emissions will be reduced and energy efficiency improved throughout the entire transport system; 2) Road safety will be improved; 3) Traffic congestion will be reduced; and 4) More equal opportunities for citizens will be offered by the public traffic system.

Discussions between private and public organisations on mobility as a service revealed that car-operating costs would be saved, and that time delay and congestion could be reduced. Taking cars off the road also means reducing the number of traffic accidents. Removing cars from the road would also generate savings for cities by allowing them to avoid road construction costs.

Transport operators are now able to provide mobility as a service, thanks to the technological advancements made possible by the Internet of Things. A widely acknowledged belief in public transportation is that the time has now come to integrate different types of transportation means, both public and private, which could offer people a flexible and convenient door-to-door alternative to private car ownership.

One of Nobina's representatives described the challenges: "In order to double the public transport market share, there needs to be a shift in our sector: from a production culture to a service culture. Through new approaches

5 This is a condensed version of a case presented in Fedrizzi, M. & Liedholm, A. (2016), Nobina and Combined Mobility Services in Sweden. A scenario-based analysis, business case research thesis, Stockholm School of Economics: June 2016, and complementary interviews: 2017.

and smarter co-operation, we will increase the efficiency of our operations, extend the range of transport services offered, and raise the quality." The main finding in an industry analysis and report was that increasing ride sharing, bike commuting, and car sharing will result in substantial economic savings for commuters as well as cities[6]. Moreover, the diffusion of smartphones and apps is what was expected to enable digitalization and Intelligent Transportation. The spread of digital payment solutions facilitates the purchase of online services and the transactions between individuals. Online platforms require new digital technologies; however, a lot of the potential comes also from the analysis of big data.

Nobina and the transportation industry are now looking more and more towards new solutions for smart mobility. The industry is already moving towards a greater integration of the services. Some projects are already running (e.g. SLL-bike sharing). "Samtrafiken", the association of all the actors of public transportation in Sweden, plans to include as members also companies operating with non-public mobility (i.e. car sharing, Uber). However, the public sector is not eager to bear the whole risk of the implementation of such new concepts. The public sector will have to rely on the total or partial investments by private actors. A private actor might even manage the overall integration of the public/private transportation network including the implementation and maintenance of a technological platform.

The actual demand for the mobility as a service is still unknown. Since narrow coverage would undermine the overall usefulness of the new concept, the geographical reach is a fundamental service feature. Innovation propelled by the public-sector will likely mean that public transportation providers will be adopting these new solutions, thus, making companies such as Nobina, key business partners with Uber, taxi firms, car-sharing enterprises, and other ancillary yet necessary alternatives in order to provide flexibility for sectors where bus and train traffic is very limited or non-existent. Striking a balance between providing flexible solutions and not compromising basic public transportation needs is one of the challenges Nobina and other involved actors identify. An obstacle going further in this digital transformation concerns which forms of bilateral agreements will be formed between public transportation and private companies or between private companies to achieve service

6 Deloitte Insights: "Smart mobility: Reducing congestion and fostering faster, greener, and cheaper transportation options". Part of the "Smart mobility" research report

integration. Interviews reveal no competitive conflicts between parties in different transportation sectors; they mainly view each other as complementary. Parties may engage in bilateral integration while participating in a public-private or private-private partnership. Forms for Public-Private Partnerships need to be developed. Local public transport agencies in Sweden already experiment with tendering mobility as service provision, as they complement rather than compete with car ownership, thus, matching the political goals of Sweden's sustainable transportation initiatives.

Nobina identifies several challenges and crucial competencies for the development and implementation of mobility as a service. The company must refine its relationship management skills in order to maintain cohesion in the emerging mobility-as-a-service networks, including alignment of the different interests. Nobina needs to coordinate actors that are currently separately running their own businesses. In addition, Nobina must be involved in building and managing a technical platform with which it has an interaction or, for example, outsourcing to IT specialists by leveraging the existing partnership with Ericsson for the development of driverless buses. Having a mobility service solution in place will require marketing efforts even though the introduction of incentive-based contracts has led the company to start focusing upon the end customers: the travellers. Communicating the advantages of the solution to travellers that are used to the traditional transportation concept is also a challenge.

CASE 3 GETINGE: CREATING NEW VALUE OFFERINGS AND EXPLORING A NEW MARKET BASED UPON BIG DATA[7]

The Getinge group incorporated its largest division, Maquet in 2000. The case concerns Getinge's critical care, which involves intensive care products such as ventilators, anaesthesia systems, and advanced monitoring.

While many businesses and industries have already embraced digitization and big data, the healthcare and medical technology sectors are still in the early phases of development. Clinical care providers offer increasingly complex and advanced procedures, thanks to the advancement of medical knowledge; however, the majority of healthcare actors are still mainly analogue.

7 This is a condensed version of a case presented in Rosén, A & Lechner, J. (2016), Advanced Market Monitoring. Sensemaking and Strategic Analysis for Medical Device Complementors to Big Data Platforms, Business case research thesis, Stockholm School of Economics, June 2016, and complementary interviews 2017.

Recordkeeping is conducted manually and medical journals are kept in paper files. Medical devices operate in "silos" and are neither connected to central platforms, nor communicated with other devices. Due to ageing populations and medical progress, governments, hospitals, and medical companies are increasingly engaged in digital transformation driven by the growing need for and costs of healthcare.

Through the use of large data sets and advanced analytics, companies and researchers are developing models that allow doctors to intervene early on in order for patients to avoid suffering and for governments to save money. In the hospital environment, facilitating and supporting digital solutions such as clinical decision support systems are seen as tools to avoid mistakes and promote best practices. Overall, government officials and opinion leaders within the sector see digitization and the use of big data analytics as the future of healthcare.

Although digitization and the subsequent development of big data solutions will improve healthcare, there are considerable uncertainties regarding what is needed for a company to survive and/or thrive in potentially radically different market conditions. The picture becomes increasingly unclear as the healthcare industry varies considerably across geographies, involving more stakeholders than a typical consumer market.

Maquet Critical Care, a subsidiary to the medical technology company Getinge, had earned a reputation for the sophisticated medical technology and cutting-edge engineering of their ventilators, advanced monitoring, and anaesthesia machines. Now, the company is increasingly feeling the pressure of the shift toward digital transformation as other medical device manufacturers are increasingly interested in the data generated by Getinge's (formerly Maquet's) machines. As part of its digitalization, Getinge faces the uncertainty of when big data platforms and solutions in healthcare will become popular. There is also considerable apprehension regarding the impact this will have upon the competitive landscape. Will there be one or several industry platforms? What organisation will be the platform sponsor? And, to what degree will the platform be open or closed for external developers and complementors? Since Getinge operates in the niche of high-end intensive care medical devices, the company has limited capabilities to develop the technological capabilities and skills to provide a platform with the necessary range. Even if pooled together with the other product and customer groups within

the Getinge Group, the company itself does not strive to become a "big data company", as one of their representatives expressed it in one of the interviews.

There are several strategic questions concerning the future digital platform(s) for Getinge: one concerns the scope, type, and the technical nature of the platform. Another concerns the number of platforms that will emerge for the potential inclusion of the data generated by Getinge's machines and competing and complementary machines in wardrooms. A third issue concerns the degree of the platform's openness to external actors. There are also questions regarding the strengths of the complementors and what platform complementors can bring to the platform ecosystem.

Another question impinging on investments in big data-based hospital services is how to deal with the institutional context. For example, the Swedish hospital system and leadership is decentralised, which forces suppliers to develop reimbursement schemes with each individual hospital. A second challenge concerns who will pay for the treatments; the government, an insurance company, or a combination of both often pay for healthcare services. Their interests, which are obviously not the same as the patient's, create tension between cost-efficiency and optimum care. Thirdly, reimbursement fee systems vary according to local jurisdiction. Vendors must contend with diverse bargaining power among public and private buyers, as well as those buyers whose administrators and clinicians often disagree on the value of a product. Old devices are incompatible for integration with new devices and are mostly replaced piecemeal, as they stop functioning. This makes hospital-wide device integration difficult and unlikely. This significantly slows down big data applications.

Furthermore, competitors' machines flank Getinge machines. Thus, various software and platform connections exist linking all these machines in order to seamlessly collect and record vital patient data. Therefore, Getinge must become a complementor to one or more other big data platform. This makes it an issue for Getinge of how many platforms they compete with, who sponsors the platform, and who will have access to develop it.

Overall, Getinge faces a scenario where it does not have a broad perspective of the big data market, which it is about to enter. Platform uncertainties create risk where they may lose competitive advantage in the high-end medical device manufacturing market to a platform provider. Machine generated patient data is stored in proprietary systems that are largely unintegrated.

The more data that are available (weight, age, back problems, smoker, and so on), the better treatment options the systems are likely to produce. Systems provide clinicians with a better base upon which to make decisions and, thus, devote more time to the patients.

A move into new big data-based service business implies a business model shift from offering products to offering services. The shift from selling products to services is expected to be hard as conservative customers still often want to buy a product, not a service provided by a product they will never own. However, continuing to sell products diminishes medical device manufacturers' capacity to acquire and profit from the combination of medical and technical knowledge needed to develop big data solutions. Secondly, enabling data and privacy legislation allows actors to easily combine, analyse and use data securely, while restraining data and privacy legislation does the opposite. Hence, there is a need for legislation to catch up. The strategic challenge for Getinge and medtech suppliers in similar stages of digitalization is the fact that, by attracting new users (medical scholars, insurance companies), complementors add value to a big data platform while often protecting intellectual property rights in their applications (more competitive, protected technology). If platform sponsors are wed strategically or by profitability to an application, complementors may sign exclusivity contracts with them. In a competitive environment with each other, complementors can protect their products with intellectual property rights: by moving quickly and by working closely with other manufacturers in the industry to ensure they provide exactly what is needed. The question of number of platforms is largely driven by multi-homing costs for users. Switching between publicly accessible platforms might lead to lower costs; however, industry stakeholders want more proprietary: modular standards that can be costlier to users. Thus, having widespread standards is also a challenge. Standards tend to converge actors and can reduce multi-homing costs.

CASE 4 SENSAVIS: AN EDUCATIONAL TECHNICAL START-UP COMPANY IN SEARCH OF A VIABLE BUSINESS MODEL[8]

Sensavis, established in 2008, is a small Swedish company that offers high quality, 3-D visualisation software for the education sector. Sensavis' stated

8 This case is a condensed version of a longer case presented in Badhani, S. & Mut, J. (2017): Business Model Innovation in Edtech; *An Exploratory Study of Business Model Innovation in a Complex Market Environment,* Master thesis, Stockholm School of Economics); and from interviews with the focal company, Sensavis 2016-2017.

vision is to improve learning outcomes by making complex and abstract phenomena easier to understand: particularly in the area of science, technology, engineering, and mathematics,. The mission is to give educators all over the world tools that enable them to include all students in learning processes. With headquarters in Sweden, the company operates in 36 countries serving over 550 schools, and reaches more than 220,000 students. Sensavis went through five distinct business model stages from 2008 to 2017, in an attempt to create an offering and a market position in a new emerging market for digitalized education. Changing the existing market was a major challenge, as the company's CTO expressed: "We are trying to change 100 years of tradition in schools, and that is the biggest challenge."

While many sectors have undergone digital transformation over the past few years, the education industry is still at an early stage (*WEF: New Vision for Education,* 2016). Firms that develop educational technologies, referred to as "edtech companies", challenge this status quo by creating digital products and services that present educators with an opportunity to change teaching and learning methods (Hsu et al., 2013). By doing so, edtech companies shape the emerging edtech industry, which has attracted significant flows of private investment over the past five years (*WEF: New Vision for Education,* 2016). In this emerging edtech industry, companies struggle to develop viable business models (Watters 2016). Needs are not yet defined and many stakeholders (students, teachers, school leaders, national and local authorities, producers of educational material, academic institutions specialising in pedagogy, and parents) have unclear or overlapping roles during the transformation process. Edtech companies need to develop business models to adapt to a complex value network, which includes private and public stakeholders and where value is strongly connected to sustainable development goals: through economic (efficient use of public money) and social (study results, equal opportunities including access to new education technology, and education better adapted to the diversified needs of pupils/students). The multiplicity of stakeholder demands, needs, and values in public-private networks, contributes to a high level of complexity within an already heavily bureaucratic organisational environment (Williams & Lewis, 2008). The public education sector, which is characterised by high levels of bureaucracy, risk-aversion, and slow technology adoption (OECD Conference: *Innovating the Public Sector: from Ideas to Impact,* 2014) stands in contrast to innovation-driven edtech companies.

Navigating in a network of multiple stakeholders is a central part of the process to develop a viable business model.

In the first step of change, Sensavis moved from being a tool provider to a product company. The journey began with Sensavis as a pure B2B company serving sales and marketing teams for their sales presentations, mainly in mining and machinery corporations. The value proposition focused upon "high tech" visualisations. Entering the education sector, Sensavis attempted to standardise its product by bundling hardware and software into "The 3-D Classroom" and selling their visualisations as an interactive visual learning tool, which enabled instructors to explain complex and abstract components of a subject in a simple understandable manner. In the second step, Sensavis changed from a product company to become a software provider. Sensing the wide range of different needs and characteristics among their customer segments, Sensavis got rid of the hardware and moved from a product company toward becoming a software provider. Sensavis changed the focus of its value proposition, emphasising the software's beneficial impact upon student motivation, educational growth, and learning outcomes. Co-creation with users had the biggest impact upon the subsequent changes in the value proposition of the firm.

In the third change step, the company went from software provider to become a pure service company. Collaboration with their expanding value network increased the company's knowledge of the institutional context and entry barriers. Sensavis sensed stark differences in institutional settings, between users and buyers, as well as among the user community; the company addressed them through a revised value proposition. "Teach – Create – Activate" (TCA) was born. The new value proposition focused upon improving learning outcomes. Due to the complex market situation and the lack of a digitization roadmap, Sensavis sensed that the real value for most of their customer segments lay in the provision of guidance, support, and inspiration. Seizing this insight, Sensavis shifted focus toward becoming a fully-fledged service company, not only selling software, but rather acting as a trusted digitalization partner to schools, municipalities, and ministries of education.

When adapting to different markets, Sensavis was forced to reconfigure the business model components to local institutional and settings.

Experience with private companies did not prepare Sensavis for the barriers in the education sector. Within the first few months, the company sensed that understanding the institutional context and positioning the company in

relation to it would be the first step toward delivering value to its customers. Having one foot in the classroom helped Sensavis understand differences in needs within and across its customer segments.

Depending upon the local institutional context, differences appeared across markets, which complicated the sales process. Sensing these differences, Sensavis changed the sales pitch, adjusting the value proposition according to which actor the company spoke, and aligned appropriate channels and relationships to match it.

Sensavis successively identified potential value flow opportunities, expanded the network, and changed the nature of existing value flows. Product development rooted in user centricity became central in value creation. Co-operation, co-opetition, and co-creation with actors in the value network changed where value was created not only by Sensavis, but also increasingly in collaboration with customers, users, and other value network participants. Initially, close contact with customers was necessary due to the complexity of the visualisations and constituted a demanding task in project management processes.

Analysis

DIGITAL TRANSFORMATION DIMENSIONS

Important dimensions in digital transformation include the digitization of information, assembling and analyses of large amounts of data (big data), internet representation of physical objects (Internet of Things), and technical platforms acting as intermediaries of information. These are all important characteristics in the following cases.

Philips develops intelligent lighting systems: an IT network with equipment composed of sensors, controls, smart lamps, and energy meters. Philips aspires to create a platform for innovation with technology partners, complementors, and customers/users: for example, municipal authorities. Digital transformation opens opportunities to redesign public transportation service to a mobility service for Nobina. This digital transformation depends upon Internet of Things: a diffusion of smartphones and apps, digital payment solutions, and the potential of big data for planning and operating public transportation, as well as the development of a technical platform. The Getinge case focuses upon the challenges and opportunities for a medical equipment company when technical and medical innovations open up for the use

of big data to increase the effectiveness of medical treatment. For this to be possible, one or more technical platforms need to be designed and operated, upon which data are assembled, analysed, and made available. A major issue for Getinge is if the data assembled by their equipment should be added to one or more platforms, be it open or private, and how this data should be used. The start-up company Sensavis participates in early phases of digital transformation for education activities, essentially promoting visualisation as an interactive learning tool. The company experiences the lack of a "road map" for digital transformation of education as being problematic, evidenced by the frequent changes in its business model. Sensavis' development does not relate to major digital transformation concepts, such as Internet of Things, big data, and technical platforms during the studied period.

DIGITAL TRANSFORMATION AND PUBLIC SERVICE INNOVATION PROMOTING SUSTAINABLE DEVELOPMENT

A WEF report (World Economic Forum, 2016) states: "We believe that digital solutions can bolster the three pillars of development on which the Sustainable Development Goals (UN) are built: improving people's quality of life, fostering equitable growth, and protecting the environment" (p.9). The report also specifies that "…digital innovation is reshaping industries by disrupting existing business and operating models. But it is also having a profound impact on society, presenting a series of opportunities and challenges for businesses and policy-makers." (p.4). Thus, the interconnected business models of both private and public stakeholders need to harbour various forms of commercial, *business value* (for example, manifested in new, extended, revised revenues and/or efficiency improvements), as well as *societal values* (where the digital transformation might lead to improving people's quality of life, foster equitable growth, and protect the environment).

Aligning policies, enhancing collaboration, and engaging the whole ecosystem of government, business, and civil society are some of the pre-requisites for making these digital transformations and broad service innovations actually happen.

In line with an observed trend in marketing literature and in business practice, the case firms shift to a more service oriented, customer centric strategy (Vargo and Lusch 2004), related to public service innovation enabled by digital transformation. For public services, interaction with public agents and adapt-

ing to public norms becomes important, which must be included in business model considerations.

A central dimension in any business model is the *value offering to the focal customers*. The value offering provided by Philips is formulated in a performance contract that promises significant environmental and financial benefits for the public customers. Digital transformation makes it possible to tailor lightning to changing needs for light and to optimise resources. Retained ownership of the products and equipment enables Philips to apply circular economy principles and to be a technology partner to the customer in application of new more effective lighting methods in the future. A seemingly unresolved issue is how the value, which is co-created, should be calculated and how a performance contracts shall be written. Also, when a contract period ends, is it possible to open a new tendering process when Philips enjoys such a dominant position?

A mobility solution for public transportation, as in the Nobina case, aims for a more flexible, needs-based, and effective public transportation system that integrates public and private operators. The value offering includes societal benefits in terms of time-savings, lower costs related to traffic accidents, and reduced CO_2 emissions. For Getinge, the added value of the data generated by use of its medical equipment depends upon how the data can be assembled in big data platforms and be used for more effective healthcare activities. The value offered by Sensavis in its latest business model is to help actors in the education sector to design and implement digital transformation projects in educational processes.

Sustainable development criteria involve a wider perspective on *what types* of values are involved compared with a more narrow traditional business model analysis. To *balance and coordinate* the business and the societal *values* associated with digital transformation and associated service innovations emerge as one common business model challenge. This becomes a matter of *defining the customers,* and the various values for different beneficiaries: consumers, citizens, business organisations, public organisations, the environment and society at large. In addition, defining the financial/economic value(s) will be part of the business model challenges. For private actors such as Philips and Nobina, this might mean radical *revenue model shifts*. Increased overlapping between public and private networks will blur the boundaries between the customer, the key partner, and the roles of supplier and distribu-

tor. In this respect, variation between different communities and different geographic locations adds to the challenges of developing business models that serve to coordinate activities across several involved business firms and localities, and to handle tensions between private and societal values. Furthermore, digital infrastructure issues also need to be handled: for example, determining upon what technical platforms to base the service innovation and the degree of the platform's openness.

Public actors need to rethink policies in order to participate in the co-creation of service innovations: for example, this relates to procurement procedures, service operations, pricing and cost accounting models, infrastructure, and principles for public/private collaboration.

The complexity of the customers and the customer interaction for the small company Sensavis became more and more apparent for two reasons: first, the small organisation had to adapt to different types of local school authority networks when the company expanded internationally; secondly, the growing service orientation meant there was closer interaction with the user networks of deans, IT support functions and schools, teachers, and pupils/students.

There are major problems in successfully developing and implementing business models for the service innovations in the cases. Nobina admits that there are problems moving from a production to a service culture, for both public and private actors, and coordinating actors that currently run their operations separately. There is also reluctance among local authorities to make the necessary investments in the digital infrastructure.

The four cases illustrate efforts aimed at *business modelling* rather than at developing a fixed business model. Nobina recognises the importance of developing incentive-based contracts focusing upon value for end customers and the need to strike a balance between flexibility and basic public transportation needs. For Nobina, as a presently traditional public transport company, it is obvious that, they need to integrate resources that are held by others especially private transportation providers in order to provide public mobility services.

The WEF 2016 report states: "Government leaders, regulators and civil servants have a significant opportunity to support the adoption and dissemination of new technologies, using the key levers that are available to them: setting the appropriate policies, regulations and national strategy for digital, while also transforming government agencies into hotbeds of innovation. Other important success factors include enhanced collaboration, both nationally and inter-

nationally, and the ability to engage the whole ecosystem of government, business and civil society."(p.22) WEF's statement focuses upon public actors while we present a private business perspective. We will now suggest five issues in digital transformation, public service innovations, and sustainable development that we argue should receive increased attention in practice and research.

Business Modelling Issues for Further Inquiries in Practice and Research

All four cases show critical influences on digital transformation by *public actors* and *public/private interaction*. The tendering process for municipal procurement of lighting for Philips needs to change. The present focus upon initial cost, ownership, and control of equipment needs to become a focus on total costs, maintenance service, ecology criteria, and technical development. Legislative issues involved in changing ownership of material, public-private partnership, and public funding should also be solved. The tendering process needs to be adapted for municipal customers: from initial purchase price to total cost and ecological effects, public-private partnership, public funding, and legislative issues involved in changing the ownership of material.

The digital transformation-based innovations by both Philips and Nobina should be helpful in implementing sustainability targets set by public actors. However, public-private partnership issues must be solved when developing and implementing the mobility solution to public transportation. For example: how should the tendering process adapt to the new criteria, what form of bilateral agreements will be needed, what type of contract is required, and who will develop and operate the technical platform? The institutional context has a major influence upon digital transformation at Getinge as well. Both private and public customers in the healthcare sector in Sweden, with its decentralised organisation and local jurisdiction, are reluctant to buy services instead of products; this is due to unclear reimbursement schemes, as well as data and privacy legislation.

Different institutional settings, bureaucratic public organisations, the influence of multiple public and private stakeholders, and public funding play important roles for the start-up, Sensavis.

In the context of sustainable development, the five areas for future attention and inquiry into business modelling adopt a broad perspective in practice and in research on business models in the public service

First, digital transformation of public service increases customer complexity and changes interaction with customers. Secondly, the process is also associated with changes in the value offering. Third, new partnerships need to be established. Fourth, digital transformation implies the creation of new infrastructures: for example, with the increased importance of technical platforms. Lastly, dimensions of business models need to be developed and implemented when it concerns the financial and economic, which includes revenue as well.

1. INCREASED COMPLEXITY OF CUSTOMERS AND CUSTOMER INTERACTION INFLUENCES BUSINESS MODELLING

All companies found an increase in the complexity and, in some ways, the institutionalised rigidity of the networks of actors (deciders, buyers, users, and so on) connected to the customer side. This concerns the structural complexity and/or the complexity of the customer practices. Public customers' procurement policies and practices were not adapted to the new value offerings provided. For *Getinge*, the complexity of the customer side was manifested in the discussion of how to approach regional authorities, hospital management, intensive care departments, and their leading doctors, and so on. *Sensavis* encountered similar challenges when it approached, to a varying extent, deans, teachers, schools' IT departments, local municipalities, central school administration units, and so on in different parts of the world. The newness of the service offerings challenged the seller's own knowledge of the customer's varying needs of different units, and the customer's view of the new value offerings.

We find that more attention in practice and research is needed on how awareness of and adaptation to the complexity of structure and practices within the public sector shapes customer business modelling.

2. INCREASED END-USER ORIENTATION PROPELS BUSINESS MODELLING AS FIRMS SUCCESSIVELY DEVELOP THEIR SERVICE-BASED VALUE OFFERINGS

The development of the value offering or ideas about a new value offering over time was associated with a successively increased orientation toward end users and in end-user contexts in all four cases. Philips describes the importance of understanding the various needs of the citizens in (big) cities. Nobina focuses upon the total and detailed transportation needs of individual travellers. Getinge directs its attention to big data through an increased interest in

doctors' decisions and support needs in interactions with patients, as well as the machines in intensive care contexts. Lastly, Sensavis successively shifts the attention to the pedagogical needs of teachers in their interactions between students with varying needs, which also includes student-to-student interactions and teacher/community interactions. Hence, the deeper companies go into the digital transformation processes in order to create and implement new service-oriented value offerings, the more they need to understand the details of the end-users' use contexts.

We find that more attention in practice and research is needed on how business modelling successively adapts value offerings to increased end-user orientation.

3. PARTNERSHIP CHANGES AND NEW PATTERNS OF COOPERATION AND COMPETITION DRIVES DIGITAL TRANSFORMATION AND BUSINESS MODELLING

The three incumbent firms' show the same general pattern: cooperation with others increases in order to integrate resources and implement new value offerings. The number of key partners needs to be expanded, often resulting in increased overlapping of networks and, consequently, new patterns of cooperation and competition. For the small start-up Sensavis, the later stages of the company's business modelling process indicated the start of similar network complexity and expansion, as the company began to connect to partner companies in the publishing industry.

We find that more attention in practice and research is needed on how business modelling is associated with expansion of the relevant network of actors involved in the provision of the digital service.

4. BUSINESS MODELLING RELATED TO SHIFTS IN THE ROLES AND POSITIONS OF DIGITAL PLATFORMS

The first three cases describe an emerging digital infrastructure, which comprises the development of two or more competing technical platforms. In the Sensavis case, larger platforms are beginning to emerge. In all cases, business modelling is importantly influenced by the planned or existing technical platforms upon which the planned value offering should be based. Which actors will become owners and/or managers of platforms? How will the technical platforms as intermediaries between actors involved in the provision

and use of services relate to individual actors' business modelling? A powerful actor such as Philips would more easily manage the competition between technical platforms than would a less powerful one, such as Getinge. However, for a small start-up such as Sensavis, the lack of dominating technical platforms creates opportunities for the continued development of the company's own technical platform, before competition increases between the platforms, thus, affecting competition and customer relations.

We find that more attention in practice and research is needed in order to understand how shifts in digital infrastructure and technical platforms interact with business modelling.

5. IMPORTANT SHIFTS IN BUSINESS MODELS DRIVEN BY EXPERIMENTATION (INNOVATION) AND THE TESTING OF NEW ECONOMIC MODELS

A central challenge for most companies is to find a viable revenue model as part of the business model. Business modelling is often associated with considerable experimentation and successive adaptation of the model for financial viability. Financial viability includes the challenge to find, test, and manage new revenue, as well as charging, pricing, and cost management models. Digitalization with more service-based offerings challenges existing revenue models. Sensavis changed revenue model several times, thus, shifting from product service sales to more "pure" service and access-based contracts. In the other cases, customers' public procurement policies did not seem to be adapted to this new form of interaction, relationship, and contracting with service providers. While the value offerings required other contractual relations and longer-term interactions between the suppliers and the public customers/users, the traditional procurement policies and procedures of the latter, indeed, imposed obstacles.

We find that more attention in practice and research is needed in order to understand how experimentation related to service innovation requires that business modelling include new aspects of economic viability of public services.

References

Andersson, P. and Mattsson, L-G. (2015). Service innovations enabled by the 'internet of things'. *IMP Journal,* Vol. 9 Iss 1: 85–106.

Araujo, L. and Spring, M. (2006). Services, products and the institutional structure of production. *Industrial Marketing Management,* Vol. 35: 797–805.

Ehret, M. and J. Wirtz (2017). Unlocking value from machines: business models and the industrial internet of things. *Journal of Marketing Management,* 33:1–2: 111–130.

Håkansson, H. Ford, D., Gadde, L-E., Snehota, I. and Waluszewski, A. (2009). *Business in Networks*. Chichester: Wiley

Johanson, J. and Mattsson, L-G. (1992). Network positions and strategic action – An analytical framework. In: B Axelsson and G. Easton (eds.), *Industrial Networks: A New View of Reality,* London: Routledge

Kindström, D. (2010). Towards a service-based business model – key aspects for future competitive advantage. *European Management Journal,* Vol. 28 No. 6: 479–490.

La Rocca, A and Snehota I. (2017). Business models in business networks-how do they emerge? *IMP Journal,* Aug 2017.

Maglio, P.P. and Spohrer, J. (2013). A service science perspective on business model innovation. *Industrial Marketing Management,* Vol. 42 No. 5: 665–670.

Mason, K. and Spring, M. (2011). The sites and practices of business models. *Industrial Marketing Management*, Vol. 40 No. 6: 1032–1041.

Mattsson, L.G. (1998). Dynamics of overlapping networks and strategic action by the international firm. In: Chandler, A.D., Hagström, P. and Sölvell, Ö. (Eds), *The Dynamic Firm,* Oxford University Press, Oxford, 242–259.

Osterwalder, A., Pinneur, Y. and Tucci, C. (2005). Clarifying business models: origins, present, and future of the concept. *Communications of the Association for Information Systems,* Vol. 16: 1–25.

Vargo, S.L. and Lusch, R.F. (2004). Evolving to a new dominant logic for marketing. *Journal of Marketing,* Vol. 68 (January): 1–17.

Vargo, S.L., Wieland, H., and Akaka, M.A. (2015). Innovation through institutionalization: A service ecosystems perspective. *Industrial Marketing Management, 44*: 63–72.

World Economic Forum (2016). *Unlocking Digital Value to Society: A New Framework for Growth. In Collaboration With Accenture*. White Paper, January 2017

Zott, C., Amit, R. and Massa, L. (2011). The business model: recent developments and future research. *Journal of Management,* Vol 37 Issues 4, July: 1019–1042.

Business Models and Ecosystems

The Role and Potential of IoT in Different Ecosystems

JAN MARKENDAHL, STEFAN LUNDBERG, AND STAFFAN MOVIN

Introduction

The concept of Internet of things (IoT) usually includes both technology and services that is based upon connected devices and the use of the collected data. In this chapter, we study how IoT can be introduced and used in different industrial sectors. We analyse various cases with IoT products and services in order to identify how different business aspects and conditions affect the ability for actors to make commercial use of the new technology. We discuss in terms of IoT technology. The analysed cases are about introduction of ICT solutions in general; this is just a part of the ongoing digitalization of products and services.

The objective of our research is to study the conditions for the use of IoT in order to identify drivers and benefits, as well as problems and challenges. We want to identify common patterns and key challenges for introduction of IoT as a new technology. In order to do so, we look into different industries: industrial IoT (typically manufacturing), smart energy, smart homes, smart cities, healthcare & social care, and sport & well-being.

Introducing IoT can clearly lead to improved efficiency; however, it is not only about technical performance. The improved working efficiency is also reflected in changed or new working processes, usually in combination with new roles and business opportunities for market actors. Although Ericsson is a technology-oriented company, it has discussed for many years now digital society in terms of business transformation[1]. We claim that it is not enough

1 https://www.ericsson.com/digital-services/offerings/digital-transformation

that the technology works as expected. We want to highlight the need to also consider the business model aspects when new technology is introduced.

Digitalization is not only about increased efficiency; it is also about the opportunity to offer new services or to offer them in innovative way. The value of specific technical solutions must be seen in an overall context. A new technology may result in direct benefits within an actor's existing business; it may also be that the full benefit of a new solution cannot be achieved by providing the solution itself in isolation. In order to achieve the full benefits, a solution may need to be combined with other solutions (that is offered by other actors). This implies that one needs to have an understanding of the customer's entire needs and how different actors can cooperate, as well as study ecosystems and networks of actors (business networks) and how the actors interact.

So what do we mean with a business ecosystem? This term has been widely used over the past years, especially for mobile services (Basole, 2009); it has also been used to describe and analyse IoT services, businesses, and actors involved (Westerlund, Leminen, Rajahonka, 2014), (Ghanbari, Laya, Alonso-Zarate, Markendahl, 2017). We will look into business ecosystems with a multitude of co-existing "businesses", each described by a value network. Our results support the assumption that there are several different ecosystems and industries in which IoT is included or can be included; we do not think that IoT will have an ecosystem of its own.

The main question discussed in this chapter is the following: What are the main business-related challenges that we can observe when a new technology such as IoT is introduced?

The primary research contribution is discussing the introduction of new technology from three separate perspectives: i) How a new solution can be evaluated differently depending upon the overall context; ii) How the value can be assessed; and iii) What activities are performed by different actors. Our key point is that one needs to consider the role of new technology and services within an overall business context and not only the technology itself.

The chapter is organised as follows: first, we discuss theory, the analysis approach, and the data collection, which lead to the cases to be presented. Then, we present a number of selected cases, what can be observed from these cases, and a summary of common patterns and challenges. A discussion on observed patterns, drivers and challenges then follows and, lastly, a summary.

About Theory and Methodology

IOT AND BUSINESS MODEL RESEARCH

There have been a number of research papers over the last five years discussing the business aspects of IoT products and services. Westerlund et al (2014) looked into business models and the business ecosystem aspects for IoT applications, claiming the ecosystem structure is not clear with many multi-industry solutions and that actors are still looking for their roles.

Business model definitions usually consist of a number of different dimensions or components. Although they differ, we claim they cover the same aspect, to a large extent; it is a matter how you organise the analysis and what aspect you include in each component. For example the STOF model has four main components or domains describing services, technology, organisation, and finance (Bouwman, Haaker and De Vos, 2008). Here, the organisation domain includes the value network. The business model definition used by Chesbrough and Rosenbloom (2002) consists of six main components. One component is firm organisation and value chain; the other is firm in the value network. The business model canvas proposed by Osterwalder is a well-known example where different components are used to describe the business model (Osterwalder and Pigneur, 2010).

The concept of networked business models, including business networks and partners, is important for our analysis. A key issue discussed in research on networked business models is the move from single firm business models to networked business models (Palo and Tähtinen, 2013), (Bankvall, Dubois and Lind, 2017). For our analysis, it is relevant to capture multi-actor aspects of value creation and how the value network can be composed. Citing the work of Palo and Tähtinen (2013) about the network-level business model "by developing collective understanding of the business opportunities and shaping the action to exploit them".

RESEARCH APPROACH

For our analysis, we need to identify what are actors in the ecosystem that interact with each other; this includes being customer, supplier, partner or competitor. In our analysis, we are interested in seeing which actors do business with each other or cooperate in order to do business. We are also interested in evaluating the importance of the new (IoT) solution that we study.

Hence, we need to look into the value proposition; that is to say, what type of value is offered to the customer: possibly an end-user or it could also be a company or an organisation.

Since we look into specific services where the IoT solution plays a part, it is natural to identify the activities involved: both the ones where a new IoT-based solution plays an important role, as well as all other activities that make up the overall service. Examples of overall services include the following: waste management in a city, cleaning of office buildings, maintenance of infrastructures such as power plants or bridges, and municipality homecare services for the elderly.

Besides the activities and analysis, we need to look into which actors perform different activities: "Who is doing what?" Identifying which actors have relations is linked to this: that is to say "Who is doing business with whom?" This reasoning leads to concepts such as the ARA model discussing Actors, Resources, and Activities (Håkansson and Snehota, 1995) and the activity systems (Zott and Amitt, 2010). The activity systems of a business model can be described from different perspectives, content, structure, and governance. The content refers to which activities are performed. The structure describes how activities are linked and the governance describes who performs the activities.

DATA COLLECTION AND ANALYSIS

We have a rich set of primary data from different industrial sectors collected at workshops and interviews: from 2016-2017. Most of the case studies and findings are the result of a Swedish research project called "IoT Ecosystems"[2]. Besides academic researchers, the project included big industry companies (Ericsson and Sandvik), one SME, providers of energy and telecom services (Vattenfall, Telia), Stockholm City, and an employer organisation (Almega). The participation of these big organisations enabled us to get in contact with a large number of people with different experiences.

WORKSHOPS AND INTERVIEWS

We invited guests to a total of 18 workshops, and organised approximately 20 separate interviews (see Table 12.1). The collected data is used in the following two ways: i) to present selected cases, which illustrate key characteristics when

2 The work is supported by the Swedish Innovation agency, Vinnova and the Strategic Innovation Program, IoT Sweden: research grant #2015-06151

IoT is introduced; and ii) to present common pattern and challenges. We have described and identified cases and conditions from different sectors based upon the collected data: industrial IoT, smart energy, smart homes, smart cities, healthcare and social care, and sports and well-being. During the interviews in the workshops, we collected information on which actors were doing what, how actors interacted with each other, and how working processes were or were not changed. People sharing insights about IoT-related projects and initiatives provided the basis for identifying drivers, benefits, obstacles, and common patterns related to the introduction of IoT products and services.

Those interviewed were open about their experience within their respective organisations and partners. They could also share insights about cases of general interest. We found that technology itself usually works as expected; however, there are still obstacles for commercial breakthrough. We want to identify these obstacles and understand the reasons for them. The collected data enabled us to identify common patterns, challenges and problems, and select good cases to illustrate these hurdles: see next section Cases and Findings.

Table 12.1. Sources of Primary Data Collection

Industry Sector	Companies and Organisations Contributing to Data Collection
Smart cities	ABB, ElectriCity, Envac, Ericsson, Fortum InfraNode, Qlocx, Riksbyggen, Scania, Skanska, Stockholm City, Veolia, Volvo
Smart homes and smart energy	ABB, Ericsson, Electrolux, Ellevio, Fortum, HEBA, Intel, NCC, RISE, Telia company, Vattenfall
Sport, health and wellbeing	Biosynch, Ericsson, Interactive Institute, MSD, MTC, RaceFox, The Swedish School of Sport and Health Sciences
Healthcare and social care	Alleato, Almega, Biosynch, Cenvigo, Hemfrid, Intel, Joicecare, Phoniro, Sensative, Stockholm city, Stockholm county council, Telia Company and Municipalities Nacka, Norrtälje, Södertälje, and Uppsala
Industrial IoT and manufacturing	ABB Corporate Research, ABB Robotics, Berotec, Clayster, Combient, EzeSys, Ericsson, Sandvik, SICS, Telia, Volvo

How To Use The Collected Data? We present a number of cases in this chapter that illustrate the use of IoT and/or Smart home/city products or services. Here, it is important to note the observations represent two types or levels of "cases". On the one hand, we have the specific IoT solutions: for example, the connected waste bin/ soap dispenser/ bolt/ smart lock; we call this an IoT-based innovation. On the other hand, the collected data is used to describe

specific business contexts or environments where the IoT-based innovations are used. Examples are maintenance, cleaning, and waste management or homecare services.

When we look into our cases, we make use of the aforementioned approaches, structure the primary data, and analyse the activities from three different perspectives:

a) In which activities is an actor involved?
How large or important is that actor's contribution?

b) How important is a specific activity for the overall service?
What is the value of a specific activity and how important is the actor's role in performing said activity?

c) What other activities are needed in order to exploit the value of a specific activity? Which actors are involved in these other activities?

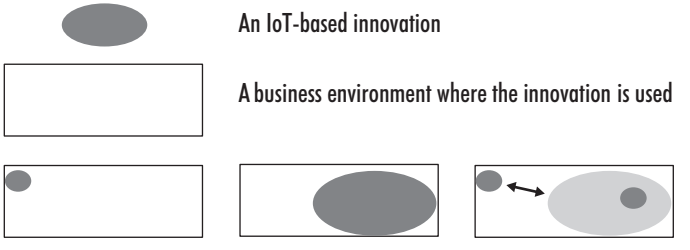

Figure 12.1. Illustration of IoT-based innovation playing a small or big role in a business environment or being linked to/being a part of another service.

Cases and Findings

In this section, we present selected cases along with key observations and identified patterns and challenges that arise when introducing new technology. The challenges will be further discussed in the next section.

SELECTED CASES

The Connected Trashcans: An Example of Urban Furniture. Connecting trashcans to a monitoring system has become a solution to avoid emptying half-empty trash cans, thus, saving time and the environment. The trashcans report when they are full. One provider of such a solar panel-based solution is Big-

Belly[3]. This kind of system is used in many towns in Sweden: for example, Uppsala. Since the trashcan is a connected system, it has a feature where you can offer people WiFi services. Other features may include information to visitors about the local area.

Will this be a complete business solution focusing on efficiency for waste management? Or can you expect that it is the beginning of a larger service, which can include all cleaning and care in an area? Equipment, such as trashcans, is sometimes called urban furniture. Other examples include: lamp posts, bus stops, ad signs, and billboards. This urban furniture can provide the basis for a connected infrastructure that can be used for different services without relying upon mobile operator networks. Operators can also make use of the urban furniture instead of deploying (their) own base stations (Ghanbari, 2016). This possibility for re-use of equipment is highlighted on Bigbelly's webpage: "Bigbelly provides a public right-of-way platform to deliver Smart City solutions and host communications infrastructure".

The Connected Bolt: Going From Product to Service. The Swedish start-up company, StrainLabs[4], has developed a connected bolt that opens up for a new type of business: in the area of smart monitoring and inspection. A sensor embedded into a cavity in the head of the bolt monitors preload and temperature. When it detects that a bolt is about to come loose, it alerts the user; thus, pre-emptive action can be undertaken. Inspection today is a manual activity performed in the field, posing several challenges. An offshore oil platform has a hundred thousand bolts in hard-to-reach places that need to be inspected over a 5-year period. A wind turbine has giant blades: high above the ground. The amount of time and money spent on inspecting and reporting globally upon critical applications is staggering.

The StrainLabs solution is an example how one can offer a service based upon a connected device. The CEO says: "We no longer sell a screw; we sell a service to monitor the screw connection"[5]. This service represents a large share of a set of activities for monitoring and inspection. Power by the Hour, the Rolls-Royces maintenance program for airline companies is another well-known example: where a product offer is replaced by a service. This

3 http://bigbelly.com/

4 http://strain-labs.com/bringing-internet-of-things-to-bolted-connections/

5 https://www.nyteknik.se/startup/uppkopplade-skruven-larmar-nar-den-blir-los-6579513

includes a complete engine and accessory replacement service on a fixed-cost per flying-hour basis.

The Connected Soap Dispenser: A Part of a Cleaning Service. SCA is Europe's largest private forest holding company, producing solid-wood products, pulp, publication papers, and renewable energy. One product is liquid soap for everyday hand washing in schools, restaurants, nursing homes, and public spaces. SCA also offers soap dispensers and other equipment for toilets. Soap dispensers can be connected using the Tork EasyCube™ concept, which focuses upon improved cleaning[6].

Tork EasyCube is a cloud-based service that collects data from connected devices. Displayed in web applications, information directs cleaning teams to exactly where they are needed. SCA offers connected devices, visitor counters, real-time data collection and display, and an analytics tool for optimizing operations.

The solution is tested at amusement parks and zoos, such as Skansen and Furuvik; customer cases are presented on the SCA web site. Clear benefits have been identified for amusement parks that can handle unpredicted large variations in number of visitors [7]. However, the value with the connected soap dispenser is not so clear for cleaning regular offices or workplaces, where the new technology is more used for improving the efficiency of toilet cleaning. This is one of the overall represented activities: cleaning, facility management, running an office or an amusement park.

Connected Vehicles: Toward Transport as a Service. The concept of connected cars and self-driving (or driver-assisted) cars has been discussed for some time now. Although concepts such as the connected vehicle cloud[8] were presented some years ago, the big break-through for consumers is still to come. For professional use, however, the situation is different.

Manufacturers of transport vehicles have looked for years into the possibilities with connected vehicles. Companies such as MAN, Volvo, and Scania have developed and have used solutions where one can track different types of data: for example vehicle, engine, driving, and driver information. Scania has a large number of connected trucks that are delivered to different trans-

6 http://www.torkusa.com/easycube/

7 https://www.tork.se/kundcase/furuviks-zoo

8 https://www.ericsson.com/digital-services

port companies[9]. Scania and other companies foresee a development path from the connected vehicle to a connected fleet, possibly leading to "transport as a service" instead of selling vehicles.

Vehicle manufacturers have different types of vehicles on the market; all have specific in-vehicle communication systems. This leads to potential problems for the transport companies that usually have trucks from many manufacturers. The actors in this sector, however, have agreed upon a solution that helps transport companies handle this multitude. The Fleet Management System (FMS[10]) standard enables common interfaces and third parties to access vehicle data. Regardless of which manufacturer produced a certain vehicle, if it is equipped with an FMS interface (gateway), there is the same output for all vehicles.

Digital and Smart Locks. Digital locks or smart locks are part of a growing market, mainly focusing upon offices: as an access system to real estate buildings, and in various applications within other industries. Digital locks offer opportunities in other sectors as well, primarily in the field of homecare for the elderly. "Keys" are installed in mobile phones, so there is no need to collect physical keys before one visits the home of an elderly person. Attempts have been made in several rounds over the past 25 years, and it is only now there is an interest and an understanding of digital locks in the homecare sector.

Technology solutions are emerging, thus, developing the opportunity to produce advanced solutions at attractive prices. This means that digital locks should be considered as part of a larger whole since they could possibly solve other needs too, if used in a more complex context. Insurance companies have started accepting digital locks, so they can replace the old locks in all homes. In this case, the lock becomes a part in a significantly larger whole, meaning that a digital lock will not automatically be a "smart" solution. Their role, in a certain context, must be properly analysed. For the individual private house owner, the individual lock is a fully adequate solution; however, it may not be so for an entire municipality.

The Connected Service Box or Delivery Room. The company Qlocx[11] offers solutions where logistics companies and users have access to common delivery "boxes" or rooms. Qlocx develops these smart delivery containers and spaces to ensure that one receives goods or deliveries without physically

9 https://www.scania.com/group/en/scania-reaches-milestone-250000-connected-vehicles/

10 http://bus-fms-standard.com/Truck/index.htm

11 http://www.qlocx.com/

needing to be there. This allows for a simpler and more efficient logistical flow in the workplace.

Qlocx has developed smart digital locks to devices adapted for package delivery for private persons and housing companies. One can open the device with a mobile phone and hand out digital keys to anyone. Typical use cases are delivery companies that can deliver mail or a neighbour who wishes to borrow a tool when you are not at home. Hence, one can receive or share with neighbours by giving out a digital one-time key. With the Qlocx delivery box, one can also rent or loan one's car to someone else without physically needing to be in place to issue the key.

Qlocx also offers smart delivery spaces for companies, which makes it possible to receive goods or deliveries without anyone physically needing to be there to receive them. This allows for delivery to working spaces outside of regular working hours, as well as a simpler and more efficient logistics flow to the workplace. The Qlocx solution can be used for service boxes, delivery rooms, and even delivery containers.

Table 12.2: Identified Drivers and Benefits of Selected Cases

Case	Drivers and Benefits
A. The connected trashcan	Improved working efficiency Re-use of infrastructure
B. The connected bolt	Improved working efficiency Possible to offer new services
C. The connected soap dispenser	Improved working efficiency Possible to offer new services
D. Connected Vehicles	Improved awareness Improved uptime
E. Smart and digital locks	Improved working efficiency Possible to offer new services
F. Smart delivery box or container	Improved working efficiency Possible to offer new services

WHAT WE CAN LEARN FROM THE SELECTED CASES

When looking at the value proposition that is enabled or strengthened by the introduction of IoT products or services, a number of clear drivers and bene-

fits can be identified. For example, improved awareness and control of activities leads to improved working efficiency and processes. This implies better resource utilisation, improved uptime, and reduced costs. In addition, the IoT solution also offers the possibility to be re-used for purposes other than the originally intended one. Finally, the IoT solution may lead to the possibility of offering new types of services: that is to say, new types of businesses and revenues (see Table 12.2).

We can also obtain greater insight by studying specific activities and which actor that is doing what in the selected cases. This relates to the components of the value chain or network: for example, business model aspects as "firm organisation and value chain" and "firm in the value network" (Chesbrough & Rosenbloom, 2002). Here, we can also identify whether the offer consists of one or several services and if one service is part of another. In addition, we identify whether or not it can be offered as a stand-alone service and if the IoT solution enables a new product and/or service (see Table 12.3).

Table 12.3: Analysis of Main Activities From Cases

Activity Under Study	Who Performs the Activity	Stand-alone or Part of Another Service	Type of Novelty
Emptying Trashcans	Municipality itself	Stand-alone	New product (new service)
Monitor bolts in large systems	Bolt provider or System owner	Stand-alone	New product and service
Smart cleaning of toilets	Facility manager or cleaning company	Part of overall cleaning	New service
Monitor heavy vehicles & fleet	Vehicle manufacturer	Part of support and vehicle maintenance	Improving service
Access using smart locks	Homecare provider	Part of homecare	Improving Service
Delivery of Goods	Delivery company	Stand-alone or part of delivery service	Improving service

IDENTIFIED PATTERNS AND KEY CHALLENGES

We have identified a number of obstacles besides drivers and benefits, and have observed some recurrent patterns. These are all related to how new technology or a new solution is introduced in the market. We will now briefly describe these key challenges.

Being Part of a Solution. A specific IoT solution often tends to be a small part of the overall solution or even "a part of the whole" overall service. An IoT solution may be too small in order to be a sustainable stand-alone business. For a "part of a whole solution", a lack of understanding the overall picture (service) may limit the potential with the new solution.

Unclear Business Context. Another observed challenge is the uncertainty about "in what kind of business you are". Is the business about selling an IoT product, or does it concern providing a service based upon the IoT product, or providing a type of overall service where the IoT product of service is just one component among others?

Market Position. Another challenge is the need to change and obtain insight about the role and/or market position. For manufacturing companies, this is typically about moving from selling and maintaining products to offering "something as a service".

Fragmentation. We can find a multitude of similar technical solutions, each with it its own dedicated infrastructure, although it is deployed in the same location for a single customer. This fragmentation leads to scalability problems when a large number of solutions need to be deployed and maintained. This fragmentation of solutions can be observed in several areas: facility management, factories, and homecare services.

Discussion

In this section, we will discuss and delve deeper into the identified patterns and key challenges. But first, we will discuss the impact of the overall context using the smart lock as an illustration. Smart locks can, of course, be part of the "lock business." We will discuss smart locks as part of homecare or municipality services.

SMART LOCKS: AN ILLUSTRATION OF THE ROLE OF THE OVERALL BUSINESS CONTEXT

Homecare Service.

There is a need in the homecare sector to manage a growing group of elderly people without compromising the quality of care with the available human resources. This means there is a need to develop innovations that can increase productivity without having a greater workload; it is also important not to lose human contact with the elderly since it is so vital for the well-being of the elderly person. Therefore, it is necessary to streamline the peripheral services that form part of total service production.

There is no technology tradition in homecare, which makes it difficult to pinpoint what could or should be replaced by technology without sacrificing the meeting between the care and the elderly. However, various technology-oriented projects have begun to create an understanding of what could be improved with technology solutions through the use of early start-up companies, (Ihlström, Eriksson, and Svensson, 2009). There has also been a new generation of homecare workers who have a different habit of technology in their daily lives (Griffiths, et al, 2012).

The problem today mainly consists in not seeing that vertical solutions will lead to future problems in operation and maintenance. This means that a municipality today can focus upon a certain solution: for example, digital lock, instead of analysing the entire home service value chain. A digital lock is ”part of a whole” and the supplier of the lock will never be able to expand its business to cover the entire value chain. The digital lock is then a product or technology solution rather than a service. The product approach is to solve the issue “how to close this passage when needed and open when it should”. The service approach of “who must be able to get through this passage and at what time, who should provide an access license or permissions and in what way, how to deal with acute access permission and under what conditions, how should the locks fit into the support organisation, how should the access licenses communicate with an invoice or administration system”, and so on.

The product can create added value for the homecare service provider if it is part of a context in which its skills are utilized. This is not a problem for the lock manufacturer; for homecare service, however, it will be once new technology solutions are implemented and exist in parallel with the user’s home. This can force the homecare service provider into different support and service system: each with its own conditions; sometimes, it can even be necessary to have the same data in different systems. For example, if the lock system has a database of users and their access rights, then a time planning system has the same users in another database. That means that same information must be maintained in different systems. Without the possibility to only use one single database for all systems, this will eventually lead to error and different user information in the different system. The users quit or change phone numbers and so on; this is information that must be added in all the systems that use this kind of information. Information gaps between the different systems will occur sooner or later, which can be crucial for the safety of the providers’

operations. Homecare services need to change strategy; instead of implementing an independent solution one at a time, they will need to look at the over-all picture instead (Laya, 2017) and analyse which parts of the value chain can be replaced by a more efficient sub-service (such as a digital lock system).

With a different approach, the homecare service owner and the principal can ask different questions to the market. In other words, instead of asking for the "best digital lock", ask for "the best and most effective delivery of home services to the users." However, the latter requires that you have a clear understanding of how to integrate sub-businesses with each other in order for the whole to work. One becomes aware that each digital product must be included in a context that makes it a service and that some parts of the context may be part of another digital service (Miori and Russo, 2017). If the focus is only upon the lock as a product solution, then it misses the importance of the context into which the locks must fit. It is important to understand that the upfront investment in a product is outweighed by the support and maintenance costs for the management over many years.

Digital locks must be installed, configured, keys need to be distributed, and permission is to be given that may change over time; the lock needs to be maintained, and the keys are included in an administrative tool either managed by the principal or as part of the service. In case of problems, there is a support service that can be shared by other digital services, and so on.

The Smart Lock in a Homecare Context

Each actor who delivers a shared service to the homecare service will try to understand how to expand its own service within the value network in order to be more competitive. Features such as log-in/log-out and time reporting are linked to the lock solution itself. Other discussed features are time planning for the homecare staff and a shared dairy about the elderly patients (Markendahl and Laya, 2014).

One example is the Swedish lock manufacturer Phoniro[12], which purchased the digital video service provider Vision and now supplies these two services on the common platform, Phoniro Care, thus, expanding its home business service. The company's ambition is to become a supplier of complete solutions for the care of the elderly. Digital cameras, camera surveillance, care tools, and DoseSystems for medical management are available in their current

12 http://www.phoniro.se/

product portfolio. Phoniro has evolved from a digital environment: where locks were their first digital solution for elderly care.

Other lock manufacturers have given up the elderly homecare service market today because Phoniro has such a big headline amount that it is difficult for other lock actors to compete: not necessarily because Phoniro offers the best lock solution. What Phoniro does provide, however, is an understanding of the homecare context; it knows that homecare has several situations that could benefit from a digital solution. Phoniro builds an ecosystem on its platform. The company did not come up with the camera surveillance; instead, it acquired it. Phoniro did not build the DoseSystem; it simply has the right to include it on its platform. By doing this, the company strengthens its offer and shows it can handle several solutions in one platform. Thus, Phoniro has a very strong USP.

Only other players in the same segment are in competition for locks in the home service market, such as Tunstall[13]. Founded in the UK, the company began to deliver security alarms in Sweden. Both Phoniro and Tunstall expanded within the home-service industry: the former from a now well-established lock service; the latter from a well-established security alert service.

Figure 12.2 illustrates a simple analysis of the homecare service business where the two routes of expansion of the two companies are depicted.

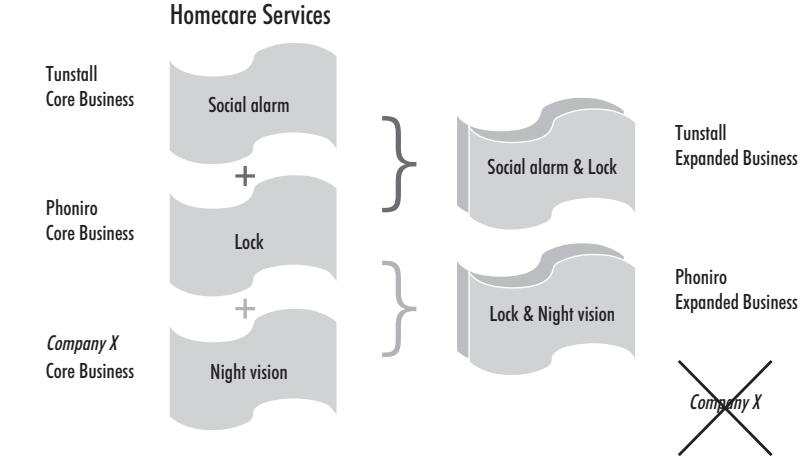

Figure 12.2. Examples of development paths for companies in the homecare business.

13 http://www.tunstall.com/

THE SMART LOCK IN A MUNICIPALITY SERVICE CONTEXT

The field of elderly homecare is only part of the municipality's activities in an area. The municipalities also run schools and other community service facilities in which it also uses similar services (see Figure 12.3). Using all similar services, such as locks, the municipality turns to different users – even to the same one - within a given area or neighbourhood. Therefore, it is preferable to make an overall view of the need for locked areas before any lock system is purchased.

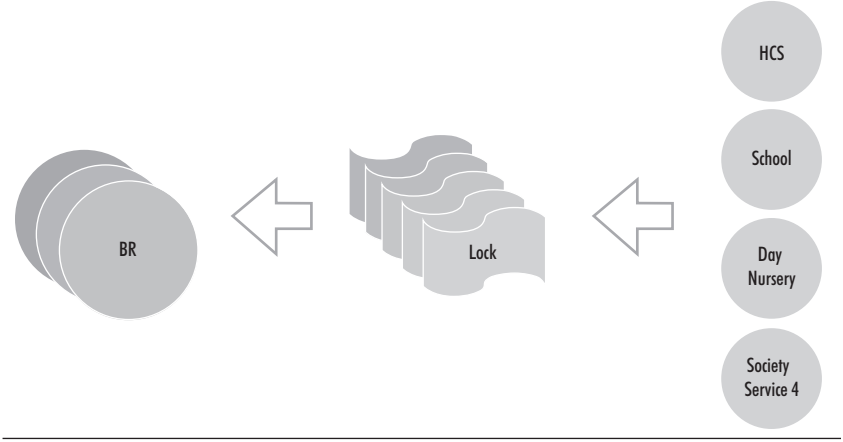

Figure 12.3. Example of society services in a geographic area or district.

Another level up reveals several players in a particular geographical area using similar services. There may be reasons to ask who is best suited to offer the access service discussed in the aforementioned examples.

On the other hand, a company in the homecare business or a school management may be appropriate if the municipality chooses to procure access on the lowest level. The municipality, however, will find that it has an access provider for each of its services: one for healthcare and another for school, and so on.

On that level, no company or organiation without access service as its core business is probably the most suitable for schools, daycare centers, health centers, stores, and so on.

Perhaps the best solution would be to make a deal with an access operator that takes care of all locks and delivers access permission upon the terms set up by the municipality? In order to make such a judgment, the whole picture needs to be clear.

There are many questions that must be answered before selecting an appropriate sub-service provider; if they are not analysed, the municipality will pay more than necessary for parts of a particular service to be performed in parallel organisations.

In summary, this discussion of the invention of "the digital lock" illustrates several challenges in relation to the lock business, homecare, and municipality services. Moreover, the analysis shows how these challenges are interrelated.

Comments on the Identified Key Challenges

A SMALL OR BIG PART OF THE OVERALL SOLUTION

One of the challenges we identified was the need to understand if the new technical solution represents a small or big part of the overall resolution. This also includes determining whether the solution can solve a small or big part of the overall problem. Most of the results with a connected device contribute to an increased awareness, which enables the user to use its resources more efficiently. This applies to the screw connection monitoring: toilet cleaning, and homecare staff using cameras for nightly check-up of the elderly patients. One type of value in all cases is that no staff is sent out if it is not necessary.

In the case of connected bolts and waste bins, looking into existing activities can identify the benefits. If one is aware, one does not need to send out people "just to check". In the soap dispenser case, the situation is more complex. The full value of the information from the soap dispenser is revealed when it is combined with other information (visitor counting data) and put into an overall context. Hence, we can conclude that a solution that solves a limited part of a bigger problem can be very beneficial if it is put into the overall context. Conversely, the added value is little or not clear if the overall picture is missing. Using the soap dispenser case again, substantial value can be seen when it is combined with visitor data, especially during periods with a high and varying number of visitors such as an amusement park. However, the potential value is much lower if the solution is used as a stand-alone feature in an environment with less frequent users: for example, an ordinary office.

IN WHAT BUSINESS ARE YOU?

For some solutions, such as with the connected bolt and the connected waste bin, it is quite clear in what business you are: installation monitoring and

waste management. The answer is not so clear when it concerns the connected soap dispenser and the complete EasyCube concept. In these case, it could be any of the following types of businesses:

- Cleaning of toilets
- Cleaning of facilities
- Facility management in general
- Selling connected products to facility managers
- Offering toilet refill services (soap, towels, toilet paper)
- Offering refill services for a building (coffee, copy paper, and so on)
- Selling connected devices in general
- Selling systems for staff resource planning

By comparing SCA and StrainLabs, we see that SCA offers products and solutions that enable a more efficient cleaning operation for the customer; whereas StrainLabs makes use of the connected bolt in order to offer a complete and new type of service.

ON FRAGMENTATION AND STOVEPIPE SOLUTIONS

The fragmentation with so-called stovepipe solutions has been identified for many years. Well-known examples from smart cities, facility management, and social care services are reported in research (Markendahl and Laya, 2013). One actor typically provides each solution, thus, solving a specific task or problem. The solution includes sensors, service platform, and communication infrastructure. The main problem is the complexity to deploy and maintain all multiple solutions. Clear evidence can be found from homecare services. Representatives from the IT department of a municipality in Sweden say: "It is not feasible for us to maintain this multitude of different systems. An elderly person may have three or four different systems in their apartment and we have to ensure that they all work". These types of systems are typically a social alarm, digital lock, and camera for night surveillance (see Figure 12.2).

Findings from the current research confirm that fragmentation remains a key characteristic. In each of the different studied sectors, we have found new or remaining cases of parallel stovepipe solutions. One example comes from factories with multiple robots or machines in an assembly line; the manufacturer of a given machine is connected to and monitors each machine. No common overall picture for the factory owner is provided since the machine

manufacturers do not want to share data. Another example from sport and health is the multitude of sensors and apps that use different platforms. An individual may need to have several sensors, each reporting data through a dedicated app with its own login and interface.

We tried to determine at the workshops the motivation and drivers for the fragmentation. Most actors did recognise the pattern of fragmentation. Some of the expressed reasons include the following:

i) Fear of losing or changing the customer relations
ii) Distrust among actors to share platforms and data
iii) Hesitation to give one's "own" data to others
iv) Lack of motivation to change one's own business model

A common solution to the fragmentation problem is to introduce open and shared service, platforms, and infrastructure. There are a number of projects and initiatives about open and common platforms. In Sweden, we can find examples from transport[14], healthcare[15] and smart homes[16]. This technical approach is usually combined with the idea of a neutral third party managing the shared and open platform; however, it is not clear what the business model for the use and operation of a shared platform looks like. One key question is the following: Can anyone be the trusted third party or should service providers (offering end-user services making use of the platform) be excluded from taking that role?

Another approach allowing co-existing company-specific solutions is to agree upon a standard for data formats and interfaces. In one of the aforementioned cases, leading truck manufacturers developed the FMS standard (Fleet Management System). Hence, transport companies with vehicles from different truck manufacturers can more easily handle a multi-vendor fleet.

We also want to mention here the solution used by mobile parking ticket providers. There is currently a multitude of providers and solutions for mobile phone parking in Sweden (see Figure 12.4 on the left). The common feature is that the ticket exists as a record in the database with active parking sessions for all parking ticket providers. The ticket control staff has handheld devices

14 https://www.vinnova.se/p/open-transport-effectiveness-service-platform/

15 https://joinup.ec.europa.eu/community/epractice/case/sweden%E2%80%99s-health-innovation-platform-helps-third-parties-develop-healthcare-

16 https://www.acreo.se/projects/smarta-hem

connected to the database with active parking session and car registration data. By entering the registration number of a car, valid parking information is provided (see Figure 12.4 on the right). These two examples illustrate that strategies to handle the multitude of solutions, manufacturers, and service providers do, indeed, exist.

Figure 12.4. Ticket machine illustrating multiple payment solutions for parking (left) and a snap shot showing the user interface of the handheld device for the ticket control staff (right). Pictures from (Markendahl & Laya, 2013). Photo: Jan Markendahl.

Summary

The purpose of the research described in this chapter is to identify the conditions for using IoT in different industries: industrial IoT, smart energy, smart homes, smart cities, healthcare and social care, sports and well-being. The research provides more insight into business opportunities and obstacles surrounding the introduction of IoT (and also digitalization) in different sectors. The following are the main obstacles:

- Specific IoT solutions often tend to be a small part of the overall solution; hence, it may be too small in order to be a sustainable stand-alone business.
- There may be uncertainty and/or lack of knowledge regarding of which overall services or business the IoT solution may be part.

- There could be fragmentation due to the diversity of parallel "closed" solutions that lead to insufficient scalability.
- There is distrust and hesitation among actors to share common/open platforms and data.
- There is the fear of changing one's own business model.

The analysis of our cases indicates that most of the challenges occur due to the fact that the solutions initially have been developed using a single firm business model. Potential gains with IoT and digitalization risk not being achieved if actors continue to stick to the single-firm business model. Hence, co-operation and networked business models need to be considered in order for IoT solutions to be commercially successful.

In addition to collaborating with other actors in the ecosystem, it is important to have knowledge about specific sectors, the customers, and their ways of working. This is especially the case when the customer is an actor in the public sector. Although public sector actors have staff for procurement and IT support, it may be difficult or take too many resources to integrate different technical components into an overall solution. Moreover, it will also take resources to educate the staff and change work processes.

The situation is different when the customer is a technology-oriented company, a manufacturing industry, a telecom, or an energy provider. These types of actors usually have both a high level of understanding technology as well as good control of the work processes, which are often automated with little or no human involvement. Hence, a technology-oriented company can more easily handle and integrate an IoT solution.

Providers of IoT technology and solutions who have the insight and competence about their customers and their work processes can help their customers to integrate and maintain the solution. Hence, these actors would be more useful as technology providers to their customers, regardless of whether or not they provide a product or a service. In summary, we believe that knowledge about specific sectors and business contexts is important in order to adapt specific technical solutions to the overall context.

References

Bankvall, L., Dubois, A., & Lind, F. (2016). Conceptualizing business models in industrial networks, *Industrial Marketing Management, Volume 60*, January 2017, Pages 196–203

Basole, R. C. (2009). Visualization of interfirm relations in a converging mobile ecosystem, *Journal of Information Technology, 24*(2)

Bouwman, H., Haaker, T., & De Vos H. (2008). *Mobile Service Innovation and Business Models,* New York: Springer

Chesbrough, H., & Rosenbloom, R.S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change, 11*(3), 529–555.

Ghanbari, A. (2016). *Competition for Mobile Service Provisioning: Is it About Infrastructures, Services or Both?* Licentiate dissertation, KTH, Stockholm

Ghanbari, A., Laya, A., Alonso-Zarate, J., & Markendahl, J. (2017). Business development in the Internet of Things: A matter of vertical cooperation, *IEEE Communications Magazine, vol. 55,* No. 2

Griffiths, F., Cave, J., Boardman, F., Ren, J., Pawlikowska, T., Ball, R., Clarke, A., Cohen, A. (2012). Social networks – *The future for health care delivery, In Social Science & Medicine, Volume 75,* Issue 12, Pages 2233–2241,

H. Håkansson H., & Snehota, I. (1995) *Developing Relationships in Business Networks,* Routledge: London

Ihlström Eriksson, C. & Svensson, J. (2009). *Co-creation in Living Labs: Experiences From Halmstad Living Lab*. Halmstad, Sweden.

Laya, A. (2017). *The Internet of Things in Health, Social Care, and Wellbeing,* PhD dissertation. Stockholm. http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-212548

Markendahl, J., & Laya, A. (2013), Business Challenges for Internet of Things: Findings From E-Home Care, Smart Access Control, *Smart Cities & Homes,* 29th IMP Conf., Atlanta.

Markendahl, J., & Laya, A. (2014), Transformation of Home Care Services, Working Processes and Business Models Due to Introduction of Mobile Technology, 30th IMP Conf., Bordeaux

Miori, V., & Russo, D., (2017), Improving life quality for the elderly through the Social Internet of Things (SIoT), 2017 *Global Internet of Things Summit (GIoTS)*, Geneva, pp. 1–6.

Osterwalder, A., & Pigneur, Y., (2010), *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. New Jersey, NY: Wiley

Palo, T., & Tähtinen, J., (2013), Networked business model development for emerging technology-based services. *Industrial Marketing Management, 42*(5), 773–782.

Westerlund, M., Leminen, S., & Rajahonka, M. (2014). Designing Business Models for the Internet of Things, *Technology Innovation Management Review, 4*(7), 5–14.

Zott, C., & Amit, R. (2010). Business model design: An activity system perspective. *Long Range Planning, 43*(2–3), 216–226

Digitalization, Collective Intelligence, and Entrepreneurship in the Care Sector

ERIK LAKOMAA

Abstract: Parallel to the formal private or public (health) care organisations in Europe, a number of community-driven care projects have emerged. They may supplement the formal organisations by reducing costs or provide care to groups that, for some reason, do not have access to the formal sector. Drawing upon the Ostromian theory of commons and on previous theory and research on open software development (which share some of the characteristics of "open care"), I use historical cases of community-driven care to examine the prospects for such projects to help remedy the cost crisis in the care sector. I explore under which institutional settings "open care" is likely to emerge and when open care projects have potential to scale. It is found that open care is more likely to emerge and prosper when it builds upon existing organisational structures: where the participants do not need to create new hierarchies or governance structures, and where they share common values.

Introduction

Research in health economics shows that the health sector is characterised by high costs, a high degree of regulation, and a lack of entrepreneurship. There is also a limited dissemination of process innovations in the care sector (Cutler, 2011)[1].

Despite the fact that digitalization has fundamentally affected industries and, in many cases, led to dramatically reduced costs, it has primarily led to better technical equipment in the field of care: not to reduced costs or to new forms of organisation.

1 In this context, care should be viewed in the broad sense of the term, and include child care, elder care, health care, assistance to persons with disabilities (mental and physical), and the treatment of addiction.

Cutler discusses why innovation has not reduced inefficiency and waste in healthcare as in other sectors. Examples include the slowness to adopt efficiency savings and the fact that doctors waste time on routine administrative tasks that could be provided by less-trained personnel or by information technology.

Cutler (2011) further argues that improved production processes of the type that has been observed in such sectors as retail, logistics, and manufacturing are far slower in spreading to healthcare due to the lack of organisational innovation:

> "Medical care is complex, and it is natural that there will be inefficiencies in complex settings. Indeed, in any industry where human action is important, there are bound to be mistakes. The failure of medical care is not so much that mistakes are made, but rather that the system has not evolved mechanisms to minimize those mistakes. For many years, Toyota was famous for its attention to error reduction; Wal-Mart is equally known for its supply-chain management."[2]

The explanations can be found in the current organisation and financing model. Healthcare is almost always, and other forms of care often, funded by third parties. This means that the business must be controlled and audited. A public entity will rarely be able to spend money on something that is beyond its control. The same holds true for a listed company.

A privately held company or foundation can act more freely. However, these are bound by regulations that cover the healthcare sector in most countries. This binding provides a low level of experimentation and, in principle, new solutions must be approved before they can be used. Meanwhile, there are limited incentives for innovation, as the financing models imply that the businesses receive compensation for actual costs.

Different rules within different jurisdictions also make it less possible to scale. Although people are very similar between different countries, the organisation of care is often nationally regulated. This organisation is due to compliance and documentation, among other things, that constitute a significant part of the business. This fact may explain why we do not find globally integrated care companies. Those that do exist are often conglomerates with separate national parts.

2 Cutler (2011 p 2).

On the other hand, new solutions have arisen outside the realm of organised care. I call these "open care".[3]

Open care has similarities with open software development, as it is bottom-up and (generally) not for profit. One type of open care projects is where people are organised to offer care, yet do not do so within the framework of the public or private formal institutions. This often occurs on a voluntary basis. Another type involves projects where patients themselves participate in care, exchange experiences, and pool their knowledge. A good example is Alcoholics Anonymous in drug addiction. One can summarise open care as "community and/or collective intelligence-based care projects".

Although it is easy to observe the connection to open source (as in open source software), it should be noted that open care is not necessarily IT based. IT might play a significant role in some open care projects (for example, as a means of communication and to create critical mass); however, open care does not need to have any connection at all to IT. Open care projects might have existed hundreds or thousands of years before the invention of the first computer. That said, most "open" projects will probably be driven by digitalization.

This chapter will focus upon open care projects that, in some way, build upon the potential of digitalization. I will use cases collected as part of an ongoing European research project on open care. Approximately 30 cases from European countries currently exist. [4] Cases include both ongoing and historically discontinued projects. My research will describe when open care arises and make an attempt to answer the question of when open care can help meet the challenges of care and the conditions under which open care emerges.

This chapter is organized as follows: first, I review the theoretical background on the concept of the commons and the connection to open care, followed by a discussion of the reasons for the increasing costs of care. Then, an empirical part will present some findings from existing open care projects. Finally, it will conclude with a discussion on when open care projects are likely to emerge.

3 As a concept, open care does not exist in previous research (other than as a synonym for "outpatient care").

4 The cases collected include community-organised clinics in Greece, care for immigrants in France, parallel imports of pharmaceuticals in Romania, and various online forums where patients can discuss their (sometimes rare) illnesses and, in some cases, provide feedback to caregivers and researchers upon the side effects of medications, for example.

Theoretical Background

The theoretical foundation for developing this concept draws inspiration from research on the commons (Hess & Ostrom, 2005; Ostrom, 2007; Ostrom, Burger, Field, Norgaard & Policansky, 1999; Poteete, Janssen & Ostrom, 2010) and open source software development. Institutional economics explains that community self-organisation is a third method for organising activities, apart from the traditional market and government division that, in many situations, works well (Ostrom, 2007). Collective intelligence and open care in general are classic examples of such commons. In many cases, self-organised communities work better than hierarchical systems; however, they do have their own challenges. This body of research also points to practical guides on how self-organised communities can better overcome collective action problems.

Self-organisation and basic economic models predict that conflicts of interest cause voluntary collective action to fail, even when such cooperation is to everyone's mutual benefit. Mancur Olson concluded:

> "Unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve their common or group interests" (Olson, 1971).

This occurs when rational, self-interested individuals have a stronger incentive to free ride than to contribute to collective benefits. The collective action problem can be theoretically shown in n-player prisoner dilemma games, where cooperation fails despite mutual gains

The "zero contribution thesis" in public good production, however, is not the full story. While cooperation is challenging, I also empirically observe that many examples of successful voluntary organisation are common. The work of Ostrom and her team showed that self-organised communities could solve collective action problems using cooperative norms. They examined real-life common pool resources, such as fisheries and grazing land. They found that, over time, communities organically developed collaborative institutions to overcome collective action problems. The rules for managing common pool resources could be monitored, and the community could impose sanctions. The studies found that, in a setting with repeated interaction and communication, social norms can replace an externally imposed set of rules: sometimes even outperforming them (Ostrom, 2014).

Ostrom focused upon the commons, which is any resource to which members of some group share access. Individuals can extract resources from the common pool for private use, but at the risk of degrading the commons through excess use: the "tragedy of the commons"(Hardin, 1968). One way to solve this collective action problem is privatising the resource into parcels of private property, while another is assigning management to a central authority. Ostrom showed that groups could also cooperate and act as their own stewards: in practice, transforming the resource into common property.

Successful cooperation is far from guaranteed and often fails. The potential for successful self-organisation, however, is wider than the simple self-interested theory would predict. Individuals often follow norms of reciprocity and are willing to restrict their own use of the common resource as long as most others do the same.

In addition to trust and reciprocity, successful commons governance requires an active community and evolving rules that are well understood (Ostrom, Stern, & Dietz, 2003). The longer-term survival of these institutions also requires so-called design principles. These include boundary rules, restrictions on the use of resources, monitoring, graduated sanctions on offences, conflict resolution, and the ability of the participants to elect leaders and modify rules. Cooperation works because the participants monitor each other and can sanction or exclude cheaters. Over time, social norms, internalising the preference to follow the rules, often evolve. This phenomenon allows for high levels of cooperation, without the need for close monitoring or costly sanctioning.

Organisational cooperation requires individuals to keep their promises to each other. Simple theoretical models often predict that credible commitment in negotiations is impossible without the coercive power of an external authority, such as the state. Ostrom et al. (Ostrom, Walker, & Gardner, 1992) argued that other mechanisms could also effectively enable credible commitments:

> "Empirical evidence suggests, however, that individuals facing social dilemmas in many cases develop credible ex ante commitments without relying on external authorities".

This was possible through repeated interaction, communication, and the ability to sanction those who acted opportunistically and broke their promises. In this setting, the threat of sanctions could create sufficient incentive to cooper-

ate and often outperform other arrangements. The authors concluded that self-governance is possible and that

> "[When] individuals are given an opportunity to restructure their own situation, they frequently – but not always – use this opportunity to make credible commitments and achieve higher joint outcomes without an external enforcer."

Defining healthcare as a commons would stretch the definition too broadly, making it useless. There are, however, specific elements of healthcare provision that can be viewed as common pool resources. One important example is the provision of complex healthcare requiring the collaboration of different actors.

The Increasing Cost in Healthcare

Over the past few decades, health expenditure has outgrown the overall economy in developed countries driven by factors such as ageing, higher incomes, and the adoption of new technologies.

Relative to the rest of the economy, health spending was historically fairly stable, yet began to grow rapidly around the 1950s in both the United States and in Western Europe (Getzen, 2014). Between 1960 and 2010, health spending as a share of GDP grew from approximately 5 to 17 per cent in the United States and from 3 to 10 per cent of GDP in Western Europe (Rebba, 2014). Interestingly, the rate of growth of healthcare expenditure is similar in the United States and Western Europe, albeit it remains at a lower level in Europe (Getzen, 2014). The increase in expenditure slowed sharply in recent years, though this is likely to be a temporary effect of the economic crisis.

The high cost increase in healthcare also affects equality by making healthcare unaffordable for low-income individuals. Even in Europe, healthcare tends to have a significant component of private out-of-pocket spending. Lower-income groups are, therefore, more likely to perceive a lack of access to health services even in countries that have universal healthcare. High expenditures have placed great pressure on public finances and created an impetus for reform aimed at increasing productivity in healthcare in order to maintain the long-term viability of the welfare state. The costs of healthcare delivery vary significantly by provider and region beyond what can be explained by quality and input costs. This suggests that many providers produce at sub-optimal levels of productivity

The causes of the high cost and low effectiveness in healthcare have been intensely debated in recent years, with no definitive answer. While this issue is not fully understood, it is often argued that the particular characteristics of healthcare cause unique organisation, which reduces the incentives for process innovation, thus, creating a bias toward high cost increases (Weisbrod, 1991).

Weisbrod (1991) writes:

> "To understand the markets in which healthcare is provided and financed, it is useful to consider ways in which healthcare differs from most other commodities. First, it sometimes involves the preservation of life or, at least, major effects on the quality of life. Second, it is a technically complex commodity that abounds with informational asymmetries, adverse to consumers."

One important explanation appears to be that the ethics of healthcare tend to incentivise technological change that is focused upon increasing health quality and saving the patient regardless of the cost, rather than on lowering costs (Weisbrod 1991). Technological improvement can either focus upon improving the quality for a given cost or decrease the cost for a given quality. There is a strong bias in healthcare toward the former: not for technological, but rather for institutional reasons.

Firms that invest in innovations know that providers, regardless of the cost, would almost never deny a new treatment or drug that improves the chances of survival. Focusing upon drugs or treatments that lower costs may not be as profitable. Technology often decreases costs, but has had a tendency to make health costs increase instead.

Open Care and Digitalization

In this section, I will use cases collected as part of the European Open Care research project to outline what can be considered open care. The cases in this study are limited to those using information technology.[5]

The first identified category of open care is online communities for patient interaction.

Patient information sharing sites can play a key role as knowledge brokers in the healthcare sector. This fact is particularly true if patient organisations can be encouraged to participate in the platforms. As collectives with varied members and activities, patient organisations have a unique capability of

5 For a thorough discussion on the project and the concept of open care, see (Sanandaji & Lakomaa, 2016).

easing the flow of information across networks (Nicholas & Broadbent, 2015). One such online platform is PatientsLikeMe, which was founded in the United States in 2004.[6] The social media platform, which has a global outreach, also engages many European patients and patient organisations. The health information-sharing site encourages users to input data about their symptoms, environmental triggers, medication, and so on over time. The result is the creation of ongoing medical records. Users are encouraged to communicate with others who have similar health statuses and exchange knowledge. PatientsLikeMe also process aggregated and de-identified data, which forms the basis of future health advancements. In addition to providing useful information to those who experience health issues, the mass data gathered at PatientsLikeMe is also useful to increase the understanding of diseases. Numerous scientific publications rely upon the data gathered by the patient communication platform.[7] In the long run, the mass data obtained from this and similar platforms can play an important role in fostering collective intelligence in healthcare (Tempini, 2015).

The second category is multi-function health communication platforms of which several may be considered open care. The Hungarian PraxisPlatform is a platform that, in addition to facilitating communication between patients, serves as a way for healthcare professionals to communicate with patients.[8] The latter role is achieved through sending therapy-related information to patients in order to increase their adherence to and compliance with medicinal therapy and medical device use. Through the online platform, pharmacy care services to large patient populations can also be conducted. PraxisPlatform is an example of how a single platform can fill two different roles: first, e-healthcare, through which the traditional healthcare system can efficiently reach out to patients at typically low costs and, second, as a social patient communication platform.

The combination of facilitating patient-to-patient communication and healthcare sector-to-patient communication (as well as patient-to-healthcare sector feedback) might create synergistic effects for patients in addition to

6 There are similar sites in other countries, e.g., Carenity, which is now established in several European countries (Castejón, Chekroun, García, Gay, & Rebollo, 2013).

7 An example is the paper by Naujoks et al. (Naujoks et al., 2016), in which patient-reported data from the PatientsLikeMe community are used to explore how migraines impact the day-to-day life of patients.

8 PraxisPlatform website, https://www.praxisplatform.hu/.

healthcare professionals. For example, these might occur since patients can receive complementary information through the same platform and the burden upon health professionals to reach out with online information can be reduced if patients receive from other patients some of the information they are seeking. Through these forums, patients can also help each other better understand the information given to them by health professionals.

HealthUnlocked is another example of a social-patient communication platform developed in Europe; its aims is to become the social network for health. HealthUnlocked is a peer-to-peer support network through which individuals with health issues can communicate safely online, with guidance from credible institutions and organisations. Founded in 2009, the platform is multi-functional since it also encourages patient advocacy organisations to become engaged as well. Through HealthUnlocked, these organisations can communicate with their members about health-related matters, as well as allow members to foster patient-to-patient health sharing.

Communication platforms are also encouraging and simplifying open communication between care providers. Hospitals and health clinics tend to be organised in a hierarchical manner, in which communication between different units and even between different doctors in the same hospital is often limited. Information sharing to patients is even more limited within the traditional hierarchy of healthcare provision. Information-sharing applications during recent years have disrupted this system by encouraging more open communication. An example is Klara. This communication platform was launched in 2014 and simplifies information sharing from doctors to patients. The cloud-based web and mobile apps offered by Klara have since spread to hundreds of health systems across the United States, including solo providers and large medical groups. Klara has gradually moved toward simplifying communication between healthcare workers and healthcare systems. The company is currently attracting capital to finance future improvements. The aim is to allow patients to exercise greater influence over the healthcare that is provided to them, as well as allow operational efficiency in health provision by simplifying information sharing. The example of Klara shows that open information sharing among patients, between patients and health providers, and among health providers can occur through the same basic platforms.[9]

9 PR Newswire (2016). "Healthcare Messaging Platform Klara raises $3 Million from Lerer Hippeau and Project A to become the Central Nervous System of Healthcare", 2016-09-14.]

A similar platform in Europe is ENJECT. ENJECT is a 4-year coordination project funded by COST: a European funding organisation for research and innovation networks.[10] ENJECT focuses upon promoting new models of healthcare delivery, thus, incorporating wireless, digital, and mobile technologies. The stakeholders in the process of health delivery are connected in information-sharing networks. The aim is to promote the concept of "connected health", in which the patient can gather, link to, and interpret information from different sources. Providers, patients and researchers can also use aggregate data in order to improve decision-making. This information sharing from providers to patients is relevant in the scope of open care, since the information can be fed into social patient communication platforms and peer-to-peer support networks.

A third category is that in which digitalization realises "long tail effects" (Anderson, 2006). RareConnect is an international platform for rare disease communities. The platform, which has been developed by Eurordis and NORD, acts in cooperation with patient organisations. The organisations contact the site managers to gain permission to set up community pages. These pages have learning resources in the form of moderated forums and spaces for patients to share their stories with one another. Individual patients can also connect with health professionals in the forums. Another platform is HealthTalk, developed in partnership between the charity DIPEx and the Health Experiences Research Group at Oxford University. The platform collects text and video narratives from patients who communicate their experience of having a certain disease. The experiences of individual patients are presented on a timeline through the early stages, diagnosis and treatment, hence, reflecting the entire patient experience. The patients included for each disease are chosen to represent a range of disease stages, ages, genders, socio-economic status, and so on. (Nicholas & Broadbent, 2015).

When Does Open Care Emerge?

Open care projects are unlikely to emerge where the traditional care institutions work well, but rather where they are inadequate. This phenomenon may apply either where care systems failed due to an economic crisis or in areas where no such systems have been established: for example, care for recent

10 ENJECT website, http://enject.eu/about/.

immigrants or for minorities or people in remote geographic areas. They may also emerge where scale effects exist but the number of patients in a specific jurisdiction is too small to cater to the demands of the users or patients. The ability of a patient with a rare disease to share knowledge with others might be of little value if the number of patients in a country is four and the knowledge exchange is organised within the national healthcare system. The value, however, could be enormous if the patient is able to interact globally with tens of thousands of other patents.

Several projects that have been able to scale successfully are those in which the users themselves are the prime beneficiaries. The aforementioned PatientsLikeMe and other social media platforms are devoted to the acquisition of knowledge. This also applies to non-digital open care projects, such as Alcoholics Anonymous: where their own participation is both important for the alcoholic participant and for the other participants in the gathering. Therefore, projects based upon self-help and exploiting economies of scale and the lack of regulatory border obstacles may have greater potential than other projects.

Projects based upon the acquisition of big data may also be successful even if they are likely to rely upon external incentives for participation, insofar as data collection does not give immediate benefits to the participants. The interest in creating such incentives may be substantial, as alternative opportunities for obtaining these data are often missing within traditional health services.

To help solve the healthcare cost crisis, open care projects must be able to scale. The insights from Ostrom offer some help in hypothesising when this is likely. Most open care projects are organised as non-profits. As they do not have a bottom line and the efficiency of the projects is difficult to evaluate, thus, allowing room for opportunism. A strong common culture might be the remedy. Historically, many projects that can be defined as open care have been organised by religious organisations where a common set of values already exist – a person who is involved knows what is a good outcome. This phenomenon also increases the costs for opportunistic behaviour from outsiders. The cost for a person to follow religious rules and rituals is low if the person is a believer in the faith; however, it can be costly for an outsider. Religious organisations may also provide an organisational structure, thus, alleviating the need to create one for a new project.

A common understanding of what is considered a good outcome also exists in other communities. What constitutes superior performance in the open software culture is generally agreed upon: for example, the writing of structured and commented code. Different functions are also more or less likely to be developed in the absence of financial incentives (Von Krogh, Spaeth & Lakhani, 2003). Research on software development, therefore, could be used to also understand open care projects.

Conclusions

Open care is a novel concept that can be useful in understanding the formation of care projects outside formal (health) care institutions in a world where health care costs is increasing and, in some cases, limited access to care is a growing problem. In this chapter, I have given some examples of how IT-based open care projects – both in the collective intelligence and the community provision type – may help solve some healthcare challenges.

As historical examples show, digitalization often, yet not always, facilitates open care projects. Through the use of the cases and previous literature on the commons and institutional entrepreneurship, it is possible to hypothesise where open care projects may emerge: mainly where the traditional public or private healthcare system is inadequate or has failed. This phenomenon applies both to public and private systems.

That open care is easier to organise if the participants have shared values because they can more easily agree upon what is a good result (Capiluppi & Michlmayr, 2007) may also be assumed. For instance, this phenomenon has been identified in open source software development: where there is a consensus on what is considered to be good code and what the rewards are. The same can be observed within collective intelligence projects, such as Wikipedia: where the internal incentive and reward systems are based upon a common culture.

Open care may also foster innovation by means of lowering the cost of experimentation. Formal care institutions are often risk averse due to the high costs of failures; however, open projects – party as a result of their smaller scale and the low stakes – might be more prone to experimentation. This means, a few successes that could scale could then outweigh the cost.

Thus, open care may relieve the pressure upon the formal healthcare system in two ways: first, by facilitating entrepreneurship and the dissemination

of process innovations. If some "open" solutions are able to scale, then they might lower the cost for specific treatments or types of care. This fact is especially true when similar projects – due to, for example, high monitoring costs if organised within formal care institutions – have a limited potential to scale. Through the structuring of incentives, many of the projects described in this chapter will avoid the problems described in the "commons" literature.

Secondly, even when they lack the potential to scale, open care projects can help by providing benefits to groups that have limited access to formal care institutions or where the participation of the patients is in itself therapeutic. In both cases, open solutions might increase access to care without incurring a cost to the formal care institutions. Open solutions might also increase the quality of care by creating incentives for experimentation and innovation, also without increasing the costs to the formal, private, and public care providers.

References

Anderson, C. (2006). *The long tail: Why The Future of Business is Selling Less of More:* Hachette Books.

Capiluppi, A., & Michlmayr, M. (2007). *From the Cathedral to the Bazaar: An Empirical Study of the Lifecycle of Volunteer Community Projects*. Paper presented at the IFIP International Conference on Open Source Systems, 2007.

Castejón, N., Chekroun, M., García, J. M., Gay, C., & Rebollo, P. (2013). Patient Networks as a Data Source for Patient Reported Outcomes Research. Carenity Experience. *Value in Health, 16*(7), A608.

Cutler, D. M. (2011). Where are the Health Care Entrepreneurs? The Failure of Organizational Innovation, *Health care Innovation Policy and the Economy, Volume 11* (1–28): University of Chicago Press.

Getzen, T. (2014). Measuring and forecasting global health expenditures. in Scheffler (ed.) *World Scientific Handbook of Global Health Economics and Public Policy, vol 3*. World Scientific.

Hardin, G. (1968). The Tragedy of the Commons. *Science, 162* (3859), 1243–1248.

Hess, C., & Ostrom, E. (2005). *Understanding Knowledge as a Commons: From Theory to Practice*.: MIT Press

Naujoks, C., Olson, M., Simsek, D., de Vulpillieres, F. d. R., Vo, P., Kendall, K., & Cerrato, D. (2016). How do Migraines Impact Patient Day-to-Day Life? an Exploratory Analysis of Patient Reported Data from the Patientslikeme Community. *Value in Health, 19*(7), A438–A439.

Nicholas, L., & Broadbent, S. (2015). *Collective intelligence in patient organisations*. : Nesta

Olson, M. (1971). *The Logic of Collective Action : Public Goods and the Theory of Groups:* Harvard University Press.

Ostrom, E. (2007). Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework. In P. Sabatier (Ed.), *Theories of the Policy Process* (pp. 21–64): Westview Press.

Ostrom, E. (2014). Collective Action and the Evolution of Social Norms. *Journal of Natural Resources Policy Research, 6*(4), 235–252.

Ostrom, E., Burger, J., Field, C. B., Norgaard, R. B., & Policansky, D. (1999). Revisiting the Commons: Local Lessons, Global Challenges. *Science, 284*(5412), 278–282.

Ostrom, E., Stern, P. C., & Dietz, T. (2003). Water Rights in the Commons. *Water Resources Impact, 5*(2), 9–12.

Ostrom, E., Walker, J., & Gardner, R. (1992). Covenants with and without a Sword: Self-governance is Possible. *American Political Science Review, 86*(2), 404–417.

Poteete, A. R., Janssen, M. A., & Ostrom, E. (2010). *Working Together: Collective Action, the Commons, and Multiple Methods in Practice:* Princeton University Press.

Rebba, V. (2014). *The Long-term Sustainability of European Health Care Systems*. Dipartimento di Scienze Economiche" Marco Fanno".

Sanandaji, T., & Lakomaa, E. (2016). *Care, Commons and Entrepreneurship,*. SSE Working Papers in Economic History 2016:2. Stockholm School of Economics.

Tempini, N. (2015). Governing PatientsLikeMe: Information Production and Research through an Open, Distributed, and Data-based Social Media Network. *The Information Society, 31*(2), 193–211.

Weisbrod, B. A. (1991). The Health Care Quadrilemma: an Essay on Technological Change, Insurance, Quality of Care, and Cost Containment. *Journal of Economic Literature, 29*(2), 523–552.

Von Krogh, G., Spaeth, S., & Lakhani, K. R. (2003). Community, Joining, and Specialization in Open Source Ssoftware Innovation: a Case Study. *Research Policy, 32*(7), 1217–1241.

AgTech and the City: The Case of Vertical Farming and Shaping a Market for Urban-Produced Food

MARIA J. BUSTAMANTE

Introduction

The world population is expected to reach nine billion by 2050, and the UN Food and Agriculture Organization predicts that food production must increase by 70 per cent to feed the growing population (Beecham Research, 2016). With pressure to not only produce more food, but more sustainable food, agriculture is undergoing a digital transformation as it seeks to use technological solutions to increase yields while reducing food loss and negative environmental effects. Vertical farming, which grows products in vertically-stacked layers, is an emerging trend showcasing how technological innovation can lead to new solutions for food production. This is part of the urban agriculture movement that strives to produce food closer to metropolitan areas where an increasing proportion of people live. Vertical farms utilise new growing techniques, such as hydroponics: growing plants in water, and aeroponics: providing water and nutrients via a spray mist. This, along with technologies such as LEDs, sensors, and software enable farmers to constantly monitor and adjust nutrients, water, and temperature to maximise efficiency and optimise the plant's nutritional content. AeroFarms, based in the United States, boasts using over 30,000 data points to monitor not only the environment around the plants; it also controls the colour, texture, nutrition, and flavour (http://aerofarms.com/). The technological efficiency coupled with the elimination of weather, and other potentially harmful externalities enables the farm to be 130 times more productive from a crop-yield perspective to the equivalent field farm (Ryan, 2017). This digital transformation

of food production does not disrupt the current agricultural network; instead, it has the potential to develop a whole new one since the rural setting is exchanged for an urban one. Actors, including urban planners, city governments, and real estate developers now have a role to play.

In order for the technological innovation to be successful, it must find a market. In other words, although technical solutions to produce safer and less harmful agricultural goods in cities do, indeed, exist, it is not assumed that the consumer and the larger agriculture system or other relevant industries will support it. Vargo et al suggest: "Market innovation does not occur automatically when actors (e.g. firms), or groups of actors (e.g. innovation networks) introduce new ideas or products, but only when new practices (i.e., solutions) become *institutionalized*" (Vargo, Wieland, & Akaka, 2015). This implies that it is too narrow to consider innovation strictly from a technology perspective. There is also a need to expand the range of innovation to include the relationships, processes, and collaborative initiatives that ultimately lead to market innovation (Vargo, et al, 2015).

Founders of vertical farms are redefining how we think about food production. In order for it to become institutionalised, they will need to influence the broader ecosystem of stakeholders. The purpose of this chapter is to explore the different dimensions of market innovation that complement the technological innovation of vertical farming by seeking to answer the following question:

> *What activities are the founders of vertical farms performing in order to influence market innovation?*

This chapter will first outline an analytical framework that will be used for discussion, and then present two cases of vertical farms in the Swedish market. The chapter will then discuss the activities that these market entrants are using to affect market innovation using the model. By outlining the activities, we can then begin to see which relationships and collaborations are vital for these farms: that is to say, the ecosystems that vertical farms are establishing in order to build a market for their products. The chapter concludes with a summary based upon the findings and future market considerations as we rethink food networks and production methods in a digital era.

Concepts and Analytical Framework

The key concept and model introduced here will establish a framework that will be used to discuss the cases.

SERVICE ECOSYSTEMS APPROACH

Ongoing negotiations within a firm – that is to say, the vertical farm – as well as within the broader ecosystem, which includes a number of stakeholder institutions, shape both technological and market innovation. By approaching innovation in this way, we recognise that there is more to the success of an innovation than just the binary analysis of the firm/innovator and customer/adopter. A number of actors and institutions will, indeed, play a role.

The service-ecosystems view provides an integrative approach to marketing that examines both goods and services. In this context, innovation is said to be "driven by collaborative efforts to find or develop new ways to create value" (Vargo, et al 2015). This interpretation consolidates the views of technology and market innovation and defines them as follows:

> "*Technological innovation* is the co-creation of new value propositions, or collective, combinatorial evolution that leads to the generation of new, potentially useful knowledge."
>
> "*Market innovation* is driven by and drives the development of new technologies, but also requires the acceptance of a value proposition as well as the continued exchange, integration and application of a particular technology among multiple actors, over time (i.e. institutionalization)." (Vargo, et al 2015)

To consider vertical farming through a service ecosystems lens, we must first acknowledge that farming has become more than just a "goods" business. Food has transformed from a survival product to one that encompasses a whole range of values: what it means to be organic, locally grown, all natural, and so on. While food remains a product, vertical farming is introducing a new value proposition. In order to institutionalise the idea that urban-produced food is an important part of our future food system, actors will need to engage in "institutional work and co-create institutions through multiple iterations" until shared value is developed (Vargo et al, 2015).

MARKET PRACTICE MODEL

Markets tend to be defined by relationships that are already established, which means actors must work to change "mental barriers" that inhibit current actors' ability to see the market differently (Storbacka & Nenonen, 2011). As a result, market actors who wish to redefine or reshape a market must undertake a number of activities. In the case of vertical farms, the founders seek to shape a market for urban-produced food. To help outline the activities of the vertical farms, I will use the market practice model developed by Kjellberg and Helgesson (2007). The framework outlines three linked activities the authors call *exchange, normalising, and representational practices* that are executed continuously. Exchange practices include the activities related to economic exchange such as presenting products, negotiating prices, advertising, and so on. Storbacka and Nenonen extend this definition to include the idea that exchange practices are also the activities that shape an accepted and shared value proposition (2011). Representational practices include the activities that look to depict markets and/or how they work. Lastly, normalising practices are defined as activities that seek to establish guidelines on how a market should be shaped according to some group of actors. This can include norms and rules: such as technological standards, codes of conduct, and so on (Kjellberg and Helgesson, 2007).

The model will be used to outline the activities vertical farms are performing to overcome the mental barriers of current actors and develop a shared value of urban-produced food aided by digital technology.

Overview of Vertical Farming

Food has been produced "inside" in greenhouses for quite some time. Vertical farming builds upon the concept of greenhouses and incorporates the urban setting due to technology providing the opportunity to produce food in an untraditional environment: that is to say, without sun or soil inside different types of structures. While greenhouses have made strides in technological advancement and have been effective in producing products in bulk, they continue to work within their established networks along the value chain. The urban location of most vertical farms today is the catalyst for the need to evaluate the network and ecosystem for food production and distribution in the city.

Urban agriculture has been around for years: in the form of rooftop and community gardens. The concept of vertical farming, however, is still rela-

tively new. Vertical farming is defined as "the practice of growing plants in vertically stacked layers, vertically inclined surfaces and/or integrated other structures. The modern idea of vertical farming uses Controlled Environment Agriculture (CEA) technology, where all environmental factors can be controlled" (Association for Vertical Farming, n.d.). In 2010 when Despommier wrote his seminal work on vertical farming, there were none in existence (Despommier, 2011, pg. 4). Today, however, vertical farms of various size and set-up can be found in countries all over the world: including the United States, Japan, the UK, Singapore, and Sweden. They can be found in repurposed warehouses, newly constructed buildings, and shipping containers. Some strive to sell to wholesale markets; others target consumers, while others exist solely for the purpose of educating and training. Water efficient growing techniques, such as hydroponics and aeroponics, coupled with technologies such as LEDs, sensors, and software enable farmers to constantly monitor and adjust nutrients, water, and so on in order to maximise efficiency. The main output tends to be leafy greens and herbs, though efforts to expand into other crops and fish are underway.

While vertical farming is new to Sweden, a few entrepreneurs have seen an opportunity for the technology and have entered the market. Based upon semi-structured interviews with founders and secondary research, the following sections will outline two cases of vertical farms being developed in Sweden today.

The Case of Plantagon

> *I said that this is almost impossible because there is absolutely no market for vertical farming. There are no clients.* (Hans Hassle, Co-founder, Plantagon)

Headquartered in Stockholm, Plantagon positions itself as a "global innovation pioneer". Much of Plantagon's work has focused upon building relationships with stakeholders and communicating the possibilities of vertical farming through summits and other presentation opportunities. Meanwhile, it has grown its number of patents and initiated a standardisation process for urban food production. Plantagon develops and operates urban farms; its business model is based upon management and performance fees. International awards and recognition have followed Plantagon's ambitions and activities. While plans and agreements for vertical farms exist in Sweden,

Singapore and China, the company has faced challenges regarding zoning and financing; no fully functional vertical farm has come to fruition to date.

BACKGROUND

The seeds for Plantagon were cultivated in 2002 as a project led by Hans Hassle. Other partners included Sweco, Åke Olsson (innovator) and the Onondaga Nation, a Native American entity in the United States. The goal was to develop a sustainable business for high-technology food production. Each entity brought a different perspective to the table. Sweco was able to put Olsson's concept of a vertical farm into the context of their sustainable city project, thus, growing food with limited land. The Onondaga people saw an opportunity to protect food sources in the face of climate change. After long discussions and negotiations, Plantagon was officially incorporated as a company in 2008, and was set up as a hybrid company: a non-profit organisation (Plantagon International Association) and a for-profit company (Plantagon International AB). The goal of the model is to find a balance between the commercial and ideological driving forces of a company.

An in-depth visibility study followed: focus was placed upon building a brand and patent portfolio rather than a prototype that would be expensive and obsolete in just a few years. Building a strong brand would enable the company to apply it to other technologies and pursue high-impact partnerships. The company approached the Swedish clean tech industry and contracted large companies to do research and development since they already had the teams, knowledge, and ideas. In this way, the organisation was able to uncover challenges quickly: such as climate control in a vertical building or thinking through water, logistics, and distribution channels. Energy would become a big challenge. Plans were almost abandoned in the middle of the visibility study in 2008–2009, due to the energy costs needed to make the concept work. However, a turning point came when Tekniska verken in Linköping contacted the company. As one of the biggest energy companies in Sweden, it had been working with renewable ideas and sustainable waste management for years and wanted a project that would showcase its work to the public. Tekniska verken was interested in Plantagon's vertical greenhouse concept and wanted to connect the greenhouse with existing infrastructure.

> "They offered us the spillage heat for free. So then we took down the energy consumption…and then it made sense economically."
> (Excerpt from interview with Plantagon)

With the agreement, Plantagon had a viable solution to produce food vertically in a controlled environment. The pitch was adjusted from a stand-alone vertical greenhouse to an integrated façade system, which combines the vertical greenhouse concept with a normal real estate project. The goal was to show the potential for the vertical greenhouse to add value to real estate projects.

Rendering of Plantagon's World Food Building in Linköping, Sweden. Photo credit: fyyr/Henrik Vesterberg.

In February 2012, Plantagon held the ground-breaking ceremony for the Plantagon World Food Building in Linköping, Sweden. This has been the company's premier project, embodying the integrated façade system with a greenhouse on one side and an office building on the other: where people and plants will mutually benefit from the building's airflow. Once completed, it is

estimated that the building will produce 500 tons of vegetables per year in a 60-metre tall building (http://www.plantagon.com/exhibition/). The concept incorporates automation, vertical production, and Plantagon's patented uPot, which optimises the indoor environment for plant growth. In addition, the project includes a number of partnerships in order to develop integrated solutions for energy, waste, water, and carbon dioxide.

Plantagon AB has driven many of the above activities: the for-profit company set up as part of the hybrid structure. The organisation drives all commercial activity: including the development, and sales of Plantagon's technology, as well as the discussions with potential partners in the public and private sector.

Non-profit corporation, Plantagon International Association, focuses upon opinion-shaping activities, such as seminars, education, and lobbying to bring to the forefront the issues and possibilities of urban agriculture. Vegetables produced indoors cannot be classified as organic under current regulations due to the lack of soil use, even though the food is produced without chemicals or pesticides. This became a market and branding problem; therefore, Plantagon realised there needed to be a standard for urban-grown food to ensure safe production and to build consumer understanding.

> "… So we arranged a seminar in Brussels, which was the first on urban agriculture... [To discuss] what is really meant with sustainable food production in cities." (Excerpt from interview with Plantagon)

These global activities with city officials, governments, and international bodies help to define and establish what is vertical farming, as well as its potential for both business and society. The non-profit's current membership stands between 300 and 400 people/organisations.

THE PRESENT

While Plantagon continues to work with local partners to build the World Food Building, it has begun to focus upon other types of projects as well. One of the big challenges for the company has been to convince real estate companies of the economic viability of incorporating food production in buildings. The conversation has been more about the business of food production rather than a specific technology.

> "… We're building a new part of infrastructure in cities…it's much bigger than a simple business plan. Of course we have business plans and excel sheets and all of that…but [investors and partners] need to share this extreme long-term perspective." (Excerpt from interview with Plantagon)

Plantagon realised it needed to show that indoor urban food production could be profitable. The company plans to launch its first full-scale energy smart farm in 2017 in a completely controlled underground environment in Stockholm; this will be done in partnership with Fabege, the owner of the building where the farm is being built. The produce will be sold in neighbourhood markets and in the building; this will be the first time the new urban food label is used. The automation and vertical technology upon which Plantagon has built its patents, however, is not the best option to produce in the underground environment. Yet, the company strategy to build its brand as an expert in the conceptualisation and design of indoor food production, rather than tying itself to a specific technology, has enabled it to work with partners to find the best solutions. Hence, it is working with a company it believes has the best technology for the underground environment.

THE FUTURE

Plans for the future include adding at least nine more production facilities in office buildings in Stockholm and ten more in residential buildings throughout the country. The company has also noted that it has transitioned from research and development into *agritechture*, or a "combination of agriculture, technology, and architecture" to safely and locally produce food in cities (http://www.plantagon.com/about/business-concept/agritechture/).

With the new planned projects, Plantagon does not see real estate as much of a challenge moving forward. Once production begins to hit the market, it will be a matter of who will buy the products. There will also be new owners, which the company is currently negotiating.

The Case of Grönska

> *Every part of the value chain has new things we have to, maybe not entirely reinvent, but rethink and perhaps do differently.* (Natalie de Brun Skantz, Co-founder, Grönska)

Grönska is a vertical farm start-up located in Hammarbyhöjden, just outside downtown Stockholm. The company is building out its growing system in the basement of an existing office space. The team currently consists of a grower/hydroponic systems expert, an architect, and a business and marketing professional. Grönska is the first to grow plants vertically and sell them on the market in Sweden. The company currently owns the whole value chain: from technology development through to distribution. As the team learns about the market by doing and iterating, Grönska sees working on a small scale as a key advantage: not just with how they produce plants; benefits lie with pricing strategies, business models, and distribution as well. Grönska's goal is to make the city self-sustainable.

BACKGROUND

The seeds of Grönska were planted in 2014 when friends Petter Olsson and Robin Lee rented space in Hammarbyhöjden and began experimenting with growing plants hydroponically. They welded and built their own LED light systems to optimise what was currently available on the market. Grönska was officially registered as a company in 2016 when Natalie de Brun Skantz joined the team. That same year, they began selling their first products at Paradiset: the largest supermarket provider of natural and organic products in Sweden.

> "Getting out to market has allowed us to have dialogue with customers, to try packaging, to try logistics…. And also to understand how groceries work… Paradiset is very generous with information, so it's more of a cooperation than us just being a supplier." (Excerpt from interview with Grönska)

The relationship between the two companies has been instrumental for Grönska. They work together on pricing in an attempt to find the right level for Paradiset, Grönska, and the end consumer.

While grants and scholarships from entities such as Almi, Stockholm Business Region, and Stockholm Venture Cup have helped bring in some money, the company is largely bootstrapped by the owners. Other revenue comes from opportunistic activities: speaking engagements, consulting on architecture, and real estate projects interested in incorporating food production in their designs.

THE PRESENT

Grönska's main product is basil, which is grown in pots at a capacity of about 600 plants per month under its proprietary LED lighting system. Beyond the lighting system, Grönska uses a sensor and app to monitor and adjust environmental parameters in the farm: such as carbon dioxide, temperature, and humidity levels. Other parts of the process – including harvesting – are done manually. The company currently sells about one tenth of the yield and uses the rest for testing to optimise growth and nutrition. Growing plants in pots was a conscious decision, since the Swedish consumer is accustomed to buying herbs in this way. In addition to Paradiset, the company also sells to Centan: a restaurant focused upon using locally-produced products. Through in-store promotions and demonstrations at events such as Smaka på Stockholm, Grönska has also invested time in talking to end consumers.

> "Feedback from customers has been super positive, but there is initial confusion about why we can't say we're organic even though we don't use pesticides." (Excerpt from interview with Grönska)

Educating customers on how the product is grown and why it does not carry the organic label can be time consuming. Grönska believes there is a need to distinguish between urban-produced food and other available products; it has supported efforts from Plantagon to establish an urban food label that would clarify these differences for consumers.

The company is targeting wholesale, retail, and restaurants, with other customers in the pipeline. There is opportunity selling to wholesalers and restaurants that desire food produced in Sweden, which is often difficult to find given the harsh winter climate. Sweden traditionally has approximately three harvests per year: Grönska, however, is able to have 12: amounting to one per month. In addition, its products have a consistent look regardless of whether it is summer or winter, which is not the case for greenhouse or other traditionally-produced goods. Prices are negotiated with the retailers and are set at "a bit of a premium, but still competitive in price." Grönska admits that it is still experimenting and negotiating for the best price level. The challenge has been how to balance growing customer interest with growing production capacity.

Herbs growing in Grönska's farm: just outside downtown Stockholm, Sweden. Photo credit: Grönska.

Experimentation and iterations can be found throughout the whole process. The substrate or material that anchors the plant for growing hydroponically in the production phase is a big point of discussion. Grönska started with soil, then tested a number of materials: from paper pulp to fabrics to coconut coir. In the end, they have returned to using soil for the time being. The reason for this is that it comes down to not only what is organic and cost-effective; it also depends on what is available nearby. For example, coconut coir would need to be imported from the Caribbean, thus, negating any positive impact of local food production.

With regard to the business model, Grönska is thinking about different options and considering whether or not customers are willing to book orders beforehand, so the company can schedule production accordingly, thus, reducing waste or whether it will need to find a secondary market for unsold products. Grönska is also currently handling distribution; as production grows, the experimentation of models in this part of the value chain will also take place.

Grönska is currently building a larger capacity production system that will enable it to produce up to 5,000 plants per month. Half of these will be sold; the other half will be reserved for testing. Automation will also soon be tested in some aspects of the production. Due to costs, however, full automation will not be implemented until a third planned phase of expansion. Grönska deems the current construction of a larger scale proof of concept to be instrumental in developing its cost structures and production model. Plans are underway to have the next capacity phase up and running by the end of 2017. Parallel to these activities, the company is participating in events and lobbying the government about the importance of food production to help build self-sustaining cities. Grönska also hopes to form partnerships with important actors in the agriculture sector, such as the Swedish Board of Agriculture (Jordbruksverket) and others.

> "We have spoken with LRF [the Federation of Swedish Farmers]. We think we should be incorporated in the group. There's no difference between us and a field farmer." (Excerpt from interview with Grönska)

THE FUTURE

As the farm grows, the plan is to introduce automation in planting and harvesting as well. In the long term, Grönska hopes to target crops that have a large import rate to Sweden, cutting down on greenhouse gas emissions and enhancing the flavour of products available to the Swedish consumer. The company also plans to move into other types of packaging, as well as having nine larger growing facilities in Sweden and then expand to other countries in the Nordics and Europe. Grönska is also testing a more distributed business model in addition to its in-house production that would place its technology in offices or stores, thus, enabling on-site production. While it believes the market is not there yet, it does have a test system installed at Hyper Island: a school in Stockholm.

A number of challenges remain. Distribution is one of them. Currently, the majority of vegetables in Sweden, even if grown near Stockholm, go through Helsingborg. Ideally, Grönska wants to distribute directly. Due to the potential large volumes, however, this might not be possible. The aim will be to balance the benefits of building new networks or joining existing ones.

Discussion

The two cases of vertical farms in Sweden show that the companies are taking different approaches in establishing their respective businesses and building a network to support their product. Plantagon is focused upon designing large-scale projects with state-of-the-art technology; it has worked on a local and international level with a focus upon high-level organisations and contacts to grow the acceptance of vertical farming prior to bringing a product to market. Grönska is a start-up that has concentrated upon building relationships with sellers and the end consumer in Sweden in order to bring product to market on a small-scale; it iterates and makes improvements along the way in operations and technology. The conceptual model of markets (Kjellberg and Helgesson, 2007) will be used in this section to outline and discuss the activities that Plantagon and Grönska are performing to encourage other actors to accept the value proposition of urban-produced food; these include real estate partners, governments, consumers, among others.

Representational practices are those activities that look to reduce the ambiguity around a market. The concept of vertical farming is new to potential customers, sellers, and partners. Therefore, both companies have worked to shape an understanding of it by engaging with a number of different actors: government officials, energy companies, real estate companies, supermarkets, restaurants, distributors, and end consumers. This is achieved through meetings, events, and technology demonstrations. The difference here though is the geographic target. Grönska is more focused upon presentation in Sweden and on influencing the local ecosystem. Plantagon has focused more upon building an international network: for example, organising urban agriculture summits in Brussels and Washington.

Normalising practices help to establish guidelines and rules for how the market should work; it also includes activities related to strategic planning. One challenge that both Plantagon and Grönska have encountered is how to position their products since they do not fit under current rules and regulations for what is considered organic. Plantagon has been leading a standardisation process that has reached the international ISO level in order to establish legitimacy and uniformity when presenting urban-produced food with new technology. Grönska supports these efforts; however, it has not been a focus for the company. Plantagon has also put in place structures to assist with international strategic efforts, as well as an official board of directors

with backgrounds in areas such as advertising, banking, non-profit, public sector, and sustainability. Grönska has also worked with a group of advisors on an ad hoc basis, which also represent various sectors; these include environmental research, construction, and the public sector.

Perhaps the biggest difference between the two cases is in the exchange practices. With no product on the market, Plantagon has focused upon setting up large partnerships with various stakeholders: most critically, with real estate and energy companies. Emphasis has been placed upon negotiations of contract terms (for example, rent, subsidised energy costs, and so on) as well as the design of the production set-up, which would enable the co-creation of value for the parties involved. Grönska has focused upon the exchange practices related to selling product to the end consumer. Social media, packaging, press releases, and demonstration products are all examples of activities it has adopted to attract potential sellers and customers. Securing Paradiset as a seller early on has been instrumental in establishing prices.

These activities by both firms are intertwined, and help shape the overall market for urban produced food. What becomes apparent is that they are initially focusing upon influencing two distinct markets: the real estate market (that is to say, vertical farming structures) and the market for the end product (for example, salad greens, herbs, and so on). Plantagon has largely focused upon building a real estate market for urban farming. In doing so, exchange practices related to product price is less the focus; instead, attention has been diverted to building relationships with architects, the real estate sector, and other actors in the city whose support will be instrumental: such as city and national governments. Plantagon has developed renderings and gathered data on building costs, which speak directly to its real estate and architecture audience. Only after the company has been able to secure partnerships that will enable it to test and prove that urban food production is economically feasible, has it turned to the seller and end-consumer market. The initial focus upon brand and technology development also affected the network Plantagon has built; it has focused upon an international network in addition to its Swedish one.

Grönska has concentrated primarily on the customer market in Sweden: both through building economic exchange mechanisms with sellers and participating in activities that enable it to educate the end consumer about vertical farming. Grönska participates in events where it can showcase its product and

have direct contact with the end consumer since getting product to market is its intention. While the company also interacts and speaks with architects and other real estate actors, it is not done as a focused strategy. This also affects how the company positions itself, which is as a farm and as a local Swedish producer of food. In this way, Grönska espouses the values of locally-produced safe food.

Vertical farming does not fit squarely in the agriculture or real estate industries. Therefore, vertical farmers must educate and communicate not only with the sellers and end users of their products; they must also reach the larger institutions in society that contribute to the value creation and acceptance of urban-produced food. This links back to the idea of institutionalisation (Vargo, et al. 2015). Plantagon and Grönska are introducing a new concept of farming; for true market innovation to occur, however, there will be an ongoing need for the firms to build relationships (for example Grönska and Paradiset), processes (such as more efficient production and distribution methods) and collaborative initiatives (as with Plantagon and Tekniska Verken).

Summary & Conclusion

The development of technology that enables food production in urban areas has resulted in the emergence of firms that believe not only is food production in cities feasible; it is also a necessity to feed a growing urban population. This chapter's premise was technological innovation must be complemented by market innovation in order for digital transformation to occur and have an impact. This research explored through two cases the current activities upon which vertical farms are focused in order to build a market for urban-produced food: Plantagon and Grönska. A conceptual model of markets was used to help outline the market shaping activities, as well as the network of actors that are vital in institutionalising the idea of urban-produced food. Vertical farming is still in its early stages of development in Sweden and yet, it is already establishing the need for different industries to work together. Plantagon and Grönska are building a network of actors to support their efforts. Relationships in a variety of industries are needed to enable market innovation: including real estate, government, clean technology, food distributors, food markets, and end consumers.

The cases revealed how many activities of the two farms are similar, yet they differ on the scale of the endeavours and the timing at which the compa-

nies chose to focus upon them. The reason for this is the two firms are actually shaping two distinct markets: a real estate market and a seller/consumer market. This has affected which actors and networks they have wanted to influence as well as establish relationships. As part of an emerging market in Sweden, however, both companies' efforts appear to be beneficial in building the larger ecosystem that will be ultimately needed for a sustainable market of urban-produced food. For true market innovation to occur, new agricultural standards and norms must be integrated into the current food production system. In other words, vertical farming must become institutionalised. The level of success in which vertical farms are able to co-create the value with other institutions in the ecosystem will have a large effect upon what does and does not eventually work. This also highlights how the values and social forces of current markets have the ability to constrain or encourage the integration of new technologies and form new markets.

FUTURE ECOSYSTEM CONSIDERATIONS FOR URBAN-PRODUCED FOOD

As more technology innovation occurs, which kind of market innovation will need to follow?

In order to scale the output of the farm, there needs to be a scaling of the necessary expertise to run the farms. Managers, engineers, data scientists, plant biologists, technology and software developers, and farm workers will also be required. Laws may need to be modified to enable structures in urban areas to be used for food production. Government and educational institutions will need to support and invest in educational programs that train the needed workforce to produce food in a digital environment. Demand and supply mechanisms must also be balanced to ensure that goals are met, such as the reduction of food waste and reducing transportation needs; it is not one specific practice. The constant and iterative work of the vertical farms, with a number of stakeholders across different industries, will lead to the digital transformation of food production in cities.

References

Beecham Research. 2016. *Enabling the Smart Agriculture Revolution: The Future of Farming Through the IoT Perspective*. London: Beecham Research Ltd. [Online] Available at: http://www.beechamresearch.com/downloads.aspx [Accessed 20 June 2017].

Despommier, D. 2011. *The Vertical Farm: Feeding the World in the 21st Century*. (2nd ed.) New York: Picador.

Association for Vertical Farming (n.d.). *Glossary for Vertical Farming*. [Online] Available at: https://vertical-farming.net/vertical-farming/glossary-for-vertical-farming/ [Accessed 12 June 2017].

Kjellberg, H. and Helgesson, C-F. 2007. On the nature of markets and their practices. *Marketing Theory, 7*(2): 137–162.

Storbacka, K. and Nenonen, S. 2011. Markets as configurations. *European Journal of Marketing, 45*(2): 241–258.

Vargo, S.L., Wieland, H., Akaka, M.A. 2015. Innovation through institutionalization: A service ecosystems perspective. *Industrial Marketing Management*, 44: 63–72.

Ryan, K. 2017. The Future of Farming May Not Involve Dirt or Sun. Inc.: 14 Jun 2017. [Online] Available at: https://www.inc.com/kevin-j-ryan/aerofarms-disruptive-25-2017.html [Accessed on 27 July 2017].

Future Outlook

Future Outlook on Digitalization

ROBIN TEIGLAND, CLAIRE INGRAM BOGUSZ, AND ANNA FELLÄNDER

Introduction

Since the year 2000, digitalization's influence on products, services, processes, and business models is the primary reason that just over half of the names of the companies on the Fortune 500 list have disappeared.[1] Technology-based companies are increasingly taking centre stage, thus, replacing traditional asset heavy companies with their asset light operations. For example, in terms of market capitalisation Microsoft was the only technology company among the top five publicly traded firms in 2000: GE, Citibank, Walmart, Exxon and Microsoft. By 2016, however, all five were technology companies: Apple, Alphabet, Microsoft, Amazon, and Facebook.[2] Turning to the S&P 500, the percentage of tangible assets in these companies' valuation from 1975 to 2015 fell from 83% of the total value to 13% with the value of intangible assets, rising from 17% to 87%.[3]

In addition to technology companies taking centre stage in terms of market valuation, digitalization is also influencing value creation activities on different levels. Digitalization is dissolving the boundaries of the firm on the more basic process level, as some firms move the nexus of their value-creating activities, such as branding and innovation, to informal networks outside the firm. Secondly, some firms are moving away from traditional value-chain, pipeline-based business models on the business model level, to multi-sided platform business models that enable transactions among strangers in what has been labelled the *Platform Economy*. We are seeing digitalization's potential to transform entire industries on an even higher level – that of industry. Furthermore,

1 https://www.weforum.org/agenda/2016/01/digital-disruption-has-only-just-begun/

2 http://www.visualcapitalist.com/chart-largest-companies-market-cap-15-years/

3 http://www.oceantomo.com/blog/2015/03-05-ocean-tomo-2015-intangible-asset-market-value/

there are indications "under the surface" that there are even more significant forces at work: forces that challenge our basic assumptions of an industrialised society and work, as we know it today; and that these forces may be taking us rapidly from the third into the fourth industrial revolution, as discussed at the World Economic Forum in January 2016.[4]

The purpose of this chapter is to provide a broad overview of digitalization to date as well as provide some thoughts on how digitalization might influence the future of value creation in society. This research is intended for a broad audience: from practitioners to policymakers, as well as those interested in learning about digitalization's influence upon society. We focus first upon crowdsourcing activities: one of the initial areas significantly influenced by digitalization; we then turn to the Platform Economy, and the related Sharing Economy: discussing how these new business models are challenging our traditional strategy tenets. We then raise our level of discussion and turn to industry evolution and digitalization's influence upon the transformation of industries, with a focus upon one industry in particular: the financial services industry and the FinTech phenomenon, as well the recent trend of fusing the physical with the digital. We then branch out to some emerging technologies that are currently receiving the most attention: IoT data analytics, artificial intelligence (AI), blockchains, 3D printing, and virtual and augmented reality. We discuss how digitalization may impact the future of the labour force. Lastly, we end the chapter with some recommendations for both managers in general, as well as policymakers in Sweden.

Digitalization of Processes: Dissolving Firm Boundaries through Crowdsourcing

One of the first hallmarks of the current digitalization era has been the emergence of crowdsourcing that describes how the collective resources of a large group of people can be used to help solve problems. While crowdsourcing has existed throughout history, the internet along with digitalization has greatly facilitated the means with which crowdsourcing can emerge: ranging from a group of strangers self-organising on the internet (for example, open source software) to user-generated content supported by hierarchical organisations (such as a firm). Taking this into consideration, crowdsourcing can be defined

4 http://marketrealist.com/2016/01/fourth-industrial-revolution-need-know/

as "a collaboration model enabled by people-centric web technologies to solve individual, organisational, and societal problems using a dynamically formed crowd of interested people who respond to an open call for participation" (Pederssen et al., 2013). As such, crowdsourcing has also led to the development of the term *Collaborative Economy*.

User-generated content lies at the heart of organisations such as Wikipedia and Facebook, in which users create content without any expectations for reimbursement; six of the ten most popular content sites in the world are primarily user-generated (Brynjolfsson & McAfee, 2014). A recent study of US millennials (those born between 1977 and 1995) revealed that they spend 18 hours a day consuming media, and 30% of this time is with user-generated content as compared to 33% on all traditional media combined (TV, print, radio).[5] Furthermore, the same study found that millennials trust UGC 40% more and find it more memorable than traditional media.

As a result of these changes, businesses have realised over the past ten years that they no longer can rely upon traditional media for their marketing and branding efforts and are, thus, enabling customers to play a much more active role in their business decisions: such as marketing and product development. They have increasingly shifted from static websites to interactive platforms using a variety of social media applications that enable user-generated content (UGC). Many are calling this a paradigm shift since these platforms have led to a move from "one-to-many" (kinds of) communication between the business and the customer to "many-to-many" interactive dialogues among the business and its customers. Burberry's Art of the Trench website is one of the first examples of this. Launched in 2009, it enabled users to upload and comment upon pictures of people wearing Burberry products. Within one year, Burberry's ecommerce sales rose by 50%.[6]

In addition, numerous firms have developed user innovation communities specifically to help in the development and testing of new services and products. For example, companies such as Dell and Starbucks host electronic social environments in which globally distributed customers can share their knowledge and expertise with the community and the organisation through their comments upon existing products and services, while proposing new innovations.[7]

5 http://corp.crowdtap.com/socialinfluence

6 http://blog.hubspot.com/marketing/examples-of-user-generated-content

7 http://blog.hubspot.com/marketing/examples-of-user-generated-content

Another well-known example is Threadless: a company founded in 2000 that enables anyone to design t-shirts and a variety of other small products that are then produced and sold through the Threadless platform if selected by the crowd. Under this business model, customers now conduct many of the traditional in-house value-creating activities: such as idea generation, product design, marketing, and sales. Due to their customer voting system that ensures all t-shirts produced are sold, Threadless has significantly reduced its unsold inventory compared to traditional clothing manufacturers.[8] As a result, the company's profit margin was estimated to be 30%, which is remarkably high for a company in a commodity industry.[9]

User innovation communities can lead to beneficial results, such as faster innovation times; more successful new product launches, and increased customer satisfaction. However, they also present considerable challenges to managers. For example, a study of Dell IdeaStorm identified four key challenges in its first 18 months managing the community: understanding the ideas posted, identifying the best ideas, balancing the needs of transparency with the community against disclosure to competitors, and sustaining the community (Di Gangi et al., 2010).

While this model of "flipping the firm" is receiving considerable attention from researchers and managers alike, one of the most widely cited companies is Quirky, which declared bankruptcy due to its inability to sustain profitability. As a result, several people question whether the crowd is capable of selecting which products the market wants.

Digitalization of Business Models: Strategy Tenets Challenged

Moving beyond crowdsourcing and user-generated content, the development of multi-sided or matchmaking platforms that enable peer-to-peer transactions has spread from industry to industry: that is to say, individual-to-individual rather than firm-to-individual transactions. Transactions can be mediated either by firms, such as Uber, that run their own platforms or by groups of private individuals who use existing social networking sites, such as Facebook; they can even be mediated by those who design their own apps using open source software to self-organise their peer-to-peer activity in the cloud

8 http://www.fastcompany.com/1714561/company-community-threadless-puts-everyone-charge

9 http://www.inc.com/magazine/20080601/the-customer-is-the-company_pagen_2.html

with the help of blockchain-enabled smart contracts. These platforms may locally connect acquaintances on a face-to-face basis or they may digitally connect strangers from all over the world: for example, Airbnb and Upwork. In particular, firms that have multi-sided and technology-based platforms at the core of their respective business model have redefined the global business landscape throughout recent decades. This has been increasingly the case within the past ten years.[10] Companies such as Amazon, Alibaba, Apple, eBay, Facebook, Salesforce, Upwork, and Google have all emerged basing their business models and operations upon platforms that provide the infrastructure and rules for interactions between users, and they differ substantially from traditional offerings in terms of their value chain.

One interesting observation when comparing a traditional company with a platform company delivering similar products or services within an industry reveals a remarkable reduction in the total number of employees per firm. For example, Marriott, which was founded in 1927, had around 200,000 employees and a market capitalisation of USD 32 billion in 2017 while Airbnb, which was founded in 2008 and now offers more rooms than Marriott, had only 5,000 employees and a market capitalisation of USD 31 billion. A second example is Walmart, which was founded in 1962: with approximately 2.3 million employees, it has a market capitalisation of USD 200 billion compared to Alibaba, which was founded in 1999, and has around 36,000 employees and a market capitalisation of USD 240 billion.

In the traditional strategy literature, value is accumulated from left to right as value-adding activities occur in sequential processes; inputs are delivered to a transformation process, which then become outputs. These activities are generally conducted in-house by the firm's employees with costs being incurred throughout the value chain and revenues generated only on the downstream side. Since the firm owns many of the resources, employs individuals with the necessary skills, and provides the management, organisation, and physical infrastructure necessary for the process, it incurs considerable fixed costs. A firm strives to achieve supply-side economies of scale in order to then create competitive advantage, through increasing production volume and sales to reduce the unit cost, thereby, creating entry barriers. However, the firm reaches diminishing returns at some point, as acquiring

10 https://hbr.org/2006/10/strategies-for-two-sided-markets

new customers becomes more difficult and more expensive since fewer people find the value proposition of the firm appealing (Eisenmann et al., 2016).

These basic assumptions in strategy are now being challenged with multi-sided platforms (Eisenmann et al., 2016). Since the platform serves two groups of users, not only are costs incurred on both the left and the right side; revenues are also generated on the left and the right side of a value activity system. Moreover, with platform-based businesses, the firm merely plays an intermediary role matching those that own resources with those looking for them. Firms are relatively asset light and do not own the resources being transacted, nor employ the individuals to perform the resource transaction process; they merely provide the infrastructure and the rules of transaction for the two. What is new is that successful platform-based businesses experience increases returns to scale due to network effects. Network effects are based upon Metcalfe's law, which states: "The value of a telecommunications network is proportional to the square of the number of connected users of the system".[11] Platforms strive to gain users to build critical mass such that it can more efficiently match supply with demand and raise the likelihood that users on both sides of the platform have their demands fully satisfied. As more people use the platform, the value of the platform to each user rises. To create a competitive advantage, firms strive to leverage network effects in order to create demand-side economies of scale (Parker et al., 2016). In contrast to traditional manufacturing and service firms, platform-based firms' experience improved margins, as the number of users grow since users will pay more for access to a bigger network (Eisenmann et al., 2016).

As the platform-based business model continues to penetrate industries, one aspect that is becoming increasingly prevalent is the "winner takes all" effect. More specifically, platform leaders are able to drive out weaker rivals and create a barrier to entry due to their ability to leverage higher margins through investing more in R&D and, thus, lowering their prices. This leads to mature two-sided network industries usually being dominated by a handful of large platforms with some extreme situations in which a single company emerges as the winner, taking almost all of the market (Eisenmann et al., 2016).

These new market dynamics are not unique to B2C markets. Indeed, B2B industries are also seeing a rise in the number of firms focusing upon building

11 https://en.wikipedia.org/wiki/Metcalfe%27s_law

platforms to support their traditional business models, as well as striving to achieve the "winner takes all" effect. For example, with the goal of becoming a top 10 software company by 2020, GE has invested more than USD 1 billion in creating a market around the industrial internet through the development of its Predix platform, based upon open source software and the blockchain.[12] GE entered a partnership with Apple in October 2017, and unveiled a new software development kit (SDK) to enable developers to create their own industrial IoT apps using predictive data and analytics based upon the Predix platform.[13]

In connection with the rise of platforms, the use of the notion "Sharing Economy" has also become prevalent and is defined to include the renting, bartering, loaning, gifting, and swapping of assets that are typically underutilised: either because they are lying unused or because they have not yet been monetised (Felländer et al., 2015). Sharing Economy companies are based upon two-sided networks with the premise that a consumer's underused or spare fixed assets can be shared: a business model that is predicted to grow from $26 billion globally in 2015 to $335 billion by 2025.[14] Some Sharing Economy companies have achieved substantial valuations in a very short period due to the promise of network effects and increasing returns to scale, as users pay more for access to a bigger network and margins improve as the user bases grow: for example, AirBnB with $31 bln[15]. However, a debate is ongoing as to whether this is truly sharing or merely a new form of capitalism: this phenomenon known as "crowd-based capitalism", as some researchers, such as Professor Arun Sundararajan, have labelled it.

Digitalization and Industry Evolution

"Creative destruction" is a term coined by economist Joseph Schumpeter in 1942 (Schumpeter, 1942); it refers to the process whereby the creation of a new industry or method of doing things destroys the industry or process that preceded it. Creative destruction is obviously evident in some industries: for example, the replacement of records with tapes, CDs, DVDs, and then by

12 http://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/how-b2b-digital-leaders-drive-five-times-more-revenue-growth-than-their-peers

13 https://www.apple.com/newsroom/2017/10/apple-and-ge-partner-to-bring-predix-industrial-apps-to-iphone-and-ipad/

14 http://www.pwc.co.uk/issues/megatrends/collisions/sharingeconomy/the-sharing-economy-sizing-the-revenue-opportunity.jhtml

15 https://www.cnbc.com/2017/03/09/airbnb-closes-1-billion-round-31-billion-valuation-profitable.html

streaming. However, it is not clear how this process will play out across industries as digitalization progresses. Under the Sharing Economy umbrella, although incumbents in the hotel and taxi industries have, indeed, been forced to innovate in order to survive due to new entrants and platform business models, neither the industries nor their processes have been "destroyed" by the advent of sharing. Rather, traditional goods and services have been augmented through an interconnected array of digital services, such as social networks, location services, online payments, and rating systems. Such novel elements bring greater benefit to consumers, which often leads to the destruction of old practices, yet this will not necessarily lead to the destruction of old products and services.

Research investigating industry transformation by Anita McGahan (2000) at the University of Toronto indicates that industries evolve along four trajectories: radical, progressive, creative, and intermediating. These trajectories are determined by the degree to which the industry's underlying core activities and core assets are threatened, as they become less relevant in the marketplace due to new and alternative solutions. Core activities are the recurring value-creating activities that attract and retain suppliers and buyers in the industry, while core assets are the durable tangible and intangible resources that enable these efficient core activities.

This research also suggests that the traditional model of industry life cycle is only relevant for industries experiencing progressive or creative change and not for radical or intermediating change. An alternate model was suggested instead, in which an emerging industry that start-ups developed offers alternative value-creation solutions and grows in volume to supersede the sales' volume by industry incumbents with traditional activities. Competitive advantage in the industry then becomes increasingly based upon the ability to provide products and services that are evaluated based upon the new criteria as new industry standards are created (McGahan, 2000).

A study of the transformation of US industries from 1980 to 1999 by McGahan revealed that the 43% of industries were characterised by progressive change, 32% by intermediating change, 19% by radical change, and 6% by creative change. As digitalization pervades industry after industry, it will be worth revisiting these figures to see how industries have transformed on a global scale.

FINTECH AND THE TRANSFORMATION OF THE FINANCIAL SERVICES INDUSTRY?

One industry that is rapidly transforming is the financial services industry: due to the emergence of the FinTech sector enabled by the mobile internet, cloud computing, the smart phone, changing consumer behaviour, and a mistrust in the established banks along with declining internet technology start-up costs. While there are many definitions of FinTech companies, one of the most frequently used is "those that offer technologies for banking and corporate finance, capital markets, financial data analytics, payments, and personal financial management" (Skan et al., 2014). The FinTech sector attracted investments of USD 36 billion globally in 2016.[16]

A look into the transformation of this industry reveals that FinTech start-ups are specialising in individual services and products traditionally provided by the larger banks as opposed to competing with established banks in multiple products. As the entrances of these FinTech companies press margins and take market share from industry incumbents, a McKinsey study predicted in September 2015 that the profitability of the established private banks may fall up to 60%.

The book, *The Rise and Development of FinTech: Accounts of Disruption from Sweden and Beyond,* published in 2018 by Routledge Publishers, offers an in-depth discussion of the transformation of this industry. One area discussed is crowdfunding, which falls under the label of the sharing economy previously discussed in this chapter. Crowdfunding, or the accumulation of small investments in individual projects from a large number of individuals (the "crowd") via or with the help of the Internet and social networks (De Buysere et al., 2012), is enabling new forms of investment for private individuals, entrepreneurs, SMEs, and even large organisations. There are four established categories of crowdfunding: donation-based or philanthropic, reward-based, equity-based, and lending or debt-based (often referred to as P2P lending), with some claiming that the particular form of real-estate crowdfunding should be recognised as a category. P2P lending currently dominates the other crowdfunding forms, in terms of money transacted, and while it was predicted to account for approximately USD 25 billion of the total USD 34

16 https://letstalkpayments.com/global-fintech-funding-36-bn-2016/

billion globally raised through crowdfunding in 2015, reports claim that P2P lending topped USD 150 billion in 2015 in China alone.[17]

One of the greatest challenges in taking an idea to the marketplace is the ability to raise funds. Several researchers are now suggesting that crowdfunding is democratising the process of innovation through providing access to necessary capital to those individuals outside of traditional investor networks, such as through gender discrimination, or located in remote areas. For example, the company Laser Unicorns raised more than USD 600,000 from almost 18,000 individuals across the globe for the production of its movie, *Kung Fury,* despite being located in Umeå, a town in the north of Sweden.

Other areas developing rapidly within FinTech include the robotisation of personal wealth management as well as the penetration of cryptocurrencies and blockchain technologies for new payment and reconciliation solutions. The 2008 white paper "Bitcoin: A Peer-to-Peer Electronic Cash System" was published on the internet under the pseudonym of Satoshi Nakamoto.[18] A few months later, in early 2009, the project was launched on an open-source project repository. These initial developments have spawned more than 900 cryptocurrencies today although only around a handful have a market capitalisation of more than USD 10 mln.[19] A cryptocurrency is a digital, decentralised, peer-to-peer currency that uses cryptography to validate and secure transactions. The largest and most well known cryptocurrency is Bitcoin: with a market cap of almost USD 100 billion during October 2017. Since Bitcoin does not have a central clearing house, there is no central authority in charge of the money supply, nor are there any financial institutions involved in the transactions, Bitcoin differs from traditional fiat currencies: that is to say, nation-state currencies, such as the USD and SEK. The members of the Bitcoin network perform these tasks themselves: by verifying and validating every transaction that occurs between network members in order to avoid the risk of double spending. Today there are more daily transactions with Bitcoin than there are through Paypal.

At the core of Bitcoin is the blockchain protocol, which in essence is a shared public ledger of all verified transactions. During 2015, a number of large multinationals, such as Goldman Sachs, JP Morgan, IBM, and Samsung,

17 http://www.crowdfundinsider.com/2016/01/79612-report-china-p2p-lending-topped-150-billion-in-2015/

18 https://bitcoin.org/bitcoin.pdf

19 http://www.cryptocoincharts.info/coins/info

began to pay increasing attention to the bitcoin blockchain and other emerging blockchain protocols, such as ethereum, hyperledger, and R3Corda. This was due to the potential of a number of uses for the blockchain and their ability to incorporate IoT, smart contracts, and machine-to-machine micropayments within financial services and supply chains. These are just some of the examples of the many FinTech companies founded in recent years; we will be able to see in time whether these start-ups are capable of gaining enough momentum to transform the industry.

STRATEGIES FUSING THE DIGITAL WITH THE PHYSICAL

Another area of industry transformation relates to an increasing number of companies implementing strategies that fuse the digital with the physical. In order to create a sustainable competitive advantage with a digital strategy, an increasing body of research is arguing that companies that are able to fuse their physical and digital operations, such that customers can easily move between the two, will be more successful at creating a sustainable competitive advantage.[20] While many argue that online operations will displace physical operations in numerous industries, research is finding that the two worlds are complementary, and the combination of the two is the real transformation that is occurring. For example, as part of Burberry's fusion strategy to attract millennials, the company developed digitally immersive physical experiences, such as in-store digital screens that turned into catwalks: a strategy that tripled the firm's stock from 2006 to 2014.[21]

Not only are physical firms fusing with digital; digital firms, such as the two early pioneers of online trading: E*Trade and TD Ameritrade, are also integrating physical offerings with their digital ones. More recently, Amazon has made major efforts into the physical retail space in the USA: including the purchase of Whole Foods Grocery Chain for USD 13.7 billion, a partnership with Kohls – the retail department store chain to provide return locations, the opening of bookstores, the establishment of lockers and pick-up spots in retail stores and on college campuses, and a Treasure Truck in six cities that sell certain items at a discount.[22] Amazon's efforts have revealed that having a

20 http://www.gartner.com/imagesrv/books/digital-edge/TheDigitalEdge.pdf, http://www.bain.com/publications/articles/leading-a-digical-transformation.aspx

21 https://hbr.org/2014/09/digital-physical-mashups

22 https://www.cnbc.com/2017/09/19/amazon-is-firing-on-all-cylinders-to-grow-its-retail-presence.html

physical presence fuels online sales. For example, Amazon sold about $500,000 worth of Whole Foods-branded products online in the first week after making them available following the purchase of the chain.[23]

Other examples include Local Motors, which focuses upon motorised vehicles, and First Build, focusing on household appliances. Both of these companies have created micro-factories or physical workspaces that enable the "crowd" to participate in the development and production of products, thus, bridging the divide between virtual community and physical participation.

Investigating the level of transformation within 20 industries, the aforementioned research found that industries, such as the airlines, automobile and insurance industries, will be those that have the greatest level of innovation in fusing the physical with the digital within the next five years.[24] Developments in areas such as the Internet of Things, 3D printing, and virtual and augmented reality will likely hasten this transformation in many industries.

Emerging Technologies

Some of the greatest areas of uncertainty about the future relate to the development of emerging technologies: such as the IoT data analytics, artificial intelligence (AI), blockchains, 3D printing, and virtual and augmented reality. We provide a brief overview of each of these below.

IOT DATA ANALYTICS

Both technology evangelists and consumer goods manufacturers have hailed the rise of the Internet of Things (IoT), wherein everyday devices and products contain tiny computers and will communicate directly with machines and with one another. Things can be programmed not only to alert the user to certain events; they will also communicate with each other and even to coordinate and make micro-payments directly among themselves without human involvement. The name "Internet of Things" is perhaps somewhat inaccurate. A more accurate label might be "The Internet of Small Computers on Things", which is another way of saying that the things themselves cannot be endowed with the capacity to connect to the Internet. Rather, manufacturers have started to install small computer processers on devices and these computers both connect to the internet and control the device. This idea is

23 https://www.cnbc.com/2017/09/19/amazon-is-firing-on-all-cylinders-to-grow-its-retail-presence.html

24 https://hbr.org/2014/09/digital-physical-mashups

not new; however, advances in both computer hardware and internet connectivity have occurred over the last decade, including increasingly smaller computer parts and an increasing number of processes being hosted in the cloud. Thus, the Internet of Things has become a realistic possibility.

To date, health and fitness has seen the most activity with established brands; Nike, Adidas, and Apple have taken advantage of the emerging technologies in wearables. However, this is one area that is expected to further spawn growth and transformation across all industries. From 2003 to 2012, the number of connected devices grew from 500 million to 12.5 billion; this is expected to grow to 50 billion by 2020. Furthermore, the machine-to-machine (M2M) market, in which machines communicate and perform functions with no human intervention, is expected to reach €40 billion by the end of 2017.

One driver of this rapid growth is the falling costs of sensors; a sensor that cost €50 in 2009 fell to €15 in 2013. Another is the development of cloud computing that enables data analytics. As businesses and their users are producing an increasing amount of data, some cloud providers are providing the hardware and algorithms to mine these data for in-house operational and customer insights, such as the ability to predict and influence customers online and offline (McAfee, 2012). The need for computing power required for big data analytics continues to rapidly grow as the amount of data created each day doubles every 40 months or so (McAfee, 2012). However, the cloud enables any business, regardless of the size or financial resources, to achieve the IT productivity of the largest enterprises with extensive IT budgets. Thus, there are opportunities in every sector, as IoT will be employed to lower costs and improve productivity and safety.[25]

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) refers to a "broad set of methods, algorithms and technologies that make software 'smart' in a way that may seem human-like to an outside observer".[26] Artificial intelligence is often confused or used simultaneously with other terms: such as machine learning, deep learning, neural networks, and cognitive computing. One way of describing the differences

25 https://www.bcgperspectives.com/Images/The%20Mobile%20Internet%20Economy%20in%20Europe%20Dec%202014_tcm80-178364.pdf

26 https://www.computerworld.com/article/3040563/enterprise-applications/5-things-you-need-to-know-about-ai-cognitive-neural-and-deep-oh-my.html

among these is that they are similar to Russian Dolls in which deep learning is a subset of neural networks, which is a subset of machine learning, which is a subset of artificial intelligence.[27] Arthur Samuel at IBM first defined machine learning in 1959 as a "field of study that gives computers the ability to learn without being explicitly programmed".[28] Thus, machine learning distinguishes itself from more general AI as it has the ability to learn or modify itself without human intervention when it is exposed to more data. Neural networks are a one kind of machine learning technique that is based upon the way in which neurons work in the brain. Deep learning, or deep neural networks, is a relatively new field within machine learning that has become popular of late due to the availability of large amounts of data combined with major advances in processing power. Deep learning is based upon a "family of algorithms that implement deep networks with unsupervised learning"[29]; it includes a large system of neurons arranged in several hidden layers. Finally, the term cognitive computing is a bit controversial since it is unclear as to whether it is a true category of AI or just a buzzword; however, the primary idea is that the application of AI focuses upon "reasoning and understanding at a higher level, often in a manner that is analogous to human cognition -- or at least inspired by human cognition," with the purpose of making high-level decisions in complex situations.[30]

AI is not new, yet the technology has been rapidly maturing due to greater access to more data through maturing technologies, such as IoT and improved access to processing power: for example, through the cloud. The vast amount of data in decentralised networks is making the algorithms smarter. Thus, AI using large datasets can create enormous gains for firms: such as customer loyalty and trust, lower costs, improved quality, and increased agility. Personalised offers and recommendations can be scaled and large efficiencies can be created across the value chain. We are entering a new era where every organisation must be able to handle data to create customer and operational value.

27 https://deeplearning4j.org/ai-machinelearning-deeplearning

28 https://www.ibm.com/developerworks/community/blogs/jfp/entry/What_Is_Machine_Learning?lang=en

29 https://www.ibm.com/developerworks/library/cc-beginner-guide-machine-learning-ai-cognitive/index.html

30 https://www.computerworld.com/article/3040563/enterprise-applications/5-things-you-need-to-know-about-ai-cognitive-neural-and-deep-oh-my.html

However, come critical issues that must be addressed come with the opportunities of using algorithms on data. Without the proper oversight, data and AI usage can have unintended consequences: such as machine bias and discrimination, misuse of data, and sensitive data breaches. For example, ethical considerations lie in the bias of the programmer when programming how an autonomous driving vehicle should act in a crash situation. Furthermore, many now argue that data are the new gold, and there is an increasing competitive divide between leaders and laggards using AI on large data sets, thus, leading to monopoly situations occurring faster than ever before.

A study conducted by MIT[31] in partnership with BCG provides insights into AI maturity levels among organisations and what they need to do in order to develop an AI strategy. The results reveal low risk awareness and knowledge gaps in organisations. Many believe in the future of AI, yet few have a concrete strategy for how to get there or to govern it. Executives underestimate the security, and the organisational and technological capability gaps. The study also shows that very few organisations have strong data governance practices.

BLOCKCHAINS AND SMART CONTRACTS

One of the most promising areas of emerging technologies is in the use of blockchain-based technologies to automate processes. The best known use of the blockchain is probably as the underlying infrastructure that supports the cryptocurrency Bitcoin. However, the technology has also been widely used to build other automated networks. Another well-known network is the Ethereum ecosystem, which provides a platform for the creation of new automated systems, and a marketplace for the release of Decentralised Apps or DApps. These DApps require the network currency Ether to operate.

Blockchain technology generally works by transmitting a transaction to a network of computers that verifies when the transaction fulfils all the requirements for transaction execution: for instance, that the initiator of the transaction owns the asset being transferred, or that the sender has fulfilled the requirements for the assets to be released from escrow. The computers do the verification; then they receive tokens in exchange for verifying the transaction,

31 *MIT Sloan Management Review,* September 2017. The study found that more than 3,000 executives, managers, and analysts across industries. Complemented with 30 in-depth interviews with technology experts and executives.

encrypting it, and releasing into a network-maintained ledger. This process is known as mining; and in most blockchain systems, the tokens have come to have monetary value as currencies in their own right, as has happened with Bitcoin. Once the transaction has been transmitted and verified, the miners receive their reward and transmit the individual transaction to the network; it is typically not possible to reverse or alter the transaction. This is because no single computer in the network controls the ledger of transactions; changes can only be made when more than 50%[32] of those in the network agree to the change.

Blockchain automation holds a number of potential applications, beyond just the creation of new currencies. These include self-executing smart contracts, and organisations with automated vote verification and collection. To automate land registration,[33] Swedish Läntmateriet (The Swedish National Land Survey) has already experimented with smart contracts, and Axel Johnson to automate supply chains.[34] Blockchains are also being experimented with for use in standardised international transaction systems,[35] and for online trading of securities and other commodities.[36]

As a way of obtaining entrepreneurial finance, creators of new blockchain-based firms are even using smart contracts and existing cryptocurrencies. ICOs or initial coin offerings do so when these new firms sell tokens in their new system in exchange for an existing cryptocurrency: typically, Ether. The largest ICO to date, Filecoin, raised $205.8 million for tokens that allow individuals to share unused space on their computers—and sell it for Filecoin tokens.[37]

3D PRINTING

3D printing or additional manufacturing can be disruptive as it will transform industries through shifting competitive advantage and changing organisational structures, as it accelerates product-development cycles, thus, enabling

32 Some researchers argue that the threshold is really 30%.

33 https://www.lantmateriet.se/contentassets/6874bc3048ab42d6955e0f5dd9a84dcf/blockkedjan-framtidens-huskop.pdf

34 https://digital.di.se/artikel/axel-johnson-gruppen-vill-ta-blockkedjan-till-fruktdisken

35 Both for the transfer of funds and for smart contracts, see http://www.r3cev.com/blog/2016/4/4/introducing-r3-corda-a-distributed-ledger-designed-for-financial-services

36 https://www.coindesk.com/coinbase-integrates-gdax-exchange-with-algorithmic-trading-platform/

37 https://www.coindesk.com/257-million-filecoin-breaks-time-record-ico-funding/

new manufacturing strategies, shifts profits, and requires new capabilities.[38] 3D printing technology has existed since the 1980s, yet the range of consumer uses for 3D printing today is still quite limited to small plastic and metal objects such as toys, jewellery, and small household and electronics items. For example, Mattel has plans to sell 3D printer kits including the printer and app with design software for children for approximately USD 300.[39] However, 3D printing within industrial and other production areas is already printing parts in a variety of materials such as glass, titanium, and human cartilage; rapid prototyping and cheaper product molds are currently commonplace, thereby, removing economies of scale in many industries. As the technology continues to mature, companies now explore how 3D printing can transform product design. Not only can objects include moving parts; they can also be stronger or lighter than their traditional counterparts due to novel designs often based upon nature. For example, GE's 3D printed fuel injection nozzles for airplane engines are 25% lighter, saving approximately USD 1.4 million for each LEAP plane; its new single-prop Cessna plane engine is 85% 3D printed, thus, reducing the number of parts from 855 to 12.

The improvements above are incremental, however, compared to how 3D printing may radically transform manufacturing since it enables an idea to be instantaneously transformed into physical reality anywhere in the world. Today you can scan your foot with Volumental's technology in New Balance stores and receive your running shoes with perfectly fitting midsoles a few hours later. Local Motors prints cars in its USA micro-factories instead of manufacturing them in low-cost countries and shipping them over the ocean. Ivaldi will digitally send its designs to ports across the world and 3D print spare parts for the maritime industry. Amazon plans to 3D print objects in delivery trucks while on the way to your door.

According to a recent the International Data Corporation, global spending on 3D printing is predicted to grow from nearly $11 billion in 2015 to $26.7 billion in 2019 at a 27% compound annual growth rate (CAGR).[40] The McKinsey Global Institute has also estimated that 3D printing could have an annual economic impact of up to USD 550 billion by 2025. As 3D printing advances, traditional sources of competitive advantage, such as economies of

38 http://www.mckinsey.com/business-functions/operations/our-insights/3-d-printing-takes-shape

39 http://www.thingimaker.com/

40 http://www.idc.com/getdoc.jsp?containerId=prUS40960716

scale and low cost of labour, will decline in importance. As a result, manufacturing may be moved back to rich industrialised countries and increasingly performed by SMEs and entrepreneurs[41], encouraging disruption not only in the manufacturing industries; it will also be evident in logistics and transportation industries. For example, Local Motors has plans to manufacture its 3D printed cars in micro-factories in the US, cars that will be adapted to local driving conditions, energy sources, and regulations.

Additionally, manufacturing may move to local or online communities of individuals designing, printing, and selling a wide variety of objects. Sites such as Thingiverse, Blender, and Shapeways currently facilitate such activities while 3D Hubs platform claims that its more than 27,000 printers in 150 countries across the globe provide one billion people with access to a 3D printer within 10 miles of their home.

VIRTUAL AND AUGMENTED REALITY

2017 saw a revival in virtual and augmented reality with an increasing number of solutions coming onto the market and money being invested in these technologies. Within the past few years, Facebook bought Oculus Rift for USD 2 billion and Microsoft purchased Minecraft for USD 2.5 billion, and Magic Leap has raised USD 1.4 billion, with USD 800 million in a series C round: the largest series C round for an internet company at the time to date. With such money being invested in these technologies, it might come as no surprise that the market for VR/AR is expected to explode within the next few years to more than USD 600 billion in 2025 with some predicting that VR/AR technologies will replace the smartphone.

Although it is developing, virtual reality already enables various forms of immersive training as well as the ability for multi-national employees spread across the globe to simultaneously collaborate on project work or for children from distant schools to build Minecraft models that they then print out on their 3D printers. For example, Nvidia has plans to develop its software in order to enable immersive collaboration for manufacturing design. Many argue that augmented reality may have more potential than VR since it has extensive uses in e-commerce and mobile commerce, as well as for use in

41 http://www.economist.com/node/21552901

industrial areas: such as manufacturing, equipment operations, and material and inventory handling.[42]

Influence of Digitalization on the Labour Force

With its emerging technologies and new business models, digitalization has already begun to influence the labour force. For example, the number of freelancers in the world is rapidly increasing. One recent study in 2016 reported that the number of freelancers in the US had reached 35% of the workforce and that this number continues to rise.[43] Advances in artificial intelligence will more than likely enable temporary freelance platform-based organisations in ways we have difficulty imagining today. For example, a research group at Stanford University has developed Flash Organisations: a concept for AI-enabled temporary organisations. The group is currently working on its Foundry software with the purpose of enabling crowd workforces to flexibly assemble and reassemble themselves into collectives "that rival modern organisations in their prevalence, impact, and achievements"[44]. With the help of AI, the software builds a temporary organisation by recruiting freelancers from an online labour market – such as Upwork. Then, as project demands change over time, it continuously updates the organisation with new freelancers.

We now discuss two related areas: the immersive internet and automation, in addition to taking a look at the implications of a freelance workforce.

IMMERSIVE INTERNET

Virtual and augmented reality solutions along with virtual world solutions, such as OpenSimulator: the open source virtual world platform software, are encouraging the development of the "Immersive Internet": internet's next generation that enables individuals to immerse themselves into an internet with 3D sight and sound, and an increasing ability to transmit the sense of touch, thereby, offering an immersive working and networking space. Regardless of physical location, entrepreneurs may collaborate on value-creating activities in these environments, with one another as well as with other individuals from

42 http://ftalphaville.ft.com/2015/12/01/2146247/welcome-to-your-simulacrum-future-a-674bn-opportunity/

43 http://www.marketwired.com/press-release/new-study-finds-freelance-economy-grew-55-million-americans-this-year-35-total-us-workforce-2164446.htm

44 http://hci.stanford.edu/publications/2017/flashorgs/flash-orgs-chi-2017.pdf

both large and small firms, academia, hobbyists, and the public sector. This has already been clearly demonstrated by the OpenSimulator project: an open source virtual world platform project, in which the expression "meeting face-to-face" has lost its physical meaning, indicating instead a virtual meeting of avatars in a 3D online space.

Anyone with access to the internet will be able to learn just about anything and engage in a world of economic opportunities through the next generation of the internet; therefore, the number of freelancers across the globe will only continue to rise. Moreover, individuals who have previously been hindered from entering the workforce due to physical disabilities or peripheral locations will be able to learn and work through this immersive environment. One significant question this raises is how this "mobility" of labour and the "mobility" of physical goods due to 3D printing will impact the competitiveness of regions and nations.

We are finding indications of "open entrepreneurship" through the immersive internet, or the process of entrepreneurs openly engaging in social capital-building activities through the free contribution to the public of intellectual property and other resources, with the purpose of pursuing individual business-related interests while contributing to the pursuit of collective goals. While these entrepreneurs may give away for free their intellectual property, knowledge, time, and other resources, they do so in the pursuit of creating a social structure, which enables them to overcome the inherent difficulties in attracting the necessary human, financial, and other resources due to the uncertainties of their new venture and the liabilities of newness and small size. Through the immersive internet, entrepreneurs may more easily overcome these liabilities: factors that have traditionally disadvantaged small firms compared with large organisations, which have generally led to their failure. Furthermore, we are beginning to see signs that the immersive internet is leading to, or implicated in, a migration from an economic model characterised by centralised hierarchical firms controlling in-house resources to a model of decentralised social production by communities of globally distributed firms and workers. Such fundamental changes clearly bring into question how and to what degree well-established multi-national organisations and their brands will continue to dominate economic activity.

As 3D printing becomes integrated with the immersive internet, as well as becomes commonplace for household and industrial objects, we will not only

be able to design and experience objects in these virtual spaces; we will also be able to simultaneously produce these objects in our garage or workplace, thus, enabling an era of social manufacturing. Not only will the borders between industries be blurred; the entire value creation system may be revolutionised due to the convergence of the immersive internet with material, production, and other related technologies: from the sourcing of inputs and production in the supply chain through to distribution and end-user consumption.

AUTOMATION

In a 2014 study by Carl Benedikt Frey & Michael Osborne from Oxford (2014) on the future of employment, the authors predicted that 47% of total US employment is at risk due to computerisation. Today, robots already cut our lawns, vacuum our houses, write our sports articles, and make or lose our money in the stock market, while drones deliver small packages in some countries as well. Japan, the country that wants to be the world's leader in robots, now has two hotel – Henn-na Hotels, owned by the low-cost travel agency H.I.S. Co. in Nagasaki and in Tokyo – that are run almost entirely by robots. Robots help you check in, carry your luggage, provide concierge services, haul your trash away, and even provide entertainment as fish in the lobby's tank.[45] The only human tasks left are changing the sheets and taking care of said robots.

However, there are a number of tasks that computers will have difficulty in performing, and Carl Benedikt Frey & Michael Osborne developed in their 2014 Oxford study a list of nine task dimensions with computerisation bottlenecks, as they are primarily non-routine tasks. These tasks fall under three categories: perception and manipulation (finger and manual dexterity, cramped workspace, and awkward positions), creative intelligence (originality and fine arts), and social intelligence (social perceptiveness, negotiation, persuasion, and assisting and caring for others).

As a result, not all jobs will disappear. Indeed, it may be more beneficial to consider which tasks, as opposed to jobs, will AI and/or robotisation control. We can expect that some non-routine jobs will be augmented by computers performing routine tasks while new jobs will appear, especially within the high-paying sector. For example, five high-paying jobs that did not exist ten

45 http://www.japantimes.co.jp/news/2016/11/18/business/nagasakis-robot-staffed-henn-na-hotel-gets-guinness-nod/#.WDWBV7VwpME

years ago include data scientist, mobile applications developer, information security analyst, digital strategist, and green building and retrofit architect.[46]

However, we will see a middle-tier job squeeze as software applications and robots continue to replace routine tasks. This will force middle-skilled labour to compete for jobs in the lesser-skilled sector, which has the effect of reducing wages (Felländer et al., 2015). Furthermore, the falling cost of automation and robotisation will put downward pressure upon wages as the cost of substitution for traditional labour continues to fall. Such structural factors will hold back wage increases and employment in routine jobs: even in the current environment with a cyclical upswing in the US labour market.

Thus, as in previous technological paradigm shifts, it is predicted that there will be technological unemployment as technological advances outpace the rate at which we can find new uses for the displaced labour. Although this prediction implies certain negative effects in the short run, the long-run effect should be positive because history reveals that people tend to move higher up in the value chain over time as lost jobs are replaced by new ones. With the right training and circumstances, we can expect that self-employed individuals or freelancers can replace, to a certain extent, jobs that are lost due to digitalization and robotisation. The question is with which pace firms, entrepreneurs, and freelancers will be able to create opportunities and jobs in both highly-skilled and lesser-skilled sectors.

A FREELANCE WORKFORCE?

Another area that deserves consideration is to what degree society is prepared for a labour force that is composed of an increasing percentage of freelancers and entrepreneurs. Labour regulations to date have focused upon protecting the rights of workers vis-à-vis their full-time employers; however, such regulations about the rights of freelancers and self-employed entrepreneurs are often silent. Today's digital platforms do not guarantee an individual's well-being in the same way that a "traditional" employer does, and individuals who provide their services through online platform transactions generally bear a considerable amount of risk. For example, platforms such as Uber and Airbnb, do not define themselves as employers in the transportation and hotel sectors, respectively. Rather, they argue they are merely digital platforms that

46 http://www.payscale.com/career-news/2015/09/5-high-paying-jobs-that-didnt-exist-10-years-ago

match drivers with clients, and property owners with tourists. Hence, these companies claim they are not responsible for the social benefits and insurance of the drivers and property owners.

Furthermore, individuals often have no control over when and from whom they receive work assignments. In addition, as the number of global freelance labour platforms increases, freelancers may be affiliated with more than one platform, thus, complicating the situation even more. For example, an individual might work full or part-time in Stockholm for Uber while simultaneously developing software for an organisation in China or Australia through the Upwork platform.

In most countries, because freelancers such as Uber drivers and other local sourcing platforms are not considered to be legal employees, they are not able to organise to obtain the collective bargaining privileges and protections that those belonging to most labour unions have. Thus, although some people argue that the Platform Economy offers flexibility and supplemental income not available from traditional jobs, others argue that it signals a return to the piecemeal labour system that exploited workers.

Moving forward, traditional unions will not capture the entire labour force. Thus, labour market regulations must be adapted: not only to ensure the traditional safety net for individuals, and to provide regulatory and tax incentives to incentivise self-employment as well. One such organisation, the Freelancers Union in the US, has emerged to serve the needs of this labour force. However, as aforementioned, the line between employee and freelancer is not always clear, and the Platform Economy is increasingly generating more ambiguous situations. For example, what happens if individuals barter or are paid in kind, rather than in money? Can residents of a community volunteer for a housing association in exchange for reduced rent? If so, what do they need to declare for tax purposes, given that the association may not employ them? For that matter, does the association employ them?

Recommendations for the Future

What will the world look like in in the future? On the one-hand, it is most likely that the penetration of the mobile Internet along with an internet-savvy workforce will continue. Global mobile internet penetration is predicted to reach 71% by 2019 while usage per device is to triple and will most likely

exceed the use of desktop and mobile browsers combined.[47] By 2020, on the other hand, the world will have its first generation of individuals who will have grown up in an entirely digital world, and 50% of the global workforce will be millennials.[48]

When it comes to firms, a study by McKinsey & Company suggests that the average rate of digital penetration across all industries is only approximately 37% and, as penetration increases, industries will continue to see downward pressure upon revenue and profit growth.[49] Increased price competition will result as the number of digital platforms grows and other technological advances decrease entry barriers and contribute to transparency. New entrants, so-called *born globals* and *micro-multinationals*, are accessing the global market right from their inception, which means that previously protected local providers will find themselves facing global competition (Felländer et al., 2015). Traditional middlemen, which generated higher transaction costs and higher fixed costs of holding capital or labour, will be eliminated; the more perfect matching of supply and demand through digital platforms will further decrease transaction costs. Thus, although demand may grow in many economies, companies will find it increasingly difficult to increase their margins.

As a result, the pace of change is predicted to only increase. Research has shown that the average lifespan of a company on the S&P 500 index has declined from 61 years in 1958 to 25 years in 1980 to 18 years in 2012, and is forecast to further shrink to 14 years by 2026.[50] At the current churn rate, 75% of the S&P 500 firms are predicted to be replaced by 2027.[51] This "creative destruction", wherein some jobs, firms, and industries are transformed or destroyed only to make way for others, has been depicted by some as thrilling and promising, while others are more concerned. There is a lot that remains to be seen; however, as we move into this era, which may be the beginning of the fourth industrial revolution, characterised by the mass adoption of expo-

47 https://www.internetsociety.org//globalinternetreport/2015/assets/download/IS_web.pdf.

48 https://www.pwc.com/m1/en/services/consulting/documents/millennials-at-work.pdf

49 http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-case-for-digital-reinvention#0

50 https://www.innosight.com/insight/creative-destruction-whips-through-corporate-america-an-innosight-executive-briefing-on-corporate-strategy/

51 https://www.innosight.com/insight/creative-destruction-whips-through-corporate-america-an-innosight-executive-briefing-on-corporate-strategy/

nential technologies,[52] many argue that even more significant disruptive changes in economy, business, society, and individually are yet to come[53].

We now present some more general recommendations for managers on how to tackle the challenges of digitalization. In addition, we discuss some policy considerations for Sweden and its policymakers on measures to ensure that Sweden can benefit from digitalization in the future.

RECOMMENDATIONS FOR MANAGERS

One study by the MIT Sloan Center for Information Systems Research found that the winners in this new era will be those companies that fully embrace digitalization. Those companies that had 50% or more of their revenues generated within digital ecosystems and understood their end customer better than the average competitor exhibited 32% higher revenue growth and a 27% higher profit margins within their industry than the average (Weill & Woerner, 2015).

Digitalization is expected to even increase its pace; thus, it is impossible to predict what industries will look like in ten to twenty years time as the majority of what will happen in the future is beyond our comprehension – we do not even know what we do not know about the future. One of the reasons that companies are unable to survive in the long run is that they get blindsided by changes in their industry: that is to say, they were unable to scan the periphery of their industry for weak signals that later led to significant changes in their industry, thus, rendering them obsolete.

However, scenario analysis is one strategic analysis tool that is becoming increasingly useful in enabling companies to prepare for the future, especially in response to the rapid pace of digitalization; it should be noted that scenario analysis is not a forecasting tool that projects historical trend data into the future, nor is it a vision for how a company would like the future to be. Rather, it is a tool to enable managers to produce scenarios of how the future of around ten to fifteen years out could potentially be dependent upon how a number of uncertainties develop. Since scenarios promote creative thinking and challenge conventional wisdom, they enable managers to make better decisions if they are developed correctly. Companies that have been successful using scenario

52 https://www.weforum.org/agenda/2016/01/digital-disruption-has-only-just-begun/

53 http://www3.weforum.org/docs/Media/KSC_4IR.pdf

analysis are Shell, GE, IBM, and UPS, thus, enabling them to retain their position as market leaders even as their industries transform.

While there are many scenario analysis tools, one of the most commonly used is a 2x2 scenario matrix that enables managers to consider the question: "What if this were to happen…?".[54] The scenario matrix is created by choosing two mutually exclusive, critical uncertainties for the axes, which may significantly change the medium to long-term future in relation to a key strategic issue for the company. For example, a key strategic issue is whether to open a new factory in another country, to develop a completely new product line, or to invest in a new technology or competitor. One way to determine this is to think about the question: "What one question would you ask a real psychic?"

The two critical uncertainties can be uncovered by performing a PESTEL (political, economic, social, technological, environmental, and legal) analysis in which these trends are analysed based upon the degree to which they are uncertain and influential for the key issue. For example, one critical uncertainty may be related to governmental regulations ranging from strict to relaxed governmental regulations, while another might be related to the adoption of a new technology from high to low.

Four scenarios are then developed: one for each of the matrix boxes (figure 15.1). These scenarios are in narrative form and describe potential futures in which the company needs to consider how they will perform. Conclusions can then be drawn related to the strategic issue, thus, providing the company with input into how it can build robust strategies and enable it to be agile and sustain its competitive advantage regardless of which scenario unfolds. Leading indicators are then determined to scan for early warning signals for the various scenarios.

Scenario analysis can be used in a more large manner in which all employees and stakeholders are involved in a lengthy process that could last several months, which enables the company to develop its vision; it may even be used in a small-scale manner among a group of a handful of individuals in their decision processes.

54 A Note on Scenario Planning, Harvard Business School.

- Test 4–5 most Critical Uncertainties in pairs in scenario framework
  - Must be very low correlation between pair of uncertainties
- Develop characteristics and narrative for each scenario

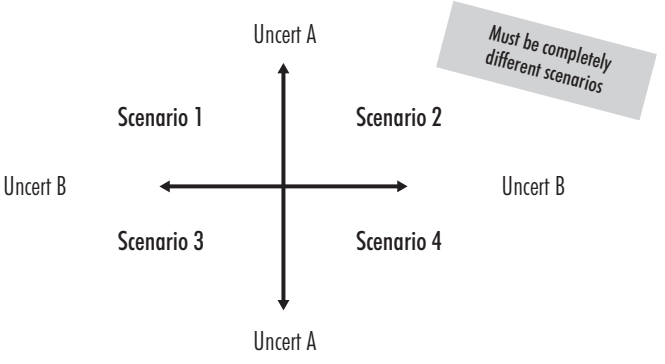

Figure 15.1. The 2x2 scenario matrix

POLICY CONSIDERATIONS FOR SWEDEN

While digital disruption has only just begun, the characteristics of the Swedish economy suggest that Sweden is in a relatively good position to benefit from digitalization. These characteristics include the following: a highly skilled workforce in information technology, natural sciences and engineering, user interface and design, communication services, high levels of internet and smart phone penetration, a global outlook, a focus upon entrepreneurship and thriving entrepreneurial ecosystems in many medium to large cities, a leader in the area of FinTech, a stable and advanced welfare state, and Sweden's ideological concern for sustainability (Berkes et al, 2000).

Sweden, however, is still likely to feel the adverse effects of increased digitalization and automation. Recent studies predict that 36–60 per cent of the current jobs in Sweden – primarily routine jobs – will be lost during the next 20 years as algorithms and robots are employed to perform an increasing number of tasks (Fölster, 2014). This is partly because its largest sectors of employment are currently transportation, construction, and metal manufacturing. However, although 10 per cent of Swedish jobs disappeared between 2006 and 2011 due to automation, the employment rate has remained relatively unchanged. The reason for the stable employment rate is threefold: 1) digitalization and

increased revenues have increased the demand for labour, such as computer specialists and engineers; 2) higher disposable incomes of highly-skilled individuals have increased the demand for local service sector jobs; and 3) labour market reforms, particularly those targeted toward youth labour, have had a positive impact on employment.

Regarding wages: lower labour mobility and lower wage flexibility cause more wage rigidity in Sweden compared to the US. Nevertheless, the aforementioned underlying forces do lead to the same wage pressures; commentators and academics are concerned about the fast pace of digitalization and automation and their potential impact on the labour market, especially since wages in the Swedish manufacturing industry are relatively high.

As digitalization proceeds, the questions arising are of deep importance for governments and public sector bodies at all levels. The regulatory framework must be adapted to significantly address the protection of consumers and employees while simultaneously enabling the creation of new jobs. How should taxation and legal systems be designed: to promote innovation as opposed to hinder it? How should resources be invested in virtual trans-national clusters of economic activity, such that this investment benefits local taxpayers and citizens? These tasks will require a balancing act; some policy suggestions are noted below. Many of these were developed in connection with a report we published on the Sharing Economy in 2015 (Felländer et al., 2015).

Facilitate a flexible labour market. The labour market may need to be more flexible, thus, creating incentives both for mobility and for self-employment. However, such flexibility is difficult to balance with a safety net for vulnerable individuals. The Swedish welfare model, which is characterised by risk sharing among individuals and security for the individual, has benefited the economy. In our view, it is even more crucial to aim for social cohesion in the future. Nevertheless, the model must be adapted to the newly emergent labour market.

Provide a workforce with skills that meet the future needs of the Swedish economy. Sweden boasts a strong skill base and a traditionally high share of graduates in natural sciences and engineering, which bodes well for the future of digitalization in the country. However, there are increasing concerns about the quality of education and the ability to provide a workforce with skills that meet the needs of Sweden's future economy. Swedish students rank in the

middle of the OECD countries in science education, and the pay-offs of higher education in Sweden lag behind those of many peer countries (Ketels, 2009).

Attract foreign skill. Sweden does not rank high in attracting foreign skill, which Ketels (2009) argues is increasingly necessary in the global economy. Diversity tends to spur creativity that, in turn, leads to a dynamic and innovative climate characterised by higher productivity. In addition, Sweden's regulatory scheme and administrative practices are viewed as bureaucratic, and Sweden has one of the highest levels of taxation in the world, especially for individuals.

Reassess the tax base. Taxation remains a significant and unresolved issue. The cost of labour will increase in the future as digitalization spurs a knowledge-intensive service sector. Thus, increasing taxes on labour might not be the best approach. Other tax bases must be explored instead. Some international discussions on this issue include the consideration of both wealth and property taxes. Furthermore, as we move more toward a platform economy, who is responsible for reporting the sale and pay the sales or income tax? What about exchanges in which money does not change hands: for example, a farming cooperative where individuals receive produce from the farm in exchange for labour or an Uber-like exchange where the number of hours spent driving others can be exchanged for rides from other participants? Similarly, when new currencies are created, should they be treated as goods, services or currencies for the purposes of VAT? Such debates have already begun to emerge with regard to Bitcoin: a cryptocurrency.[55]

Conclusion

The purpose of this chapter, which was intended for a broad audience, has been to provide a broad overview of digitalization and its many influences upon firms and society. There are many areas to explore – and only more will emerge as digitalization continues to penetrate industries and new technologies emerge and converge with others. Digitalization and technological developments combined with political and societal changes continue to change the world, as we know it; therefore, it is important to view these changes in the "longue durée". We may seem to be moving forward, but many also profess that our technological and societal advances have led us to the edge of the cliff

55 http://www.coindesk.com/europe-inches-towards-decision-bitcoin-vat/

of the anthropocene era: the period during which human activity has globally impacted the planet. Paul Dukes writes that we entered this era in 1763, when the available data indicate the beginning of a growth in the atmospheric concentrations of several greenhouse gases (Dukes, 2011). Digitalization, however, offers promise in reducing the pressure of growth upon pollution and large cities across the globe. A McKinsey study recently reported that this trend of large city growth has been broken in countries such as the US and India, as smaller cities and rural areas are gaining popularity across age groups. Yet, how it is unclear how we further develop to secure the future of the planet for generations to come; building roads tends to increase traffic, rather than relieve it. Recent research in entrepreneurship has recognised the basic human paradox of seeking to simultaneously fulfil both individual and collective interests. The question remains: How will future developments impact this dialectical nature of human beings: Will it encourage us to act more collectively or perhaps more in our own self-interest?

References

Berkes, F., Folke, C., & Colding, J. (Eds.). (2000). *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press.

Brynjolfsson, E., & McAfee, A. (2014). The digitization of just about everything. In *The Second Machine Age: Work, Progress, And Prosperity in a Time of Brilliant Technologies*, pp. 57–70.

De Buysere, K., Gajda, O., Kleverlaan, R., Marom, D., & Klaes, M. (2012). A framework for European crowdfunding. *European Crowdfunding Network*.

Di Gangi, P. M., Wasko, M. M., & Hooker, R. E. (2010). Getting customers' ideas to work for you: Learning from Dell, How to succeed with online user innovation communities. *MIS Quarterly Executive, 9*(4).

Dukes, P. (2011). *Minutes to Midnight: History and the Anthropocene Era from 1763*. Anthem Press.

Eisenmann, T., Parker, G., & Van Alstyne, M. W. (2006). Strategies for two-sided markets. *Harvard Business Review, 84*(10), 92.

Felländer, A., Ingram, C., & Teigland, R. (2015). *Sharing Economy: Embracing Change with Caution*. Näringspolitiskt Forum Rapport (No. 11).

Fölster, S. (2015). *De Nya Jobben i Automatiseringens Tidevarv*. Stiftelsen för Strategisk Forskning.

Ketels, C. (2009). *Clusters, Cluster Policy, and Swedish Competitiveness in the Global Economy*. Stockholm: Globalisation Council.

McAfee, A., Brynjolfsson, E., & Davenport, T. H. (2012). Big data: the management revolution. *Harvard Business Review, 90*(10), 60–68.

McGahan, A. (2000). How industries change, *Harvard Business Review,* October.

Parker, G. G., Van Alstyne, M. W., & Choudary, S. P. (2016). *Platform Revolution: How Networked Markets are Transforming the Economy--And How to Make Them Work for You*. WW Norton & Company.

Pedersen, J., Kocsis, D., Tripathi, A., Tarrell, A., Weerakoon, A., Tahmasbi, N., & de Vreede, G. J. (2013). Conceptual foundations of crowdsourcing: A review of IS research. In *System Sciences (HICSS), 2013 46th Hawaii International Conference on* (pp. 579–588). IEEE.

Schumpeter, J. (1934). *Capitalism, Socialism, and Democracy,* New York: Harper & Row.

Skan, J., Lumb, R., Masood, S., & Conway, S. K. (2014). The boom in global fintech investment: A new growth opportunity for London, *Accenture,* p 15.

Weill, P., & Woerner, S. L. (2015). Thriving in an increasingly digital ecosystem. *MIT Sloan Management Review, 56*(4), 27.

About the Authors

Gustav Almqvist is a PhD Candidate in the Center for Media and Economic Psychology in the Institute for Research (SIR) and the Department of Marketing and Strategy at the Stockholm School of Economics (SSE). He holds a BSc. degree in Business and Economics from SEE and a MSc. in Psychology from Stockholm University. His research investigates judgment and decision-making under risk and uncertainty. gustav.almqvist@phdstudent.hhs.se.

Per Andersson is a Professor at the Institution for Marketing and Strategy at the Stockholm School of Economics. He received both an MSc and a PhD from the Stockholm School of Economics. His research projects focus upon industry change and dynamics connected to changes in information and communication technologies (ICT). His recent research involves service innovation processes in media and ICT markets, and how companies in various industries manage digital transformation processes. per.andersson@hhs.se

Angelica Blom is a PhD Candidate in the Center for Retailing at the Stockholm School of Economics. She holds a MSc. from SSE. Her research interests are in omnichannel retailing and customer journeys. Her research has been published in Journal of Business Research and Journal of Retailing and Consumer Services. angelica.blom@phdstudent.hhs.se

Karl Joachim Breunig is a Professor of Strategic Management and the Head of the Research Group on Digital Innovation and Strategic Competence in Organizations (DISCO) at Oslo Business School, Oslo and Akershus University College. He received his PhD from BI Norwegian Business School, and holds a MSc from London School of Economics. His research focuses upon knowledge-based value creation, in particular related to strategy, innovation, management control, and internationalisation of knowledge work. karl.joachim.breunig@sintef.no

Maria J. Bustamante is a PhD Candidate in the Department of Marketing and Strategy at the Stockholm School of Economics. Her research interests include the digital transformation of agriculture and the opportunities and challenges farms and firms will face as they incorporate new technology into their processes. Maria previously spent 10 years in the private sector with responsibilities

in marketing, business development, and strategy. Maria holds a M.Sc. in General Management from the Stockholm School of Economics and a B.A. from The Pennsylvania State University. maria.bustamante@phdstudent.hhs.se

Martin Carlsson-Wall is Associate Professor in the Department of Accounting at the Stockholm School of Economics. He received a PhD from the Stockholm School of Economics in 2011. His research focuses upon performance management and how it relates to innovation, creativity, and digitalization. Martin is currently involved in a European project exploring the role of the finance function in digital transformation. martin.carlsson@hhs.se

Robert Demir is a Lecturer in Strategic Management at Lancaster University Management School and Research Fellow at Ratio. He received his PhD from the Stockholm University School of Business. His research concerns open strategy, management innovation, and strategy as practice focusing upon the emergence, adaptation, and renewal of management and strategy practices. His research has appeared in *British Journal of Management, Long Range Planning,* and *International Business Review*. He has facilitated executive networks in Sweden, China, Hong Kong, and India. robert.demir@lancaster.ac.uk

Anna Felländer is a Digital Economist. She is a visiting fellow at the Swedish House of Finance at the Stockholm School of Economics and is affiliated with Sweden's Royal Institute of Technology. She is a Senior Advisor to the Boston Consulting Group and an advisor to the Minister of Digitalisation. She is also a board member and expert advisor to digital start-ups focusing upon Artificial Intelligence and has recently joined the board for transportstyrelsen. anna.fellander@mac.com

Henrik Glimstedt is Associate Professor of Business Administration at the Stockholm School of Economics. He obtained a PhD in History from the University of Gothenburg. His research focus is on the evolution of global innovation and competition in wireless communication technologies, and related high-tech areas. henrik.glimstedt@hhs.se.

Mikael Hernant is an Assistant Professor at the Center for Retailing, Stockholm School of Economics/Skövde University. He obtained a PhD from the Stockholm School of Economics. Mikael has 20 years of practical retail experience, having worked at various positions for the ICA Retail Company. His research addresses the profitability performance of retail stores. mikael.hernant@his.se

Claire Ingram Bogusz is a Researcher at the Stockholm School of Economics. She obtained her PhD from the Stockholm School of Economics. Her research interests lie in how code-based tools alter how individuals and organisations organise, especially pursuant to work practices and entrepreneurship. claire.ingram@hhs.se

Erik Lakomaa holds a PhD in Economic History from Stockholm School of Economics. He is the Director of the Institute for Economic and Business History Research. His research has primarily focused upon how organizations have historically adapted to external change: for example, new technology or new regulations. This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No. 688670. The author is grateful for data and valuable comments by Tino Sanandaji, Alberto Cottica and the members of the Edgeryders community. erik.lakomaa@hhs.se.

Fredrik Lange is an Assistant Professor in the Center for Retailing at the Stockholm School of Economics. Fredrik is also the Program Director for the BSc. Program in Retail Management at the Stockholm School of Economics. His current research interests relate to consumer behaviour, marketing communications, and retailing. His research has been published in *Journal of Advertising Research, Psychology & Marketing, and Journal of Business Research*. fredrik.lange@hhs.se

Stefan Lundberg graduated from the Royal institute of Technology (KTH) as a civil engineer in 1977 in the area of urban planning. He received his PhD degree from Sweden's Royal Institute of Technology in 2007 and is now an Associate Professor at KTH. He has been working in the industry both at Ericsson and at various housing companies, as well as for the government. His area of interest is how to plan for the inclusion of the elderly in the city and how to support ageing-in-place. stefan.lundberg@sth.kth.se

Lars-Gunnar Mattsson is a Professor Emeritus at the Stockholm School of Economics. He is affiliated with the Center for Business Markets and the Mistra Center for Sustainable Markets at SSE. He obtained his PhD at the Stockholm School of Economics. His long-term research interests focus upon market dynamics in a business network perspective. His present research concerns

two phenomena: sustainable markets and ICT-based service innovations. lars-gunnar.mattsson@hhs.se

Jan Markendahl is an Associate Professor in Wireless Infrastructure Deployment and Economics at Sweden's Royal Institute of Technology. After more than 20 years in the industry, Jan joined KTH in 2003 as research program manager and received a PhD degree in 2011 in Techno-Economic Analysis of Wireless Networks and Services. Jan obtained his Docent degree in 2014 and has been supervisor for seven PhD students. He has managed techno-economic research projects and tasks in the EU and national projects. janmar@kth.se

Erik Modig is Assistant Professor at the Stockholm School of Economics. His research centres upon market communication effectiveness, as well as the underlying explanation in the mind of the consumer. His research has been published in various advertising and marketing journals. He has published four books and his most recent one *Bang for the Buck* (2017) was awarded the Marketing Book of the Year in Sweden. Erik is a popular teacher and a demanded speaker at organisations and conferences. erik.modig@hhs.se

Staffan Movin is the Managing Director for the Foundation Marketing Technology Center (MTC). As a non-profit organization, MTC's mission is to promote links between practitioners and academics in the field of marketing, organization, and business management. Staffan has been project leader for R&D projects addressing business models, flexible entrepreneurship, internet of things, digital transformation, financial structures, and world-class customer experiences. staffan.movin@mtcstiftelsen.se

Magnus Mähring is Professor of Business Administration (Information Systems) at the Stockholm School of Economics. He obtained his PhD at Stockholm School of Economics. He sits on the Swedish government's expert committee for digital investments. His research concerns digitalization, particularly in relation to organizational decision-making, transformation processes and work practices. magnus.mahring@hhs.se

Frida Pemer is Assistant Professor in the Department of Management and Organization at the Stockholm School of Economics, where she also earned her PhD. Her research centres upon how private and public organizations use professional services, as well as what consequences digitalization will have for professional

service firms. Frida has published her research in journals including *Human Relations, Journal of Public Administration Research and Theory, Journal of Supply Chain Management and Industrial Marketing Management*. frida.pemer@hhs.se

Sara Rosengren is a Professor in the Center for Retailing at the Stockholm School of Economics. She is a Foundation of Ica Retailers' Professor in Business Administration, especially Retailing and Head of SSE's Center for Retailing. She holds a PhD from the Stockholm School of Economics. Sara's current research deals with consumer behaviour, marketing communications, and retailing: three areas that are currently undergoing major transformations due to digitalization. sara.rosengren@hhs.se

Christopher Rosenqvist is an Associate Professor and Lecturer in the Center for Digital Transformation and Innovation at Stockholm School of Economics and at SSE Institute for Research. He holds an MSc in Media Technology from Sweden's Royal Institute of Technology as well as a PhD and Docent in the area of Media Production & Business Development. His research concerns the effects of new technologies upon the ecosystem of actors in different industrial arenas. christopher.rosenqvist@hhs.se

Tale Skjølsvik is Associate Professor in Computer Science at the Oslo Business School: Oslo and Akershus University College. She holds a Ph.D. in Strategic Management from BI Norwegian Business School and worked as a management consultant at Bain & Company: Stockholm and Gemini Consulting: Oslo. Her research includes: strategic management, digitalization, and purchasing knowledge-intensive service. She has published papers in *California Management Review, The Service Industries Journal, Journal of Supply Chain Management* and *Journal of Public Administration Research and Theory*. tale.skjolsvik@hioa.no

Torkel Strömsten is an Associate Professor at the Stockholm School of Economics and a Professor at the Royal Institute of Technology. His research lies in the interface between management accounting and industrial networks. He is particularly interested in how control tools are used in value creating processes. He is also an advisor to start-ups and serves on advisory boards for private and non-profit organisations. torkel.stromsten@hhs.se

Martin Söndergaard works as a Research Assistant and holds a BSc in Business and Economics at Stockholm School of Economics, as well as a BSc in

Psychology from Stockholm University. He won the Folke Kristensson Scholarship in 2016 for Outstanding Essay of the year in Marketing & Strategy for his paper entitled *Effective Mobile Display Advertising: The Impact of Product Involvement and Creativity*. Martin has plans to soon start his doctoral studies at SSE. His main focus area is understanding consumer psychology through statistical analysis. martin.sondergaard@hhs.se

Robin Teigland is Professor of Business Administration in Strategic Information Systems Management at the Stockholm School of Economics. She holds a B.A. in Economics from Stanford, an M.B.A. from Wharton, an M.A. in International Studies from the University of Pennsylvania, and a PhD from the Stockholm School of Economics. Her research focuses on strategy, entrepreneurship, social networks, and emerging technologies. Robin has five children and was one of the 125 most influential women in Sweden in 2017. robin.teigland@hhs.se

Karl Wennberg is Professor of Management at Linköping University and Research Fellow at Ratio and the Stockholm School of Economics Institute for Research (SIR). He obtained his PhD at the Stockholm School of Economics. His research concerns entrepreneurship and its societal implications. karl.wennberg@hhs.se

Adam Åbonde is a PhD student at the Center for Media and Economic Psychology (Department of Marketing and Strategy) at the Stockholm School of Economics (SSE). His research interests revolve around consumer psychology and behaviour, especially related to information in digital contexts. Adam has a BSc in Business & Economics and MSc in Business & Management from SSE. adam.abonde@phdstudent.hhs.se

About the Language Editor

Karyn McGettigan is a Writer, Editor, and Language Specialist. She has led communication projects in more than 180 countries, and has edited academic manuscripts for some of the world's leading researchers representing 55 prestigious institutions in 20 different countries. Her writing has been translated into 8 languages and her work has been cited in several peer-reviewed international journals. Karyn is also an International Correspondent and a Member of Sweden's Foreign Press Association.

Karyn holds an Honours B.A. in French Language and Literature from the University of Western Ontario, an M.A. from the University of Victoria, a degree in Broadcast Journalism & Media Communications from the British Columbia Institute of Technology, a Language and Communications certification from the Paris Institute of Language and Culture, and received an Honours Scholarship to study at the University of Nice.

With dual citizenship in Canada and in Sweden, Karyn McGettigan is based in Stockholm.

www.mcgettigan.se

An Assortment of Our Latest Publications

An assortment of publications from Stockholm School of Economics Institute for Research and the Stockholm School of Economics. Books and dissertations are published in the language which is indicated by the title. Books can be ordered by e-mail from publications@hhs.se.

PUBLICATIONS SINCE 2014

2017

BOOKS

Einarsson, Stefan & Kallifatides, Markus. *Parternas bolag. Ett diskussionsunderlag.*

Kallifatides, Markus & Lerpold, Lin (ed). *Sustainable Development and Business.*

DISSERTATIONS

Freddi, Eleonora. *Strategic Ignorance and Social Institutions.*

Freij, Åke. *Mastering the Impact of Regulatory Change--The Capability of Financial Services Firms to Manage Interfaces.*

Hosseini Tash, Fatemeh. *Essays in Entrepreneurial and Household Finance.*

Hultin, Lotta. *Go with the Flow: Post-humanist Accounts of how Matter Matters in Organizational Change.*

Jeremiah, Rupin. *R&D Configurations and Innovation Outcomes. The Case of Swedish R&D Offshore.*

Lagrelius, Anna-Maria. *Doktorns dilemman: Att välja läkemedel med standarder som styrverktyg: effekter och konsekvenser.*

Laurin, Ebba. *Box Paradox--How Key Account Management Contributes to Business Model Innovation.*

Li, Jieying. *Essays in Empirical Finance.*

Lundgren, Gustaf. *Essays on Job Market Screening, In-Group Bias and School Competition.*

Muço, Arieda. *On Anti-Corruption Tools in Developing Countries.*

Owalla, Beldina. *Women's Entrepreneurial Identities. A Typology Based on Insights from Entrepreneurship Programs in Two Different Contexts.*

Petri, Henrik. *Lexicographic and Social Choice, Takeovers, and Fixed Points.*

Sebhatu, Abiel. *Deregulation, Institutional Change, and Entrepreneurship in the Swedish Education System: Intended and Unintended Effects of Competition.*

Sokolovski, Valeri. *Essays on Currency Risk and Financial Frictions.*

Stigzelius, Ingrid. *Producing Consumers: Agencing and Concerning Consumers to Do Green in Everyday Food Practices.*

Yetis Larsson, Zeynep. *Open Entrepreneurship: Investigating Entrepreneurship in Open Source Software Communities.*

Wikberg, Erik. *Artful Organizing: Essays on Places, Measurements, and Money Flows in the Contemporary Cultural World.*

Åhblom, Per. *The Financial Performance--A study of how financial numbers become meaningful.*

Åkestam, Nina. *Understanding Advertising Stereotypes. Social and Brand-related Effects of Stereotyped versus Non-Stereotyped Portrayals in Advertising.*

Ählström, Jenny. *"Alla ska behandlas med respekt". Uppkomst och utveckling av narrativet om mänskliga rättigheter i globala leverantörskedjor.*

2016

BOOKS

Einarsson, Stefan. *Medlemmar, ideologi och strategi. En studie av IOGT-NTO 1970–2009.* Forskning i Fickformat.

Schuster, Walter. *Finansiell Redovisning.*

Sjöstrand, Sven-Erik. *Nordic Corporate Governance. An extensive in-depth study of corporate governance and board practices in 36 large companies.*

Sjöstrand, Sven-Erik. *Nordisk bolagsstyrning. En närstudie av ägarstyrning och styrelseprocesser i 36 storbolag.*

Wahlund, Richard (red.) *Risker och riskhantering. I näringsliv och samhälle.*

DISSERTATIONS

Amberg, Niklas. *Firms and Banks in the Macroeconomy: Empirical Essays using Microeconometric Methods.*

Ceh, Ana Maria. Public Debt, *Private Liquidity and Welfare.*

Chen, Jun. *Essays on Information Acquisition.*

Efendic, Nedim. *Expatriate Entrepreneurship: The Role of Accelerators in Network Formation and Resource Acquisition.*

Facchinello, Luca. *On the Role of Information in Educational Choice.*

Forsell, Eskil. *Experimental Testing of Old and New Hypotheses in Economics.*

Fröberg, Emelie. *Seeking Alpha – and financing it. Empirical studies of the impact of information acquisition behavior, market beliefs and risk attitude on fund performance among equity fund managers in Sweden.*

Gillqvist, Anna-Stina. *Conversations on Accounting Practices--A Study of an Enforcement Body in a Time of Regulatory Change.*

Heidari, Mahdi. *Essays on Financial Market Anomalies and Investment Strategies.*

Karmaziene, Egle. *Essays in Empirical Finance.*

Karlberg, Gabriel. *Styrning av outsourcad offentlig service. En balansakt mellan fasthet och flexibilitet.*

Karsberg, John. *Reception, reception, reception. The effects of receiver context on advertising effectiveness.*

Larsson von Garaguly, Joacim. *Vasaloppet – Resan från skidtävling och skidlöpare till produkter och kunder. En studie om kommersialisering och professionalisering.*

Lopez Aliouchkin, Ricardo. *Essays in Financial Economics.*

Lundin, Erik. *Empirical Essays on Strategic Behavior in the Electricity and Water Sectors.*

Murtic, Adis. *Soaking Up Knowledge: A Multi-level Analysis and Conceptualization of Absorptive Capacity.*

Ringbo, Joel. *In search of the optimal grocery store layout. Examining the effect of placement order for complementary product categories in the store environment.*

Thörnqvist, Tomas. *Essays in Household Finance.*

Töndevold Liljedal, Karina. *Communicated Consumer Co-creation: Consumer Response to Consumer Co-creation in New Product and Service Development*.

Özbek, Nurgül. *Entering a Global Play: Insights into Swedish Small Life science Firms' Legitimation in International Networks*.

2015

BOOKS

Bay, Charlotta. *Finansens folkdräkt Om att översätta ekonomi så folk förstår*. Forskning i Fickformat.

Sölvell, Örjan. *On Strategy & Competitiveness. 10 recipes for analytical success*.

Yttermyr, Olga. *Skolans nya värld Att organisera en kundvalsmarknad – med grundskoleutbildningen i fokus*. Forskning i Fickformat.

DISSERTATIONS

Berg, Hanna. *Faces of Marketing: Examining Consumer Responses to Depictions of People in Marketing*.

Christner, Carl Henning. *The Valuable Organisation--A Study of How Activities are Calculated, Controlled and Made Valuable*.

Di Casola, Paola. *Essays in Macroeconomics and Institutional Economics*.

Khapko, Mariana. *Essays in Financial Economics*.

Koptyug, Nikita. *Essays on Consumers, Risk and Rationality*.

Luistro Jonsson, Marijane. *Cooperating for Sustainability: Experiments on Uncertainty, Conditional Cooperation and Inequality*.

Milonas, Kristoffer. *Essays in Empirical Finance*.

Morgulis-Yakushev, Sergey. *Exploring Fit: Essays on the Role of Organizational Cultural Fit for Knowledge Transfer*.

Nilsson Altafi, Sofia. *Evaluations as Mirrors and Co-constructors: An Empirical Investigation of a Microfinance Rating Agency and Its Rating Practices from 1999–2014*.

Shir, Nadav. *Entrepreneurial Well-Being: The Payoff Structure of Business Creation*.

Sichlimiris, Spyridon. *Public Debt, Business Cycles and Institutions*.

Wehrmüller, Simon. *Credit, Labor and the Great Recession*.

Xia, Qing. *Creditor Rights and Innovation: Evidence from China*.

2014

BOOKS

Beckerman, Carina. *Skepparen först, båten sedan. En bok om Marcus Wallenbergs värld och synen på ledarskap*.

Jacobsson, Bengt & Sundström Göran. *Demokrati och förvaltning. En festskrift till Rune Premfors*.

Näslund, Lovisa. *Får jag lov? Förtroendeskapande bland konsulter och teaterregissörer*. Forskning i Fickformat

Sjöstrand, Sven-Erik & Hammarkvist, Karl-Olof. *Om ägarstyrning i statligt ägda företag*. Ingår i "Ekonomiskt värde och samhällsnytta – förslag till ny statlig ägarförvaltning." Expertbilaga i Ägarutredningen (SOU 2012:14).

Söderlund, M. (red) *Marknadsföring och påverkan på konsumenten*.

DISSERTATIONS

Bernergård, Axel. *Best replying, to yourself and others.*

Bird, Miriam. *The Impact of the Family on Entrepreneurial Outcomes: The Role of Social Embeddedness.*

Brattström, Anna. *Trust in a Product Development Context: Drivers, Dynamics and Consequences.*

Breckenfelder, Johannes. *Empirical Essays in Financial Economics.*

Crosta, Alberto. *The Effects of Credit Rating and Watchlist Announcements on the U.S. Corporate Bond Market.*

de Rezende, Rafael B. *Essays on Macro-Financial Linkages.*

Elger, Paul. *Essays on Taxation and Consumption.*

Faragó, Ádám. *Essays on Disappointment Aversion in Portfolio Choice and Asset Pricing.*

Hagbjer, Eva. *Navigating a Network of Competing Demands--Accountability as Issue Formulation and Role Attribution Across Organisational Boundaries.*

Hartwig, Markus. *Interest Alignment, Delegation of Authority and Economic Rent – A Collection of Empirical Papers.*

Hederos Eriksson, Karin. *Essays on Inequality, Gender and Family Background.*

Junker, Sven-Olof. *Att skapa gemenskap: hur beslut fattas i en EU-myndighet.*

Lazarczyk Carlson, Ewa. *Essays on Electricity Markets: Information and Trading.*

Löfgren, Angelika. *International Network Competitiveness: Technical and Foreign Market Knowledge Development in International SME Networks.*

Mengistu, Andualem. *Empirical essays on the monetary markets of developing countries.*

Molin, Jonas. *Business Streamlining: Toward a Substantive Theory of the Management of Outsourced Business Processes.*

Nilsson, Andreas. *Financing of Nonprofits and Social Enterprises.*

Rosenström, Martin. *Att skapa en marknad: marknad och politisk styrning i symbios?*

Sandberg, Anna. *Empirical Studies on Sources of Inequality.*

Schnitzler, Jan. *Empirical Essays in Finance.*

Svahn, Mattias. *Pervasive Persuasive Games: The Case of Impacting Energy Consumption.*

Vardardottir, Arna. *Family and Friends: Essays on Applied Microeconometrics.*

Yildirim, Mustafa. *Incentives in Contests.*

Managing Digital Transformation

Digitalization has arrived.

Digitalization disrupts markets. Changes in power and structures in a fast-paced environment demands strategic and insightful change. A change leaders must act upon.

The impact upon organisations is multi-dimensional and profound, affecting both internal and external processes and structures in new and unexpected ways. This book serves as a tool to support managers and other stakeholders in pursuing digital transformation. An inspiring collection of chapters from 27 scholars across various academic disciplines provide several insights, frameworks, and perspectives that will help you leverage and govern organisational change and digital transformation.

This inspiring collection of current research can assist you in facing key challenges in today's organisations, in the quest to adapt to ever-evolving business environments. This book examines new demands and behaviours, and discusses how businesses need to adapt and re-organise in order to bridge the gap to the digital customer. These visions and actions on digitalization can help corporations and organisations discover new ways of earning money and delivering value.

This is just the beginning.

STOCKHOLM SCHOOL OF ECONOMICS
SSE INSTITUTE FOR RESEARCH

mtc
STIFTELSEN MARKNADSTEKNISKT CENTRUM

ISBN 978-91-86797-31-7
9 789186 797317