MANAGING DIGITAL TRANSFORMATION

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

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Karyn McGettigan, Language Editor

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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.

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STIFTELSEN MARKNADSTEKNISKT CENTRUM

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

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

Contents

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

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

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

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

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

Introduction

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

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

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

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

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

PART 1: DIGITALIZATION – DIFFERENT PERSPECTIVES

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

PART 2: THE NEW DIGITAL CUSTOMER

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

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

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

PART 4: BUSINESS MODELS AND ECOSYSTEMS

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

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

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

Staffan Movin, Stiftelsen Marknadstekniskt Centrum

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?

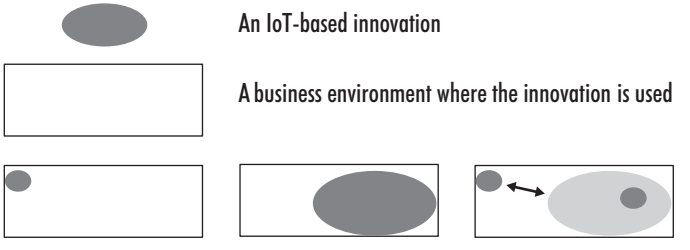

Figure 12.1. Illustration of IoT-based innovation playing a small or big role in a business environment or being linked to/being a part of another service.

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.

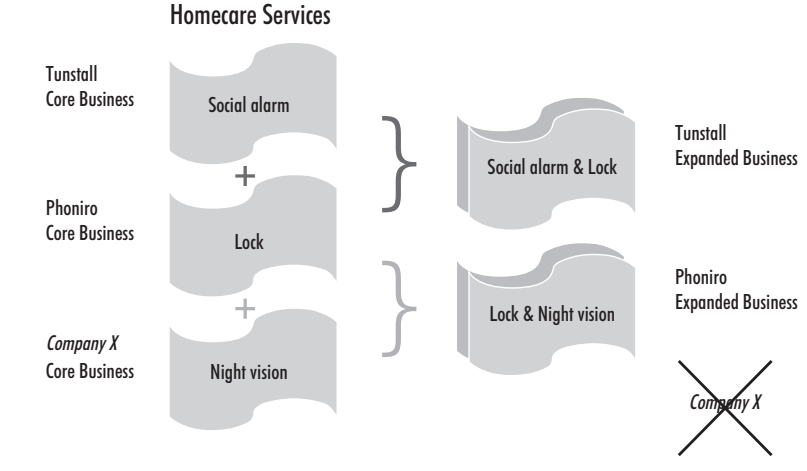

Figure 12.2. Examples of development paths for companies in the homecare business.

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.

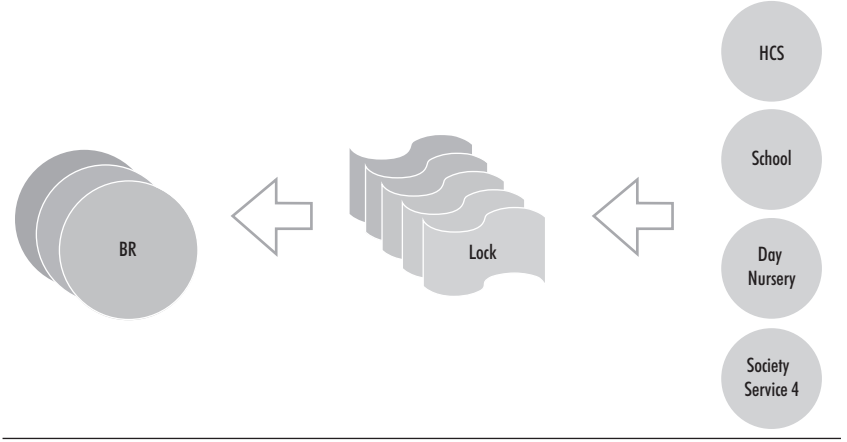

Figure 12.3. Example of society services in a geographic area or district.

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.

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