Management for Professionals

Nils Urbach · Maximilian Röglinger
Karlheinz Kautz · Rose Alinda Alias
Carol Saunders · Martin Wiener
Editors

Digitalization Cases Vol. 2

Mastering Digital Transformation for Global Business

Springer

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Testimonials

*"*Nothing helps current and future managers understand the complexities of critical issues better than case studies. *Digitalization Cases Vol. 2* offers 20 outstanding cases about companies and governmental agencies around the globe to help students and practitioners explore the challenges and opportunities they may face, and the alternatives others have made, about digital disruption, business, and transformation,.*"*

—Dr. Keri Pearlson,
Executive Director of Cybersecurity, MIT Sloan Research Consortium

"While the intensity of discussions about digital transformation has significantly increased through the COVID-19 pandemic, the topic too often remains on an abstract or buzzword level. The second volume of *Digitalization Cases* brings these discussions back on the ground and delivers actionable insights. The presented cases help to reflect one's own activities and initiatives and inspire new ones. It is a great resource and a must-read for everyone interested in digital transformation.*"*

—Dr. Thomas Mannmeusel,
Executive Vice President Global Process Excellence & Group CIO, Webasto

*"*Our CEO Satya Nadella said last year at the beginning of the pandemic: we have experienced 2 years of digitalization in 2 months. Since then I have spoken to so many customers; it is not a question of if, or even when. It is about the How! It is even more evident that organizations must transform to thrive in the digital economy and gain or regain a competitive edge to stay relevant. *Digitalization Cases* provides firsthand insights into the efforts of renowned companies. The presented actions, results, and lessons learned are a great inspiration for managers, students, and academics. This book gives real pointers on the how and where to start.*"*

—Anna Kopp,
Head of IT Germany, Microsoft

*"*The second volume of *Digitalization Cases* is a successful continuation. The book offers many interesting starting points for practitioners, but also points of departure for future research. A great reading for all interested in real digitalization cases.*"*

—Dr. Quirin Görz,
Chief Information Officer, KUKA

*"*Almost every organization is trying to figure out how best to respond to the opportunities and threats posed by digitalization. This book provides valuable lessons from those organizations that have already begun their digital transformation journey.*"*

—Michael D. Myers, PhD,
Professor of Information Systems, University of Auckland

*"*Following a mature digitalization strategy in organizations is a key factor for the development and facilitation of new business models, business growth, and future mode of business operations. Active business-IT alignment and organizational setup change skillsets, toolset, and mindset and sustainably support digital transformation. The second volume of *Digitalization Cases* represents a real eye-opener by providing most valuable cases in different countries and sectors based on academic research and domain experience.*"*

—Robert Mayer,
Head of IT Central & Eastern Europe, Fujitsu

"Digitalization is like New Year's resolutions: Everyone talks about it, but little is known about how to get started. By providing a highly diverse set of examples, the second volume of *Digitalization Cases* gives you an idea of how to set off your digital transformation—no matter where you currently stand."

—Melanie Kehr,
Member of the Executive Board, KfW Group

*"*Digital transformation is advancing at breathtaking speed, leaving no business model untouched. Hence, the close interlocking of business success and IT is the core element of our time. Publications like this help decision-makers to benefit from the wealth of experience of others. With the 20 international and cross-sector cases from the

automotive to the insurance industry, this book provides insights into multifaceted digital challenges and contributes to a successful macrosocial digitalization.*”*

—Dr. Axel Schell,
Chief Transformation Officer, Allianz

*“*Digitalization puts the customer in the center and requires well-thought-through end-to-end processes, and an intelligent enterprise architecture approach to sustainably meet and exceed customer expectations. This book is a great source of inspiration as it showcases how different actors tackled this challenge. I can only recommend this book to every practitioner before engaging in digitization initiatives.*”*

—Dr. Martin Petry,
CIO and Head of Business Excellence, Hilti Corporation

*“*The cases compiled in the second volume of *Digitalization Cases* show how digital disruption can be actively managed. Further, long-term insights from extended success stories of the first volume highlight that courage to change pays off well. This book serves as a motivation for many organizations to drive their digital transformation journeys proactively.*”*

—Dr. Markus Richter,
State Secretary at the Federal Ministry of the Interior, Building and Community and Federal Government Commissioner for Information Technology, Federal Republic of Germany

Foreword

Nearly every company or organization one visits today says that it is engaging in digital transformation, planning to do so, or afraid that others will do it and make them obsolete. At the same time when asked what they mean by digital transformation, one gets a row of confusing, ambiguous answers and even avoidance to answer this question. This is no surprise as nobody can *exactly* pin down what this transformation is and what it is not, or how it differs from earlier ways of engaging and implementing information technologies in organizations that has been taking place at least over the last half-century. But everybody appears to be convinced that this time *it is different*, bigger, more pervasive, and more drastic posing unprecedented challenges to organizations.

There are several reasons to accept this account. Technologies are now cheaper, more encompassing and powerful, and faster to deploy and modify. They pose less roadblocks in imagining and introducing radical organizational change. Therefore, managers and employees need to ask: what should we do now when we can design and implement nearly everything we can imagine? Because the technologies are easier and cheaper to deploy, they can be introduced modularly and in a staggered manner. Consequently, their implementation and use take place faster and are easier. Overall, there is less resistance and friction and very different types of business cases than in the past. Because the technologies are more powerful and flexible, they are now cognitively challenging to integrate and think as part of the organization and task design. This calls for new innovative, entrepreneurial, and design-focused approaches that were not feasible in the past. This then poses new challenges of how to engage the workforce and how to make it more forward-looking and cognitively nimble. Finally, the use of these technologies demands new types of collaborations; they force new relationships and alliances and open unthinkable business opportunities and markets. Simply, they challenge the identity of many organizations and their employees. Organizations need to seriously reconsider in which business they are and what are their positions in their established supply chains, industries, or institutional fields. This overall heightened technological, organizational, and institutional complexity and speed of change is something which we did not experience in the past waves of using digital technologies and which, I posit, has called for the use of the new label "Digital X."

In this new "digital" setting—if one wants to think of a similar whirlwind of industrial change one probably needs to look at the period of 1870–1920 in the USA when the corporate form of industrial organization and markets emerged during a short period of a half-century. In such a setting there is little guidance from what we know from the past. The only guidance we can get is to look at the moment and try to grasp the bewildering variety of changes and to build through gazing this mosaic of changes a larger picture and understanding what is truly happening, i.e., to try to see dimly through the fog of change and separate the signal from the noise. Therefore, editorial books like this second volume of *Digitalization Cases* are valuable. They provide grounded concrete histories of a variety of successful and less successful digitalization-related change and transformation initiatives and offer necessary detail and raw material to start painting the contours of the deeper transformation that is taking place.

After reading through the 21 cases in this second volume I can note some of the emerging contours more starkly. The first one is that no one will remain untouched. The variety of organizations of different sizes, industries, and settings included in the cases suggests that the phenomenon is pervasive. The second is the scale and depth of reported process re-engineering, efficiency seeking, and automation that is being sought and achieved. The predictions of the death of process engineering in the 1990s appear to have been premature. The third is the rising importance and challenge of dealing with (big) data and analytics challenges and how to integrate these new kinds of intelligent technologies to the work organization. The fourth challenge is the grandiosity of the structural, cognitive, and organizational changes that most organizations face as the steamroller of digitalization unfolds. Most struggle how to prepare for these changes structurally and through workforce transformation and education. In this regard, the cases provide ample evidence in the form of concrete detail how organizations learn to deal with and address such issues. As such, the included cases can be used by organizations and managers to learn from others. In addition, they offer valuable insights to many university-level courses and other educational settings as to convey clearly how digital transformation takes place and what challenges it poses to involved stakeholders. I hope you will enjoy examining and learning from them as much as I did.

Shaker Heights, OH, USA
March 2021

Kalle Lyytinen

Preface

In the digital age, emerging technologies significantly influence processes, products, services, and business models, for example, by connecting individuals, organizations, machines, and other "things," by enabling novel working, collaboration, and automation models, as well as by providing access to untapped data sources. The resulting digital economy is volatile, uncertain, complex, and ambiguous. This raises a wide range of challenges for organizations. Hyper-connected customers with individual needs, opaque regulatory requirements, and continuously increasing competitive pressure from startups and digital giants are just a few examples. However, today's business environment also offers untapped potential and many opportunities. Among others, these include the enhancement and disruption of existing business models, the identification of previously unknown customer needs, the exploration of new markets, and the collaboration with other market players. To thrive in the digital economy, organizations must unfold the potential of digital technologies—not only emergent ones (e.g., distributed ledger, artificial intelligence, augmented reality, and quantum computing) but also established ones (e.g., social, mobile, analytics, and cloud)—in their business strategies and business models. They must also reimagine their work routines, processes, and structures, as well as manage and govern IT infrastructures that are central to their value propositions.

Our original idea behind editing this book was to present a rich compilation of real-world cases on digitalization. With all economic and societal sectors being challenged by digital technologies, we aimed at illustrating how organizations leverage their capabilities to create disruptive innovation, to develop digital business models, and to transform themselves. Since the publication of the first volume of this book, the world has moved on, which is why we decided to compile a second volume. For this volume, we have again compiled 20 diverse cases—this time from four continents—on how companies and public organizations rethink their business for the digital age. Some cases also present updates of success stories published in the first volume. The case descriptions report on best practices and lessons learned from different organizations that succeeded in tackling the challenges and seizing the opportunities of the digital world. The cases provide insightful examples for practitioners as well as interesting cases for researchers, teachers, and students. All cases follow a unified template, making them easily accessible for readers.

As in the first volume, we grouped the cases into three major blocks, representing the major action fields of digitalization. Part I contains cases of *digital disruption,* a field that refers to the monitoring and analysis of emerging technologies. It also includes the development of competencies for leveraging these technologies. The cases of this part stem from ELIS Innovation Hub, Satherm GmbH, Arçelik, Germany's Federal Office for Migration and Refugees, Future Health, and Deutsche Telekom Service Europe. Part II represents cases related to *digital business,* a field covering the realization of new business models that are enabled by digital technologies and disrupt traditional businesses, often resulting from the smart fusion of the physical and digital world. The cases report on Huawei, DEVK, RAPS, and SCHOTT, among others. Finally, Part III covers cases on *digital transformation*, which refers to technology-induced organizational change. It embraces the organizational, processual, and technological efforts necessary for organizations to succeed in the digital age. This part includes cases from Listemann, Ghana Water Company Limited, Springest, FPT Software, Acardis, medi, and Arbonia.

We want to thank several people for supporting the compilation of this book. Most importantly, we thank Fabiane Völter for continuously supporting us in managing the overall book project. We are also very grateful to Barbara Bethke from Springer who supported the project from the publisher's side. Finally, we thank all the colleagues who served on the editorial board of this book and who dedicated much time and effort in providing reviews to further develop the cases presented in this book. We are specifically grateful for this support, as not only the business of all case companies but also the private lives of the individuals engaged in this project were substantially "shaken" by the COVID-19 pandemic during the compilation of this book. We hope you will enjoy reading the book and working with the cases, and invite you to contact us for questions, feedback, and discussions.

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Introduction to Digitalization Cases Vol. 2: Mastering Digital Transformation for Global Business

Nils Urbach, Maximilian Röglinger, Rose Alinda Alias, Karlheinz Kautz, Carol Saunders, and Martin Wiener

Abstract Digitalization confronts organizations with huge challenges and opportunities. With all economic and societal sectors being affected by emerging technologies, the digital economy is highly volatile, uncertain, complex, and ambiguous. Against this backdrop, this book reports on the best practices and lessons learned from organizations that succeeded in tackling the challenges and seizing the opportunities of the digital economy on a global scale. It illustrates how 20 organizations leveraged their capabilities to create disruptive innovation, to develop digital business models and to digitally transform themselves. These cases stem from various geographical regions and industries, covering the many facets that digitalization may have.

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1 The Impact of Digitalization on Global Business

Digitalization reflects the adoption of digital technologies in business and society as well as the associated changes in the connectivity of individuals, organizations, and objects (Gimpel et al. 2018; Vial 2019). While digitization covers the technical process of converting analog signals into a digital form, the manifold sociotechnical phenomena and processes of adopting and using digital technologies in broader individual, organizational, and societal contexts are commonly referred to as digitalization (Legner et al. 2017).

The key drivers of digitalization are digital technologies. Due to considerable investments in technological progress, various digital technologies are available on the market. Thereby, an ever-faster commoditization and time to market can be observed. For example, early hardware-heavy information and communication technologies such as the telephone required 75 years to reach 100 million users, whereas lightweight applications such as Instagram achieved the same coverage in little more than 2 years (Statista 2017). Digital technologies include both emerging technologies such as the Internet of Things (IoT), blockchain, and artificial intelligence (Schoeman and Moore 2019), which are currently converging into the machine economy concept (Schweizer et al. 2020), as well as more established technologies such as social media, mobile computing, advanced analytics, and cloud computing (SMAC) (Fitzgerald et al. 2014; Gartner 2017). Loebbecke (2006) refers to digital technologies as all technologies for the creation, processing, transmission, and use of digital goods and services. Further, Yoo et al. (2010) argue that digital technologies differ from earlier technologies in three characteristics: re-programmability, which separates the functional logic of a device from its physical embodiment; homogenization of data, which allows for storing, transmitting, and processing digital content using the same devices and networks; and a self-referential nature yielding positive network externalities. Digital technologies can be further classified with respect to whether they involve humans actively or passively, how they treat data, whether their input and output is purely digital or can also be physical, or whether they serve infrastructural or application-oriented purposes (Berger et al. 2018). Baskerville et al. (2020) even refer to an ontological reversal, where reality "becomes a purposeful product of the digital world" (p. 509) instead of technologies only representing it. In sum, digital technologies enable platforms, autonomous products, sensor-based data collection, analytical insight generation, as well as analytical and augmented interaction.

Based on advances in digital technologies, digitalization impacts business and society. Digital technologies enable innovative business models such as the platform-based models of well-known companies including Airbnb, Uber, or Facebook or decentralized models enabled by blockchain and 3D printing (Fridgen et al. 2018; Goodwin 2015). Digitalization also changes industry structures (Gimpel et al. 2018): reduced entry barriers help technology-savvy start-ups to flourish and digital giants such as Google or Apple to expand into manifold sectors. Regarding the IoT, for example, 50 billion smart devices are expected to be connected to the

Internet by 2030, having an economic impact of $110.6 billion in 2025 (Mercer 2019, Statista Research Department 2020). Further, the volume of available data is known to double every 3 years (Henke et al. 2016), and insights-driven businesses are predicted to take away $1.2 trillion per year from less-informed competitors by 2020 (McCormick et al. 2016).

Digitalization also empowers customers and impacts our private lives. Today, more people have access to cellphones than to toilets, and one in five people has an active Facebook account (Halleck 2015; UN International Telecommunication 2014). In the digital age, wowing customers is more critical—and more challenging—than before, independent from an organization's position in the value network, as customers decide themselves how to interact with organizations (Hosseini et al. 2018). Likewise, employee behavior and thought patterns evolve toward a new future of work, calling for new work and collaboration models (Kerpedzhiev et al. 2020). Digitalization, however, is neither a new phenomenon nor will it be the final evolutionary stage of information and communication technology (Porter and Heppelmann 2014). Data has been processed and exchanged digitally for more than half a century. An early example is electronic data interchange. Further, the Internet has been used for civil purposes since the 1990s, and e-commerce was first promoted around year 2000. With smart devices and mobile applications, digitalization experienced an additional boost. In the last couple of years, more and more companies have experienced a transformation toward software-defined businesses (Alt et al. 2020). While, in former times, digitalization only concerned data managers of corporate IT departments, it now affects all business departments as well as product and service offerings (Urbach and Ahlemann 2018; Urbach et al. 2017, 2019). Consequently, discussions moved (again) from support to core processes, from efficiency to excitement, from hygiene factors to opportunity factors, as well as from cost reduction to revenue generation.

In our opinion, the most significant characteristics of digitalization are not the usage of data or adoption of technology, but the unprecedented speed of change and level of connectedness, which also facilitates the customers' dominant role as well as the convergence of the physical and the digital world (Gimpel et al. 2018). As such, digitalization shapes a world that is at once the cause and effect of its own characteristics: volatility (i.e., constant and massive changes), uncertainty (i.e., lack of predictability), complexity (i.e., multitude of interrelated and self-organizing actors), and ambiguity (i.e., confounding cause-and-effect relationships) (Bennett and Lemoine 2014).

As our discussions with senior managers (e.g., Chief Executive Officers, Chief Information Officers, Chief Digital Officers, and Digital Transformation Officers) in the last years showed, nobody doubts that digitalization "came to stay," continuing to impact on all facets of organizations, i.e., customer relationships, value propositions, data analytics, operations, organizational setups, collaboration, and transformation management itself (Gimpel et al. 2018). Rather, the key questions relate to the "what" and the "how," i.e., what organizations should look like in the future and how a to-be state can be reached both in an agile and adaptive manner and without jeopardizing existing assets and capabilities (A.T. Kearney, Project Group BISE of the Fraunhofer FIT 2017). Many organizations already defined accountabilities for digitalization and set up transformation initiatives. Nevertheless, digitalization remains a vague concept. What is missing are success stories, good practices, and lessons learned that make the benefits of digitization tangible, help prioritize investments, help choose among action possibilities, reveal "internal homework" that needs to be done before customer-facing initiatives make sense, and provide a platform for exchanging thoughts on challenges and opportunities ahead. However, in our research and project work, we also came across many successful companies—be it incumbents or start-ups—that successfully leveraged their capabilities to create digital innovation, develop digital business models, and transform themselves. These organizations have valuable first-hand insights to share.

Against this background, we initiated the *Digitalization Cases* book series to match the supply and demand for ideas, experiences, benefits, and lessons learned related to digitalization. Together with an international editorial board of forward-thinking digitalization experts, we set up *Digitalization Cases Vol. 2* and compiled 20 identically structured case descriptions that provide rich insights into the digitalization activities of renowned organizations from diverse geographical regions and industries.

Below, we first structure the field of digitalization into digital disruption, digital business, and digital transformation as a first step to make it more tangible (Sect. 2). After that, we provide an overview of the cases included in this book structured around these three fields of action (Sect. 3). We conclude with hints on the unified structure of the included cases and on how to read this book (Sect. 4).

2 Structuring the Field of Digitalization

To structure the field of digitalization, we use an enterprise architecture model that consists of five layers (Fig. 1). These layers include business model, business processes, people and application systems, data and information, and technological infrastructure. To tackle the challenges and to seize the opportunities of the digital age, it is essential for organizations to align these layers.

Considering the turbulence of business environments and the rich set of opportunities available, a key challenge for organizations in the digital age is to distinguish sustainable opportunities promising in the long run from short-term hypes. Against this backdrop, an organization's *business model* is of utmost importance, as it enables exploiting existing market potentials and seizing new opportunities. Business models specify on target markets, operating models as well as cost and revenue streams. This also involves the organization's value propositions, describing which customer needs are satisfied by which product and service offerings. In the digital age, digital technologies allow for entirely new business models such as platform-based business models or innovative decentral models.

To turn their business model into reality, organizations require cross-functional work routines structured around *business processes*. In the digital age, process

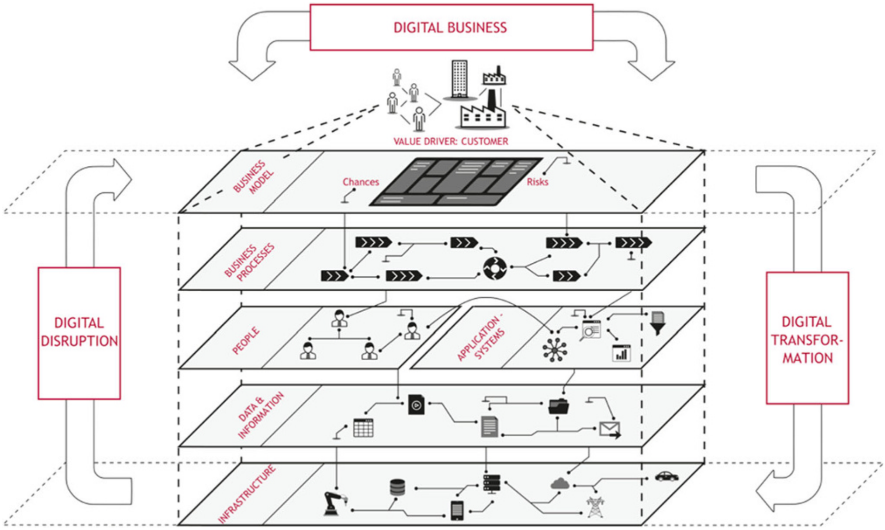

Fig. 1 Structuring the field of digitalization along the enterprise architecture

thinking must not only span across departmental but also organizational boundaries, covering the entire value networks and ecosystems. Thereby, business processes define the tasks to be performed to achieve specific goals. Beyond established business process management (BPM) concepts that support efficient and stable execution of routine operations, organizations also require agile and exploratory BPM concepts that support non-standard operations, the management of emerging and proactive organizational behavior, as well as fast reactions to changing customer needs and process innovation (Grisold et al. 2019; Kerpedzhiev et al. 2020).

The tasks included in business processes can be performed manually by employees, automatically by machines or application systems, or collaboratively. Thus, *people* are part of an organization's structure that systemizes roles, responsibilities, and reporting lines. In line with the shift toward agile BPM concepts, organizations must also foster people agility by moving from hierarchical to network-like structures as well as by fostering employees' digital mindset and related skills. Further, organizations must account for new roles involved in business processes such as crowd workers, freelancers, robots, and autonomous things. Particularly, the collaborative execution of tasks is strongly advanced by technologies related to human-machine interaction, artificial intelligence, smart devices, and robotics. Many of these technologies also push the frontier of automation, because not only well-structured but also unstructured tasks can be automated. Consequently, organizations need not only adopt traditional enterprise systems (e.g., enterprise resource planning or customer relationship management systems) but also novel system types such as mobile apps or digital assistants.

Employees, application systems, and machines create and process *data and information*. In line with the increasing adoption of digital technologies, the volume of data available is growing rapidly, revealing new knowledge potential. Structured data (e.g., tables or relational databases) can still be analyzed by means of statistical analytical methods. In addition, modern algorithms, leveraging advances in artificial intelligence (e.g., cognitive computing or deep learning), allow for an increasingly precise processing of unstructured data (e.g., texts, graphics, videos, and audio files). Big data analyses enable analyzing and combining large amounts of data from different sources and thereby enable organizations to make better decisions, predict trends in their business environments, reveal optimization potential, and, above all, understand the needs of customers and employees.

To exploit the potential associated with digitalization, organizations need an appropriate *technological infrastructure*. Besides traditional components (e.g., personal computers, tablets, servers, network, and security components), the infrastructure includes also novel components such as cyber-physical systems as well as shared resources such as smart meters, smart grids, autonomous cars, or cloud infrastructure. In the digital age, conventional information and communication infrastructure is becoming increasingly integrated with production infrastructure (operations technology) to bridge the gap between the physical and digital world.

Organizations that aim to thrive in the digital age must unfold the potential of digital technologies, rethink their business models, and transform themselves. Accordingly, we see three major fields of action spanning the different layers of the enterprise architecture as described above (Legner et al. 2017):

- Companies face the challenge of making strategic decisions on the timely use of disruptive technologies. Due to the extensive impact on organizations at large, the goal of the action field *digital disruption* is to monitor and analyze emerging and maturing technologies to reduce uncertainty in the selection of technologies (Blume et al. 2020). In this context, systematically analyzing potentials and threats as well as deriving recommendations for action is of great importance. This also includes developing competences for utilizing these technologies.
- In the digital age, many companies are forced to adapt their business models, e.g., from product to customer and service orientation as well as from stand-alone to ecosystem-enabled value propositions. In fact, digitalization is not about making existing models more efficient, but about designing new models. Thus, the action field *digital business* refers to the realization of new business models that are enabled by digital technologies (Wessel et al. 2021). This often results from the fusion of the physical and digital world. Data-driven services, smart products, product-service hybrids, and platforms are examples of new business opportunities in the digital age. Developing viable business models requires organizations to understand the effects of digitalization on the individual, organizational, competitive, and increasingly societal level.
- Due to fundamental changes in business models, a thorough transformation of the entire enterprise architecture is necessary. The technology-induced change is covered by the action field *digital transformation* (Vial 2019). This embraces the necessary goal-oriented organizational, processual, and technological transformation necessary for organizations to succeed in the digital age. Digital

transformation requires organizations to understand how business models can be implemented and how digitalization itself changes how organizations must be managed. Existing business processes and organizational structures, application systems and data, as well as the underlying infrastructure need to be aligned with the requirements of new customer needs and business models in an integrated manner.

3 Introducing Cases of Digitalization

We classified the digitalization cases included in this book in line with whether they relate to digital disruption, digital business, and digital transformation. Below, we briefly overview all cases structured around these three fields of action.

3.1 Digital Disruption

First, in the case of *ELIS Innovation Hub*, Andreozzi et al. tackle two relevant challenges in order to foster digital transformation in the insurance value chain: sensitive data detection and anonymization on claim images as well as manipulation detection on claim images. By applying a six-step methodological approach to managing projects focused on the domain of deep learning applied to image analytics, the case analyzes the benefits resulting from the adoption of such an approach, as well as its impact in terms of training, validation, testing, deployment, and operations.

In the following case with *Satherm GmbH*, Danner et al. overcome the challenge of automating invoice processing with a volume of about 20,000 invoices per year by means of AI-based state-of-the-art technology for intelligent document processing in order to free employees from repetitive tasks and thus to counter the current as well as future shortage of skilled workers.

Yıldırım et al. report on a case with *Arçelik*. The company deploys digital twin technology to one of their thermoforming production lines developed with Simularge to increase production quality and reduce raw material consumption. Besides developing a high-tuned digital twin by combining engineering formulations, simulation modeling, and real-time data acquired from the production line, the case provides insights on and encouragement to implement digital twin technology to other manufacturing processes.

In their case with *Germany's Federal Office for Migration and Refugees*, Amend et al. examine the use of blockchain technology in the context of the asylum-seeking procedure. More specifically, they report on the development of a blockchain-based solution to support the coordination of asylum procedures across authorities on all levels of Germany's federal government structure. This case does not only provide insights into the technological solution but also creates a deeper understanding of the organizational challenges faced in blockchain projects within public administrations and of the steps taken to overcome these.

Aiming to improve care for patients in the comfort of their own home, the case of *Future Health Services* explores the leveraging of technological solutions to expand their tele-home monitoring services. Brohman et al. report on the collaboration of the case company with paramedics to introduce a remote patient monitoring program. The authors provide insights on the development and implementation of new business cases leveraging both fruitful partnerships and technological solutions.

Further, Czarnecki et al. discuss cognitive Robotic Process Automation (RPA) as a key technology to achieve the automation targets of *Deutsche Telekom Service Europe*. Since the first RPA pilot implementation in Q3/2016, a total number of 172 software robots have been successfully implemented across six different functional areas within finance and controlling, procurement, and HR domains. Those implementations resulted in measurable performance improvements, such as lead time reductions, full-time equivalents (FTE) reductions, and cost savings.

3.2 Digital Business

As *Huawei Technologies Co. Ltd* faced internalization-related problems such as country of origin, liability of foreignness, latecomer, and lock-in effects, Guerrero et al. lay out the firm's journey of overcoming these challenges and becoming a world-leading ICT company. By following a digitalization approach on a managerial level and emphasizing the importance of promoting and coordinating management practices based on value creation, collaboration, and decentralization, the case demonstrates that the success of digitalization relies on managerial changes rather than on technological changes.

Schiffer and Stockhinger report on the case of *DEVK*, one of Germany's largest insurance companies with a long-standing tradition. The case company is—like most incumbents—primarily focusing on its non-digital core business. Nevertheless, the company is highly aware of the disruptive potential brought by new digital technologies. To benefit from new business opportunities and gain experience with digital products and business models, the company founded its own digital insurance company in 2017. The case provides in-depth insights into various challenges associated with externalizing digital business and ways to overcome them.

Glismann et al. develop a comprehensive digital service for *RAPS*, a German spice manufacturer, to overcome the main challenges of a non-digital industry. The case demonstrates how a platform-independent application helps alleviate strong market consolidation, comply with increasing regulatory requirements, and address technological complexity in the meat production industry. Thereby, the case shows how leveraging digitalization potential allows RAPS to expand its value proposition, to differentiate itself from competitors, and to increase its market share.

In the case of *MobilityXLab*, Hjalmarsson Jordanius et al. inquire how a traditional incubator, as a joint enterprise by a coalition of incumbent automotive and telecommunication firms, transformed into a collaboration hub for matchmaking and start-up-cooperate collaboration for digital innovation in the automotive industry. Facing several tensions related to digital transformation of traditional innovation processes, the development of MobilityXLab has increased the inflow of externally initiated digital innovations to the collaboration partners supporting future mobility.

Oberländer et al. tackle the challenge of incumbents to develop digital innovations in the following case with *SCHOTT AG*. By combining problem-centric and resource-centric innovation approaches, the case demonstrates the advantages of both perspectives while applied in an overarching innovation process. Thus, the case not only introduces and compares problem-centric and resource-centric innovation approaches but also highlights how an integrated perspective benefits innovation success.

In the case of *Lohmar|Digital|For Everyone*, Schaefer et al. demonstrate the opportunities that a regional city can take to create a more sustainable and attractive city. Through the successful application of "RBS Mobil" by the Federal Ministry of Interior, Construction, and Home Affairs, the case demonstrates how digital transformation projects can be applied to the mobility sector and a regional city can be a lighthouse city for sustainable and inclusive mobility, mapping the entire journey (first and last mile).

3.3 Digital Transformation

As for digital transformation, Kamm et al. describe a digitalization project at *Listemann Technology AG* which aims at improving the company's communication and interaction with customers. As an exemplar of small- and medium-sized enterprises (SMEs) that often face the challenge of dealing with scarce resources, the case provides insights into the actions an SME can undertake to keep up in the digital age. The main takeaway is that every organization can develop a digitalization strategy in alignment with its resources.

Mensah et al. report on the public utility company *Ghana Water Company Limited* undergoing a digital transformation. The company is digitalizing customer payments, where customers can make water bill payments through mobile money and other digital payment platforms. The authors demonstrate how a digital payment change management framework was developed and implemented to increase the usage of digital payments for bill collections.

The following case presented by Schaupensteiner et al. addresses the challenges of digitalization regarding the transformation of the workforce. The approach leads to a fundamental understanding of what transformation means within a traditional organization and what needs, obstacles, and interests exist within the workforce. The case not only shows how raising awareness of the need for transformation can increase its acceptance. It also shows how management's quantitative transformation goals can be given practical relevance and validated in terms of feasibility.

Springest, a Dutch platform business, aims to draw on information technology to enable holacratic organizing (a form of self-management). In this case study, Wurm et al. explain the principles of such organizing and the various IT tools that Springest uses to support them. For Springest, Holacracy has not only led to considerable growth but also to sustained employee happiness far above industry average.

Dang-Pham et al. introduce "Digital Kaizen" as a methodology for conducting complex digital transformation programs at *FPT Software*. Inspired by the well-known Kaizen philosophy for management, Digital Kaizen focuses on making incremental changes that address pain points across organizational functions and aim for fast realization of benefits. The adoption of Digital Kaizen further allows the organization to commercialize its successful internal digital transformation initiatives, as well as nurture the organization's readiness for future digital transformation.

With the *Arcadis* case, Danneels et al. provide insights into how a fragmented incumbent organization made cultivation a key part of its digital transformation program. The case puts learning and belonging center stage and provides inspiration on how to create a learning organization to which everyone can contribute.

In their case with *medi*, a leading manufacturer of medical aids, Buck et al. illustrate the preparative steps for transformation into a digital and data-driven company. The case elucidates how the company analyzed its current process and application landscapes as starting points for its digital initiatives and development of a data strategy. Further, medi collected and prioritized ideas to successfully transform its historically grown infrastructure and data management, which had an influence on both culture and technology in the organization.

Last, Kiselev and Langenegger report on the tensions *Arbonia Doors* faced at the beginning of the implementation of their ERP program across four highly autonomous local subsidiaries and how "glocal" governance was set up to bridge conflicting demands and enable both local differentiation and global consistency. They demonstrate how a boundary-spanning sense of community and collaboration and thus a sound basis for future digital transformation within the group could be established.

4 How to Read the Cases

The case descriptions compiled in this book aim to provide insightful examples for practitioners and interesting cases for researchers, teachers, and students. Each case illustrates how a specific company or public organization leveraged its capabilities to create disruptive innovation, to develop digital business models, and to digitally transform itself.

To make the case descriptions easily accessible and comparable for readers, they follow a unified structure, which has been initially proposed by vom Brocke and Mendling (2017) and successfully adopted by Urbach and Röglinger (2018). Each case elaborates on the situation faced in the focal organization, the actions taken, the results achieved, as well as lessons learned. The situation faced highlights the initial problem situation and specifies the needs, constraints, incidents, opportunities, and objectives that induced action. The actions taken reflect what the organization did to tackle challenges and opportunities. The results achieved reflect on realized and expected outcomes of the actions taken and how they changed the organization. Finally, the lessons learned reflect the overall case and propose empirical learnings that can be transferred to other contexts.

Due to the unified structure, each case can be read independently from all other cases. Readers may read the cases in line with their preferences regarding digital disruption, digital business, or digital transformation. Further, many cases reveal the organization where the case was conducted such that readers can select cases by the most similar organization or industry or just focus on the cases that interest them most.

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Part I
Digital Disruption

Enabling the Digitalization of Claim Management in the Insurance Value Chain Through AI-Based Prototypes: The ELIS Innovation Hub Approach

Alessandra Andreozzi, Lorenzo Ricciardi Celsi, and Antonella Martini

Abstract

(a) **Situation faced**: Digital transformation in the insurance value chain is fostering the adoption of artificial intelligence, namely, of deep learning methods, for enabling the improvement and the automation of two relevant tasks in the claim management process, i.e., (i) sensitive data detection and anonymization and (ii) manipulation detection on images. The proposed approach is technically feasible, lightweight, and sufficiently scalable due to the properties offered by currently available cloud platforms, and it also yields a sensible reduction in operational costs.

(b) **Action taken**: Since well-established guidelines to address insurance digitalization use-cases requiring deep learning do not yet exist, we propose a customized data science workflow for designing and developing two prototypes that tackle: (i) sensitive data detection and anonymization and (ii) manipulation detection on claim images. We propose a six-step method that is implemented using deep convolutional neural networks in Keras and TensorFlow and is seamlessly integrable with the most frequently used cloud environments. During prototyping, different training and testing iterations were carried out, thus progressively fine-tuning detection models, up to the achievement of the desired performance.

(c) **Results achieved**: The developed prototypes are able to (i) robustly anonymize claim images and (ii) robustly detect manipulations on claim images (robustness means that, from a statistical viewpoint, the declared performance level is

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preserved even in the presence of highly heterogeneous distributions of the input data). The technical realization relies on open-source software and on the availability of cloud platforms, this last both for training purposes and for scalability issues. This demonstrates the applicability of our methodology, given a reliable analysis of the available resources, including the preparation of an appropriate training dataset for the models.

(d) **Lessons learned**: The present work demonstrates the feasibility of the proposed deep learning-based six-step methodology for image anonymization and manipulation detection purposes and discusses challenges and learnings during implementation. Specifically, key learnings include the importance of business translation, data quality, data preparation, and model training.

1 Introduction

ELIS Innovation Hub is a business unit of CONSEL[1] offering consulting services in the field of technological innovation. Over the last years, ELIS Innovation Hub's support has been requested by companies joining CONSEL—such as Cattolica Assicurazioni, Assicurazioni Generali Italia, Campari, Lottomatica, and Rai Radiotelevisione Italiana—in specific need for innovative solutions enabled by image analytics, ranging from integrity checking on identity documents, through visual sentiment analysis, to multimedia forensics applications.

In particular, in the insurance domain, ELIS Innovation Hub has been actively supporting the digital transformation paradigm shift, with respect to the specific aim of the abovementioned insurance organizations to become customer-centric lifetime partners to their target customers. More in detail, artificial intelligence (AI) has been identified as one of the key factors for digitalizing the claim management process. It represents one of the most important processes in the insurance value chain, and digitalizing it enables:

- the achievement of higher performance in terms of time required by the tasks it consists of;
- enhanced customer experience through all relation, prevention, and protection channels, enabling the company to enlarge its selling proposition with innovative personalized services;
- increased efficiency, streamlined operations, reduced costs, and optimized allocation of the involved human resources.

Furthermore, competitive advantage can be obtained by leveraging data and image analytics, especially as the automatic analysis of claim data is a fundamental step in claim management (Turner 2019).

[1]Consorzio ELIS per la formazione professionale superiore.

Driving decisions and gaining insights in such a way are strictly linked to the application of deep learning, as this allows knowledge extraction from large amounts of images, especially since the image format constitutes a large part of insurance companies' data assets.

With this emerging scenario in mind, CONSEL's insurance companies commissioned a series of pilot projects to ELIS Innovation Hub, aimed at achieving the following objectives.

- Paving the way toward end-to-end automation of the claim management process. In this respect, insurance companies are rushing to move from the architecture of legacy systems relying on isolated data silos to the more modern paradigm of a comprehensive data hub orchestrating the information flow, based on the capabilities offered by over-the-top cloud-based solutions (in this respect, consider, for instance, Microsoft Azure, with its Azure Data Lake framework).
- With a 10% overall increase in fraudulent claims since 2010 (Celent 2013), leveraging on AI technologies to improve fraud detection to yield higher customer satisfaction and loyalty as well as to foster a more motivated employee base.
- Developing valuable AI-based solutions that successfully address insurance-specific use-cases.

The design and development of AI prototypes are not trivial, and at present there is no standardized process. The best practices for managers and practitioners have not been formalized yet. Such prototypes are based on complex deep learning models, whose implementation requires a detailed preliminary analysis of the business context, together with targeted assessments of required hardware, software, and human resources (De Mauro et al. 2018).

ELIS Innovation Hub's team succeeded in assessing a reliable workflow for the design, development, and deployment of lightweight AI-based prototypes, aimed at enabling the automation of two specific tasks of the claim management process:

1. the claim settlement task;
2. the fraud detection task.

The purpose of the presented work is to describe the proposed workflow, highlighting similarities and challenges that arise when managing use-cases 1 and 2.

2 Situation Faced

In the insurance industry value chain (Fig. 1), one of the most relevant processes is the claim management one. Managing this process is complex, since it is the most important touchpoint with the end-user. The process consists of the following steps.

- Open a file relative to the single claim.
- Check insurance coverage.

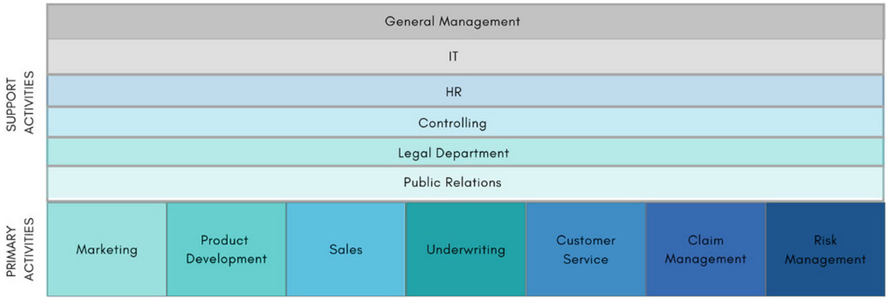

Fig. 1 Insurance value chain adapted from Porter (1985)

- Check that the accident the claim refers to is not fraudulent (i.e., fraud detection task).
- Determine damage entity and reimbursement amount.
- Settle the claim (i.e., claim settlement task).

Since the advent of digitalization, insurance companies have tried to restructure their value proposition to customers, allowing the end-user to have multiple channels of digital interaction with the service line. Thanks to the massive usage of web applications, a customer can now access semi-automated claim management systems, thanks to the real-time upload of personal and claim data. This has encouraged the pursuit of the end-to-end digitalized customer journey paradigm (Brüggemann et al. 2018), so that the customer takes an active part in the claim management process.

For the two relevant use-cases presented in this work emerging from real business needs expressed by CONSEL's insurance companies, we describe the key digital assets for achieving automated claim management, according to the framework reported by Brüggemann et al. (2018) (Fig. 2).

2.1 Use-Case 1: Sensitive Data Detection and Anonymization on Claim Images

Anonymization permits to work on de-identified data: anonymized data have to be bare of any identifiable information so that it is impossible to derive any insights into the identity of the individual owning such data. Removing sensitive data (e.g., faces, person shapes, license plates, and vehicle identification numbers) from claim images is needed for ensuring compliance of claim management with the EU General Data Protection Regulation (GDPR) (2020).

Also, the average settling time for a single claim is crucial for guaranteeing the expected *customer journey*. Hence, the automatic anonymization of image data in

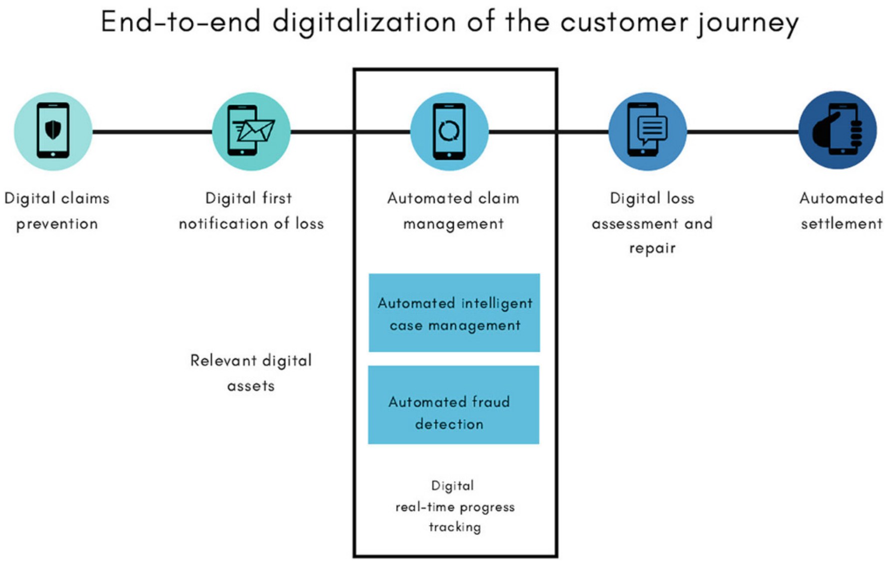

Fig. 2 Digitalizing claim customer journey adapted from Brüggemann et al. (2018)

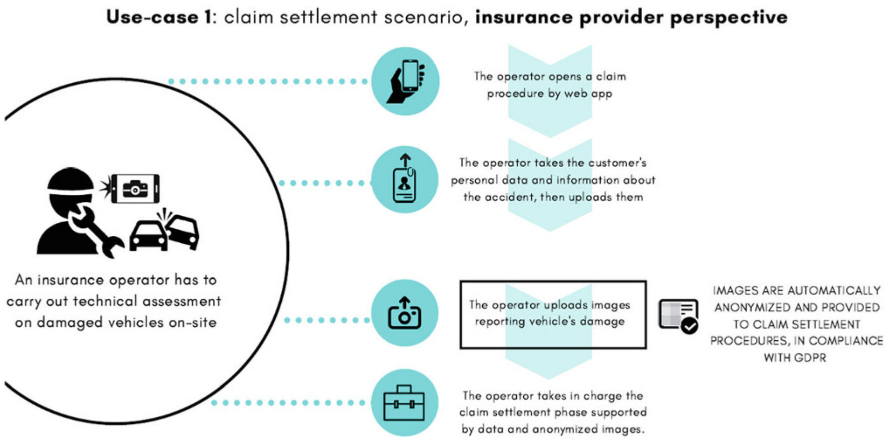

Fig. 3 Use-case 1 in claim settlement task

compliance with the GDPR contributes to let the abovementioned average settling time shrink from days to hours.

Anonymization can indeed be used to reach fully automated claim management: this is why we targeted such a business need by designing and developing a procedure for addressing the automated anonymization of claim images and subsequently delivering an AI-based prototype embedding this function (Fig. 3).

2.2 Use-Case 2: Manipulation Detection on Claim Images

In claim management relative to car accidents, it is typical to use photographic material as proof of damage. Nevertheless, the spread of advanced photo-editing tools has made it easier for customers to counterfeit images reporting car damages.

Due to the increasing amount of claims every day, traditional systems are likely fooled by repeated tampered claims, thus leading to a potentially relevant economic loss. This is why insurance companies are in need for an automated fraud detection system that should intervene before settling the claims. By relying on such a system, any critical image would undergo a manipulation-checking stage, in charge of detecting any tampering evidence that very often escapes the attention of a keen human eye. This significantly speeds up claim investigation, since, by contrast, manual manipulation checking on a large scale does not allow to meet the speed requirements imposed by the digital customer journey in the claim management process (Fig. 4).

The availability of AI-based tools targeting the two use-cases described above with respect to claim images, in the medium term, yields potential benefits according to three drivers listed below, which are key to preserving competitiveness in the insurance sector (Brüggemann et al. 2018).

– *Efficiency*. A potential increase in efficiency can be achieved by reducing the operating costs relative to a single claim by 25–30%. IBM analyses show that by exploiting digitalization, namely, by automating up to 80% of the claim management process, an increase in efficiency up to 90% can be obtained, together with a cost reduction between 30% and 40%. In addition, the usage of digital tools that automatically anonymize data enables to share data in full compliance with GDPR requirements, thus supporting timely decisions.

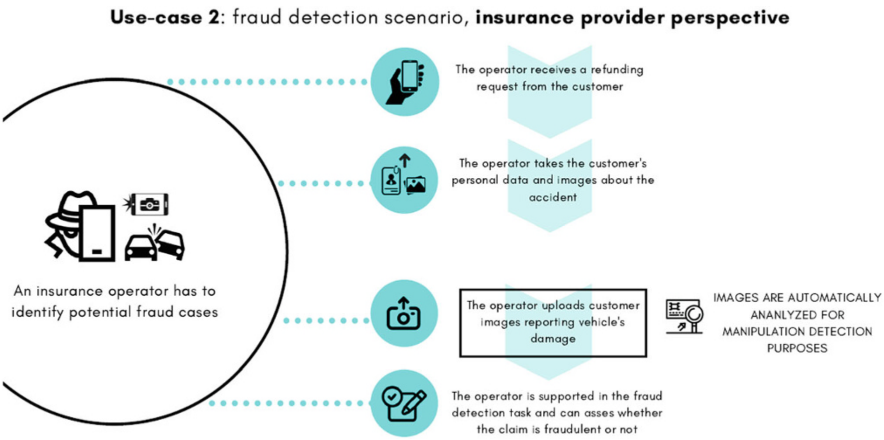

Fig. 4 Use-case 2 in fraud detection task

– *Effectiveness*. Effectiveness can be referred to the sensible improvement in claim management accuracy, which is proven to be quite higher if supported by AI, especially when managing unstructured data such as images. Consequently, error rates—that is, the number of wrong compensations for fraudulent claims—as well as management and evaluation error costs decrease.
– *Enhanced customer experience*. From the customer perspective, the higher speed and accuracy offered by automated systems enhance customer satisfaction. Customers desire reactivity, high quality of experience, and increased connection, which are all enabled by digital interfaces running on top of automated systems.

The recent technological developments in AI (in particular, deep learning and convolutional neural networks) foster the development of automated tools for analyzing pictures taken on vehicles subject to accidents (Eling and Lehmann 2017; Accenture 2018). Additionally, cloud platforms capable of extracting, transforming, loading, storing, and processing unstructured data have become remarkably powerful, allowing the creation of training databases containing thousands of real pictures of damaged vehicles. These data are constantly updated by customers and/or technical operators while assessing the entity of a car accident in the claim management process.

The potential of AI-based tools is fully exploited if their eventual deployment is scaled up to the dimensions of the company-specific production environment and if they can be effectively integrated as decision support systems for the managers and professionals who are in charge of decision-making.

In this respect, ELIS Innovation Hub is helping CONSEL's insurance companies to enhance the claim management process with AI. This objective has been pursued, for each of the considered use-cases, through the progressive release of incremental proofs of concept, (i) iteratively augmented with better-performing computer vision functions based on deep learning algorithms and (ii) planned, designed, and implemented according to the emerging Agile project management methodology (Beck et al. 2001).

For the sake of completeness, Table 1 reports a classification for potential AI-enabled use-cases (in addition to the two use-cases detailed in this work) for the claim management process.

3 Action Taken

ELIS Innovation Hub actively supported the digitalization process of leading insurance companies in the Italian market that commissioned two innovative projects for the development of automated AI-based systems, providing the hardware, software, and data needed for implementation. The overall aim of these initiatives was automating the claim settlement task, as regards use-case 1, and the fraud detection task, for the use-case 2.

Designing and developing an AI-based prototype is a highly complex process and subject to uncertainty (Stadelmann et al. 2018; Daugherty and Wilson 2018). As a

Table 1 Potential AI-enabled use-cases for the claim management process in the insurance value chain

Tasks	Use-cases	Use-case description
Fraud detection	Image and video analysis Pattern/anomaly detection	**Image and video analysis**: Implies the definition of image severity or the extraction of relevant information based on photos taken by customers during claim reports The aim is also to improve speed and convenience **Pattern/anomaly detection**: Implies validating claims by checking external data sources, e.g., weather reports for validation to save costs of wrong validation **Text analytics and natural language processing (NLP)**: Implies the generation of structured datasets based on claim reports, in order to process claims faster **Recommendation engines**: Recommend templates for incoming claims based on similar historical claim reports, in order to process claims more effectively **Conversational service solutions**: Implies the provision of chatbot interfaces for claim reporting based on natural language and historical claim data to improve efficiency **Speech recognition:** Implies automatic text production of speech claims including emotions and behavior-based phone calls, in order to improve efficiency **Natural language generation**: Implies the generation of automatic claim reports based on structured data to optimize workload for employees
Claim settlement	Image and video analysis Text analytics and natural language processing (NLP) Recommendation engines Conversational service solutions Speech recognition Natural language generation	

matter of fact, nowadays there are still no best practices or relevant methodologies regarded as a validated standard to conduct such projects. More in detail, up to the authors' knowledge, there are no formalized methodologies for project management in the domain of deep learning applied to image analytics (Shamshurin and Saltz 2018).

ELIS Innovation Hub's team has therefore set up a workflow, starting from the classical data science workflow (De Mauro et al. 2018) and adapting it to the image analytics domain. The resulting framework is aimed at providing a structured approach for the design and development of AI-based prototypes (in particular, deep learning-based ones) that is also suitable for the digitalization and automation tasks such as the two described use-cases relative to the claim management process in insurance contexts.

The proposed workflow follows a combination of six logical steps: *Problem Setting* (Step 1), *Functional Model Analysis, Evaluation, and Selection* (Step 2), *Data Preparation* (Step 3), *Model Implementation* (Step 4), *Model Training Validation and Testing* (Step 5), and *Model Deployment* (Step 6). We chose a prototype-oriented process model, according to Agile project management. Our model may require iterations (especially relative to Step 5), and it may also imply cycling back to previous steps (viz., to Step 2, Step 3, and Step 5).

3.1 Problem Setting

The first step is to formally define the problem to be solved, not just from the business point of view but also from the technical point of view.

Choosing the most appropriate techniques for solving the problem is fundamental in any deep learning application, as it impacts the subsequent phases from model set-up, through model training, to eventual model testing.

In this respect, for both the addressed use-cases, the problem to be solved was the object detection one. To properly address object detection, it is necessary to decompose the task into two relevant sub-problems to be solved, namely, classification and localization of the desired objects appearing in the image. Both tasks can be learned by employing supervised learning and deep convolutional neural networks (Fig. 5).

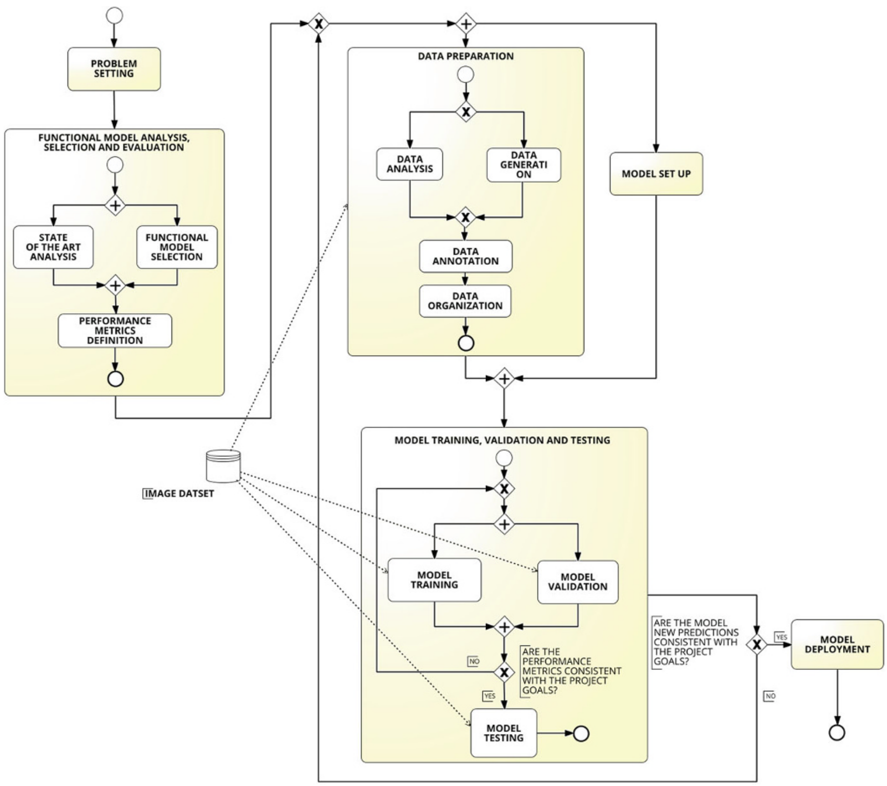

Fig. 5 The proposed six-step methodology

With respect to use-case 1, an object detection model suitably trained on claim images and embedded in a web application accomplishes the need for detecting and removing sensitive data, thus ensuring compliance with the GDPR.

Sensitive data classes within claim images were identified as the following: *license plates*, *vehicle identification numbers* (VINs), and *person shapes* (including faces). These groups represent categories to be predicted in the classification task, whereas the simultaneous search for their coordinates inside each image solves the localization task (subsequently drawing a bounding box around the detected sensitive data).

Instead, a manipulation detection model, suitably trained on claim images and embedded in the same web application as above, accomplishes the need for detecting any forgery attempts on the accident images uploaded by customers. This manipulation detection problem can be considered as a very particular object detection one since localization and classification of tampered areas are quite more challenging than mere object detection. Indeed, for each analyzed claim image, the detector must be able to tell whether the image is manipulated or authentic. If a tampered area is detected, a bounding box is drawn around it to provide the insurer with visual evidence of the detected forgery.

To achieve full comprehension of digital image manipulation in the insurance domain, focused discussions with insurance experts led to the identification of three main relevant manipulation classes, namely, *splicing*,[2] *copy-move*[3], and *removal*.[4]

3.2 Functional Model Analysis, Selection, and Evaluation

The second stage in our methodology is aimed at determining the most used algorithmic models for solving the considered problem and then at selecting the best-performing model based on the business requirements. This stage comprises the review of the scientific literature and state-of-the-art study, in order to select the most appropriate functional architecture, as well as to define the most relevant metrics for performance evaluation.

According to Liu et al. (2019), the best-performing functional architecture relies on deep convolutional neural networks. In this perspective, for each use-case, we first performed a state-of-the-art analysis of deep convolutional neural network architectures.

[2]Splicing means that the vehicle's license plate is replaced by that of another vehicle.

[3]The copy-move technique means that existing damages on the vehicle (such as scratches) are duplicated or even created ex novo on an undamaged vehicle image.

[4]The removal technique involves the removal of existing damages on the vehicle in such a way as to maliciously obtain benefits in the resolution of the insurance policy.

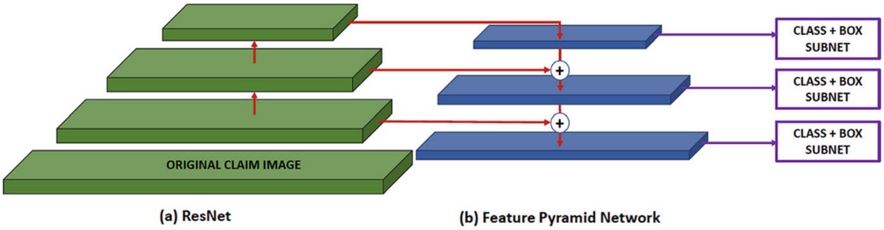

Fig. 6 RetinaNet architecture adapted to use-case 1 from Lin et al. (2018a, b)

After carrying out assessments based on practical implementations of inference models, we decided to adopt the RetinaNet architecture (Fig. 6) proposed by Lin et al. (2018a, b) to address use-case 1, since it offers the best trade-off between performance accuracy and ease of implementation, especially in terms of the integrability of the Python TensorFlow implementation with high-performing cloud platforms and due to the subsequent scalability advantage. Furthermore, RetinaNet is capable to successfully handle the class imbalance relative to our available dataset through the so-called focal loss function.[5]

Instead, as regards the *manipulation detection* use-case, the Two-Stream Faster Recurrent-Convolutional Neural Network (TSFR-CNN) architecture by Zhou et al. (2018a, b) was identified as the most promising one. The results presented by already existing studies applying this architecture to available open datasets[6] outperform other relevant methods proposed by Bayar and Stamm (2018) and Bappy et al. (2017) in terms of robustness both to image resizing and compression. This eventually enabled our adoption of the TSFR-CNN architecture for solving use-case 2 (Fig. 7), thus allowing us to classify the tampered area among predetermined manipulation classes.

The last step in this phase was the *Definition of Performance Metrics*. The goal of this step was to comprehend the most suitable metrics able to link the model's learning performance with business objectives.

As "in-process" performance indicators, training and validation losses were selected for both use-cases. As "post-process" indicators instead, Recall and Precision were chosen.

Use-case 1 privileged Recall as the most relevant *key performance indicator* (KPI) to be maximized, since having as few false negatives (FN) as possible implies that human operators can be relieved from the considered task, thus enabling for such a task the full replacement of capital for labor that is intrinsic to automation and

[5]Class imbalance issue occurs if one class presents overwhelmingly more instances than another. In use-case 1, we dealt with class imbalance, since license plates and VINs were distributed with a much lower frequency than human shapes. The focal loss function, intrinsic to RetinaNet, allowed us to focus the learning phase on a sparse set of examples of minority classes (hard examples) and then keeping the classes ratio as close as possible to that of a real production dataset in this context.

[6]For example, COLUMBIA (Hsu and Chang 2006), CASIA (Dong et al. 2013), COVERAGE (Wen et al. 2016), and NIST (Guan et al. 2019) datasets.

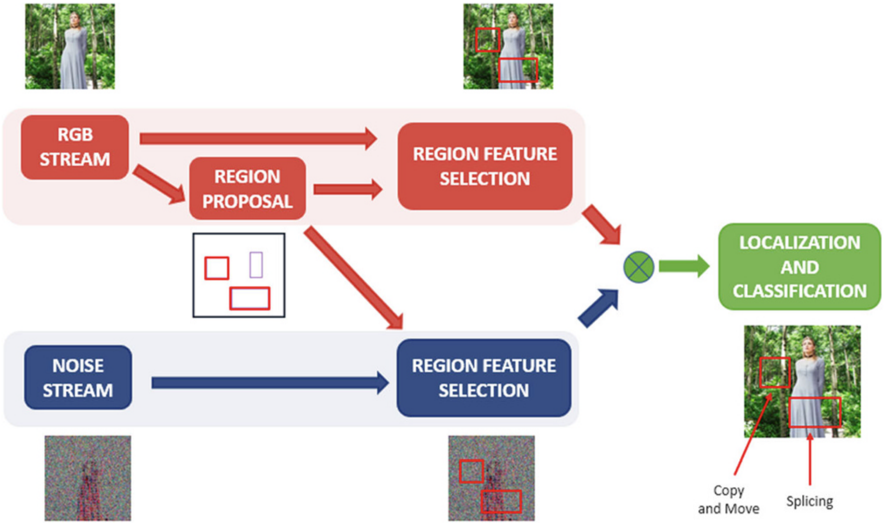

Fig. 7 The TSFR-CNN architecture adapted to use-case 2 from Zhou et al. (2018a, b)

yielding significant savings in terms of human resources' effort. For use-case 2 instead, Precision was regarded as the most relevant KPI to be maximized, in that the minimization of false positives (FP) implies as few false alarms as possible.

3.3 Data Preparation

The third stage in our methodology is composed of the following sub-activities: *Data Collection/Generation* and *Analysis*, *Data Organization*, and *Data Annotation*. The first activity to carry out is *Data Analysis*.

We refer to *Data Collection* when the data (i.e., claim images) used as training and validation sets for the deep learning models are already available and do not need to be generated from scratch: in this way, the best inference results are obtained when such data are provided directly by the domain experts of the insurance organization. Considering use-case 1 for this purpose, 14,000 claim images from business units in charge of claim management in several European countries were accessed.

Data Analysis follows: this step is needed to fully understand the dataset structure so that it is possible to extract knowledge from it accordingly. Specifically, a proper evaluation of the distribution of the classes to be detected all over the collected dataset has to be carried out.

On the contrary, in use-case 2, the insurance company did not have a pre-existing dataset of counterfeit images large enough to train a manipulation detector, which is why the team had to pursue *Data Generation* in place of *Data Collection*, that is, they generated a synthetic dataset composed of artificially tampered images. The artificial manipulation process was performed, without loss of generality, by using the free software GNU Image Manipulation Program (GIMP) on the authentic images provided by the insurance company.

Once the datasets are collected and/or generated, the *Data Annotation* activity is aimed at suitably labeling images for the subsequent training and validation phases. *Data Annotation* is therefore focused on the creation of ground truth annotations[7] for each of the images belonging to the collected/generated dataset, so as to arrange the set of claim images into the so-called Analytical Base Table (ABT) that can then be processed by the detector model while training, in a supervised learning fashion.

In both the considered use-cases, annotations[8] were manually provided thanks to the open-source LabelImg software, supporting the most commonly used PASCAL VOC (Everingham et al. 2010) and COCO (Lin et al. 2014) styles for annotating an image set with the related ground truth.

Eventually, *Data Organization* was aimed at partitioning the dataset into separated training, validation, and test sets to be fed to the selected deep learning architectures. For use-case 1, out of the approximately 6500 collected claim images containing sensitive data, we chose an eventual split into 70% for training, 25% for validation, and 5% for testing. Instead, for use-case 2, we chose an eventual split of the 1250 generated tampered images (the synthetic dataset) among 80% for training, 16% for validation, and 4% for testing.

It is important to note that, according to the abovementioned Agile approach, both *Data Annotation* and *Organization* were carried out incrementally, that is, by expanding the dimension of training sets until all collected/generated images were used, on the one hand, and the detector performance eventually *stabilized* at metric values that satisfy the requirements expressed by the insurance company, on the other hand (see Tables 2 and 3).

3.4 Model Set-Up

For the RetinaNet and TSFR-CNN detector models, trained, respectively, for use-case 1 and use-case 2, we replicated the same architectural framework like the ones implemented by Lin et al. (2018a, b) and Zhou et al. (2018a, b), respectively.

More in detail, on a Microsoft Azure NC6 virtual machine instance equipped with 6-vCPU Intel Xeon E5-2690 V3 (Haswell), 56-GB RAM, and a Tesla K80 GPU, Fizyr's Keras RetinaNet architecture implementation was relied upon as the

[7]Ground truth annotations consist of annotating whether the image contains a specific class of sensitive data in use-case 1 or a specific manipulation class for use-case 2 and of annotating the coordinates of the image area occupied by the detected object.

[8]Basically, the annotation procedure consists of manually drawing rectangular bounding boxes around the very objects the designer wants the deep convolutional neural network to be able to automatically detect as a result of the supervised learning process (as briefly described in Sect. 3.5).

Table 2 As reported in Sect. 3.5, for each training iteration in use-case 1, the training set was incrementally enlarged to improve the model learning process and achieving incremental Average Recall, Average IoU, mAP, and Macro F1-Score improvements

Use-case 1					
Training iteration	Training set (excluding negative examples)	Average Recall	Average IoU	mAP	Macro F1-Score
1	1473	84%	74%	58%	69%
2	4103	91%	76%	74%	83%
3	4550	94%	78%	83%	89%

Table 3 As reported in Sect. 3.5, for each training iteration in use-case 2, the training set was incrementally enlarged to improve the model learning process and achieving incremental Precision, Recall, and F1-Score improvements

Use-case 2				
Training iteration	Training set (excluding negative examples)	Precision	Recall	F1-Score
1	200 tampered	68%	17.5%	27%
2	400 tampered	73%	32%	45%
3	720 tampered	82%	53%	64%
4	1000 tampered	87%	57%	69%

development framework which we could successfully train the sensitive data detector onto. Fine-tuning of the hyperparameters at each training iteration up to the performance results reported in Sect. 4 was carried out using standard training, validation, and testing functions offered by Keras and TensorFlow Python libraries.

3.5 *Model Training, Validation, and Testing*

The learning approach adopted for the resolution of the required detection tasks was the transfer learning[9] one.

For both *sensitive data* and *manipulation detection* use-cases, transfer learning from a pre-trained ResNet-50 backbone[10] was performed. As regards use-case 1, pre-trained ResNet-50 weights were imported from the API reference of Keras library, as in (https://keras.io). As regards use-case 2 instead, since sheer transfer learning from models trained on COCO and ImageNet datasets was deemed not

[9]This approach consists of using pre-trained object detection architectures on "generalized" datasets. Instead of initializing the model weights randomly, "learned" weights were re-used, for subsequently re-training the model on the obtained task-oriented training dataset, annotated and organized by guidelines provided in Sect. 3.3.

[10]That is, the part of the deep neural network architecture aimed at extracting specific features from claim images, for each class to be learned and detected.

viable for the considered manipulation detection purpose, we had to devise suitable backbone pre-training on a dedicated synthetic dataset of tampered images.

According to the abovementioned Agile approach, training, validation, and test stages were repeated for a few iterations until the measured values for the most relevant performance metrics (see Sect. 3.2) satisfied the requirements of the insurance company. More in detail, three iterations were needed for the RetinaNet-based model (use-case 1), while four iterations were needed for the TFSR-CNN model (use-case 2). Training datasets were iteratively expanded at each iteration since, in both use-cases, the trained networks proved to yield better results as the training set dimension increased.

Finally, such performance was evaluated:

- with respect to *sensitive data detection*, on multiple 300-image test sets, completely disjoint from one another (and, of course, from the training and validation sets) and characterized by different distributions of the classes of sensitive data to be detected;
- with respect to *manipulation detection*, on a 300-image unbalanced test set, where the distribution between tampered and authentic images was set according to a realistic 1:5 ratio.

Also, for the RetinaNet-based use-case 1, the blurring function for the actual anonymization of the detected sensitive data was performed relying on the OpenCV Python library.

3.6 Model Deployment

The *Model Deployment* phase involved the creation of a PoC (i.e., a proof of concept) for a visual web application that makes both detection functionalities available to the end-users. The same methodological and operational approach was used, integrating both developed neural network architectures.

Eventually, the two trained detectors were released as separate functions embedded in the visual web application. It relies on a user interface, accessible via any web browser, where claim images can be uploaded and the produced result (i.e., the output of the object detection processes) can be visualized. The visual app is a software that provides all the tools needed to feed the neural network with claim images and then extract its outputs. A Dockerfile is responsible for setting up the flask image accounting for the back-end layer and the user interface accounting for the front-end layer (Figs. 8 and 9).

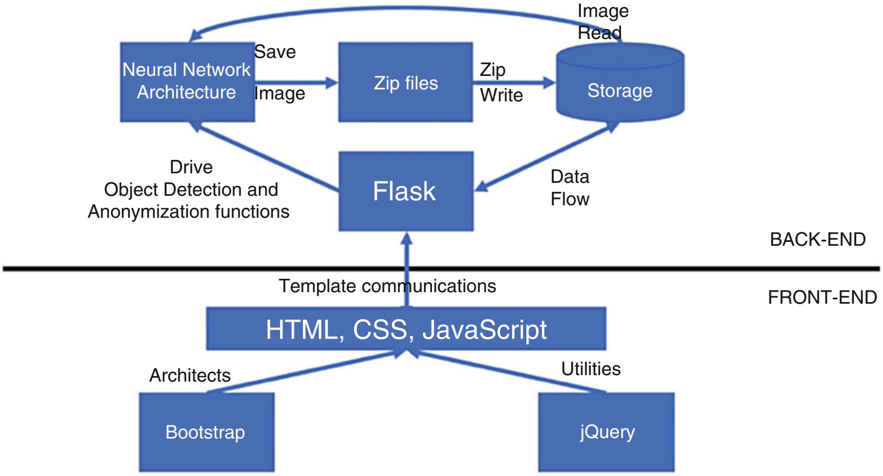

Fig. 8 Visual app front-end and back-end architectures

Fig. 9 Front-end graphical interface

4 Results Achieved

The major goal of this work was to help digitalization in the insurance value chain by building two prototypes that show the feasibility of adopting AI, namely, deep learning, for serving the purpose of the two use-cases introduced in Sect. 2. The running prototypes are currently being used for such insurance-specific purposes, and they are inspiring further stakeholders about potential application areas: in particular, the proposed approach is regarded as a viable one for enabling digital transformation to speed up and automate the claim management process.

Significant effort was devoted to suitably translating the business requirements to define our workflow (Fig. 2) and thus allow value creation from the methodological framework of training, validating, and testing our deep learning models. Only such a tight weave between AI, on the one hand, and business translation, on the other hand, allowed to reach satisfactory object detection performance in terms of anonymizing claim-related pictures and detecting manipulations on those images.

Tables 2 and 3 show the increases in performance metrics for the two use-cases analyzed. Such improvements were obtained thanks to the concomitant enlargement of the training set for each iteration of the *Model Training, Validation, and Testing* phase.

Table 2 reports the performance metrics for use-case 1 evaluated in terms of Average Recall, Average Intersection-over-Union (IoU), mean Average Precision (mAP), and macro-averaged F1-Score (or Macro F1-Score).

Namely, Recall (also known as sensitivity or true positive rate), with respect to the ground truth bounding boxes, indicates which proportion of the actual positives is correctly identified by the evaluated algorithm, and it is defined as the ratio between the number of correct predictions and the number of all annotations. Average Recall in Table 1 is evaluated as the arithmetic mean among the Recall results returned by the detector with respect to each of the selected classes of sensitive data appearing in the input images.

Instead, given the area of overlap between annotation and model prediction, on the one hand, and the area of the union between annotation and prediction, on the other hand, for all positives, Average IoU is computed as the average value, over all positives, of the ratios between the areas of overlap and the areas of the union.

In order to have trustworthy benchmarking for the different detection architectural models, mAP is regarded in the literature as the most reliable absolute metric allowing to compare how different models perform for the provided set of images. It can be computed as the arithmetic mean of the Average Precision (AP) values over the different classes of objects to be detected, where AP is defined as the area under the Precision vs. Recall curve, showing the Recall values on the horizontal axis and the Precision values on the vertical axis, and, more formally, it is computed as the average of maximum Precision values at several recall values, for instance, through the 11-point interpolation method (Davis and Goadrich 2006).

Last but not least, for a comprehensive evaluation, we provide macro F1-Score, defined as the arithmetic mean of the per-class F1-Scores. In particular, F1-Score is useful to assess the model quality as it conveys in a single score the information coming from both Precision and Recall for each considered classification task: it is computed as the harmonic mean between Precision and Recall.

All in all, in use-case 1 Average Recall is the KPI that drives the design of detector when it comes to translating the relevant business need into the corresponding image analytics effort. In other words, the higher the Recall, the most successful the related AI prototype is at addressing the problem discussed in use-case 1.

By contrast, in use-case 2, *Precision* was established to be the relevant KPI driving the design of the detector. Yet, as use-case 2 is dealt with as a problem of two-class classification (tampered vs. authentic), for the sake of completeness, we report in Table 3 also the corresponding results in terms of Recall and F1-Score.

The developed prototype was able to score 94% Average Recall for use-case 1. Instead, as regards use-case 2, the detection of tampered car images was successfully performed with 87% Precision, thus yielding a +37% improvement on a human expert whose performance had been assessed to be about 50% (Verdoliva 2020). Anyway, we noticed that the models' performance heavily depends on the characteristics of the training set, namely, on the features appearing in the image background. This required us to generate, based on the relevant related literature (Amerini et al. 2013), a suitable synthetic training set such that the distribution of the characteristics of its images is driven by the composition of a widely heterogeneous test set—including indoor and outdoor images, urban and country settings, multiple vehicles, parking lots, road surface markings, and taking into account any irregular patterns due to the tarmac, leaves, etc.—provided by the insurance companies. In such a way, we were able to maintain detection robustness, that is, to make sure that, from a statistical viewpoint, the declared performance level be preserved even in the presence of highly heterogeneous distributions of the features appearing in the input data, up to the limitations discussed in the lessons learned—in this respect, further remarks are made in Sect. 5. More in detail, it was necessary to make sure that the training/validation set, on the one hand, and the test set, on the other hand, shared similar cameras and similar resolution (ranging from full HD to 4K), the same types of manipulation (i.e., *copy-move*, *tampering*, and *removal*), as well as the same processing pipeline when maliciously applying the manipulation on the pristine image.

The technical realization relies on open-source software (as mentioned in *Model Implementation* Section) and on the availability of widely used cloud platforms, this last both for training purposes and for the scalability issues that arise when it comes to effectively integrating the detector into the claim management process.

Indeed, the tight integration of deep learning architectures developed in Python libraries such as Keras and TensorFlow with high-performing cloud platforms such as Microsoft Azure, Google Cloud, or Amazon Web Services offers efficient lightweight computer vision tools for optimizing claim management scenarios in the insurance value chain. The eventually GPU-trained detection model weighs no more than 150 MB for each use-case and can be easily run on a virtual machine instance of any of the abovementioned cloud platforms. This demonstrates the applicability of the proposed approach concerning the existing technology, as well as the feasibility of the implementation.

5 Lessons Learned

Key lessons learned from both use-cases concern impediments to the effective development of the workflow activities reported in Fig. 5, as well as the real-word applicability limitations of the proposed AI-based prototypes.

From this perspective, we have identified two main drivers for the explainability of our lessons learned: translating business into analytics and data structure.

Translating Business into Analytics

This lesson learned incorporates relevant insights and challenges that were encountered throughout the *Problem Setting* and *Functional Model Analysis and Evaluation* phases. In particular, when identifying the business need in the *Problem Setting* phase, such business need has to be clearly and unambiguously defined. The business process into which the solution is going to be incorporated should be decided in advance, according to a sustainable strategy.

When the business need enters the analytical world to create value from it, dedicated effort has to be made to translate the needs expressed in terms of domain-specific metrics and business language into technical/mathematical requirements for the deep learning model.

Besides, the majority of data science/AI problems emerging from relevant business needs have already been addressed by the scientific community over the last 2 years. In such cases, at least one accessible and replicable deep neural network implementation is needed. In our case study, instead, manipulation detection is an AI problem that is gradually shifting from academia to industry; thus it is not a fully solved task at a practical level. The biggest limitation relative to solving this problem is undoubtedly the lack of adequate general datasets to be used for training and validating the models: there are not currently enough manipulated images depicting damaged vehicles that can be properly labeled and used for training an effective and robust detector. This is a strong constraint to the related prototype development, because it forces engineers and practitioners to manually generate synthetic datasets for training purposes (as proposed in Sect. 3).

Consequently, as of today, the lack of data has led to only very few neural network architectures capable of truly performing online tampering detection in real-world scenarios (Verdoliva 2020). Code implementation for this kind of architectures is mostly unavailable or inaccessible in open-source format. In most cases, customized, ad hoc deep neural networks are to be implemented from scratch, requiring high effort in terms of time and resources. Accordingly, the *Functional Model Analysis, Selection, and Evaluation* phase is strongly influenced by the most recent advances in neural network architectures, even if specifically targeted toward the use-cases emerging in the insurance value chain.

Data Structure

The key lesson learned comes from the *Data Preparation* phase. A critical factor in obtaining a trained model that meets the required performance regards the composition of the training dataset, both in terms of quantity and quality of images. In typical object detection problems, the training set should have a composition that allows the model to sufficiently generalize image content, but, at the same time, it should be able to learn specific features for the objects to be recognized. This challenge is not trivial, especially in the *manipulation detection* use-case, where the training dataset was not available in an original form, and the composition of the real test dataset was unknown. Moreover, a manipulation detection problem implies a strong imbalance between the number of manipulated images (i.e., the category of objects to be recognized) and the number of authentic images. Class imbalance is difficult to reproduce in a training dataset so that at the same time we have a high number of instances on authentic images and a good learning process on manipulated items.

The balance between generalization and effective learning is obtained by calibrating the training set and monitoring training results in a way that there is a proper trade-off between Precision and Recall values. Precision involves detection accuracy (i.e., minimizing false alarms), while a good Recall reflects the model's ability not to miss target detection (e.g., missing sensitive data or manipulations in claim images).

In this view, for both use-cases, it was necessary to iteratively refine the training set-up in order to obtain a robust statistical sample representative of reality, by properly modulating the feature distribution. The statistical distribution of objects of interest in training images has to be as consistent as possible with real datasets which the eventual detector will make predictions on.

Practical knowledge was acquired during the *Dataset Annotation* activity, too. The manual annotation of training and validation sets was the most time-consuming activity for both use-cases. However, this activity generated two pre-annotated datasets of a size that allowed good learning properties for the implemented neural network models. This can be considered one of the most value-added deliverables, given the scarcity of labeled datasets regarding claims and tampered claim images.

In general, this lesson learned highlights two limitations impacting on the model design. Such limitations concern:

(i) The availability of a large amount (in the order of thousands) of pre-annotated images, which can offer sufficient learning material for the deep neural network, in order to target the desired Precision and/or Recall requirements
(ii) The features' distribution in the training sets, which have to be properly arranged in order to be statistically representative of realistic foreground and background scenarios relative to pictures of damaged cars as a result of an accident event. For both the AI-based prototypes presented in this work, the frequency distribution of the features as well as the proportion between positive and negative examples in the training datasets was agreed with the insurance domain experts.

Regarding use-case 1, the proposed AI prototype is easily scalable and is currently in use in the organizations' production environments. Limitation (i) is easily dealt with due to the wide availability of images containing the mentioned sensitive data. As regards limitation (ii), in use-case 1, the frequency distribution of the relevant features appearing in a generic sample of images that capture sensitive data is easily recognizable and sufficiently stable. That is, a variation in the scenario depicted in the input image does not produce a relevant impact on the distribution of the features that are relevant for sensitive data detection. So, the performance reported in Table 2 is general and can thus be applied, without loss of generality, to all input images containing sensitive data: in other words, no dedicated re-training is required to yield the same results if the scenario appearing in the input image changes.

Relative to use-case 2, instead, limitation (i) implies that the procedure of dataset generation for training purposes will remain a necessary preparatory manual process: indeed, due to the scarcity of available tampered images, in order to meet the training set dimension that offers the Precision results shown in Table 3, it is necessary to integrate the set of already available tampered images with an additional set of manipulated images, created on purpose under the advice of insurance domain experts and enriched with the annotation of the ground truth. Also, limitation (ii) is critical when it comes to assessing the *generalizability* of the Precision performance shown in Table 3. In fact, the only way to address the issue of further increasing the robustness of the manipulation detector is to *re-train* the previously trained deep learning model as many times as the number of different image scenarios the insurance organization intends to analyze.

More in detail, given a *population* of images with a *certain* distribution of features—in terms of indoor and outdoor images, urban and country settings, multiple vehicles, parking lots, road surface markings, and taking into account any irregular patterns due to the tarmac, leaves, etc.—,the proposed AI-based prototype, by being trained on a *sample* extracted from such a population (hence, with the same distribution of features), successfully detects manipulations with the Precision performance specified in Table 3 on any image of the abovementioned population. However, it will not necessarily yield the same Precision performance with respect to an image belonging to *another* population characterized by a significantly different distribution of features. In order to surely prove successful at precisely detecting manipulations out of images belonging to this second population, the already trained detector has to be re-trained on a sample of 1000 tampered images characterized by the same distribution of features as the second population and so on. All in all, by sequentially re-training the detector on sufficiently large samples (as shown in Table 3, an amount of 1000 tampered training images is enough) extracted from the populations of images the insurance organization wants to analyze, the Precision performance reported in Table 3 eventually proves generally enough, thus allowing to successfully detect manipulations on *any* kind of tampered image.

Conclusions

This work proposes a customized data science workflow for addressing two use-cases in the claim management process. It consists of six steps that are sequential from the chronological point of view, even though each of them has a strong iterative nature. Anyway, before starting the flow, it is recommended to adequately consider common risks referred to resource limitations (such as lack of capital, time, employees), infrastructure limitations (e.g., lack of computational power), and dataset limitations (unavailable data, lack of storage capacity). The basic requirement for applying the workflow is the availability of adequate hardware and computational resources, without which it is neither possible to reproduce a suitable environment for the implementation of a deep convolutional neural network nor to train object detection models.

We highlighted how the development of deep learning models does not strictly follow the typical, classical approach to prototyping. It is more about understanding the business need, the analytical problem, as well as assessing several options for the model learning process, iteratively. The proposed iterative experimentation and validation approach resulted in being the key element to deliver the desired results promptly, with valuable business impact for both digitalization use-cases.

The adopted *modus operandi* fits with prototypical design and development in the context of data science/AI projects where requirements are fast-changing as a result of the needs expressed by the insurance organization. Our approach allowed us to deliver prototypes that demonstrate the feasibility of integrating AI-based solutions within the claim management process. Relying on a structured workflow made it possible to manage the enormous complexity and uncertainty of the outputs on time, returning a robust final solution, based on constant feedback from the insurance company.

The approach was used to face two cases belonging to the same class of AI problems. The iterative approach is fundamental, especially if the problem to be treated is still in an exploratory phase and a resolutory standard has not yet been established (as happened for the manipulation detection use-case). All in all, the proposed framework can be considered as “general-purpose,” while the operations within each of them must be customized according to the specific business and data science/AI problem.

The lessons learned highlight the major limitations for the deployment and for the scalability of the prototypes, which should be faced by managers. They strictly depend on (i) the availability of numerous and pre-annotated datasets of images and (ii) the features’ distribution in the training sets, which have to be properly arranged in order to be statistically representative of realistic foreground and background scenarios relative to pictures of damaged cars as a result of an accident event. Coping with these two limitations is key to enabling the successful deployment of the proposed AI-based prototypes into the insurance organization’s production environment. Surely, the frequency distribution in the training set has to be predictable or, at least, validated by domain experts. Anyway, in both use-cases, the frequency distribution of the instances and the relationship between positive and negative examples in the training datasets have been approved by the insurance domain experts.

The web application implementing the developed AI prototypes is currently being used in the insurance organizations joining CONSEL. The AI prototypes are going to be enhanced with additional AI-enabled functions (e.g., in terms of automatically evaluating the car damage entity as well as the car accident dynamics). Also, future developments will focus on the adaptation of the proposed six-step workflow to other industrial contexts where digital transformation is uprising.

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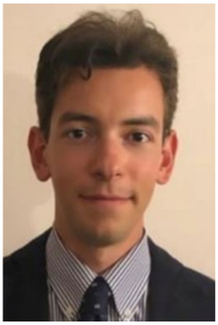

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Invoice Automation: Increasing Efficiency in the Office at Satherm GmbH Using Artificial Intelligence

Martin Danner, Björn Maurer, Svea Schuh, Tobias Greff, and Dirk Werth

Abstract

(a) **Situation faced**: The application of artificial intelligence (AI) to automate business processes is becoming more important in small- and medium-sized enterprises (SMEs). This was also recognized by the company *Satherm GmbH*. With 20,000 invoices per year, which were all being processed manually, invoicing at *Satherm* was accompanied by high process costs and a high expenditure of time. Furthermore, *Satherm* struggled with regional socio-economic difficulties such as a shortage of skilled workers and recession for which a solution had to be found. In view of the situation at *Satherm GmbH*, automation using AI technology offered a great potential not only to reduce manual activities and costs but also to overcome regional problems.

(b) **Action taken**: State-of-the-art technology consisting of seven established neural networks for superior, cognitive and automated document recognition and extraction was used in combination with a free-to-use robotic process automation (RPA) technology to automate the process from invoice receipt to payment. The implementation consisted of three steps. The first one dealt with requirement analysis, conception and identification of the necessary interfaces. To reliably extract valid data of invoices, the second step addressed the adaptation of the neural networks to the underlying documents at *Satherm* by means of transfer learning. The last step involved the setup of the holistic solution and the piloting in the company to test the solution parallel to the daily business followed by a smooth transition into final roll-out at *Satherm*.

(c) **Results achieved:** Considering the set goal of an invoice automation degree of 50%, the results achieved exceeded the expectations at *Satherm* by 20%. With an overall invoice automation of 70%, the invoice processing time was reduced from 15 days to 2–3 h per invoice. Complementary to this the costs for

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processing an invoice were reduced from € 5.77 to € 1.93. This resulted in a cost saving of about 67% per invoice. In addition, the implementation was not only accompanied by a positive impact on the process efficiency itself but also by several positive side effects like countering the current as well as future shortage of skilled workers at *Satherm*.

(d) **Lessons learned**: The use case of *Satherm* is a suitable lesson to understand how digitization and especially the application of almost ready-to-use artificial intelligence in German SMEs can increase efficiency, raise potentials and be the solution for different challenges. A sufficient pilot phase parallel to business operations can be recommended when introducing new technologies in order to build trust in the technology and ensure full integrity. With that an AI application can be the driver for the discovery of further potentials and an accelerator towards a more digitized, efficient company.

1 Introduction

The company *Satherm GmbH* from Saarwellingen specializes in the sale of electrical, mechanical, hydraulic, pneumatic as well as measurement and control components for construction and maintenance of industrial plants. Subsidiaries in the USA, Romania, Russia and Morocco ensure proximity to their international group of customers. With its headquarters in Germany, near the French border, the company employs 43 people. A major challenge for *Satherm* is that some employees will retire soon. Also, *Satherm* is struggling with the lack of skilled workers and the recession in the region.

In order to survive in global competition in the future, it is necessary for *Satherm* to deal with digitization issues. *Satherm* has already recognized that the digitalization of the business model is relevant to react flexibly to dynamic market requirements.

The first step for *Satherm* was to build a project team and develop a digitization strategy. In 2019 the project team took part in a workshop at the *Mittelstand 4.0-Kompetenzzentrum Saarbrücken* (KomZetSaar). The *KomZetSaar*, funded by the *Federal Ministry of Economics and Energy*, supports small- and medium-sized enterprises (SMEs) in improving their digitization competence. One of the main topics of *KomZetSaar* is artificial intelligence (AI). During the workshop, *Satherm* quickly recognized the benefit of AI for its own company and identified optimization potential for the process of incoming invoices.

Satherm's procurement cooperates with a wide range of suppliers and consequently receives approximately 20,000 invoices in various formats, both physical and digital. The invoices are manually checked by the employees, digitized and captured for processing in the enterprise resource planning system (ERP system). Because of many manual activities, the process is error-prone and entails high costs. This initial situation motivated *Satherm* to analyse how AI can improve this process, and it was the start of the first digitization project. The aim was to automate the process of incoming invoices using AI. The effort and costs for processing invoices should be significantly reduced by up to 50%. The realization of this project was accompanied by the regional start-up *Natif.AI* specialized in AI-based text recognition for automated document processing. The project has completed the pilot phase and is currently in the first stages of the productive phase.

The following article describes the situation of *Satherm*. It shows how *Satherm* proceeded to identify optimization potentials in the field of digitization. In particular, the article deals with the first AI project, the automation of incoming invoices. It depicts the process of incoming invoices, and the associated problems are pointed out. Furthermore, the implementation of the AI technology is described both on a technical and methodical level. Besides, the lessons learned up to now are highlighted.

2 Situation Faced

In the last years, *Satherm* has expanded internationally and strengthened the strategically important proximity to its customers with foreign subsidiaries. By setting up local sales companies in relevant countries, *Satherm* has placed the customers in the centre of its business processes. With its product portfolio, *Satherm* serves customers from steel, chemical, automotive and energy industries. The value proposition of the business model, in consideration of the industry specifics, is the fast reaction time to customer inquiries and to ensure customer satisfaction. To fulfil this requirement in the best possible way, *Satherm* introduced a web application that enables customers to make product inquiries in a simple way and to receive individual offers quickly. Nonetheless *Satherm* has recognized that in order to ensure short waiting times and professional service, the entire value-added process needs to be improved. Digitization plays a major role here.

For *Satherm*, digitization is a transformation process over the next years that must be taken step by step. To identify specific measures in the field of digitization, *Satherm* has carried out an internal analysis as a first step. A digitization project team was built that evaluated the current IT infrastructure (hardware and software) as well as the business processes. It also identified the qualifications and expectations of employees in the area of digitization and the budget available for future measures. The result was an overview of the current status and a digital readiness assessment.

In a second step, the project team has informed itself about various digitization topics. With this knowledge, first digitization possibilities especially in the field of AI were identified. Based on the previous insights, *Satherm* puts a high priority on the process of incoming invoices. Particularly this process does have an important impact on the supply chain.

With the growth of the company, the number of data to be processed has also increased, and the volume of incoming invoices has risen significantly up to approximately 20,000 per year. The ERP system and the long-standing internal processes are no longer up to future requirements. A team of four employees is editing the incoming invoices. The challenge is that the invoices are received unstructured in various formats, such as analogue in paper form or digital as PDFs, scans or images. The first step is to structure and assort the invoices. The transfer of the invoice data to the accounting system is done manually. The relevant data, such as order number, article number, document date, price, terms of payment, bank data, etc., are entered manually into the system by the employees. Furthermore, the employees have to do some specific checks regarding supplier and country. These checks are currently also edited manually by experienced employees without systemic assistance. Checking, entering and processing the data requires a repetitive manual workload. The deprecated accounting system takes a long time to process, which results in loss of time. Media breaks make work more difficult and lead to a higher error rate. Transmission mistakes cost time and can also have far-reaching consequences. Currently the processing of invoices entails high costs, requires many employees and takes a long time. Thus, the process offers a great potential for automation using AI.

According to a study by the *Federal Ministry of Economics and Energy* regarding the use of AI in the German economy, 56% of the companies that are already using AI solutions use it to automate their business processes (BMWi—Bundesministerium für Wirtschaft und Energie 2020).

To exploit the potential, the aim is to automate a large part of the invoice process by introducing a powerful technology for text recognition and intelligent document understanding based on machine learning, a subfield of AI. A software robot is supposed to transfer the data extracted automatically by AI from the digitized invoices to the ERP system. To automate the invoicing process with 20,000 invoices per year promises major efficiency increases like reducing manual activities, faster processing times and cost savings. Positive effects on employee satisfaction are also expected.

3 Action Taken

As described in Chap. 'Introduction to Digitalization Cases Vol. 2: Mastering Digital Transformation for Global Business', the goal was a 50% automation of incoming invoices with a volume of around 20,000 invoices per year in order to free employees from repetitive tasks and thus to counter the current as well as future shortage of skilled workers at *Satherm*. To achieve this, state-of-the-art technology for robotic process automation (RPA) was combined with the latest AI for text recognition and intelligent document understanding from *Natif.AI*. Such a technology stack is also referred to as intelligent process automation (IPA) (Chakraborti et al. 2020). The procedure for implementation took about 2–3 months and was roughly divided into three phases:

1. Requirement analysis, conception and identification of interfaces
2. Initial training of the AI and implementation
3. Piloting in the company

In the first phase, the initial situation on-site in the company was sufficiently discussed. For this purpose, detailed discussions were first held with the employees of the company involved in the implementation. Expectations and technological objectives were discussed to grasp the problem and to develop initial solutions. Subsequently, the employees who are responsible for processing the invoices were accompanied in day-to-day business to understand the process flow from receipt of the invoice to entry in the ERP system used. *Satherm* receives documents in different ways, so that documents including invoices are initially available both digitally and as a physical document. The physical documents are scanned as soon as they are received in order to convert them into a digital format. The already digital documents received by e-mail are available in a variety of unstructured file formats. In addition to PDFs, image files in JPEG, Tiff and PNG format predominate. As soon as all documents are in a digital format, they have to be sorted by an employee first in order to differentiate between delivery and credit notes, order confirmations and the here address invoices. After the document classification, the identified invoices get transferred to an ERP system and checked in detail. A particular challenge here arises from the fact that *Satherm* is an international company and invoices are therefore issued in different languages. After the check has been passed, the invoices are then released—again manually—by an employee (for payment) and archived. Invoices that are incorrect or are noticeable for other reasons will be annotated and processed again separately. The following challenges/requirements for the technology to be used for automation were derived from the process knowledge extracted in this way:

- Processing of multiple file or document formats (scanned documents, PDF, JPEG, TIFF, PNG, etc.)
- Sorting and classification of different documents as well as invoice identification
- Processing invoices in different languages
- Extraction and validation of the invoice information
- Making operational decisions
- Transferring of the extracted invoice information into an existing ERP system

In the next step, the listed requirements were used to identify and design a suitable technology stack to automatically map the previously manual process of the employees.

Through the use of so-called software robots, human interaction with graphical user interfaces of software systems is imitated step by step, and the automation of repetitive, rule-based processes is made possible. Simple RPA solutions that can be found several times on the market, however, reach their limits as soon as cognitive performance or a deeper (document) understanding has to be provided in the course of the process. Invoice recognition for the extraction of invoice information represents a considerable cognitive performance that can hardly be achieved with simple rule-based algorithms. Taking the content of different invoices or documents in general into account, this quickly becomes clear. Moreover, considering invoices in different file formats and languages, the variety increases, and the complexity becomes much greater. However, the steadily advancing development in the field of AI offers the possibility to counter this problem. In this way, AI outperforms human performance in a constantly growing number of areas. The conception and identification of suitable technologies therefore focused on a combination of RPA and AI in order to meet all requirements and expectations of the employees working with invoices at *Satherm* on a day-to-day basis.

With its solution for intelligent invoice recognition, *Natif.AI* addresses precisely this problem. The state-of-the-art technology from *Natif.AI* used herein the implementation is based on seven neural networks ranging from ordinary stand-alone convolutional neural networks (CNNs) to complex model architectures—e.g. the combination of CNNs with long short-term memory (LSTM) or CNNs with so-called transformers—for superior, cognitive and automated document recognition and extraction. The interaction for invoice recognition using *Natif.AI* is divided into five sub-steps.

In the first step, the documents are preprocessed. With the help of CNNs, the orientation and inclination of the documents are determined, and the background is removed. This step is particularly important for scanned or photographed documents, for which a smartphone camera is already sufficient. The second step involves word segmentation. Convolutional neural networks are also used here to separate the individual words from the background. In the next step, also referred to deep optical character recognition (deep-OCR), the pixel data of the words previously detached from the background are converted into ASCII characters using a combination of CNNs and LSTMs. In the fourth step, the actual 2D information extraction of layout, letter, word information in context, and pixel data is made possible through the use and combination of special, unique network architectures combining both CNNs and transformers, inspired by recent applications from the areas of natural language processing and computer vision (Brown et al. 2020; Peters et al. 2018). The fifth and last sub-step serves to normalize and check for plausibility. Fuzzy string searching/matching of, e.g. names and addresses, enables errors to be recognized or excluded in milliseconds and checksum checks to be carried out on critical fields such as International Bank Account Number (IBAN) and value-added tax (VAT) (Chaudhuri et al. 2003). Such a self-check or validation allows a human to be integrated into the process so that, given the uncertainties, it can always intervene in the invoice recognition process. This procedure allowing a human to change the outcome of a process is often and in the following referred to as human-in-the-loop (Garc 2020).

Since intelligent document understanding is hardly a new topic and quite similar solutions are already being in application, it needs to be mentioned that the technology described here offers some key advantages especially compared to older but still-in-use approaches for processing complex documents such as invoices. All in-use networks presented here have been pretrained with 25,000 documents of divers layouts of different document classes and formats; thus even with minor data, one is being able to achieve ambitious results regarding performance and accuracy by transfer learning (Weiss et al. 2016). Whereas older models and architectures often still rely on recurrent neural networks (RNNs) as well as LSTMs which come along with some limitations, the here-stated technology is already making use of transformers.

Transformers are quite new deep learning models first introduced in 2017 offering superior advantages in the field of natural language processing and thus being able to overcome limitations RNNs and LSTMs are restricted to (Vaswani et al. 2017). Both RNNs and LSTMs are powerful sequence learning architectures but due to their sequential computation inhibiting parallelization and therefore not being able to fully utilize the potential of today's graphics processing units (GPUs) (Hwang and Sung 2015; Zhang et al. 2015). In natural language processing, it is essential to capture the context for both short- and long-range dependencies throughout a sentence, text or document. Especially (but not only) for RNNs, it is hard to learn those long-term dependencies (Zhang et al. 2015; Trinh et al. 2018). With its unique architecture consisting of CNNs and attention models, transformers are not only able to solve the problem of parallelization leading to a boost in processing speed but also to preserve context especially for long-range dependencies (Vaswani et al. 2017; Qiu et al. 2019). If you calculate with an average of 49 data points to be extracted from an invoice document, a full-time employee can process approximately 20,000 invoices per year. GPUs available today create 192,000 calculations per GPU per hour with such a technology. Due to its architecture, the technology used here relies entirely on GPU resources. This means that up to 9600 documents can be processed per hour. With that in mind, the use of AI for automation in accounting results in a savings potential of up to 90% by reaching an automation degree of the same percentage leading to less personnel cost in accounting, and thus fewer working hours are required for repetitive tasks (Natif AI 2020). According to various reports, a company has to spend up to € 17.60 for the complete processing of an incoming invoice consisting of receipt, codification, validation, comparison, payment and archiving (Koch 2017; Beanworks 2020; Murphy 2019; Editorial 2019). By using AI and automation, these costs can be reduced to € 2–3 per invoice. Accompanying this is an enormous saving of time, which can be used by the employees to focus on more complex tasks.

Figure 1 schematically shows the workflow of automated invoice receipt based on freely accessible RPA software without license costs and the previously described AI for invoice recognition from *Natif.AI*. Invoices are received from a cloud in which all invoices including scanned documents are unstructured. In the first step, the software robot obtains the invoice documents using an application programming interface (API) available through the cloud and makes them accessible to the AI from *Natif.AI*. The AI then takes on several tasks.

First, the documents/invoices are sorted and then archived by the software robot. At the same time, the invoice documents are analysed, and the required information gets extracted from the document. The extracted results are then compared with the existing information in the ERP system. Depending on the result of the fuzzy string searching and a confidence interval of the AI, the AI makes an operational decision.

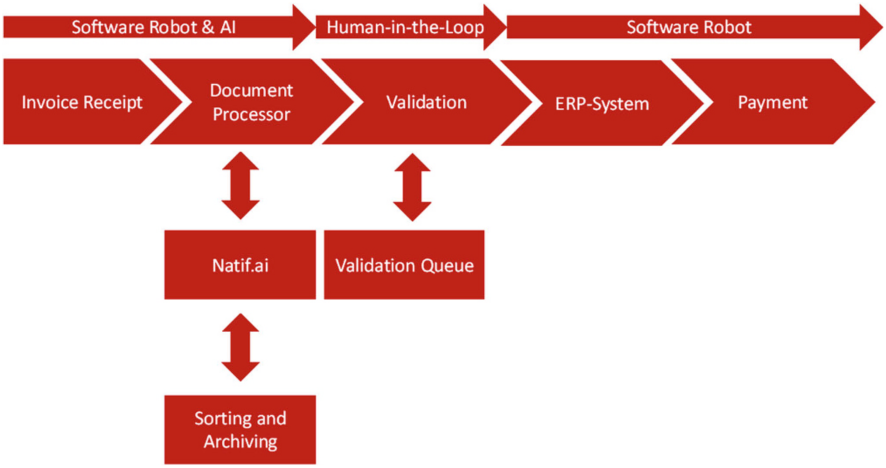

Fig. 1 Schematic representation of the technical workflow

If the fuzzy comparison was successful and the confidence interval did not fall below a certain, predefined value, which can be different for all different keys to be extracted (e.g. higher for crucial keys like IBAN and lower for less crucial ones like phone number), the software robot automatically transfers the extracted data to the ERP system via a suitable API and releases the invoice for payment. If the fuzzy comparison yields incorrect entries or the confidence interval falls below the predetermined value, the software robot transfers the invoice document together with the extracted data/information to a validation queue. In the validation queue, all invoice documents together with the data extracted by the AI are made available to a human-in-the-loop for validation. This employee can reconcile and cross-check the data. Based on this check, the employee, on behalf of the AI, makes the operational decision on how to proceed. After checking, he can either transfer the document and the associated information to the ERP system and release it for payment or manually change the data beforehand by comparing it with the original invoice or remove the document completely from the automated process.

In practice the system shown for invoice automation could be quickly implemented using a freely accessible RPA solution. Nevertheless, the transfer of AI to a new database is often a problem. Especially when using AI to make operational decisions, there must be sufficient precision. Caused primarily by the high volume of various invoice templates in several languages, *Natif.AI*'s invoice recognition could not be transferred to *Satherm*'s invoice receipt without additional training of the AI. Paradoxically, the high volume of different invoices was the cause and solution of the problem at the same time. *Satherm* is a company with a long existence and has been using the same ERP system for many years that is also linked to the technology for invoice automation presented here. As a result, there was already a large, sufficient amount of data available that could be used to adapt the *Natif.AI* neural networks to the existing processes for the upcoming billing of

Satherm by means of a technique called transfer learning (Weiss et al. 2016). For this purpose 200 documents have been manually annotated and used for renewed training. The success of the training was validated by several test runs on-site and resulted in an initial invoice automation of about 30%. After the initial validation, the technology was implemented for piloting. The piloting took place over 2–3 months parallel to the daily business, i.e. the employees processed the incoming invoices as usual, while the technology for intelligent invoice automation processed the identical incoming invoices in parallel. This procedure allowed evaluation and verification, so that information loss or incorrect invoice transfers to the ERP system could be excluded and functionality of the system was ensured. During piloting itself the corrections made by the human-in-the-loop were utilized to annotate further data in the background and sent it to the *Natif.AI* cloud architecture, where the models were frequently retrained. With that an automation of more than 70% (without making use of a human-in-the-loop) could already be achieved during piloting. The technology for intelligent invoice automation is now used in the daily business of *Satherm*, and even a higher degree of automation is to be expected.

Another important point while implementing AI in the company are the employees, who not only represent the most important resource of every company but also have the necessary expert knowledge due to many years of experience. It is not uncommon for employees especially in SMEs to have a certain scepticism about intelligent systems that change their everyday work, although it should make their daily work more efficient. In addition, there is the fear that one's job may be replaced entirely by AI. The employees of *Satherm* were not only open to the introduction of AI in the company but also started the search for technological solutions for invoice automation. Thanks to the open corporate communication, the employees were always involved in the processes as well as the next steps during the implementation and contributed directly to the implementation through their domain knowledge. This transparent approach not only led to an open attitude of the employees towards the use of artificial intelligence for the incoming invoice automation but also led to a deeper understanding of the technology. All employees of *Satherm* who work on incoming invoices are currently and will be in the future employed as humans-in-the-loop and take on more complex, responsible and interesting activities in the company due to the working time gained.

From the perspective of all companies, institutions and employees involved in the implementation, all objectives set for automating the receipt of invoices could be achieved and even exceeded. Furthermore, problems related to the shortage of skilled workers could be addressed and compensated. Where employees' everyday work was characterized by sorting, checking and transferring invoice information to an ERP system, only the physically available invoices now have to be scanned—after the scan, they are sorted, archived in the cloud and automatically processed—and expert knowledge has to be provided by acting as a human-in-the-loop for validation or modification when uncertainties arise.

4 Results Achieved

The question arises, which effects and results could be observed and quantified during the pilot phase and afterwards in direct operation. Special attention is paid to increasing performance but also conscious improvements for employees, customers and other stakeholders. It is also important to evaluate which expectations have been met and which expectations have not been fully met.

Studies such as ‘Use of Artificial Intelligence in the German Economy’ by the *Federal Ministry of Economics and Energy* emphasize that the introduction of digitization measures and, in particular, measures in the field of AI will increase efficiency in the company (BMWi—Bundesministerium für Wirtschaft und Energie 2020). In the case of *Satherm*’s invoice automation, the great need and demand for automation solutions with AI is reflected in companies in general, as shown in the study. When AI is used in companies, much digital data is not automatically usable in the corporate context because 80% of corporate data is usually available in unstructured form, such as images, scans or PDFs. In the use case of invoice automation at *Satherm*, it has been possible to automatically structure the unstructured data in the form of invoices and make it usable for invoice automation and all subsequent processing items. Especially in the preparation of the structured data but also in the linking of the data, the solution of *Natif.AI* worked out very well in the case of *Satherm* and shows a functioning interaction of several technologies from the field of AI.

The application proposed here for invoice automation has already passed the pilot phase and is already in operational use at Satherm. Since the piloting, a degree of automation of 70% has been achieved, which has far exceeded expectations. Up to now, 15 days per invoice have been used for the process of invoice entry and documentation across all stages from invoice receipt, document classification and invoice verification to invoice approval. With digitization and the invoice automation implemented in this way, *Satherm* now only needs 2–3 h to capture, process, approve and document the invoices properly, thus ensuring an efficient process. Consequently, with the introduction of invoice automation, a significant increase in efficiency in this work process was achieved, and the processing time was reduced to a small fraction of the original time. In direct operation, this means not only faster processing time, which saves resources, but also better digitalized documentation of the invoice documents. In addition, errors in the capture, processing and documentation of invoices have been greatly reduced by the automated process. The optimizations are also positively reflected in the process and error costs. For example, the original manual invoicing process across all stations costs a cumulative € 5.77 per invoice, whereas the costs for a received invoice across all process steps in automated invoice capture with AI cost an average of only € 1.93 cumulatively. The cost reduction due to the automation over the entire process is thus 67%. Considering companies like *Satherm* not dealing not with a small but a large number of invoices, the achieved savings by such an invoice automation can be impressing huge. Particularly when transferring to active operation with the 20,000 incoming invoices, one notices how great the positive effects on efficiency and cost reduction at *Satherm* are. For example, 20,000 invoices require at least three full-time employees for 1 year, whereas a GPU can process 192,000 invoices automatically over 1 h. Within a few months, in further regular operations, it is to be expected that the invoice automation of *Natif.AI* is capable of increasing the savings potential in accounting up to 90%. This can be achieved by further training of the neural networks utilizing additional data collected and annotated in the background during operations. All this is possible through the intelligent combination of technologies from the field of software robotics and AI but especially through the consistent use of neural networks for word segmentation, transcription and extraction of the data of the invoices.

Another positive point of the invoice automation at *Satherm* is the tax law perspective, because the proper recording, processing and documentation of incoming invoices ensure that the accounting system also stands up to tax law aspects. By extracting the 49 data points from the invoice documents, the regulations according to § 14 of the VAT law are fulfilled (BMJV—Bundesministerium der Justiz und für Verbraucherschutz 2020). This paragraph is primarily concerned with the correct issue of invoices and in particular as to which data points an invoice must contain.

Especially on the side of the employees, the invoice automation results in significant advantages, which can also be quantified. Up to now, three to four full-time employees have been involved in manual invoice processing, a work which was largely routine and to a lesser extent interesting. Although the process of invoice automation still requires people to intervene in special cases (human-in-the-loop), the employees can now be predominantly occupied with other and more complex tasks. In a company like *Satherm*, employee satisfaction plays not only an important role for working atmosphere but also to be able to offer the best service possible to their customers. Thus, the increase in employee satisfaction achieved by invoice automation is a valuable variable. Employee satisfaction has been surveyed through interviews and questioned in various dimensions. In addition, employees now acting as a human-in-the-loop play an even more important role, since they enable continuous learning of the system by utilizing their domain expertise in correction loops of difficult cases and thus provide annotated data to further improve the AI-driven invoice automation at *Satherm*.

In summary, it can be said that with an automation degree of 70% the results achieved so far exceeded the set goal of a 50% invoice automation by 20%. On top of that, this is not only true for the degree of automation but also for every positive developments coming along the introduction of automation, such as increased employee satisfaction and more time which can be spent on more creative as well as complex tasks resulting in even more added value. The main key figures here can be seen in the time spent for invoice processing, which was reduced from 15 days to 2–3 h per invoice, and furthermore in the processing costs per invoice, which were reduced from € 5.77 to just € 1.93. This results in a cost saving of 67% and improves scalability for future growth of the company. Beyond, it was ensured that humans still have the final decision-making power and can intervene in the process at any time if anomalies occur or the process itself needs to be adapted.

5 Lessons Learned

In this chapter, the lessons learned during the realization are listed and described how invoice automation can also be implemented and utilized in other SMEs. Furthermore as an outlook, a further digitization measure at *Satherm* in the form of an automated translation is indicated, which opens up further perspectives for the digitization of the company and additionally accelerates the rise in operational efficiency in the international business operations of *Satherm*.

Digitization and especially the use of AI are taking on an ever-faster dynamic in the optimization process of companies and are even developing into the basis for the future existence of business models and companies.

German SMEs in particular benefit from the many opportunities coming along with AI and its applications to meet current and future challenges. Current challenges SMEs have to face can be seen in the increasing shortage of skilled workers due to demographic development and in a steadily increasing competitive pressure. Possibilities resulting from the use of AI and its applications are increased productivity and improved efficiency in many areas of the company. Special attention should be paid to the possible applications of AI in the office, as it has been demonstrated by the invoice automation at *Satherm* and scientific publications several times (Maurer et al. 2020). AI applications, which SMEs purchase rather than develop themselves, are advantageous because it is faster and easier to get started with the topic. This is especially true for very small SMEs. It should be emphasized that the use of AI in Germany is still far too little in evidence, although the effects are enormous and can highly optimize a company with all its processes (Lundborg and Märkel 2019). Therefore, the *Satherm* use case of invoice automation is again particularly noteworthy and can serve as a representative example not only on how to utilize invoice automation for other companies but also to demonstrate the benefits of AI and digitization in general. In summary, AI in the office will play an increasingly important role in the future and this far beyond all sectors of the economy.

What is special about this application is the approach and the rare case that needs and solutions go so well together. With the identification of the pain points at *Satherm* regarding non-digitized manual work steps, it was possible to identify processes with a high automation potential. It is mandatory to fully understand the identified process. This contains both the understanding what the actual task (jobs to be done) is in the process and how this job is done in detail for all subprocesses involved in the overall process. All this is necessary to be able to introduce a suitable solution that takes all functional, emotional and social dimensions of the underlying process into account (Christensen Institute 2020). For the most part, this is only possible through a comprehensive needs analysis and needs-based questioning techniques in order to be able to inquire about and classify the core of the tasks and their solutions in a goal-oriented manner. In addition, a 360-degree digitization analysis is essential in order to have at least a precise overview of the state of the art and further requirements. Based on this, a specific planning for the project can be made in order to harmonize all digitization measures as well as existing and planned systems. It is important to involve all relevant stakeholders in the digitization process from the very beginning to gather important domain knowledge and represent as many perspectives as possible, in order to develop a solution that creates the most value and fit the expectations for all parties involved. Parties involved range from customers to business partners and employees who will use the solution in the future and want to support it in the company. In the digitization case of *Satherm* with the focus on invoice automation, two employees from the respective departments were integrated into project right from the start, so that first-hand insights could be utilized for the implementation, which was very important for the successful completion. In addition, employees who are involved in the implementation from the start are often particularly intrinsically motivated and want to drive the topic forwards.

During the implementation of invoice automation in the present case, it was noticed that an extended piloting parallel to the daily business over a certain period of time is very target-oriented for the roll-out in operation because it cannot only be useful for security but also to build trust in the application. Thus, at *Satherm*, the test run proofed the integrity of the solution, and the trust has grown over the pilot phase, which is important for the acceptance of the automation in every company. Furthermore, a proper documentation of the project is essential in order to transfer the successful digitalization of one area to other areas of the company or to be able to make future adjustments.

For the future, it is of course important that *Satherm*, despite the automation, continues to develop the use case and makes possible foreign invoices readable for the system in order to achieve a higher automation rate and thus continue to increase efficiency. Despite piloting and automation, it is recommended that the system should still be checked on a regular basis to ensure that it works as intended and no errors has crept in especially when new documents or invoices had to be processed. A well-thought-out controlling by humans on the AI, e.g. with a human-in-the-loop, is very important here and also offers adjustment possibilities if deviations occur.

As already indicated at the beginning of this chapter, another possibility to optimize the processes of *Satherm* lies in the automation of the translation with the help of machine translation (DeepL 2020). *DeepL* is a service that can translate texts into different languages by means of artificial intelligence. This technology is often referred to as machine translation. Also for this task neural networks like LSTMs and transformers are used as they have a particularly high quality of the translation texts. For *Satherm,* an integration into its own ERP system by means of an API provided by *DeepL* is very useful in the future in order to be able to translate texts within seconds into German, English or French. Especially for a company like *Satherm*, which bases its business model on the export of industrial goods abroad, such a solution offers a good opportunity to set up its processes even more efficiently and customer-oriented to create added value for the company. This shows that an initial AI application can be the driver for the discovery of potentials and an accelerator towards a more digitized, efficient company.

In conclusion, the *Satherm* use case is a suitable lesson to understand how digitization and especially the application of artificial intelligence in German SMEs can increase efficiency and raise potentials. The use of almost ready-to-use AI solutions to automate time-consuming, manual activities has, as shown in this case, already great positive effects on several different levels of the company if the digitization measures are planned and the pain points get addressed correctly. The here demonstrated use case of invoice automation at *Satherm* can easily be transferred to other companies that have similar dimensions in terms of the number of documents to be processed. Furthermore, transferring the use case to bigger companies may lead to an even higher increase in efficiency lowering of the costs.

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Digitalization of Manufacturing Processes with Startup Collaboration: Arçelik Developing a Digital Twin with Simularge

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Abstract

(a) **Situation faced**: Arçelik is a major manufacturer of durable consumer goods. As one of the primary products of Arçelik, refrigerators constitute 35% of its annual production. Thermoforming is a critical process of manufacturing a refrigerator's inner body, which consumes more than 20,000 tons of plastics every year. The company has decided to develop its production quality further, reduce plastic consumption, and improve its environmental footprint by integrating a digital twin into its production planning and management.

(b) **Actions taken**: Arçelik has partnered with Simularge from Istanbul, a startup specializing in digital twins. The project team has developed a digital model of the thermoforming process by combining high-end engineering formulations, simulation modeling, and real-time sensor data. They have integrated and fine-tuned the digital twin in one plant. Currently, the company plans worldwide deployment.

(c) **Results achieved:** Arçelik's partnership with Simularge has successfully generated a digital twin of the thermoforming process. Implementing the digital twin with real-time operational data has improved the product quality, has decreased scrap ratios, and has reduced plastic consumption. It has resulted in an initial cost-saving of more than $2 million annually. Gaining know-how about the manufacturing processes' digitalization has promoted a shared vision. It has also

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provided a strong example to encourage the digitalization of other manufacturing processes.

(d) **Lessons learned**: The digital twin has enabled resource efficiency and improved manufacturing execution. Additionally, integrating the Internet of Things data into the digital twin has enabled better feature engineering results and improved algorithms with extracted features from data mining. Furthermore, the Internet of Things and programmable logic controller infrastructures and engineering capabilities at Arçelik has been crucial for the digital twin's success. Arçelik's Atölye 4.0 Lab and its relationship with Istanbul Technical University's ITU Çekirdek Incubator also have a significant role in cultivating a collaborative project. Lastly, effectiveness in project management appears as a significant driver of success for a digital twin project.

1 Introduction

Digital transformation has become a hot topic of the manufacturing industry with the advent of Industry 4.0. In this context, digitalization, as the adaptation of new business models, invites technological progress and calls for innovations to the manufacturing environment, enabling manufacturing firms to adapt changes rapidly (Kotarba 2018). Digital technologies shape processes and their management (Lockl et al. 2018). These technologies transform business models by allowing new product and service offerings while requiring new business partnerships (Schallmo et al. 2017). However, organizations usually face a process improvement black box due to the variety and high uncertainty of novel digital technologies (Denner et al. 2018). This situation challenges traditional approaches to efficiency improvement, forcing manufacturing companies to build external collaborations with technology vendors and startups to adopt new technologies. Production processes' efficiency and level of raw material consumption have become primary concerns of manufacturing companies due to their need to improve their sustainability. Therefore, digital technologies' adoption has become critical since they optimize raw material consumption, improve efficiency, and deliver benefits for sustainability (Demartini et al. 2019).

Digital twins are virtual representations of physical processes or systems, showing identical behaviors with their physical counterparts. These representations utilize different simulation techniques. Digital twins consist of a physical product, a virtual functionality model, and bi-directional data connections. However, digital twins are beyond traditional simulation models. They behave like their physical counterparts in numerous dimensions and enable digital experimentation by leveraging computational techniques (Jones et al. 2020). Thus, a digital twin enables optimizing operation parameters like temperatures and pressures, therefore helping manufacturing professionals to operate systems in their best theoretically possible condition. It helps its users to decide on the desired physical state of the corresponding physical system, as in process control (Lohtander et al. 2018), machine parameters

(Kritzinger et al. 2018), and production management (Zhuang et al. 2018). Digital twins are at the forefront of manufacturing digitalization, enabling a sustainable and intelligent future (He and Bai 2021). They also align with product life cycles (Grieves and Vickers 2017). Gartner estimates that by 2021, half of all large-scale industrial enterprises will use digital twins to improve their effectiveness (Gartner 2017).

This case study describes how Arçelik and Simularge collaboratively and successfully developed a digital twin to improve the thermoforming process at Arçelik's refrigerator production. Arçelik is a large-scale durable goods manufacturer with a global presence. Simularge is a technology startup with offices in Istanbul and San Francisco. The digital twin project has resulted in significant improvements in quality and plastic consumption. Arçelik has initially saved 1600 tons of plastic each year, with a value exceeding $2 million while improving its environmental impact.

The case study illustrates several important issues and themes: First, the case study describes a digitalization project that brings significant performance and sustainability improvements. Second, the case study illustrates the importance of feature engineering, extracting raw data features with data mining to improve algorithmic performance. Third, the case study illustrates how the engineering expertise and existing infrastructures, such as programmable logic controllers (PLCs) and Internet of Things (IoT), leverage implementing a digital twin. Fourth, the case study demonstrates a successful enterprise-startup collaboration project and suggests that enterprises need to establish links with an entrepreneurial ecosystem. Startups may offer extensive digital capabilities and assume consultative roles in guiding and mobilizing large firms (Wildhirt et al. 2019). Startups also may have essential edges over big firms' speed and flexibility (Weiblen and Chesbrough 2015). Successful collaborations between startups and enterprises rarely appear in the literature. Last, the case study illustrates the critical role of effective project management for a successful digitalization project.

In the following sections, we present the situation faced by Arçelik at the thermoforming process, followed by the action taken to develop and deploy a digital twin in collaboration with Simularge. Next, we describe what the project team has achieved and what outcome measures Arçelik has observed. We conclude the case study with a discussion on the lessons learned and several implications.

2 Situation Faced

2.1 Background Information

Arçelik had founded in 1955 as a member of Koç Group, the largest industrial and services conglomerate in Turkey. As one of the leading companies in the Turkish durable goods industry, the company offers products and services worldwide with its 30,000 employees, under 12 brands manufactured in 23 different production

Fig. 1 A view from Arçelik Atölye 4.0 Advanced Robotics Lab (Source: Arçelik)

facilities worldwide. As of 2019, with an annual production volume of approximately 20 million units, the company has become the third-largest home appliances company in Europe. With 17 research and development (R&D) units in six countries and significant R&D investments, the company has a strong orientation toward innovation and technology development (Arçelik 2020a). Arçelik had introduced its first future factory in Romania to manufacture washing machines with diverse cyber-physical systems, machine learning (ML) capability, and as a testbed for Industry 4.0. World Economic Forum has selected the future factory in Romania as the Global Lighthouse Factory in 2019. The company aims to gain experience from this factory's intelligent capabilities and deploy results to other plants to engage with digitalization (Arçelik 2020a).

Arçelik prioritizes sustainability across its value chain besides financial performance. The company has been featured in the Dow Jones Sustainability Index since 2017. It has also been named an industry leader in 2019 and 2020 (Arçelik 2019, 2020b). For getting 98% of its waste recycled, the company also received the Zero Waste Award from the Turkish Ministry of Environment and Urbanization in 2019. Maintaining a sustainable performance requires Arçelik to experiment with new technologies.

In 2016, Arçelik had established Atölye 4.0 as a competency center and a startup interface to adopt innovative technologies in production lines. Specialized in industrial automation and robotics applications (see Fig. 1), Atölye 4.0 has hosted R&D projects and collaborative projects of Arçelik with universities. It also provides training to partners and employees on digital transformation and Industry 4.0. The digital twin development started in Atölye 4.0 in 2019 with Simularge.

Two engineers established Simularge in 2017 at ITU Çekirdek, Istanbul Technical University (ITU)'s incubation center. The co-founders had PhD degrees and advanced industrial experience. They decided to focus on digital twins for the manufacturing and energy industries, as they have advanced simulation expertise.

In 2019, the Global Impact Manufacturing List ranked Simularge among the top 5 manufacturing simulation startups worldwide (Start-ups Insights 2019).

2.2 Thermoforming Process

Thermoforming is among Arçelik's 14 major critical production processes. Arçelik has 8 refrigerator plants and 32 thermoform production lines in 9 locations worldwide (Fig. 2). These production lines consume more than 20,000 tons of plastics per year.

The thermoforming process involves heating plastic sheets and forming pre-heated flexible materials against a mold's contours by mechanical and pneumatic tools. After holding a mold's shape with negative air pressure, the material cools down in the intended form. Due to the high plasticity, curing, and heat allowances of the material, the technique applies only to thermoplastic components, such as a refrigerator's interior body. The finished surfaces and dimensional precision of a refrigerator's interior body are critical parameters for the product quality. Problems in the thermoforming lead to visible defects in the final product and directly affect customer satisfaction (See Fig. 3).

Maintaining the process precision and the product quality in thermoforming with reworking components and performing trial runs were problematic. These issues caused high-volume plastic scrapping, excessive plastic usage, and high levels of energy consumption. Maintaining a high level of quality also had high financial and environmental costs. Therefore, the Arçelik production team decided to decrease plastic usage and improve production quality at the thermoforming stations simultaneously.

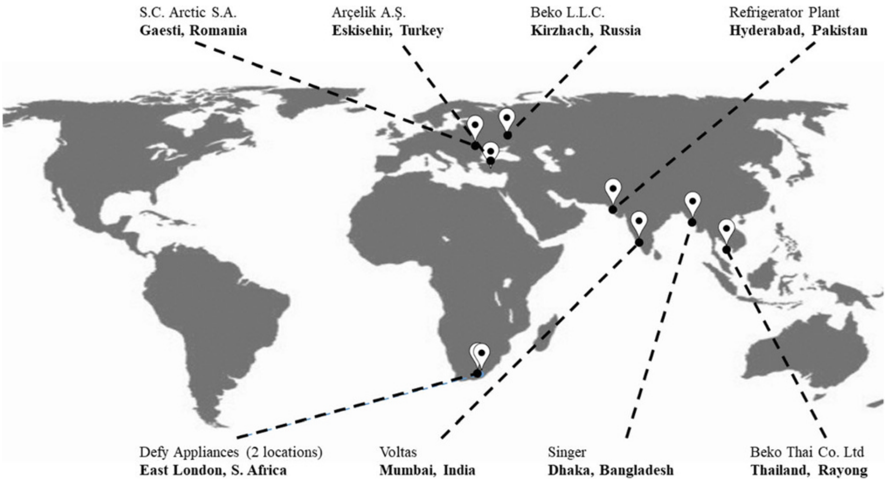

Fig. 2 Arçelik thermoforming locations (Source: Arçelik)

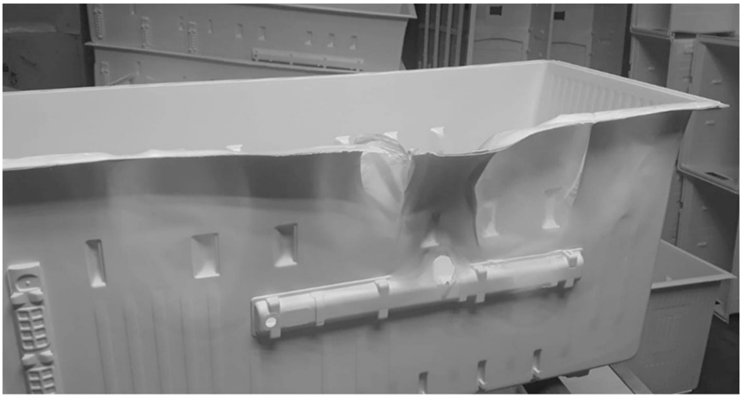

Fig. 3 A sample quality problem in refrigerator bodies (Source: Arçelik)

For this purpose, the team aimed to detect specific conditions causing process variation and quality problems. At that stage, they assumed that the existing process conditions were ideal or near-ideal as the process performance depends on the temperature, pressure, and other process parameters. However, initial tests revealed various problems, pushing them to monitor and control every step of the thermoforming process.

At that time, operators adjusted all the process parameters at the thermoforming process with their judgment and expertise. They accumulated years of experience and a deep level of process understanding. They were also deciding on corrective actions when problems arise. However, this was mostly tacit knowledge. The operator-dependent and the opaque nature of the process also were calling for digitalization.

At this stage, the Arçelik team followed the process parameters in real-time with an advanced process monitoring and control system for process intelligence. However, there were numerous parameters to follow, and they were only able to record variations after their occurrence. Thus, the Arçelik team identified digital twins as a potential solution based on the literature. They were also hoping to foresee potential production problems and automatically adjust process parameters to prevent them, as digital twins were known to enable experimentation. However, the Arçelik team came to this point after some earlier attempts.

2.3 Attempts Before the Digital Twin Project

The Arçelik team had first attempted to utilize ML techniques to predict thermoforming process's parameters and failures. They had trained various ML models with real-time process sensor data; however, they could not achieve the required accuracy and precision.

The Arçelik production team had also attempted using the finite element analysis (FEA) to estimate and analyze the process. As a well-established mechanical engineering method (Argyris et al. 1979), FEA is a numerical solution approach to model problems in heat transfer, solid mechanics, and fluid dynamics (Zienkiewicz et al. 2013). The Arçelik team had already been familiar with the FEA technique. After lengthy discussions, the production team had decided to integrate an FEA module to improve extracted features to better estimate and control process variation. They had also given up their ideal condition assumptions since they had needed to consider variability in process parameters systematically.

To check alternatives and the feasibility of FEA-based solutions, the production team had conducted a detailed literature review and field research about monitoring systems for thermoforming processes. Based on this study, the Arçelik team had realized that they require an advanced level of know-how in digital twins. The digital twin project requires developing a comprehensive simulation model and integrating an FEA-based best-fit solution into the production monitoring and control system.

2.4 Alternative Paths to a Digital Twin

Despite the uncertainties, the Arçelik team had a strict target schedule and significant budget constraints. Therefore, instead of pursuing internal development, working with an expert partner on FEA applications in process monitoring looked attractive. Therefore, the Arçelik team started considering established vendors and emerging startups for the desired system.

Established vendors were providing software solutions in this domain in the form of a black box. A customer could not learn much about what was inside and became entirely dependent on the vendor. The Arçelik team was not expecting an established vendor to provide the full rights of modifying, customizing, or scaling up their product across global locations to an enterprise like Arçelik at a reasonable price. Therefore, while established vendors had promised a potentially complete solution, the Arçelik team eliminated this option.

Arçelik team decided to partner with a startup to generate their digital twins together. They also aimed to expand Arçelik's know-how in advanced manufacturing simulations with this partnership. Therefore, they decided to seek partnering options with startups in this domain. However, it was not an easy task. Arçelik, as a large enterprise, had a lot of strict rules, stringent procedures, and structural inertia for collaborating with a startup.

3 Action Taken

3.1 Locating a Startup to Collaborate

Arçelik had contacted ITU Çekirdek, the startup incubator of ITU, to locate a startup specializing in manufacturing and engineering simulations. ITU Çekirdek had been a prominent option as it had been a well-known incubator beyond Turkey. The global university incubator rankings, for example, the UBI Index, has been listing ITU Çekirdek among the world's top 5 university business incubators (ITU Çekirdek 2019). ITU Çekirdek was a generalist startup incubator and had already generated hundreds of startups in various domains. Existing relationships of Arçelik's Atölye 4.0 with ITU Çekirdek had contributed to communicating the desired startup profile and locating the alternatives quickly.

ITU Çekirdek had introduced Arçelik to several startups from its current cohort, as well as its alumni. After meeting with potential alternatives, Arçelik had decided to seek a partnership with Simularge. They had an advanced specialization in engineering simulations, including digital twins, and had a positive attitude. After a series of meetings and a short proposal stage, Arçelik and Simularge agreed to collaborate.

3.2 Teaming Up

Participants from Arçelik's smart manufacturing group, production group, engineering group, and domain experts from Simularge established the digital twin project team. Due to the nature of digital twin projects, the digital twin's exact specification, the predictive model, and the operating application were not easy to describe at the beginning of the project. Therefore, a waterfall-type classical project management methodology was not applicable because it required a detailed definition of the final product from the beginning.

To overcome the traditional waterfall approach's pitfalls, the project team agreed to adopt an agile project management philosophy. Due to the novelty of the digital twin technology and the uncertainties involved, the project's scope focused on elaborating the problem rather than attempting a complete system analysis that froze requirements. The project team arranged regular, frequent, and short joint meetings to speed up the analysis and solution design iterations. Regular and frequent short meetings helped the entire team to get involved in project problems timely. Otherwise, such issues could disturb the project management. Agile meetings and planning also enabled rapid progress during the project.

The team performed general online sessions twice a week to continuously share their progress and identify new issues to keep the entire team updated. Team leaders also reviewed the tasks every week. The project team took an inter-disciplinary and inter-functional perspective for distributing tasks among the Arçelik participants. A sub-team worked closely with the other engineers of Arçelik at stages of design, implementation, and testing to engage Arçelik user groups. Engineers from different groups also participated in the teamwork and provided their experience:

- The process and materials technologies group investigated the thermoforming process, participated in developing the mathematical model, studied how to use data obtained from the production line sensors, and listed other teams' requirements. They were also responsible for gathering meaningful data, testing the mathematical model, and giving other groups feedback according to the production line results.
- The industrial robotics group collected and visualized the data, performed extensive research on the sensor and measurement systems, and planned further investments.
- The simulation and modeling group supported all other groups during the construction and internal dissemination of the resulting digital twin.
- The information technologies group set up the network infrastructure of the machines to collect the process data.
- The automation group installed the required hardware.
- The production group supported all other groups to understand the complete process and the sensors' functioning.
- Arçelik's Atölye 4.0 acted as the owner of the production line during the system development phase. They trained the production team before the conversion and monitored the new system in production for 6 months.

3.3 Developing a Virtual Representation

The project team needed to create a virtual representation of the thermoforming process's physical behavior. Developing a digital twin of the thermoforming process required an advanced understanding of thermoforming and in-depth expertise in complex simulation models. The project team consulted with experienced operators and production engineers to understand the production process's behavior, determining the product quality and the required material volumes.

Then, the project team observed how operators were controlling the thermoforming process and how they overcame quality problems. In this way, the group maintained the user involvement and the information flow. They also analyzed the process parameters and performance metrics, such as the availability rate, the overall equipment effectiveness, the scrap ratio, and the process costs. Then the team developed a physical representation of the process as a mathematical model based on finite elements.

To develop a FEM-based model simulating the process's physical nature, the project team used an open-source software named Calculix. However, their assumptions in developing the initial model decreased the digital twin's accuracy. This situation urged the team to make further iterations and to revise the model's assumptions.

3.4 Fine-Tuning the Digital Twin

After developing the initial model, the project team started to leave some of their assumptions, iterating with the IoT sensors' real-time data. This approach further improved the realism and increased the validity of the resulting model. At this stage, they used existing and additional sensors to achieve a comprehensive and dynamic data flow. They examined the physical aspects and the mathematical architecture of the thermoforming line from the data flow. Collecting, visualizing the data, and making the data meaningful were essential to understand the production line's mathematical and physical behavior and its material consumption.

Simularge provided insights about the methods of feature extraction for accurate prediction. During the digital twin's improvement and fine-tuning with real-time data, the project team took several steps.

Firstly, the Arçelik production team performed a design of experiment (DOE) study by varying process parameters to determine the critical parameters and acceptable error margins. Then, Simularge performed FEM simulations with the process data. Simularge engineers also met with the Arçelik team twice a week to analyze interim results and discuss current improvements/updates.

To estimate the process's theoretical behavior, the project team members ran the simulation model for all potential cases. Then, the project team used the simulation results to generate a simple function of the process characteristics. The function mimics the thermoforming process's input-output relations using the reduced-order modeling (ROM) method. The team integrated this function into the thermoforming machine, changing the PLC's operating parameters.

Arçelik's Atölye 4.0 owned the responsibility of preparing the automation and data infrastructure in this project. Together with the Simularge team, they calibrated the functional model by conducting the production trials and developed the backend and frontend application software.

3.5 The Digital Twin's Structure

The digital twin's operational process has four stages at Arçelik: Shopfloor-PLC, cloud, operator panel/feedback, and alarm control (see Fig. 4).

At the Shopfloor-PLC stage, the digital twin acquires real-time data from sensors installed on its physical counterpart. This data comes from the PLC of the thermoforming machine on the shop floor in the proposed solution. These measurements include the servo motor motions, temperature, and pressure data from sensors.

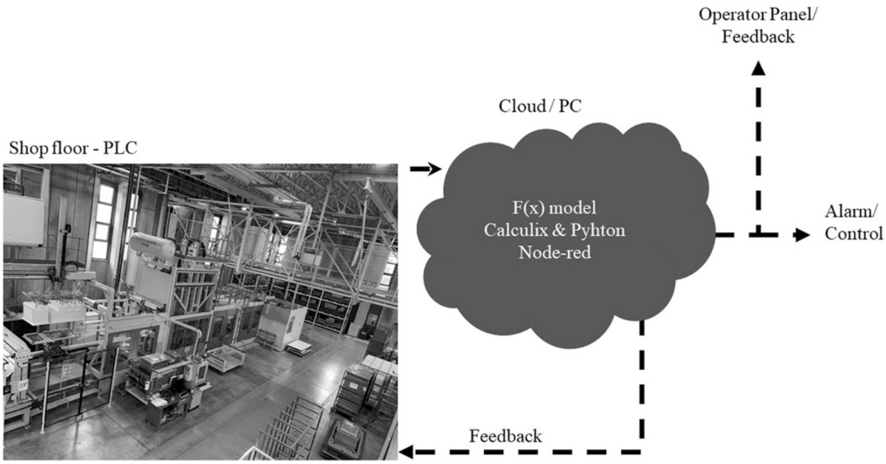

Fig. 4 The context diagram of the digital twin (Source: Arçelik)

An open-source database, created with Python Node-Red, stores the shop floor's sensor measurements on the cloud infrastructure. Engineers use this data to calibrate the characteristic function in simulations and ROM. Therefore, the digital twin is a complete virtual replica of the physical asset on the cloud. The digital twin responds to real-time sensor measurements, calculates the input-output relationship, analyzes the system's condition, and provides feedback in real time.

At the operator panel/feedback stage, the digital twin integrates the thermoforming machine and the FEM model's process parameters on an engineering tool developed based on an encoded version of the operator's know-how. This system consists of two modes to adjust the manufacturing process. The first mode generates warnings in the operator panel, where manual inputs from technicians are required. The second mode directly interferes with the thermoforming machine and automatically adjusts the process parameters to avoid process errors.

At the alarm/control stage, a dashboard monitors critical sensors to identify a systematical failure and prompt a warning. As shown in Fig. 5, the dashboard provides the cause of the loss for technical intervention.

4 Results Achieved

The digital twin project has significant benefits for critical stakeholders and the thermoforming process performance at Arçelik.

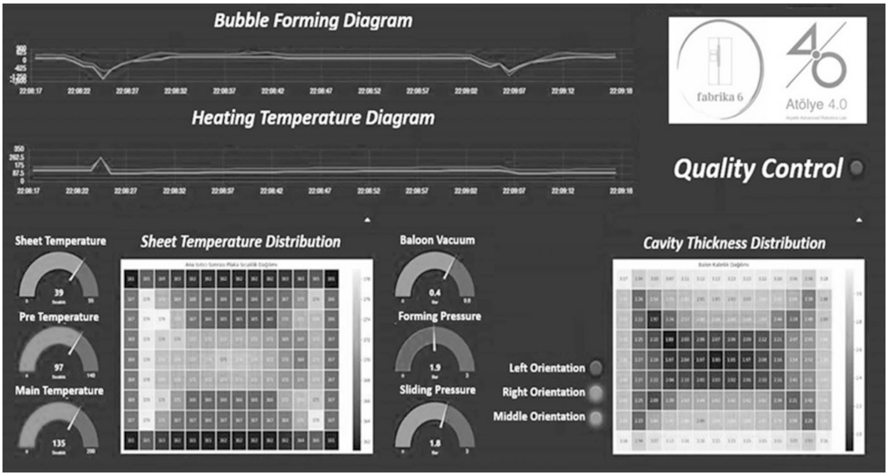

Fig. 5 Operator control dashboard (Source: Arçelik)

4.1 Business Impact

Optimized Material Consumption Conventional production systems cannot perform real-time control on the process parameters and material consumption. Arçelik has increased its sustainability performance with real-time control and has reduced its plastic usage, scrap ratio, and energy consumption. As emphasized before, the company has saved 1600 tons of plastic each year, with a value exceeding $2 million while improving its environmental impact.

Quality The material defects and process errors result in product quality problems. When a defective product is recyclable or reusable, it needs reworking. Such rework is also a waste (Ohno 1988), as it consumes additional energy and time and reduces input efficiency. However, if a defect is irreversible, then the product becomes scrap, causing a significant loss of value. Figure 6 indicates the scrap ratio has dropped from 5–8% to 1–2% with the digital twin's adoption, indicating a substantial improvement in the product quality.

Overall Equipment Efficiency (OEE) OEE accounts for the availability and performance of equipment. It is among the most critical parameters to measure manufacturing productivity (Hansen 2005). With the digital twin involving a dashboard, the machine and equipment features have become observable in real time.

Corrective and preventive interventions to the production have improved the overall efficiency. The digital twin enabled engineers to decide on the optimum production parameters without making any trial runs for planning. As Fig. 7 describes, the production line's efficiency, the OEE performance index, has risen from 68–75% to 82–92% after the digital twin.

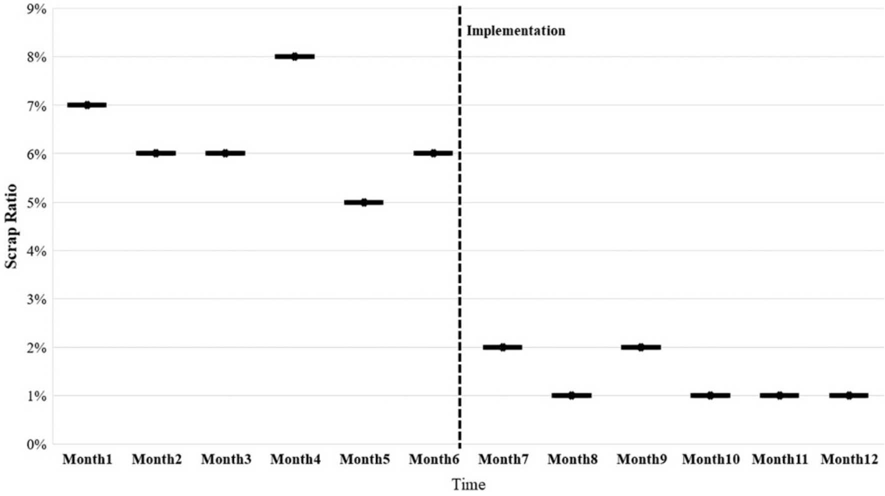

Fig. 6 Quality performance index based on the scrap ratio (Source: Arçelik)

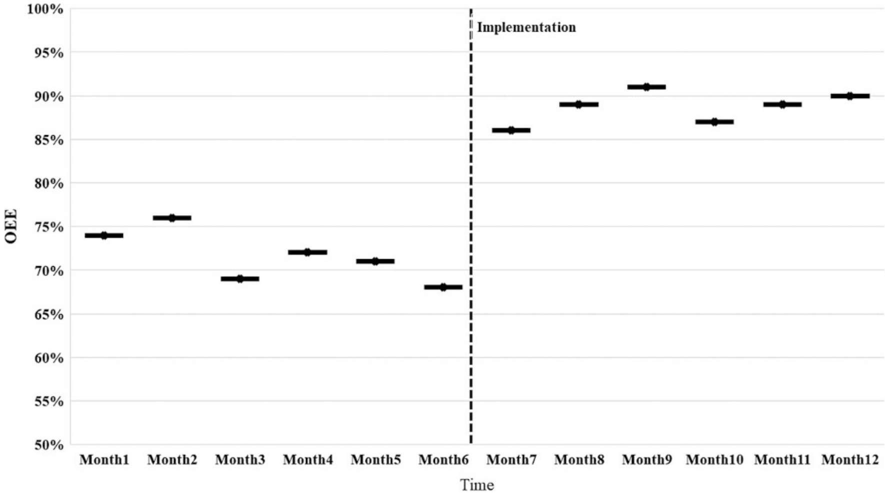

Fig. 7 OEE performance index (Source: Arçelik)

4.2 Digitalization

Encoding Operators' Knowledge The thermoforming operators' knowledge had been crucial for adjusting the thermoforming parameters. This knowledge was operators' tacit knowledge, which was action-oriented and developed with practical experience (Blackler 1995; Ambrosini et al. 2009; Collins 2010; Soler 2011). In this project, the digital twin had encoded parts of the thermoforming operators' tacit knowledge into the digital twin, as the model stores every alteration on the production line. As parts of operators' knowledge have become explicit, they also have opened to analytical scrutiny and experimentation.

Data Collection and Sensor Infrastructure Data collection had been the backbone of the digital twin project. While examining the production process, PLCs had played a significant role in collecting data from manufacturing systems. Most of the devices already have built-in sensors. However, hundreds of embedded sensors on the production line had meant terabytes of data to process. Instead of collecting every sensor data for the digital twin, the engineering team had eliminated unrelated data fields based on their expertise. They had concluded that even a single sensor might be enough to simulate the production line. After defining the measurement limits, the data collection frequency, the required data precision, and the sensor accuracy, sensor requirements had determined more precisely with different production scenarios.

Digital Dashboard as a Process Engineering Tool With the digital twin project, the project team has decided to install a dashboard on thermoforming machines' PLC unit. This device automatically modifies parameters according to the changing production conditions and enables responsive error correction.

The dashboard's user interface serves operators and production engineers for exploring parameter alterations and introducing incremental changes quickly. When a team cannot fix a production problem, production and R&D engineers collaborate to modify the parameters. The dashboard also has a developer interface for production and R&D engineers.

When a new refrigerator starts production, it requires a new FEM model using new process parameters that updates the thermoforming machine via PLC. Arçelik has a database that stores every refrigerator model's thermoforming process parameters. Hence, the system calculates thermoforming machines' production efficiency and helps the production team take timely precautions.

4.3 Project Management

As a large-scale enterprise, Arçelik has some rigid rules and conventional structures in project management. While the digital twin project team had aimed for flexibility and speed, they were still required to get approvals from various departments at different project stages. The time required to get these approval certainly caused inefficiencies and increased non-value-adding tasks in the project.

In such cases, Simularge acted as a partner with agile project management principles. When needed, they expedited the project by taking the initiative to manage change and balance the schedule variance caused by Arçelik's administrative procedures. In some instances, the Arçelik management team hesitated to delegate some tasks to the startup. However, the project team benefitted extensively from adopting agile practices and iterative development. For example, the scope definition had changed many times during the project. The project team had to reiterate the requirements analysis, design, and prototyping stages many times. However, such changes did not cause a budget or schedule overrun due to the immediate actions taken to re-plan and re-organize the tasks without sacrificing the project objectives.

5 Lessons Learned

The case described in this chapter has several lessons for manufacturing companies and potential stakeholders. This section summarizes five critical takeaways and provides two topics for further discussions.

5.1 *Digitalization for Better Performance and Sustainability*

As emphasized in the United Nations Global Sustainable Development Goals Number 12 – Sustainable Consumption and Production (Sustainable Development Goals 2015), manufacturing companies have to reduce their material footprints (Gasper et al. 2019). Following the vision on sustainability and responsible production, Arçelik has aimed to minimize its excessive raw materials usage, mostly composites, and plastics in its products.

Digital tools deliver resource efficiency to improve sustainability performance by optimizing material and energy consumption (Demartini et al. 2019). Our digitalization case is also in line with this principle. The digital twin project has the purpose of reducing raw material usage, significantly consuming less energy and materials in every Arçelik plant.

Digital twins enable sustainable, intelligent manufacturing (He and Bai 2021). Our case illustrates how developing and implementing a digital twin may allow manufacturers to reduce their materials and energy consumption. Arçelik prevents material and energy waste, offering a better environmental footprint. Digital twins may help in meeting conflicting key performance indicators, such as maintaining high product quality while keeping raw material usage and scrapping at a minimum.

5.2 *Feature Engineering and Data Mining*

Feature engineering is the process of extracting raw data features with data mining to improve an algorithms' performance. As highlighted in the "Situation Faced" section, the Arçelik team assumed that the process conditions are ideal at the beginning of the project. The group performed FEA only on the product instead of integrating FEA with the entire production line.

Arçelik had used the process data to train an ML model for modeling the thermoforming process. However, this attempt has given limited results and limited feature extraction. During the partnership with Simularge, Arçelik has increased its awareness of the criticality of feature extraction, especially for predicting critical process parameters.

Feature engineering improves the performance of ML models since the features determine model accuracy. Our case follows previous research and practice since our case study reveals that integrating IoT data, a digital twin provides reliable and effective results than limited feature extracting ML models (Min et al. 2019).

5.3 Leveraging Engineering Expertise and Technical Infrastructures

As mentioned before, PLCs played a significant role in data collection in the digital twin project. The engineering knowledge and shop floor experience of Arçelik brought an advanced understanding of the process data. As a result, the project minimized additional investment requirements.

In our case, the project team had left their earlier assumptions about the thermoforming process using the data from the IoT sensors. Availability of data helped the project team develop a better representation of the thermoforming process. Integration of the FEM and IoT data streams enhanced the validity of the digital twin with real-time data.

Recently, a similar system is reported in the literature, where a PLC collects real-time data and an open platform communications server synchronizes a digital twin with a cloud platform (Židek et al. 2020). Our case reports a similar system where a digital twin runs for quality and production control, synchronizing with IoT devices on the shop floor.

Our case also illustrates how digital twins can detect problems before they happen in a manufacturing environment, reducing material usage by enabling proactive and preventive actions.

5.4 Connecting with an Entrepreneurial Ecosystem

Intermediaries may provide substantial benefits for creating linkages between large enterprises and startups in entrepreneurial ecosystems. There are significant barriers to the manufacturing industry's digitalization (Deloitte 2015; Oesterreich and Teuteberg 2016; Semolic and Steyn 2018). Lack of effective collaboration is also a high-impact challenge for digitalization (Camarinha-Matos et al. 2017). Our case study illustrates that companies can overcome barriers to digitalization by establishing collaborative inter-organizational linkages.

In our case, Arçelik's Atölye 4.0 had acted as a hub to accelerate the collaboration between the ITU Çekirdek (incubator), Simularge (technology startup), and the Arçelik production team (enterprise). The existing relationship of Atölye 4.0 with ITU Çekirdek had speeded up the process of locating alternative startups. Based on this observation, we also suggest that large enterprises build collaborative relations and partnerships with existing innovation centers and startup incubators in their environment.

The competency, startup variety, and openness to collaborate of ITU Çekirdek had also played a critical role in overcoming inter-organizational boundaries and potential procedural obstacles. Arçelik's industrial competency in applying a specific technical solution and Simularge's real-time manufacturing experience has played a significant role in developing a successful partnership. Collaboration and partnership between Arçelik Atölye 4.0, ITU Çekirdek, Arçelik teams, and Simularge stand out as remarkable examples of collaboration in digital ecosystems against the complexity of new technologies (Bedford et al. 2018).

The partnership has contributed both to the efficiency and the sustainability performance of Arçelik and the growth of Simularge. The case shows how a collaborative attitude may be a critical success factor for digitalization. Even large manufacturing enterprises with an advanced resource base can expand their digital capabilities taking a collaborative attitude with entrepreneurial talent residing in startups.

We believe this case is an essential resource for manufacturing companies. In its planning phase, Arçelik faced a lack of detailed use-cases describing digital twin implementations in manufacturing. The manufacturing industry needs to open up inter-organizational research practices, embrace knowledge exchange, and share their case studies.

5.5 *Project Management as a Critical Skill*

Startup and enterprise collaborations offer new opportunities. For startups, it enables privileged access to a larger market and more complex needs. For enterprises, it may bring strategic renewal and open innovation. Agile practices provide a repertoire for both parties to collaborate more effectively (Weiblen and Chesbrough 2015).

Resource allocation and scheduling are crucial factors in R&D projects funded by corporate firms. Startups may help enterprises accelerate their R&D projects (World Economic Forum 2018) and refrain from traditional project management approaches' problems. In our case, Simularge intervened the project management by introducing agile practices in design, development, and testing. The Arçelik team had experienced iterative working and has acquired a practical understanding of agile practices through the project.

The advanced forms of the waterfall-type project management could be preferable if the project were predictive, including technologies or methods. As a linear project management process, it is also simple to follow and to understand. However, in projects with high uncertainty, the exact specifications of the product and the scope of the project cannot be determined precisely. Therefore, an agile project management approach would be more appropriate (Project Management Institute 2017). Our case shows that choosing the waterfall model for project management was not the right decision. Because the project team had to iterate the requirements analysis, design, and prototyping stages, revising the project's scope definition repeatedly.

Managing inter-disciplinary teams in a digitalization project is also a critical success factor (Project Management Institute 2017; Lanzolla et al. 2020). In our case, people from different units of Arçelik contributed to the project collaboratively. Rather than establishing a functional project organization, the project team implemented a matrix organizational structure. Members from different functions shared the responsibility of different project milestones with different units. They also divided project responsibilities among participants based on their expertise. Teamwork had speeded up the digitalization project and enabled engineers from diverse backgrounds to team up.

5.6 Further Discussions

Besides the critical takeaways above, our case study also highlighted the importance of open-source software and startup partnership as critical areas that are worth further discussion and research:

Open-source software is vital in delivering digital solutions. Packaged manufacturing software from established vendors offers lower implementation risks. The project team, in our case, had preferred to use open-source software to prepare a dashboard application for several reasons. Besides their high costs, proprietary packaged software is less flexible in terms of configuration and customization. The licensing limits the additional developments that the user can perform. Moreover, open-source programs let software engineers learn about the application architecture and manage their development processes. Using configurable open-source software, the project team developed a tool to read and change the process parameters, apply dynamic analytics, and conduct detailed experiments.

Defining the project scope and partnering with a startup contributed significantly to the digital twin project's success. Enterprises usually find it hard to collaborate or commit to a startup. However, this commitment and task distribution can balance and level the workload of engineers who work in an enterprise. It also helps enterprises reach a more extensive talent basis and participate in open innovation. Collaborating with a startup usually involves performing concurrent and iterative practices and agile project management. Iterative and agile project management requires developing mutual trust between all parties. Undertaking a significant change in an enterprise's project management mindset may be a prerequisite for collaborative development and partnership.

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Using Blockchain to Coordinate Federal Processes: The Case of Germany's Federal Office for Migration and Refugees

Julia Amend, Christopher van Dun, Gilbert Fridgen, Franziska Köhler, Alexander Rieger, Alexander Stohr, and Annette Wenninger

Abstract

(a) **Situation faced**: The German asylum procedure requires close cooperation and information exchange between various authorities at the municipal, state, and federal levels. Federal separation of competencies inhibits the delegation of process governance to a central authority such as the Federal Office for Migration and Refugees (BAMF). This separation also leads to regional differences as federal laws govern the procedure's general steps, whereas state laws govern implementation. Moreover, existing solutions for cross-organizational collaboration are limited in terms of flexibility, security, and data quality. As a result, the exchange of certain data on asylum procedures still occurs using Excel spreadsheets and e-mails.

(b) **Action taken**: Against this backdrop, the BAMF explored technological options that would support the decentralized governance of the asylum procedure. After a preliminary evaluation, the BAMF decided to explore a solution based on blockchain technology. Building upon a successful proof of concept, the BAMF initiated a pilot project with Saxony's central immigration authority. This project

Franziska Köhler—The views and opinions expressed are those of the author and do not necessarily reflect the official policy or position of Germany's Federal Office for Migration and Refugees (BAMF).

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aims to develop a blockchain solution that supports the coordination of asylum procedures and can be easily adapted to local differences and functional requirements.

(c) **Results achieved:** The use of the blockchain solution allows for efficient, secure, and timely distribution of status information. It supports communication and improves coordination between authorities. Despite an apparent conflict between blockchain principles and data privacy requirements, the BAMF's design complies with relevant regulation (notably the GDPR). As a first-of-its-kind project, it outlines best practices and provides valuable insights into opportunities and challenges arising from the use of blockchain in the public sector.

(d) **Lessons learned**: The BAMF's case demonstrates that blockchain solutions can be promising alternatives when the delegation of process governance to a central party is not desirable and when federal principles of organization are to be reflected technologically. However, blockchain projects require special attention to managing know-how and capabilities, software development activities, stakeholders, the regulatory context, and cross-organizational governance.

1 Introduction

Modern blockchain solutions provide an effective means of support for cross-organizational processes. They allow organizations to establish a shared truth on the current state of a process while maintaining control over their respective area of responsibility within the process. The use of smart contracts also permits the creation of automated triggers for specific process steps and extensive monitoring capabilities. Thus, modern blockchain solutions are a promising alternative to centralized process management systems for cross-organizational applications (Mendling et al. 2018; Fridgen et al. 2018).

The blockchain project of Germany's Federal Office for Migration and Refugees (BAMF) presents an interesting case in point (Rieger et al. 2021). It evaluates the use of a modern blockchain solution to coordinate cross-authority processes in the German asylum procedure. In Germany, the asylum procedure is governed by a nexus of federal and state laws. While federal laws govern the procedure's general steps, state laws govern the procedure's implementation, which means that sub-processes may differ perceptibly between different municipalities. It also entails fragmented IT systems and databases that restrict the seamless exchange of information. However, the asylum procedure requires close coordination between various authorities at the municipal, state, and federal levels. Aside from the BAMF, these include state immigration authorities and municipal authorities responsible for asylum seekers' accommodation and processing.

Necessary steps toward improving the exchange and provision of data in the asylum context were the establishment of a standardized format for data exchange (XAusländer) and a federal database (AZR) as central storage for the essential personal information of foreign nationals and, therefore, also asylum seekers. However, the standardized data format and the database are not designed for the exchange and storage of process updates and related operational data. Moreover, the delegation of process governance to a single authority does not appeal to the authorities involved in the asylum procedure due to the variety of processes and process variants. Accordingly, blockchain's promise of decentralized governance was particularly attractive to the BAMF.

One of the core objectives of the BAMF's blockchain project is to develop a blockchain solution that increases the security, efficiency, and timeliness of asylum procedures and warns against—or at least documents—deviations from standard processes. In the first step, the BAMF developed a proof of concept for such a solution. Subsequently, it began working on a pilot version. The case study at hand discusses the development of this pilot version, including the evaluation procedure and the challenges faced.

The remainder of this chapter is structured as follows: First, we briefly outline the initial situation and the case context. Second, we describe the BAMF's course of action, including the implemented process model, constraint mitigation activities, stakeholder management, and the evaluation procedure. We then discuss the results achieved. Finally, we present best practices and lessons learned from the BAMF's blockchain project.

2 Situation Faced

The right to asylum for politically persecuted individuals is laid down in the *Grundgesetz*, the constitution of the Federal Republic of Germany (Rieger et al. 2021). The German Asylum Act extends this right to anyone who flees from violence, war, or terrorism. The act governs the general design of asylum procedures and specifies the authorities' necessary competencies and responsibilities. Figure 1 provides a simplified overview of the German asylum procedure from the authorities' perspective.

While the BAMF plays a pivotal role and issues decisions regarding asylum applications, state-level migration authorities and municipal governments are responsible for the initial registration, distribution, accommodation and care, and the eventual integration or repatriation of the applicant. In addition, several security agencies conduct background checks, various health authorities provide medical care, and educational services offer language and cultural courses. Therefore, the German asylum procedure requires the exchange of information and coordination between various authorities at the municipal, state, and federal levels.

The delegation of process governance to a central authority, such as the BAMF, is not desirable because doing so would undermine the procedure's desired separation of competencies. This separation also leads to a significant degree of variation between local sub-processes, making the creation of a common process model difficult. Currently, the deliberately fractured nature of the procedure means that

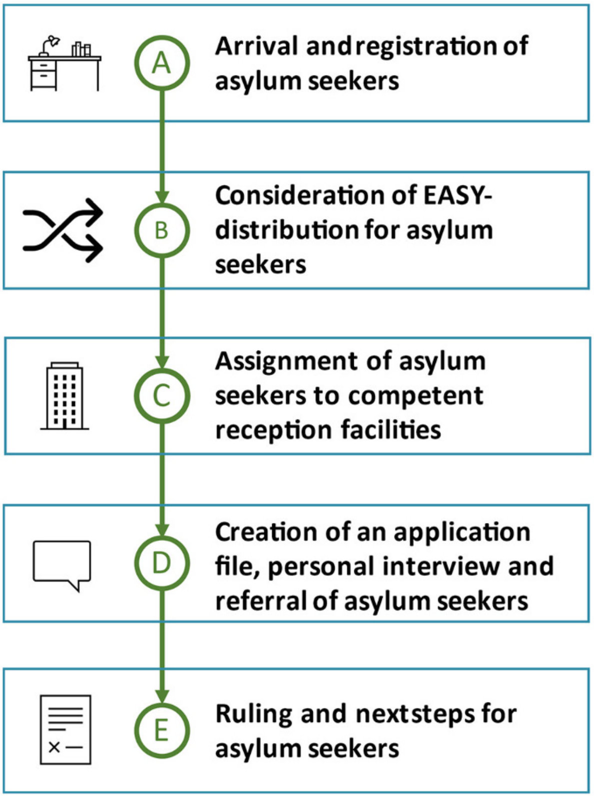

Fig. 1 The German asylum procedure from the authorities' perspective

the exchange of specific data on asylum procedures still takes place using paper lists, excel spreadsheets, and fax messages, which, in many cases, are still considered practical methods for sharing information.

However, this way of sharing information and collaborating is cumbersome and error-prone, which is why the authorities involved in the asylum procedure started various digitalization initiatives to increase the procedure's security and efficiency. Although many of these projects have been useful, some also revealed the limits of centralized IT solutions.

One prominent example is the Central Register of Foreign Nationals (AZR), a centralized database for foreign nationals in Germany. The AZR stores data on more than 26 million foreign nationals and grants more than 14,000 authorities access to read and write in these records. The size of the AZR impedes logging and informing users of data updates by other users. Moreover, the AZR is prone to data quality issues because many updates are manual and authorities do not use the AZR as their primary database. Although data security considerations are paramount, the AZR's centralized design means it is highly vulnerable to failure and attacks. Additionally, a special law governs its management and use. Since each adjustment to the AZR may represent a redistribution of competencies, extension projects generally require detailed legal examination and legislative action. This process substantially reduces flexibility, especially when a modification touches upon the competencies of many authorities.

Consequently, the BAMF began to look for decentralized technological alternatives that would not require the delegation of process governance to a single authority and would not require changes to the existing organizational and legal frameworks. One option is the use of decentralized versions of classical workflow management systems. However, these systems often emphasize the automated management of workflows, while the federal separation of competencies complicates and may even prohibit inter-authority automation and cross-organizational monitoring of processes.

3 Action Taken

Against this backdrop, the BAMF began to explore decentralized technological alternatives that would maintain regional competencies and local responsibilities for sub-processes (Fridgen et al. 2019b). Based on a preliminary assessment, the BAMF decided to evaluate the prospects of blockchain technology via a proof of concept (PoC). In this PoC project, the BAMF created a prototype for a simplified asylum procedure involving three authorities. This prototype logs and propagates the completion of essential process steps on a blockchain. An IT provider working for the BAMF also coded the simplified asylum procedure into a smart contract to allow for automated monitoring of the procedure and trigger subsequent process steps. The PoC exemplified several functional and technical benefits of a blockchain solution. Firstly, it could rapidly and securely establish a shared truth on the status and course of the asylum procedure across various authorities. Secondly, it could facilitate the coordination of the many authorities involved in handling asylum applicants. Thirdly, a blockchain solution could support decentralized structures by leaving data in the respective repositories while using status messages to document when and where a status change in the asylum procedure occurred.

Following the positive evaluation of the PoC, the BAMF decided to test the technology in a pilot project (Fridgen et al. 2019a). Due to the complexity of the German asylum procedure, the BAMF limited the scope of its pilot project to two authorities (the BAMF and Saxony's central immigration authority, LDS) in the AnkER facility in Dresden, Germany. The AnkER concept bundles representative functions and responsibilities related to the asylum procedure in one place: from arrival, accommodation, counseling, asylum applications, and decisions to local distribution and the integration or repatriation of asylum seekers. The pilot focuses on the first steps of an asylum procedure: arrival, registration, and personal interview. In the further course of the project, the BAMF envisions implementing additional areas of application such as local distribution and decision and return. Fridgen et al. (2019a) and Rieger et al. (2021) provide a detailed discussion of the different application areas and associated process steps.

3.1 Flexible Process Model

Based on a typical asylum procedure in the context of the AnkER facility in Dresden, the BAMF created a process model with a hierarchical structure of areas of application, status categories, and status messages (Rieger et al. 2021). In keeping with the federal German Asylum Act, each application area has one or more functional status categories, which reflect the mandatory elements of any asylum procedure. A functional status category can comprise one or more status messages that may differ locally in some instances. The process model also contains dependencies and rules regarding status messages, status transitions, and the corresponding effects (e.g., new status, parallel status messages, no changes).

The BAMF implemented this process model in its blockchain solution as a status machine that is changeable via simple configuration files (Rieger et al. 2021). The status machine has a modular and flexible design and can be easily adapted to meet the requirements of specific authorities. The status machine performs three primary functions: "forward," "warning," and "critical error," as indicated in Table 1 and detailed in Rieger et al. (2021). The forward function informs caseworkers of the status of asylum procedures, while the warning and the critical error functions inform caseworkers of minor and severe deviations from the typical procedure coded into the status machine. However, the blockchain solution acts only as a support system. After due evaluation, caseworkers can overrule these status messages to provide the required flexibility in the asylum procedure. The blockchain solution nevertheless records any such deviations from the typical process.

3.2 Constraint Mitigation

Live blockchain solutions are scarce, particularly in the public sector where few authorities currently possess the requisite specialized knowledge and capabilities in-house. Consequently, when it came to the implementation of blockchain technology, the BAMF could only draw from limited experience and so, with the help of external experts, begin experimenting. The BAMF took an agile approach to these experimental activities during which it had to overcome several constraints. In addition to organizational and technical challenges, regulatory requirements such as the General Data Protection Regulation (GDPR) and IT-security standards significantly influenced the implementation process and led to the continuous

Table 1 Functions of blockchain solution (Rieger et al. 2021)

Forward function	Notification to continue with the next process step
Warning function	Notification to the affected authority that there are minor deviations from the typical procedure
Critical error function	(Push) notification to the affected authority that there are serious deviations from the typical procedure

adaptation of the blockchain solution. Because complying with the GDPR was particularly challenging, we briefly describe the related challenges and actions in the following. A more detailed description of these challenges and activities is available in Rieger et al. (2021).

The GDPR standardizes rules for personal data processing by private and public data processors across member states of the European Union (EU). It grants data subjects the right to hold controllers and processors of their data accountable. Simultaneously, the law seeks to foster the free movement of personal data across EU member states. The GDPR poses three fundamental challenges for blockchain projects in general and the BAMF's blockchain project in particular: Firstly, the GDPR demands that responsibilities for ensuring compliance are clearly identified and designated, particularly when several parties jointly control the processing of personal data. Establishing these responsibilities for a blockchain solution is often difficult, especially if the blockchain network is public and permissionless. Secondly, the GDPR prohibits data processing unless this has been explicitly authorized by the subject or is required to fulfil obligations under law or contract. However, establishing a lawful basis for each act of data processing in a blockchain network can be particularly cumbersome. The third challenge is the reconciliation of the rights to rectification and erasure with blockchain's premise of tamper-resistant, permanent on-chain storage.

3.3 Evaluation Procedure

A blockchain project, such as that undertaken by the BAMF, needs to succeed on multiple levels rather than simply generate a profitable business case. To measure the success of the project and the suitability of blockchain as digital infrastructure for the German asylum procedure, the BAMF must develop a multi-dimensional evaluation concept for the blockchain solution. Thus, in an initial step, the team defined clear design objectives for the solution, such as increasing the transparency of cross-authority process steps, displaying warnings in case of process deviations, increasing collaboration productivity and efficiency, improving information quality for decisions, and increasing legal security.

These design objectives act as a basis for the development of an evaluation concept. In general, the evaluation consists of two phases. The first phase (ex-ante) will record typical instances of the asylum procedure prior to the introduction of the blockchain solution. In contrast, the second phase (ex-post) will document such instances after the solution has been introduced. A quantitative and qualitative comparison of these two phases will enable the team to evaluate its success.

This comparison considers eight evaluation criteria, which the BAMF derived based on the design objectives. These criteria relate to the utility of the blockchain solution and the degree to which it fulfills the design objectives. These criteria are (1) flexibility, (2) innovativeness, (3) integrity, (4) communication and collaboration, (5) user satisfaction, (6) legal certainty, (7) speed, and (8) transparency.

Flexibility (1) is generally understood as the ability to adapt to change while maintaining efficiency and effectiveness. The asylum procedure is prone to change and must be able to adapt to changing circumstances such as environmental conditions, new legal regulations, or changes in the authorities involved. *Innovativeness (2)* involves a planned and controlled change to a system via the application of new ideas, skills, or technologies. The ability to innovate can be crucial for organizations seeking to ensure effective and efficient procedures in the longer term. *Integrity (3)* focuses on process integrity. This dimension aims to ensure that processes are performed in a predefined manner. The use of the blockchain solution means that tamper-resistant documentation is available in the case of a process deviation. *Communication and collaboration (4)* are essential as the asylum procedure involves several different authorities on different levels of government. Communication, which can occur in various ways, is a critical factor in successful and efficient cooperation. The transmission of information strongly depends on the recipient's understanding. Thus, room for interpretation can harm the future course of the process.

User satisfaction (5) is employed to assess how satisfied various users are with a system, i.e., the existing IT systems used in the asylum procedure and the newly introduced blockchain solution. As the employees carry out the processes and benefit from possible simplification, automation, and relief, user satisfaction also reflects the employees' acceptance. Employee acceptance is crucial for exploiting the blockchain technology's full potential. *Legal certainty (6)* is based on clarity, consistency, predictability, and the upholding of legal standards. The asylum procedure is used to determine the fate of asylum seekers and is, therefore, based on a strong legal foundation that needs to be firmly integrated into the blockchain solution. The quality of information involved in cross-organizational processes must remain high to ensure that these processes function as intended and that legal standards are maintained. *Speed (7)* is used to measure whether procedures have become more efficient, e.g., in providing information regarding process status across administrative boundaries. Increases in efficiency are likely to reduce waiting times for cross-organizational process steps and, ideally, will accelerate the overall process. *Transparency (8)* aims to present cross-organizational processes in a clear, complete, almost real-time manner across authorities. Thereby, each participating authority receives all necessary information regarding the process status, taking into account responsibilities and data protection concerns. With increased transparency, the BAMF and other authorities involved may also benefit from improved resource and time management.

3.4 Stakeholder Management

Due to their decentralized design, blockchain solutions require the effective integration of various stakeholders. Thus, the success of a blockchain project largely depends on stakeholder management and the integration of potentially divergent interests and requirements.

While the BAMF held the leading role in the project, it nonetheless needed to consider the specific requirements of other authorities involved, as well as the potential requirements of authorities that might join the project in the future. The federal separation of competencies in the asylum procedure provides the respective authorities with a certain level of decision-making autonomy yet, at the same time, requires these authorities to collaborate and communicate closely in specific process steps. Therefore, the BAMF needed to consider various perspectives during their development of the blockchain solution and so held multiple workshops with different authorities to gather essential input, discuss current concepts, and iterate on these ideas as early as possible.

However, stakeholder management went beyond the authorities and individuals closely connected to the project. To live up to the characteristics of a lighthouse project and generate best practices for public sector blockchain projects in Germany, the BAMF regularly reported and discussed the project with the relevant ministries and committees in Germany. The BAMF also discussed its blockchain solutions with other authorities in Europe, the USA, and Canada.

When the project began, the BAMF had little experience with large and complex IT projects. Due to the new technology and its disruptive character, blockchain projects involve high levels of uncertainty and risk and are often subject to a significant number of questions and concerns on the part of internal stakeholders. Thus, managing internal stakeholders and responding to their questions and concerns were of utmost importance. To this end, the project team frequently presented the concepts and ideas to different divisions and directorates, took every opportunity to share news of the project via the BAMF's communication channels (e.g., the intranet or newsletters), and shared information on the project's progress as openly as possible. Moreover, the team involved the BAMF's relevant committees (e.g., the worker's councils) from the earliest days of the project.

4 Results Achieved

4.1 Architecture and Constraint Mitigation

The BAMF developed an integrative software architecture that meets all of the relevant regulatory, functional, and organizational requirements (see Fig. 2). This architecture consists of three layers: (1) Backend Systems, (2) Blockchain Platform, and (3) Integration Services. Fridgen et al. (2019a) and Amend et al. (2021) provide detailed information regarding the BAMF's architecture. Thus, here we focus on a brief description of each service, providing a basic understanding of its functionality.

The various *Backend Systems* ensure that each participating authority can continue to use their proprietary IT systems. Firstly, this means that no complex data migration or system change projects are necessary. Secondly, no external entity

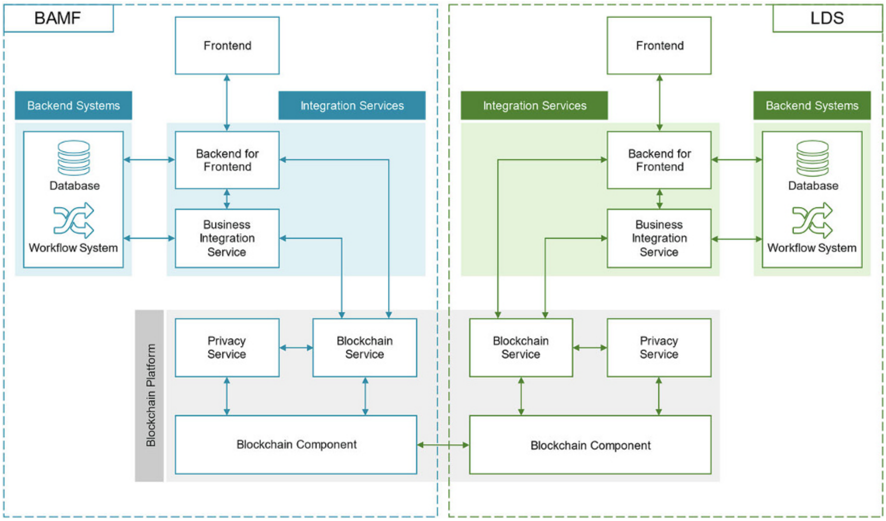

Fig. 2 Architecture of the blockchain solution

(such as another authority) needs to have access to these proprietary databases and workflow management systems, thus maintaining the high levels of security necessary in the asylum procedure. Thirdly, information that is not essential in cross-organizational collaborations is inaccessible to other authorities, guaranteeing the authorities' separation of responsibilities and competencies.

In turn, information that is essential in cross-organization collaboration (i.e., that is needed by more than one authority) is shared via the *Blockchain Platform*, representing the "shared" part of the solution. Specifically, each authority that uses the blockchain solution has the same three elements in its *Blockchain Platform*: the *Blockchain Component*, the *Blockchain Service*, and the *Privacy Service*. The *Blockchain Component* propagates pseudonymized status messages. Each of these consists of four attributes: a status update, a timestamp, a technical identifier of the authority that created the status update, and a pseudonymous identifier of the respective process instance. These attributes are the minimum amount of data required for effective use. In order to attribute pseudonymized status messages on the blockchain and comply with data privacy regulations, the BAMF design includes so-called *Privacy Services*. Each authority has its own *Privacy Service*, which features databases that map the pseudonymous blockchain IDs to functional IDs. The exchange of mapping information through *Privacy Services* is crucial in triggering the authorities responsible for subsequent steps in an asylum application. *Privacy Services* can also exchange requests for the erasure of mappings related to a pseudonymous ID. The *Blockchain Services* can write status messages to the *Blockchain Component* and read and forward status messages from the *Blockchain Component*.

The *Integration Services* are crucial for linking both of the above-described layers while complying with data privacy regulations. The integration layer has three elements: the *Business Integration Service*, the *Backend for Frontend*, and the *Frontend*. One primary function of these *Integration Services* is the submission of status messages to the *Blockchain Platform* and the display of data from both the *Blockchain Platform* and *Backend Systems*. The *Business Integration Service* connects to the authority's *Backend Systems* for information transfer and introduces a second layer of pseudonymization. This service contains databases that map the functional IDs used on the blockchain to the IDs used in the BAMF's or other authorities' *Backend Systems*, such as personal identification numbers or application numbers. This mapping is necessary since identifiers in the *Backend Systems* may change over time.

To provide a simple example: For data display, BAMF users can access the BAMF's *Frontend* through a web browser and enter various commands, for example, instructing it to display the history of a specific instance of the asylum procedure or to display all procedures that meet certain conditions. The *Frontend* will pass these instructions to the *Backend for Frontend*, which then invokes the *Business Integration Service* and instructs the *Blockchain Service* to provide the required status messages from the *Blockchain Platform*. Subsequently, the *Blockchain Service* collects—in accordance with the user's access rights and the mapping information in the *Privacy Service*—the required status messages and forwards these to the *Backend for Frontend*. The *Backend for Frontend* then complements the returned status messages with further data from the *Backend System*, if required, and forwards this information to the *Frontend* for display to the user.

Although blockchain technology and data protection seem to be—at first glance—jarring opposites, the BAMF solved this divergence by selecting a pseudonymization approach. As its name suggests, this approach bases on pseudonymizing the asylum seeker's data on the blockchain. The BAMF and the involved authorities process the personal data in such a manner that no attribution to a specific natural person, namely, an asylum seeker, without the use of additional off-chain information is possible. In particular, the BAMF decided to implement a multi-layered pseudonymous identifier solution with the already described *Business Integration Services* and *Privacy Services*. With this solution, each involved authority operates an off-chain service that maps pseudonymous identifiers on the blockchain to functional IDs. These allow the clear identification of individual asylum applications across all authorities involved in the asylum procedure and do so in a privacy-sensitive, erasable, and rectifiable manner. Without the mapping, the BAMF and other authorities involved in the blockchain solution cannot attribute the blockchain's data to an asylum seeker. To this end, the BAMF created, through an administrative agreement, a joint control arrangement with the LDS that established the purpose and means of processing and assigned responsibilities for GDPR compliance.

4.2 Evaluation Procedure

The BAMF's solution is still undergoing extensive testing. Soon, the BAMF will start the pilot phase. However, initial results indicate promising benefits regarding the defined design objectives, including increased process transparency and collaboration efficiency, improved information quality, and increased legal security. Meanwhile, ongoing discussions with current and prospective participating authorities, together with the resulting adaptations of the blockchain solution, contribute to a successful development phase. The approval of various stakeholders, including federal appointees for privacy protection, predicts promising results in the pilot phase. Although the blockchain solution still needs to demonstrate its usefulness in this subsequent phase, project members are optimistic. In particular, the stakeholders expect the blockchain solution to meet the functional and organizational requirements of the federal system. Consequently, as a nationwide flagship project for blockchain solutions in public administration, the BAMF's best practices and lessons learned have already laid the groundwork for future projects.

5 Lessons Learned

The BAMF's blockchain project is the first of its kind in Germany and provides valuable insights into the opportunities and challenges of using blockchain in the public sector. In the following, we present some of the lessons learned so far:

1. IT projects involving new technologies such as blockchain require special attention to the management of capabilities. Such projects often rely on external consultants and developers because the necessary capabilities are not yet available in-house. However, reliance on external expertise creates dependencies that need to be identified, assessed, and mediated. In particular, projects need to balance the development of in-house capabilities, which is often cheaper but slower, with the use of external expertise, which is often more expensive but faster. Moreover, measures should be taken to avoid the localized building of capabilities. Such concentration increases pressure on project members with these capabilities and creates risk and liabilities when these members are not available or leave the project.
2. IT projects involving new technologies require special attention to the management of (software) engineering and development activities. In particular, conventional software development methods are often ill-suited for use in the initial phases of such projects. Instead, such projects should initially allow experimentation with the technology to develop a clear vision of the future solution architecture. This process of conceptual adaptation and constraint mitigation requires close guidance from solution architects. Conceptual adaptation involves adapting technology to the specific context of use. Constraint mitigation helps

uncover and mitigate constraints that can arise when the technology is introduced to this particular context (Du et al. 2019; Keller et al. 2019).
3. IT projects involving new technologies require special attention to stakeholder management. Technical stakeholders may unduly favor new technologies or inadequate yet more familiar technologies, potential users may be reluctant to use immature solutions, and managers may voice overly ambitious goals. Conventional models for stakeholder management can be highly effective but may have to be adapted for use in cutting-edge IT projects. Since blockchain solutions are typically used in a cross-organizational context, stakeholder management also needs to consider cross-organizational aspects, such as different corporate cultures and mindsets.
4. IT projects involving new technologies require special attention to regulatory compliance. Although the resulting costs can be high, the risks of non-compliance are often higher. In many instances, innovative designs that ensure regulatory compliance can increase innovation capital. For example, the BAMF demonstrated that blockchain and the GDPR could be reconciled (Rieger et al. 2019; Guggenmos et al. 2020), which has earned the project increased national and international support.
5. IT projects focusing on cross-organizational process coordination require special attention to process governance. In the case of the asylum procedure, the desired separation of competences between different authorities on the different levels of Germany's federal government requires decentralized process governance. Therefore, coordinating rights and responsibilities between authorities and creating a spirit of shared product ownership are just as important as the blockchain solution in itself.

In summary, the BAMF case demonstrates that blockchain solutions are a promising alternative when the delegation of process governance to a central authority is not possible or desirable. However, blockchain projects require special attention to the management of capabilities, development activities, stakeholders, regulatory contexts, and cross-organizational governance. When these aspects are managed appropriately, modern blockchain solutions can be a valuable alternative.

Consequently, the BAMF is contemplating various expansion scenarios for the blockchain solution. For instance, future releases of the blockchain solution are planned to include additional application areas (such as the process of re-evaluating and, potentially, withdrawing protection) and functionalities for digital identity and certificate management. Another direction for expansion is the addition of other facilities in Saxony that are similar to Dresden's AnkER facility, other German states with AnkER facilities, or even other European countries to strengthen European collaboration in the asylum procedure. Lastly, the authorities involved in the asylum procedure, and authorities in general, can use best practices, concepts, and design patterns from the blockchain project as blueprints for different contexts.

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Breaking Down Barriers with Digital Technology: Reimagining Chronic Care by Empowering Paramedics

M. Kathryn Brohman and Richard Whittaker

Abstract

(a) **Situation faced**: The case company, Future Health Services (FHS), provides tele-home monitoring services to chronically ill patients in Southern Ontario. As the population continues to age, the healthcare industry is committed to leveraging technological solutions to provide care for patients in the comfort of their own home. FHS offers a program through collaboration with paramedics that aims to improve patient care at home and quality of life as well as connect patients to a broader network of care providers to appropriate care delivery according to specific patient needs. In implementing this program, paramedic services started to transform and expand their traditional operating model.

(b) **Action taken:** FHS introduced the Community Paramedic Remote Patient Monitoring program, called CPRPM. In this model, paramedics were required to onboard patients, work with patient doctors to establish clinical thresholds, and complete work required to set up and train patients to use remote monitoring devices to manage their condition from home. Once up and running, the CPRPM system alerted paramedics daily if the patient did not take their readings or one (or more) of their readings were outside the clinical threshold. This case will cover action taken by FHS to implement the program across six paramedic communities.

(c) **Results achieved**: Integrating the CPRPM into the care model for patients with chronic disease and leveraging community paramedics as a point of local access, the pilot program saved an estimated \$4.7M (\$7279/patient) to the overall health system. The program helped patients with chronic disease feel more confident staying in their home and determine when they were at risk of exacerbation, and it was appropriate to seek help (call 911). Implementation success varied across

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paramedic communities as some communities embraced the change and generated significant benefits for patients and the overall healthcare system, whereas others generated less significant results.

(d) **Lessons learned**: Topping the list of lessons learned is that digital transformation is messy, complicated, and difficult. Traditional business case and implementation planning needs to be refreshed with novel approaches inherent in design thinking and systems thinking. Forming partnerships will pave the path of least resistance, but finding the right partners is critical, and they may not be the ones that come top of mind. Feedback is an important mechanism for stitching together activity across stakeholders in an ecosystem. Finally, transformation initiatives need permission to play and explore, but leadership needs to define parameters to protect their best people and mitigate longer-term risks.

1 Introduction

Undoubtedly, one of the greatest problems that healthcare will face in the next decade is the impact the aging population will have on health service systems. In 2018, the number of people older than 64 years surpassed the number of children under 5 years old for this first time in history (Ritchie 2019). This is a problem for the healthcare system as the majority of healthcare costs are created by a small portion of the population, often seniors with chronic illnesses. The South Central Community Futures Development Corporation (SCCDC), a nonprofit organization comprised of seven Southern Ontario Community Futures Development Corporation (CFDC) offices, recognized that the healthcare system had to change to accommodate the growing demand and investigated how to keep seniors in their homes safely. In 2014, they brought together federal, provincial, municipal, aboriginal, and private sectors to develop a sustainable remote patient monitoring business model. The Community Paramedic Remote Patient Monitoring (CPRPM) program builds on the provincially funded community paramedic (CP) program to allow chronically ill seniors to remain at home. Using remote monitoring technology, CPs monitor the patient's vital signs in real time maximizing the efficiency of paramedic staff.

This case will cover action taken to implement the program and explore challenges faced as well as benefits generated from this transformational initiative. Challenges are important to explain why the pilot program ran longer than expected and fell short on enrollment targets. However, despite program challenges, the program's formal evaluation reported extraordinary benefit[1] that included an overall 26% reduction in 911 calls and emergency room visits and 32% reduction in hospital admissions. The average cost of administering the program was $1134/patient and

[1] https://futurehealthservices.ca/cprpm-project-and-evaluation.

generated an estimated $7279 savings for a 542% return on investment. This equated to an overall savings of $4.7M for Ontario in less than 2 years.

In 2019, the benefits of the CPRPM were recognized by several government ministries, and CPRPM was positioned as a major contributor in Ontario's goal to improve healthcare and end hallway medicine. Moving forward, lessons learned will be leveraged to make sure best practices in design thinking are used to develop additional tools and practices, and systems thinking to ensure barriers inherent in navigating across traditional operational and funding boundaries are identified and proactively addressed. By learning what did not work the first time, CPRPM aims to continue to reduce interference inherent in casting a wide net for change.

2 Situation Faced

The SCCDC is composed of seven CFDC offices of which most have over 20 years of experience providing business consulting and managing a loan portfolio of approximately $500 million to local businesses in their community. SCCDC created Future Health Services (FHS) as the operating company to launch CPRPM, and Rick Whittaker was assigned as the executive director in 2014. At the outset, Rick defined the terms of reference for FHS to provide asset management responsibilities including managing an inventory of remote patient monitoring devices, installation of devices in patient homes, training patients how to use the technology, and providing technical support. He was quick to realize that his expertise in rural program design and development needed to be complemented by program champions with expertise in healthcare provision and specifically community paramedicine (CP).

CP was a new model of community-based care in which paramedics utilized their training and expertise in treating life-threatening situations in non-emergency care roles. This expanded scope of practice (Boyle 2017) included assessment of chronic illnesses (Mason et al. 2008); provision of alternative care pathways to facilitate further assessment, treatment, and follow-up (De Cooper et al. 2008); and providing home-based health promotion education and chronic illness surveillance (Shah et al. 2010). Health promotion recognizes paramedics as an important health human resource, especially relevant to home telemonitoring, as they are uniquely mobile in most communities (Abrashkin et al. 2016). In Ontario, this practice was inspired by unique programs that developed systems to provide 24-h flexible and proactive support and enhanced home-based primary and community care services to older adults. Following evidence that these programs reduced overall emergency department visits, hospital admissions, and need for long-term care, CP was included as an integral component of the 2012 Senior Strategy for Ontario (Sinha 2012) and the Ontario Action Plan for Health Care (Ontario Government 2012). As responsibilities fell outside the customary emergency response and ambulance transport roles captured under the Ambulance Act, the province invested $6 million in 2014 to support the expansion and development of CP initiatives across the province.

In 2014, Rick connected with three paramedic services that were involved in these programs. They agreed to champion CPRPM and played an active role in its design. After creating multiple proposals, Rick secured funding for a 1-year, 1500 patient pilot program through Canada Health Infoway (CHI), an independent, not-for-profit organization funded by the Canadian federal government. The goal of the pilot program was to determine the cost effectiveness and system benefits of remote monitoring technology in improving community paramedic practices.

Working closely with CHI, three partners were engaged for the pilot program. *Interdev Technologies* was selected as the data partner as their software was used by most emergency services in the province. They provided CPRPM with key data elements including the number of 911 calls and emergency room transports. Getting access to this information would require patient consent, and Rick worked with consultants to design an informed and transparent patient consent procedure that adhered to Ontario's Personal Health Information Protection Act. Through a tendering process, Ideal Life® was chosen as the remote monitoring technology provider. In 2012, they had been providing remote health monitoring technology for over 9 years to customers primarily in the United States. The CPRPM program was the first to use their equipment in Ontario as their equipment was easy for patients to use, had an intuitive portal display for paramedics, and was cost-effective. Finally, the Monieson Center at the *Smith School of Business*, Queen's University, conducted the clinical and benefits evaluation of the pilot program. Benefits analyzed included reduction in 911 calls, hospital transfers, length of stay, and readmissions using data from Interdev and the Institute for Clinical Evaluative Sciences (ICES).

Lastly, to engage with the broader healthcare community, CPRPM formed a Clinical Advisory Committee to guide in the program design and provide oversight and governance. This committee decided that to qualify for program, patients had to have called 911 three or more times and/or visited the emergency department at least twice in the 12-month period prior to enrollment. They also encouraged paramedics to work closely with the patient's physician, family, and other care providers to ensure the patient had adequate wraparound care. Therefore, with funding, partners, and an advisory board in place, the CPRPM program was deemed ready to start onboarding patients.

3 Action Taken

Future Health Services (FHS) managed all aspects of the program including recruiting Emergency Medical Services (EMSs); supporting EMS services in onboarding patients; creating program guidelines, documentation, and training procedures; conducting in-depth analytics on patient data; and communicating results to policy-makers and funding partners in the broader healthcare community. They defined the high-level goals for the CPRPM program as follows:

1. Help patients take a more active role in self-managing their conditions so they can stay in the comfort of their home longer.
2. Provide access to medical professionals who can provide real-time coaching and feedback to patients on how to better manage their conditions and proactively respond to concerns in a more timely manner (as opposed to a reactively respond to 911 calls).
3. Reassure patients their health is being monitored in an effort to provide comfort and decrease stress and anxiety.
4. Build a circle of care around the patient that would allow the community paramedic to share results with primary care providers and family members via the patient portal
5. Reduce costs and burden on the healthcare system through reduced 911 calls, ED visits, and hospitalizations.

The intervention was a home-based remote patient monitoring system that transmitted data about a patient's health status from home to healthcare providers through the patient use of at-home medical devices. Consistent with the definition of telemonitoring (Paré et al. 2007), patients use medical devices to take daily biometric readings (blood pressure, SpO_2, glucose, weight) and transmit this information via a communications network to a secure health tracking and information management platform (Ideal Life®). All patients were assigned a SpO2 manager,[2] over 96% were assigned the BP manager, patients with diabetes were assigned glucose meters, and weight scales were assigned to patients mainly with congestive heart failure (CHF) to help detect changes in body mass due to water retention that can signal pending cardiac difficulties. During the installation process, patients were provided with a detailed set of standardized instructions for the proper use of each device. These instructions included:

- An in-home demonstration with instruction card for the patient on how to use each device
- Advice for the patient to take measurements (blood pressure, pulse oximetry, and blood glucose) each morning an hour after taking medications or subsequently at the time of symptom exacerbation
- Taking weight readings first thing in the morning after voiding and prior to eating
- Instructions to observe each device successfully transmitted the result before moving on to the next device
- Observing patients taking readings on their own to demonstrate competence

The platform generated two types of alerts. Non-compliance alerts were triggered when no readings had been recorded within a 24-h period, and medical alerts were triggered when a reading on any device fell outside the standard threshold set by the Clinical Advisory Committee. Medical alerts were categorized as low, medium, high, and very high based on the distance between the reading and the threshold.

[2]With the exception of two patients that did not have adequate perfusion.

	# of Patients	Total Readings	Readings / Patient / Device	Avg Patient Time on Program	Avg Reading / Month	Avg Reading Compliance Rate
1 Device	14	4,299	307	8.76 months	35	117%
2 Devices	203	95,682	236	7.67 months	31	103%
3 Devices	230	144,252	209	8.28 months	25	83%
4 Devices	203	124,277	153	7.59 months	20	67%
Total	**650**	**368,510**	**100%**	**7.89 months**	**25**	

Fig. 1 Total readings and compliance rates by device

Both types of alerts are logged in the platform's task manager tool used by the health provider—in this case, the community paramedic.

The majority of the features of the home telemonitoring system were manual and voluntary in use. The only automated features were the 24-h compliance alert and the categorization of medical alerts (low, medium high, very high). Manual procedures included patients taking daily readings on all devices, paramedics contacting the patient to remind them to take their readings, and confirm feedback had been provided by clicking a "checkbox" in the Ideal Life® system. Both patients and paramedics were trained on the importance of taking daily readings. It was explained that medical alerts could only be triggered if the patient took their daily readings, and if readings are not taken on any or all devices, the system could not monitor the patient's condition, hence reducing all potential benefit of the program. Paramedics were also encouraged to provide regular and timely response to compliance alerts. Upon the final evaluation, the SpO2 manager had the highest compliance rate (99%) followed by the BP manager with 85%. The glucose manager was third at 72% likely due to daily blood sugar testing that was not a recommended daily requirement for all patients with type 2 diabetes. The lowest compliance rate was the weight scale at 58%. This is surprising as it is very easy to do, but it is possible patients needed more education to understand that trends in weight is one of the most important clinical indicators of changes in patient health—particularly for CHF patients.

Further examination into compliance rates during the summer of 2016 used a data manipulation method for a sampling of 650 patients to gain a better understanding of how patients were using the devices (Fig. 1). The 117 and 103% average reading compliance rates for one and two devices, respectively, involved patients using the Sp02 monitor multiple times each day to regularly monitor oxygen saturation, taking multiple blood pressure readings in a single day, and/or diabetic patients using multiple test strips to monitor blood sugar. This analysis also provided some insight into reading compliance according to patient demographics and condition diagnosis. Some general observations included males that were more compliant on average than females, and more complex patients (two or three comorbidities) were more compliant than patients with one comorbidity.

	Total Patients	Total # of Readings	Total Medical Alerts	Medical Alert Activity
CHF	322	209,882	20,058	10%
COPD	452	253,623	18,662	7%
Diabetes	121	88,426	6,513	7%
1 Comorbidity	427	206,196	13,886	7%
2 Comorbidities	192	137,490	12,942	9%
3 Comorbidities	28	23,585	1,821	8%

Fig. 2 Medical alert summary by patient condition

	Alert Severity				**Total**	
Clinical Trigger	**Low**	**Med**	**High**	**Very High**	**Total**	**% of Total**
Heart Rate	4,232	772	409	67	5,480	19%
Glucose	962	568	146	49	1,725	6%
SpO2	11,688	50	0	0	11,739	41%
Systolic	739	643	201	42	1,625	6%
Diastolic	358	375	201	174	1,108	4%
Weight	1,409	4,769	779	69	7,026	24%
Total Alerts	**19,389**	**7,177**	**1,736**	**401**	**28,703**	**100%**
	68%	**25%**	**6%**	**1%**	**100%**	

Fig. 3 Alerts by clinical trigger and severity

Medical alerts are logged in the Ideal Life® platform when a reading is outside the clinical threshold. Figure 2 presents the medical alert activity by patient condition. Patients with CHF have the highest alert activity as a percentage of total readings suggesting CHF patients are more acute in terms of paramedic time and resources than patients with other conditions. Figure 3 provides a summary of medical alert severity and shows that the majority of alerts (68%) were low severity.

As the objective of the program was to generate alerts from readings that are trending in the wrong direction and intervene with "teachable" moments to improve self-management, a higher number of low and medium alerts were expected. Alerting paramedics of early signs of risk allowed them to provide feedback during low and moderate episodes in an attempt to change patient behavior and prevent future exacerbation. Relatively a few number of "high" and "very high" alerts offer proof that the program was working by either preventing conditions from deteriorating or instructing patients that they need to go to the hospital.

For paramedics, inconsistent device use by patients and low severity alerts resulted in a continuous stream of alert activity in the Ideal Life® platform.

Managing this daily workflow to check and filter priority of alerts was only one of their responsibilities. A full description of paramedic and patient tasks is provided in Fig. 4.

Although the paramedic role was deemed the responsibility of the community paramedic (CP), the routines and guidelines for this new model of care within existing paramedic services were in some cases under-developed. For example, a few services thought it is sufficient to assign paramedics who were recovering from injury or illness rather than full-time CP staff. This resulted in a lot of turnover and less consistency that in other services staffed one or two lead CPs to run the program. The work involved in recruiting, training, monitoring, and documenting notes also took some paramedic services by surprise. To do a thorough job, the average paramedic spent 4.11 h/month on each patient. This resulted in lower patient enrollments than originally expected. Figure 5 displays the total number of patients enrolled by each paramedic service as well as each service's monthly average enrollment (line graph). The numbers in brackets indicate the total number of months the service was on the CPRPM program.

The program evaluation concluded that services with average monthly enrollment (four or five patients) tended to reduce costs and burden on the healthcare system (reduced 911 calls, ED visits, and hospitalizations) more than services that enrolled more patients. The conclusion here was that services needed time and resources to monitor patients, provide thoughtful feedback, and make detailed notes in the Ideal Life® system. Although daily documentation in the notes repository was a formal requirement of the CPRPM program, the average documentation rate was only 59%, and weighted average[3] across services was 70% (ranged from 29 to 180%). Documentation rates greater than 100% indicate a service that documents notes for patient check-ins without an alert being triggered.

In post-program interviews, services with low documentation rates explained they perceived notes to be of little value; more specifically, they had relationships with the patients and were aware of their issues, concerns, and activity so making notes felt unnecessary. Services with high documentation rates explained they used notes to keep track of patient alerts and feedback, and notes were helpful when more than one paramedic was involved in supporting patients. Without notes, patients needed to repeat their concerns, and paramedics were less informed. One paramedic explained, "Notes were critical as coaching patients with chronic conditions is more of a puzzle than a process. As their conditions are lifestyle induced for the most part, adapting behavior requires intimate understanding of the patient and how they respond to different types of feedback." Others explained that "Notes helped train patients how to take a good reading. Many medical alerts were actually just bad readings, so having a note in the system that stated the patient was asked to take a

[3]Weighted average adjusted the average documentation rate by the total number of patients on program. For example, a service that had 69/212 patients achieved a documentation rate of 86% their rate would influence 32.5% of the weighted average total.

Technology Feature	Feature Description	Role of Paramedic	Role of Patient
Daily Readings (BP cuff, oximeter, glucometer, scale).	Daily readings capture information about patient vital signs.	Daily trend analysis on the patient readings.	Take daily readings
Medical Alert Detection	Alerts the provider there has been a discrepancy. Compliance alerts detect when a patient has not taken readings in more than 24 hours. Medical alerts detect when patient's vital signs are outside of normal range.	Manage daily workflow to check and filter priority of alerts.	Patient does not receive alerts but they learn what their readings should be and when they need to retake a reading (e.g., blood pressure).
Compliance Alert Communication	Communication protocol between the patient and the paramedic related to taking daily readings.	Contact patients that are out of compliance, check 'contacted' box to date and time stamp that patient contact was made.	Receive message from provider reminding them to take daily readings.
Patient Portal	Internet site used by the patient, paramedic and other invited stakeholders to share program-specific information.	Visit the portal to share information with patient and other stakeholders.	Use the portal to track readings,
Medical Alert Communication	Communication protocol between the patient and the paramedic related to clinical readings outside of normal range.	Contact patient, check 'contacted' box to date and time stamp that patient contact was made, and review and document a set of validation and clinical questions.	Answer validation and clinical questions.
Task (Interaction) Manager	List of alerts, alert filter and tasks (e.g., call patient, left message, call back).	Daily workflow to filter by alert type, check tasks, and add new tasks.	Patient does not have direct access to these technology features.
Notes Repository	Free form text box used to capture information about task (interaction) and specific patient information.	Take notes to document relevant information related to the	
		task and action recommended.	
Change Alert Thresholds	Changes medical thresholds used by the system to generate alerts.	Get consent (written or verbal) from primary care provider and document in notes repository. Make updates to patient-specific reading thresholds as directed.	Take subsequent readings to validate need to adjust alert thresholds. Communicate with paramedic.
Technical Support	Traffic table – system reports when batteries are low, connectivity low etc.	Maintain functionality of devices by repairing and/or replacing devices.	Report device problems if necessary.

Fig. 4 Features of the CPRPM system

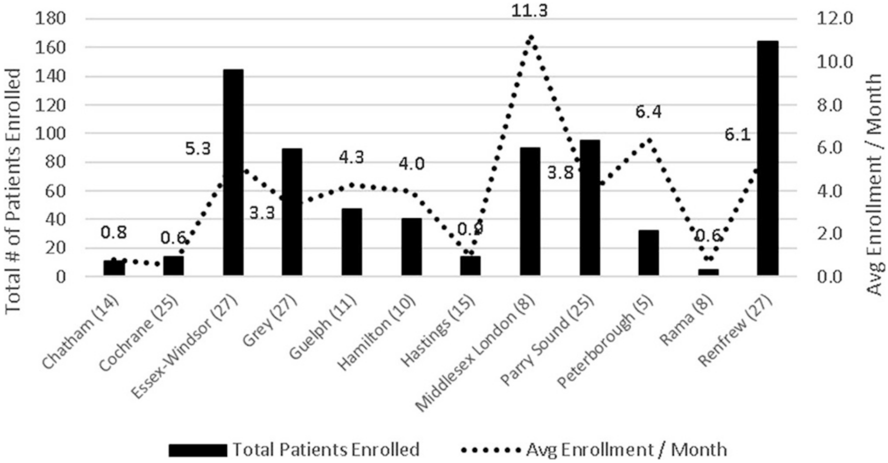

Fig. 5 Enrollment by paramedic service

subsequent reading made it clear the patient wasn't in distress, they were just learning how to use the technology."

The workload involved also made onboarding paramedic services more challenging than anticipated. After launch, three additional services joined in 2015 and six more in 2016. Although the work involved was a deterrent, the primary barrier was making a commitment to patients when it was unclear whether provincial CP funding would continue. This changed in February 2017 when the Ministry of Health and Long-Term Care announced permanent funding to support community paramedicine programs going forward. This encouraged more paramedic services to enroll; however, leveling out workflow and procedure proved more challenging. As illustrated in Fig. 6, the average time spent varied significantly from the 4.11 h/patient/month across paramedic services. Leveling this out was important as the program evaluation confirmed that dedicating more time per patient resulted in higher patient adaptation rates and reduced healthcare system costs (reduced 911 calls, ED visits, and hospitalizations) (Brohman et al. 2019a).

Another unanticipated challenge for the CPRPM program was onboarding primary care physicians to collaborate in the patient's circle of care. The initial program design included a patient portal feature that would connect patients to their entire circle of care via the Internet. Despite intentions of this being up and running within 6 months of the program launch, the patient portal feature was not delivered. This was unfortunate as primary care providers that engaged in the program in the early days thought a patient portal would be "top notch," but communicating the benefit and inspiring the intention to use another tool (that was not embedded into their existing electronic medical record) proved to be very difficult.

Beyond that, paramedics were not recognized as a member of the health system (they are not regulated healthcare professionals in Ontario), and many health professionals resisted being involved in a chronic disease program run by paramedics as they felt this was outside their scope of responsibility. Although community

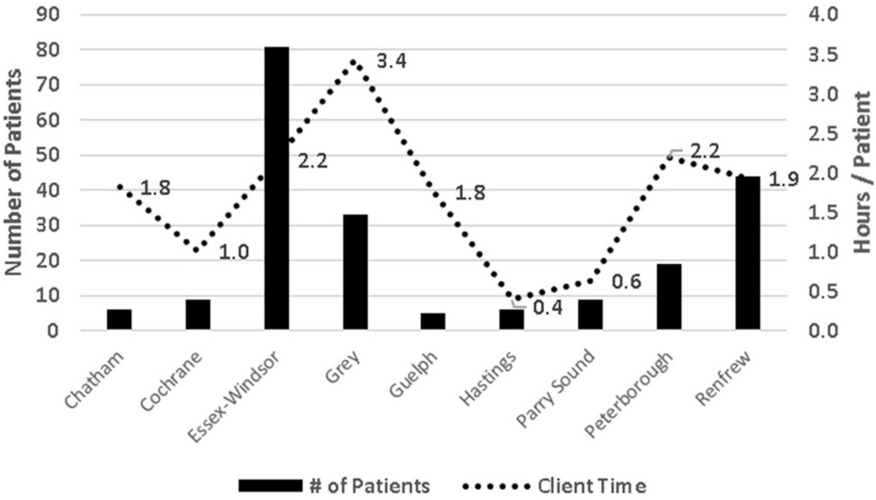

Fig. 6 Paramedic client time per month by service

paramedicine was an attempt to expand their scope, the broader health community was not overly aware of this new practice. Finally, primary care had been using a telemedicine solution, the Ontario Telemedicine Network (OTN), since 2006. By 2015, it was used by every hospital and hundreds of other healthcare locations across the province. The OTN was not only a health provision solution, but it also facilitated the delivery of distance education and meetings for healthcare professionals and patients. CHI funded both programs, and it was clear in their communication that CPRPM was a complement to OTN, not a competitor. From their perspective, running both programs simultaneously would mutually reinforce one another (Hess et al. 2016) and generate enhanced benefit for patients and the overall health system. Indeed the two programs were similar in mission, but the CPRPM program was designed for a small segment of the population, specifically complex patients suffering from one or more chronic conditions (CHF, COPD, and diabetes).

When primary care physicians failed to engage, a number of program procedures became more difficult to manage. A good example of this is physician approval required to change a patient's standardized threshold (e.g., range of acceptable blood pressure readings) in the Ideal Life® system. If the threshold entered upon enrollment was inaccurate, readings would trigger alerts that paramedics deemed to be "false" after checking in with the patient. To change the threadhold, paramedics were required to submit a request to get physican approval; however, these requests were often ignored. Evident in the notes repository, it was not uncommon for paramedics to make several attempts to contact the physician with no response. This added to the paramedic burden as the system continued to trigger false alerts requiring the paramedic to note "this reading is normal for this patient" on a daily basis. Inaccurate thresholds were also problematic as being exposed to a larger number of frequent false alerts caused alert fatigue—a situation where paramedics become desensitized and more likely to overlook valid alerts that indicate a decline in the patient's condition.

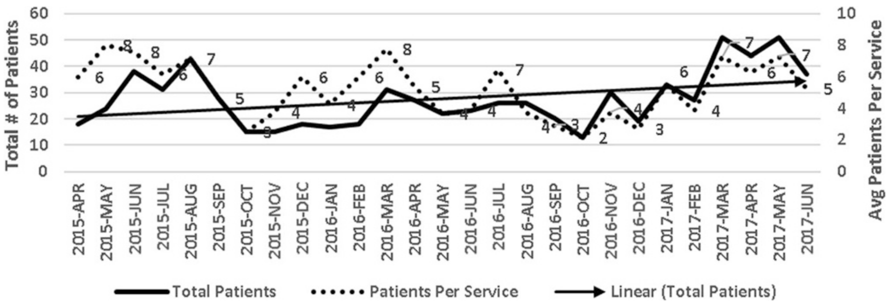

Fig. 7 Total enrollment by month

In conclusion, FHS faced many challenges that impeded their ability to pilot a 1-year, 1500 patient program. A total of 1109 patients across 14 Emergency Medical Services (EMSs) were enrolled in the program between April 2015 and December 2017. Compared to the average ADG score, 97% of the patients involved in the CPRPM program had severe medical conditions[4]; as this score is commonly used to predict mortality in a general adult population in Ontario[5], it was clear the program was well positioned to help keep patients out of hospital and comfortable in their own home. The overall enrollment trend (top line) by month is illustrated in Fig. 7. On average, 29 patients were enrolled per month (minimum 14 and maximum 56). The linear trend line shows a slight increase in patients enrolled/month over the lifecycle of the program.

4 Results Achieved

The pilot program was independently evaluated by Queen's University in 2018. Emergency (911) call data and Emergency Medical Service transport data were available through Interdev Technology Solutions (Interdev). Hospitalization data (i.e., Discharge Abstract Database (DAD)) and emergency department (ED) data (National Ambulatory Care Reporting System (NACRS)) were available through the Institute for Clinical Evaluative Sciences (ICES). ICES is a nonprofit organization that applies the study of health informatics for health services research and

[4]The Johns Hopkins Aggregated Diagnosis Group (ADG) score was used to analyze patient condition; this is a weighted score representing the presence or absence of 32 ADG diagnosis groups. ADG scores are available in the ICES Discharge Abstract Database (DAD) established in 1963. This database captures administrative, clinical, and demographic information on hospital discharges (including deaths, sign-outs, and transfers). The average ADG is 3.2.

[5]Austin PC, van Walraven C, Wodchis WP, Newman A, Anderson GM (2011) Using the Johns Hopkins Aggregated Diagnosis Groups (ADGs) to predict mortality in a general adult population cohort in Ontario, Canada. Medical care. 49(10):932–939. https://doi.org/10.1097/MLR.0b013e318215d5e2

Total Patients Enrolled (as of December 2017) Patient in Evaluation (enrolled by June 2017)	1109 745
Total Retention (>3 months on program)	650/745 (87%)
Total # of Devices	1,922
Total # of Device Readings	368,510
Total Medical Alerts	28, 703 (1 Alert / 12.8 Readings)
# of Paramedic-Patient Coaching Interactions	3, 281
911 Call Reduction (Interdev)	26% (453 Calls)
Time Reallocated to Paramedic Services Total Savings to Paramedic Services	764 Hours $331, 576
Actual Reduction in ED Transport (Interdev) Actual Reduction in ED Visits (ICES)	31% (460 Transports) 26% (467 ED Visits)
Actual Reduction in Hospital Admissions (ICES)	32% (170 Admissions)
Actual Reduction in Hospital Readmissions (ICES)	35% (18 7-day Readmits) 41% (59 30-day Readmits)
Estimated Savings to Overall Health System (650 patients)	$ 4,731,350 $7,279/patient
Estimated Cost to Implement CPRPM Program (assuming 6-month program duration)	$ 737,100 $1,134/patient
Estimated ROI to Overall Health System	542%

Fig. 8 Summary of CPRPM program benefits

population-wide health outcomes research in Ontario, Canada. Results show that by integrating the CPRPM into the care model for patients with chronic disease and leveraging community paramedics as a point of local access, the pilot program saved an estimated $4.7M ($7279/patient) to the overall health system. A summary of results is provided in Fig. 8.

Benefits were stratified by patient demographics and diagnosis to understand if the program yielded better outcomes for a specific type of patient. Overall, females generated higher 911 call reductions (34%) than males (15%) as well as higher ED visit reductions (36%) compared to males (25%). All age groups generated a positive and meaningful reduction in 911 call and ED transport volumes. Younger patients generated more savings in transport rates[6] highlighting the ability for paramedics to deal with situations in the home as opposed to transporting these patients to hospital. Older patients called 911 less; however, when they called 911, they were more likely

[6]Transport rate is the number of ED transports divided by the number of 911 calls. A reduction in transport rate means paramedics are able to manage 911 calls at home as opposed to transporting to the hospital. A negative reduction may be because a patient condition is getting more severe over time and paramedics are less able to deal with patient issues in the home or the CPRPM program is helping patients learn when calling 911 to transport to hospital is needed and necessary.

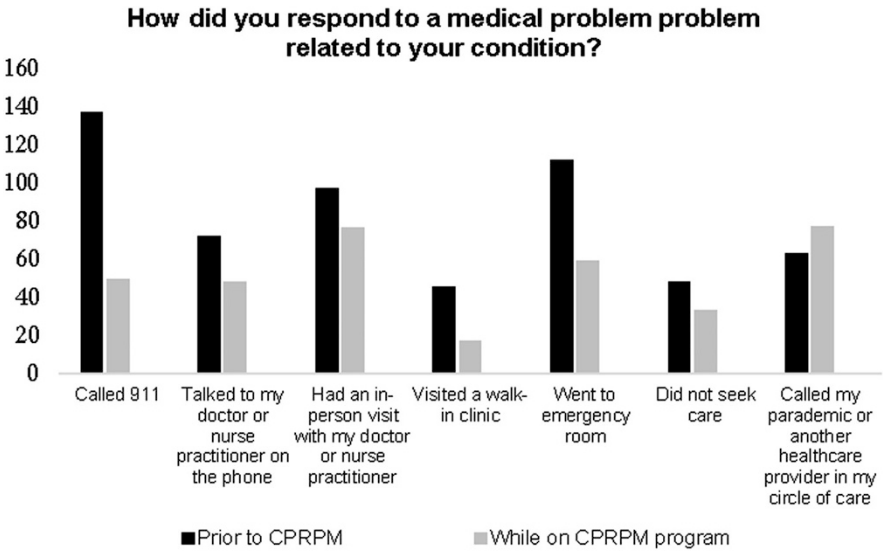

Fig. 9 Adaptations in the patient use of the healthcare system

to be transported to hospital. This result indicates that the program helped older patients determine when they were at risk of exacerbation and it was appropriate to call 911.

Patients with COPD and CHF generated similar results in that 89% agreed feeling less dependent on the emergency services (911 calls, ED visits) as a result of being on the CPRPM program. An additional benefit not captured in the quantitative evaluation was savings to other health providers, and 83% of patients agreed they had less need to visit their family doctor/nurse practitioner or walk-in clinic since the program started. A summary of pre-program and post-program behavior is provided in Fig. 9.

The rural focus was deliberate as the SCCDC was specifically trying to address the issues of more limited access to healthcare services in rural communities. Rural patients are more difficult for the health system to support, and monitoring their condition using technology allows paramedics to intervene when vitals indicated a potential risk. Overall, CPRPM patients were more rural (37%) and suburban (34%) compared to the 2015 Ontario population (6.8% rural, 18.3% suburban).[7] Only 29% of patients involved in this program were from urban regions compared to the 74.9% average in Ontario. Rural patients explain why CPRPM generated an increase in patients seeking care, and evaluators also concluded patients saved an estimated average of 7.1 h/month in travel time to and from hospitals and doctor's appointments. With the most prevalent patient population being from 75 to 84 years of age,

[7]Urban, suburban, and rural percentages provided by the Institute for Clinical Evaluative Services (ICES).

many patients had a caregiver or family member who accompanied them to their appointments. The estimated time savings from travel for caregivers was 6.7 h/month.

Another benefit of the CPRPM system was an overall increase in patients' sense of security and other emotional benefits of the program. Written statements on discharge surveys included the following: "I feel safer knowing I could call for advice," "I am very happy with this program. It has helped me to get established in the community and to trust there are good care workers out there," "It was helpful and reassuring that a second party was monitoring my case," and "This is a fantastic program and should be continued on. It keeps seniors at home and feeling independent as we can be." Patients were also extremely grateful for how the CPRPM program reduced burden felt by family members: "This program put my children at ease knowing that I was constantly being monitored. I'm most grateful for this" and "My wife felt better knowing that I was being monitored every day, she made me take my readings every day." Finally, the survey asked patients if being on the program improved their overall quality of life, and 90% agreed.

A major concern of the program in the early days was that patients would not be comfortable using the technology and would be concerned about privacy. In contrast, 96% of patients at discharge strongly agreed the devices were easy to use. This result speaks to both the choice of technology provider and the quality of training and support. Similarly, 89% agreed they felt comfortable sharing their health information, and 99% felt the program protected their personal information.

Patient adaptation rates were also examined as chronic conditions are lifestyle induced, so helping patients learn to alter what they eat and what they do (e.g., exercise, medications) explains reductions in health system use (911 calls, ED visits) as well as improvements to confidence and quality of life. Patients indicated that taking daily readings and triggering alerts allowed them to connect how their day-to-day behavior affected their health; in other words, using the technology helped them understand their chronic condition better. They also found paramedic feedback extremely helpful in determining when they needed to seek help (i.e., call 911, visit doctor, etc.). This coaching not only decreased stress and anxiety by reassuring patients their condition was being monitored, but it also helped patients understand when it was appropriate to call 911. Feedback from paramedics also helped patients take good quality readings by giving them advice such as warming their finger before taking an SpO2 reading, taking readings at a specific time of the day, etc. This coaching helped patients improve the quality of their readings and lowered the risk of false alerts.

A detailed study of feedback and behavior adaptation concluded that what paramedics said and how they said it were also very important to deriving program benefits (Brohman et al. 2019a). Specifically, feedback that informed and motivated patients to take a more active role in self-managing their condition had a positive impact on patient adaptation. Paramedics that used notes to refer back to prior recommendations (e.g., breathing techniques, when to administer supplemental oxygen, healthy eating, laying down, elevating feet) helped patients understand how behaviors generated more positive results. In contrast, paramedics that told patients what they needed to do without referring back to previous situations were less effective at adapting patient behavior. Perhaps the most surprising was that feedback that addressed patients' emotional and cognitive needs by showing empathetic concern (e.g., you are doing great, I'm concerned about you) was the most powerful in adapting patient behavior.

Although the CPRPM program had an overall strategy, paramedic services implemented the program in different ways. Some services drove change from the top, and they assigned dedicated funding and relaxed day-to-day procedures and performance metrics to allow new workflows to emerge. Other services ran the CPRPM program more like a "side job" and struggled to secure resources and faced rigid routines and structures that are resistant to change. No matter what the implementation approach, getting CPRPM up and running were difficult as it strays from the traditional "lights and sirens" part of the business and requires new supporting structures (i.e., funding, routines, roles, and responsibilities) and staff with different skills. However, services that drove change from the top experienced significantly higher 911 and ED visit reductions, enrollment and patient retention rates, as well as paramedic satisfaction and commitment.

There was also evidence of paramedics working outside the overall CPRPM strategy. For example, although the original intent of the program was to discharge patients after 6 months, several patients were permitted to remain on the program longer. Paramedics explained that in these cases, they felt very uncomfortable removing the equipment as patients were very frail and many were living alone. A follow-up patient survey confirmed that patients felt being on the program reduced their stress and anxiety knowing someone was "keeping an eye on them." When allowed to stay on the program longer, benefits to the healthcare system (i.e., 911 call reduction, etc.) appeared to sustain or in some cases increased. Results also highlight possible limitations of discharging patients prior to the 6-month enrollment target as it takes time (at least 2–3 months) for benefits to start to be realized. Patients need to get used to using the technology and change their behavior and only then do the benefits start to appear.

Finally, evaluators examined if benefits of the program were sustained after patients were discharged. Results show that without the CPRPM program, some costs return to the healthcare system. In other words, keeping patients enrolled in CPRPM keeps them out of hospital. Patients who were discharged from the CPRPM program experienced a 6% increase in ED visits and a 138% increase in 30-day hospital readmissions in the 3-month period after discharge. While these results are limited given they are based on only 182 patients, it suggests that not all patients learn how to self-manage their chronic condition while on the CPRPM program. Some patients may benefit from staying on the program to avoid costs return to the healthcare system post discharge.

5 Lessons Learned

The CPRPM program did many things well and learned some important lessons along the way. Topping the list of lessons learned is that even with a strong business case in hand and stakeholder support, transformation is a messy business. For the most part, FHS had the strategy right. Prior to submitting their proposal to CHI, they worked hard to connect with paramedic services and experts in CP to capture an intimate understanding of the context of change. They also had the technology solution sorted out to make sure it was easy to use and addressed privacy concerns. The strategy for the program also aligned well with the province's healthcare reform initiative, and FHS put significant resources into developing a comprehensive implementation plan that included clear goals as a comprehensive approach to onboarding Emergency Medical Services (EMSs), recruiting and onboarding patients, and creating program guidelines, documentation, and training procedures. Therefore, by all accounts, a 1-year, 1500 patient pilot program seemed feasible.

Key lessons learned were more related to execution (Brohman et al. 2019b) than strategy. The final program took 2.5 years to implement, and final enrollment targets fell short (1109 patients), but the overall program exceeded expectation in terms of benefits. Several opportunities to improve performance were identified for future endeavors. First, be conscious of how success for a transformation program is defined at the onset. In healthcare, binding an improvement program by the number of patients enrolled is a common approach to healthcare interventions. The idea that optimal benefit will be achieved by onboarding a critical mass of patients is a common practice—or what experts in digital design call an orthodoxy. Even though only 1109 patients were included in the final evaluation, the program benefit was extraordinary. Therefore, the lesson here calls attention to the importance of design thinking in developing the business case for transformation opportunities. Flipping orthodoxies is one of many techniques to inspire creativity and divergent thinking. It starts by:

- *Stating the assumption*: In this case "Higher enrollment will generate greater benefit."
- *Then explain why*: "because benefits are often lower in value, so increasing the number of patients will create a stronger evaluation."
- *Next, flip the assumption*: "Lower enrollment will generate greater benefit."
- *Lastly, explore the possibilities*: In the case of CPRPM, the benefit evaluation concluded that paramedic services that enrolled fewer patients generated greater overall benefits.

Moving forward, additional funding agreements might consider enrolling the right patients and providing paramedics more time to effectively coach, give feedback, and produce meaningful patient and health system outcomes. In the case of CPRPM, the 1500 enrollment target created a barrier as it delayed the overall program delivery and resulted in negative program perception by some stakeholders. In hindsight, it is possible an earlier evaluation of a smaller subset of patients would have generated similar results. The challenge of course is whether the broader health community would have been equally convinced.

The overall lesson here is that competing objectives are extremely common in transformation initiatives, what is good for one stakeholder is often deemed to be in competition with what is good for another. This calls attention to the importance of systems thinking in digital transformation as a more holistic approach to inspiring change that examines how parts of a larger system interrelate and work together over time. The CPRPM program recognized the success of the program extended way beyond technology use; to satisfy competing objectives, they put themselves in the shoes of the users to experience barriers faced in providing and receiving care. In the case of CPRPM, the enablers and challenges of a wide network of users needed to be explored. CPRPM did a very good job of embracing the entire system to empathize the needs and doctors, paramedics, patients suffering from chronic disease and their families. The stakeholder that created the most challenge for the program was the Local Health Integration Network (LHIN). This layer of government in the healthcare system was responsible for ensuring services that are integrated and coordinated, ease the flow of patients across the healthcare system, and improve access to services in communities.

As paramedics were not recognized as a member of the health system, they were not regulated by the LHINs. This was helpful in that they could explore novel care solutions with less friction; however, the LHINs controlled the province's healthcare resources which made it difficult for paramedic services to be included in the way the LHINs innovated a more comprehensive system of care (Piccoli et al. 2009). This disconnect also caused redundancy across programs (El Sawy et al. 2010) such as the perceived competition between CPRPM and OTN. From an ecosystem perspective, CPRPM was better aligned to the needs of chronic patients living at home in rural communities as paramedics are more mobile than other service providers. OTN, on the other hand, had expertise in virtual care and involved doctors and registered nurses who could prescribe medication and other supports (e.g., oxygen). CPRPM's clinical advisory board could easily see how these two programs mutually reinforced one another, but this was not clearly understood by the LHINs. In fact, one paramedic service did not renew their commitment to CPRPM after their 6-month trial as they were told by their LHIN that ongoing funding was conditional on opting out of CPRPM. This was contradictory to the design of the CPRPM program, its strategy, as well as the mission of CHI who funded both programs. It was unclear how this information was miscommunicated in that specific community so moving forward, CPRPM clarified their messaging to LHINs to differentiate the value of the two programs and how they reinforced one another.

Another lesson learned by CPRPM was to leverage partnerships to pave a path of least resistance. Knowing up front that paramedics were not recognized as a member of the health system, they should have anticipated health professionals would view a chronic disease program run by paramedics as outside their scope of responsibility. Community paramedicine was an attempt to expand their scope, but the health community was not overly aware of this new practice. Had they given this reality more influence, they might have sought a better way to seek approval to changing a patient threshold. This design flaw had a significant ripple effect that range from regular false alerts being an annoyance to alert fatigue that caused alert fatigue and desensitized paramedics to potential health concerns. Mid-program, FHS explored this further and realized the threshold most problematic was SpO2 levels for COPD patients and sought out a different solution. They formed a partnership with VitalAire, Canada's leading provider of home oxygen therapy. VitalAire turned out to be the perfect partner, and they were more community focused. As a recognized healthcare provider in Ontario, clinicians had the authority to approve adjusted patient thresholds.

In hindsight, administrating a preventative care program for patients with complex conditions with little involvement from the doctors flipped a deep-rooted orthodoxy that placed primary care at the center of Ontario's healthcare system for decades. Rick and his team experienced significant resistance due to lack of engagement from the primary care community, but being that the program casts a wide net for change, they weren't the only stakeholder making transformation a messy business. Let's explore a few other lessons learned that relate to how CPRPM fused together dynamic interactions in the broader healthcare ecosystem.

First, true buy-in from paramedic chiefs was not achieved until the Ministry of Health and Long-term Care announced their decision to provide community paramedicine within long-term funding in February 2017. What's ironic is that the case for long-term funding was built on short-term programs such as CPRPM that showed the benefit of CP practice. Therefore, the lesson here is that innovations capable of transformational change are often chicken and egg situations. Because the new opportunity challenges assumptions and existing work practices, demonstrating the capability and showing actual benefit is an essential component of the business case. Prior to long-term funding, involvement in CPRPM was inspired by one or two paramedics that felt passionate about CP and tapped into their own personal capacity for driving change. In all cases, chiefs trusted them and gave them latitude to "play and explore," but in most cases, this work was deemed lower priority than more traditional paramedic responsibilities and work commitments. This "side of the desk" approach is rarely problematic in the short term but can turn disastrous long term when stress and resentment eventually take their toll. So, there are a number of leadership lessons here:

- First, "play and explore" needs to be recognized as high-priority work if an organization is serious about the need to lead and drive change. Leaders are encouraged to be explicit about how the innovation aligns to the strategy, communicate the importance of the work, and reward people for their effort.
- Second, "play and explore" work needs clear boundaries and a commitment from leadership to intervene if/when things start to deteriorate. Escalation of commitment should be assumed when it comes to managing people leading "play and explore" initiatives (Weeth et al. 2020). They are putting everything on the line—their time, energy, and reputation to make the innovation work. So, strong leadership is needed to closely manage boundaries and monitor outcomes to alter the course when necessary.

- Boundaries arise from leaders making an up-front commitment to not only understand why the program will work but why it won't. There are many cases where the innovation may be the right thing to do, but not right for the specific organization at the time.
- Lastly, and perhaps the most important, any commitment to "play and explore" needs to remain small. All longer-term commitments to scale the innovation should only be made after a sustainable funding and incentive model is formalized.

The final set of lessons learned relate to the technology itself. First, if patients do not take daily readings, the benefit provided by the system is driven to a halt. This means that the CPRPM is not a great fit for patients that are too ill to take daily readings. It also means that technology needs to have built-in capabilities (e.g., feedback, reports) that reinforce the desire to take daily readings. In both cases, a patient may start out taking daily readings, but continued use will deteriorate over time (Guinea and Markus 2009). Also important to consider is the number of devices assigned. Learning to take good readings on too many telemonitoring devices can be overwhelming for many patients (Ayyagari et al. 2011) so the program needs to determine what devices are most effective at indicating risk and predicting oncoming exacerbations. For example, if the weight scale is truly the most effective, patients need to understand why weighing themselves daily is important and how changes in weight are associated with risk. Finally, although telemonitoring devices may have been perceived as one of many new gadgets aiming to transform the healthcare system, the CPRPM program learned that adapting behavior had more to do with the feedback provided than the technology itself. The notes repository was crucial and training paramedics on how to give effective feedback a necessity. There was also an opportunity for expanding the technology solution in ways that would help patients and providers connect the dots in complex patient care (Harris et al. 2012).

In 2019, several government ministries recognized the benefits of the CPRPM, and the program was positioned as a major contributor in Ontario's goal to improve healthcare and end hallway medicine.[8] As such, the next challenge that Rick Whittaker faces is how best to scale the program across the province. The target population for the CPRPM program is the most vulnerable 50% of the chronically ill population estimated to be 455,000 patients in Ontario.[9] Depending on the size of the municipality, paramedic services will be targeting between 100 and 500 patients in their catchment area. The business case includes an investment of $30M to keep over 16,000 high-use patients safely in their home, an estimated savings of over $118M per year through avoided emergency room visits and hospital admissions, saving municipalities close to $10M annually through reduced long-term care beds and avoided 911 calls, and creating up to 155 well-paying jobs in Ontario. As such, the program is exploring ways to standardize use cases to make device use and feedback

[8]http://www.health.gov.on.ca/en/public/publications/premiers_council/report.aspx.

[9]Data source is the Canadian Institute for Health Information (CIHI).

documentation more understandable and consistent across services. It also has plans to invest in new technology (e.g., a patient portal, Amazon Echo device) that will make communication easier; make data and feedback more accessible for patients, family members, and care providers; and incorporate analytical tools designed to improve the overall program benefit moving forward.

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Enabling Digital Transformation Through Cognitive Robotic Process Automation at Deutsche Telekom Services Europe

Christian Czarnecki, Chin-Gi Hong, Manfred Schmitz, and Christian Dietze

Abstract

(a) **Situation faced**: Subject of this case is *Deutsche Telekom Services Europe* (DTSE), a service center for administrative processes. Due to the high volume of repetitive tasks (e.g., 100k manual uploads of offer documents into SAP per year), automation was identified as an important strategic target with a high management attention and commitment. DTSE has to work with various backend application systems without any possibility to change those systems. Furthermore, the complexity of administrative processes differed. When it comes to the transfer of unstructured data (e.g., offer documents) to structured data (e.g., MS Excel files), further cognitive technologies were needed.

(b) **Action taken**: DTSE has identified robotic process automation (RPA) as a key technology to achieve its automation targets. A dedicated *Center of Excellence* was founded in order to enable a company-wide automation. The whole implementation was organized in an iterative manner following a project-based approach. From a methodical perspective, the set-up and conduction of the

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RPA project were structured into (1) organization and governance, (2) processes, and (3) technology and operations. From the content perspective, the RPA project defined and implemented a multitude of detailed RPA use cases, whereof two concrete use cases are described.

(c) **Results achieved**: Since the first RPA pilot implementation in Q3/2016, a total number of 172 software robots have been successfully implemented across six different functional areas within finance and controlling, procurement, and HR domains. Those implementations resulted in measurable performance improvements, such as lead time reductions, full-time equivalents (FTE) reductions, and cost savings.

(d) **Lessons learned**: The case provides an example for a concrete technology-induced change as part of a digital transformation. The concept of cognitive RPA provides an opportunity to automate human activities through intelligent software robots. The lessons learned utilizable for future RPA projects are as follows: (1) Close alignment with functional departments is a critical factor. (2) RPA implementation requires specific solutions for each process. (3) Differentiation between software robots and RPA systems is essential. (4) RPA requires a central governance structure. (5) Pilot-driven approach for cognitive RPA is a key success factor. (6) Operating model for RPA is a prerequisite for long-term success.

1 Introduction

Digital technologies are seen as an important driver for technology-induced changes of organizations and business models, referred to as *digital transformation* (e.g., Matt et al. 2015; Legner et al. 2017). In this context, *robotic process automation* (RPA) is an innovative approach to transform the process execution without changing the underlying application systems that can be seen as an increasing trend in practice (e. g., Plattfaut 2019; Herm et al. 2020; Hofmann et al. 2020). Generally an RPA system can be structured into input sensors, intelligence center, and output actuators (Fettke and Loos 2019). The intelligence center can vary from simple rule-based decisions to cognitive robots using advanced concepts, such as artificial intelligence (AI) (Czarnecki and Auth 2018; Houy et al. 2019; Enriquez et al. 2020). Broadening the initial scope of RPA toward *cognitive RPA* has been proposed in literature (e.g., Houy et al. 2019; Hofmann et al. 2020). Cognitive RPA uses AI and machine learning capabilities in the intelligence center in order to automate complex processes that require cognitive abilities.

Subject of this case is *Deutsche Telekom Services Europe* (DTSE), a 100% subsidiary of the integrated telecommunications operator *Deutsche Telekom AG* (DT). As most traditional telecommunications operators, DT faces various technical and market-related challenges (Czarnecki and Dietze 2017). In combination with overall stagnating revenues of the telecommunications market, DT has to invest in innovations while reducing costs through increased efficiency. Therefore, DT has already developed and implemented a digital strategy that includes the introduction of RPA in core processes, such as a field service app and a proactive problem-solving (Schmitz et al. 2018).[1]

Further effort was spent to improve the efficiency and effectiveness of administrative processes, which is the focus of DTSE and this case. Today DTSE is using software robots in different use cases. This chapter describes the concrete implementation of cognitive RPA at DTSE. The case was accompanied by the second author and is illustrated here in a summarized manner. Due to the nature of RPA, the whole project environment is volatile with a continuous adaptation of implemented software robots. The situation faced (cf. Sect. 2), the action taken (cf. Sect. 3), and the results achieved (cf. Sect. 4) are a summarized description based on the author's observations as well as official project documents collected during 2019. The lessons learned (cf. Sect. 5) are a retrospective discussion of the case.

2 Situation Faced

Deutsche Telekom Services Europe (DTSE)—the subject of this case—is a 100% subsidiary of DT. DTSE was founded in 2016, has 3300 employees, and operates at ten locations in four countries. DTSE is a shared service center for administrative processes and organized in the following eight service lines: (1) employment administration, (2) HR special services, (3) compensation and benefits, (4) recruiting and staffing, (5) procure to pay, (6) customer finance, (7) general accounting, (8) and record-to-report.

With offering services according to those topics, DTSE generates a yearly net revenue of around 370m €. Due to the high volume of repetitive tasks (e.g., 100k manual uploads of offer documents into SAP per year), automation was identified as an important strategic target with a high management attention and commitment. A dedicated *Center of Excellence* was founded to enable the automation within all process areas. As a service center, DTSE has to work with various backend application systems without any possibility to change those systems. Therefore, RPA was identified as a key technology for achieving the automation targets.

The scope of this automation initiative was a broad variety of different administrative processes on an operational level. From a detailed perspective, the situation faced was specific for each individual process. For example, the booking of electricity consumptions was a lengthy manual process including data extraction of key figures from invoices as well as the subsequent booking of the electricity consumption against individual assets. The volume per year is 14k invoices including 85k pages with 220k line items and 1.6 m fields. The as-is process required a download from SAP with a manual effort of approx. 120 h per year and an extraction of

[1]The case presented here is a completely revised version of the case published in Schmitz et al. (2018).

Table 1 Key figures of exemplary processes performed by DTSE

Process	Manual effort (per activity in minutes)	Volume (per year)
Order creation	6.0	12,000
Amendment of financial positions	6.5	30,900
Upload of attachments	1.5	120,000
Construction withholding tax	45.0	1800
Missing goods receipt	7.0	11,400

consumption values with a manual effort of approx. 1200 h per year. The automation potential for this process was estimated by 90%.

Table 1 shows further exemplary key figures of selected as-is processes. At the beginning of the initiative, all relevant processes were analyzed and evaluated on an operational level in order to understand the concrete situation faced. Based on this first analysis, concrete use cases were defined (cf. Sect. 3).

Even though the detailed as-is situation was different for each process, the key problems can be summarized as follows:

- Time-intensive manual tasks covering different applications (e.g., SAP, MS Excel)
- High volume of repetitive activities
- Routine tasks including decisions based on business rules

Furthermore, DTSE discovered that the complexity of those administrative processes differed. Experiences with the first pilots of standard software products showed that beside simple RPA solutions, also cognitive capabilities were required. For example, when it comes to the transfer of unstructured data (e.g., offer documents) to structured data (e.g., MS Excel files), an AI-based field recognition was necessary.

The overall situation persuaded DTSE to consider simple and cognitive RPA as an enabling technology to achieve its automation targets. At the same time, DTSE has seen RPA as an enabler to formulate and realize its digital strategy.

3 Action Taken

As described in the previous section, DTSE has identified RPA as a key technology to achieve its automation targets. Therefore, a dedicated *Center of Excellence* was founded in order to enable a company-wide automation. The scope of the automation were all processes within the eight service lines. The whole implementation was organized in an iterative manner following a project approach. In the first step, a high-level analysis of the relevant processes was conducted (cf. Sect. 2). Based on this analysis, use cases were defined that were implemented but also reassessed, extended, and changed in an agile project approach. Therefore, the further analysis

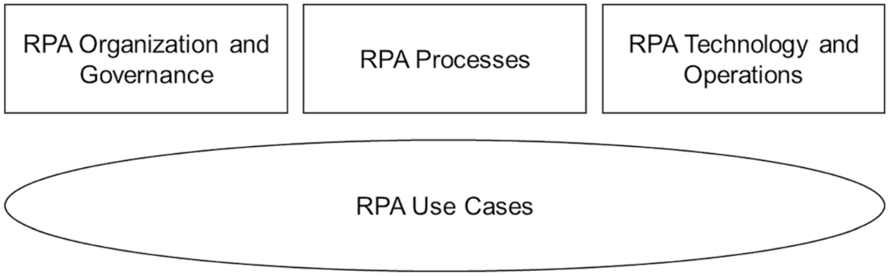

Fig. 1 RPA project framework

of the situation and continuous definition of operational targets was part of the project implementation described in this section.

From the methodical perspective, the set-up and conduction of the RPA project were structured into (1) organization and governance, (2) processes, and (3) technology and operations, which are described in the following subsections. From the content perspective, the RPA project defined and implemented a multitude of detailed RPA use cases, of which two concrete use cases are described more in detail in Sect. 3.4.1. This structure is summarized in an RPA project framework in Fig. 1.

3.1 Organization and Governance

Due to the strategic importance of the digital strategy, the realization of quick results and savings was a major requirement. Hence, a lean and agile organization was defined to reflect this mindset (cf. Fig. 2). A major challenge was the interrelation between project and line organization. The overall responsibility for the RPA implementation was linked to the dedicated *Center of Excellence*. The design and implementation of RPA in various concrete processes (e.g., procure to pay) were structured according to a project organization, while the operations of the automated solutions have been handled by the IT line organization. Overall, the *Center of Excellence* was accountable and responsible for the entire lifecycle of the RPA solution.

In the design and implementation domain, a team of RPA project leaders was defined to drive multiple smaller automation activities as separate subprojects following an agile development method. The RPA project leaders had a central role in identifying, designing, and implementing concrete RPA use cases that contribute to the overall objective of increased process automation. The project leaders were supported by a project office that was responsible for overall project management activities. For each concrete use case, a team responsible for the design and implementation of the individual RPA process automation was formed.

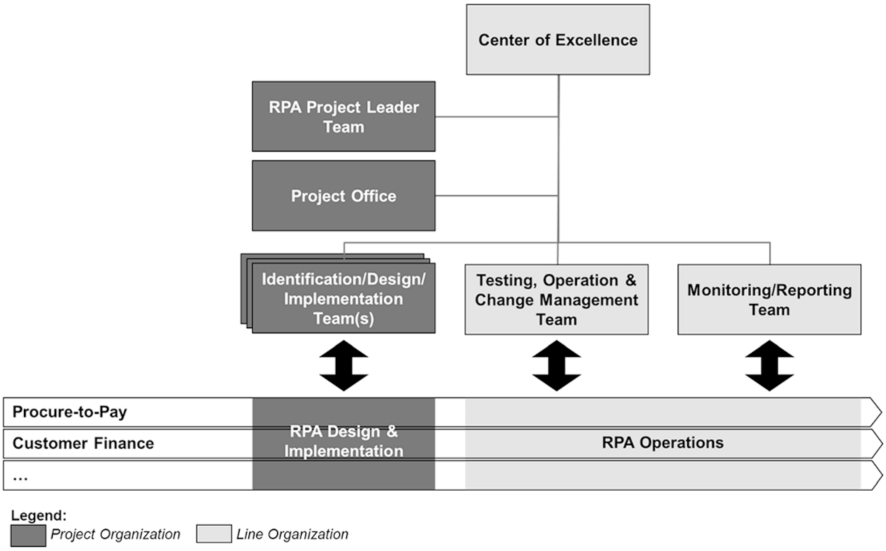

Fig. 2 RPA organizational set-up

After the implementation, the RPA use case was handed over to a dedicated team responsible for testing and operations of all automated processes. They were also responsible for change management to ensure necessary adaptations of the RPA implementations. These changes could be triggered by user requirements but also by adaptations of underlying systems, such as user interfaces, web pages, or tool templates. Finally, a team responsible for reporting of the RPA automation was defined. They were in charge of calculating the license fees to the external RPA vendors. These fees typically follow a pay-as-you-grow principle and are based on the number of automated process steps or the number of executed transactions.

Furthermore, governance aspects have been considered in order to ensure a successful RPA implementation. As software robots take over work originally performed by humans, social partners and human resources (HR) have been involved as part of the overall governance and benefit realization. Their approval was a mandatory prerequisite to start the implementation of concrete RPA use cases.

3.2 Processes

One of the key tasks of the RPA project leaders was the identification of relevant processes that could be automated by RPA. Furthermore, a prioritization of the processes was required to balance the ease of implementation with related saving potentials. Some processes were identified that could be easily automated by RPA foreshadowing low-saving potentials, while others promised substantial savings

Use Case	Process	Description	Application	Frequency
1 Electricity consumption data extraction	finance	▪ Download of relevant invoices from SAP ▪ Extraction of consumption data per consumption point through text field recognition ▪ Booking of data in SAP	▪ free text, SAP MM	▪ daily
2 Transfer of offer data in SAP	purchasing	▪ Extraction of data from offer documents ▪ AI-based text recognition ▪ Start of the SAP transaction and entry of fields with information from offer documents	▪ PPT, PDF, DOC, SAP MM	▪ daily
3 Shopping bot	ordering	▪ Bot creates shopping cart based on Excel lists for the procurement of smartphones for employees ▪ 10,000 of 25,000 shopping carts created within 9 months	▪ MS Outlook, SAP MM	▪ daily
4 Scanning and booking of invoices	invoice verification	▪ Entry of incoming invoices and comparison with purchase order and goods receipt ▪ Entry in SAP FI and posting of the invoice depending on the value limit	▪ free text, SAP FI-AP	▪ upon need
5 Ordering of office supplies via smartphone	requirements recording	▪ Scanning the barcode of office material via app on the smartphone generates an email to the functional mailbox, robots use it to generate a request	▪ purchasing catalogue	▪ upon need
6 Posting outdated goods receipt and invoice items	goods receipt	▪ Bot checks goods receipt and invoice items according to the posting date for a defined period. Depending on this, he creates a predefined mail to the requester or books the goods receipt	▪ SAP FI, MS Office	▪ daily
		...		

... = classsical RPA ... = cognitive RPA

Fig. 3 Exemplary RPA use cases

related to high implementation efforts. Therefore, end users have been involved into the identification and prioritization of use cases.

The automation of RPA processes was structured into three phases: (1) as-is analysis and evaluation of RPA potential, (2) design of RPA use cases, and (3) implementation of RPA use cases. In the first phase, DTSE has analyzed the as-is situation and evaluated the RPA potential based on quantitative performance indicators and possible benefits. In the second phase, different use cases with an automation potential through RPA were identified and designed. For all those use cases, the relevant sub-processes, application systems, and the execution frequency were described (cf. Fig. 3). Some of those cases are related to classical, and others are related to cognitive RPA. The first two cases are exemplarily described into detail in Sects. 3.4.1 and 3.4.2.

The prioritization of RPA use cases was based on the following two dimensions: (1) process complexity and (2) number of process executions.

Leveraging these two dimensions allowed a prioritization of the processes according to their maximum of impact in an optimal manner. Overall, it was the target to find the optimum between the two dimensions *process complexity* and *number of process executions*.

3.3 Technology and Operations

At the beginning of the project, the decision was taken to realize the RPA use cases with external partners. The functional—not the IT—department was responsible for the vendor selection as well as the operations of the RPA solution. The objective was to get a higher flexibility compared to a standard IT-based approach with long release cycles. Hence, the RPA project had to cover vendor management and operations of the RPA software and hardware.

As the migrated processes should run fully automated, it is of high importance that the software robots are available 24/7. Therefore, operational support was organized through the RPA project. Also, the reporting of the migrated processes and their actual operational status had to be available in real time. The vendors offered their own dashboards to report the status for their respective RPA systems. As DTSE decided for a multi-vendor strategy, no vendor agnostic integrated dashboard was available. Consequentially, a proprietary dashboard system was developed in-house. Considering the security, several technical requirements arose. As the software robots emulate end-user inputs, they had to be aligned with the access protection of all relevant application systems. This was a significant effort, as DTSE has more than 170 software robots running. Each of them, for example, required individual logins that have to be securely stored. In addition, the confidentiality level of all accessed information had to be investigated carefully.

3.4 Use Cases

Each RPA use case is related to concrete processes and application systems, which are automated by specific software robots that were implemented and customized according to the specific use case. This implementation requires a detailed knowledge of the as-is situation. The relevant design decisions and implementation tasks are illustrated based on two exemplary use case.

Use Case 1: Electricity Consumption Data Extraction

Scope of this use case is the handling and booking of electricity consumption data, which was at the beginning of the project a highly manual process. The data is provided by the energy provider as paper invoice, which is uploaded to SAP by an accountant of DTSE. Afterward, a dedicated expert downloads the invoice from SAP, extracts the consumption values per consumption point, and books the

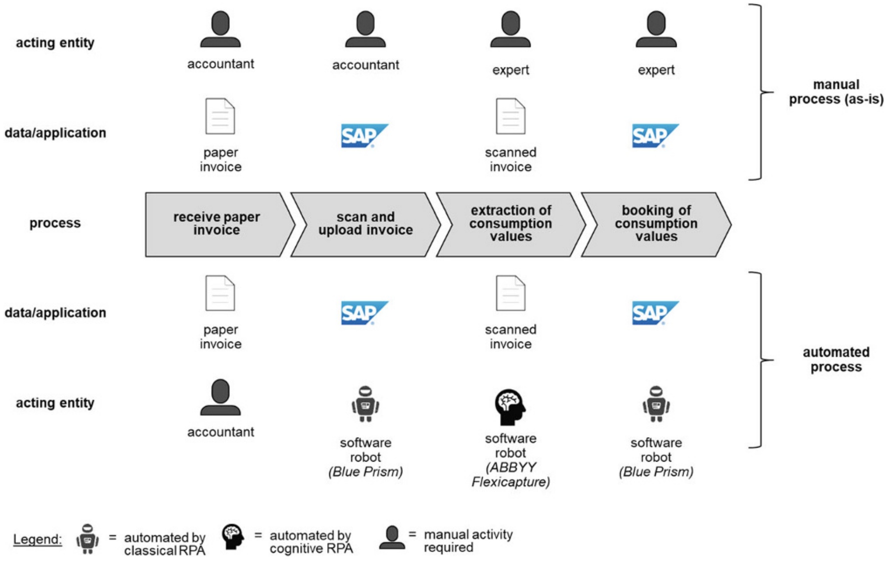

Fig. 4 Use case 1—Electricity consumption data extraction

information in SAP. Especially the extraction of data is a highly manual process, as each invoice includes on average 16 line items and 114 data fields. With approx. 14,000 invoices per year and an average manual effort of 5.2 min per invoice, the total manual work per year sums up to 1248 h, which equals to approx. 0.7 FTE.

With the implementation of cognitive RPA, the whole process was automated. First, the download of invoices from SAP is handled by a software robot using *Blue Prism*. Second, the optical character recognition (OCR), the data extraction, and the text field recognition are performed by a software robot using *ABBYY FlexiCapture*, which is a document workflow platform that captures and classifies unstructured data.

As a result, the manual effort as well as the processing time was decreased. The handling of an invoice was on average reduced to 19.5 s, which results in a total effort of 76 h/year and a time reduction of 94%. The accuracy was measured based on different indicators. Overall, the document and line item discovery rate reached 100%, and the field discovery rate reached 99%. Nevertheless, looking more into the details, 52% of line items and 11% of fields required a verification which is still a manual step.

As a result, the process of electricity consumption data extraction was streamlined and automated utilizing RPA. Figure 4 shows the process before and after the RPA implementation.

Use Case 2: Transfer of Offer Data in SAP

The scope of the second use case is the purchasing process. During this process, suppliers provide offers as answer to purchasing requests. Those offers include—based on the complexity of the requested product or service—a variety of attachments (e.g., product specifications). In the administrative part of the purchasing process, the offer data has to be transferred to a purchasing order. In this context, the extraction of data from the offer documents results in high manual effort. In the as-is situation, approx. 100k uploads of offer attachments with a manual effort of 1.5 min and 1k purchase order creations with a manual effort of 7.5 min result in a yearly effort of 2.6k h.

The automation of this process requires the following steps:

1. *Acquisition of incoming offer documents (including attachments)* in different formats (e.g., PDF, graphics) through intelligent scanning software
2. *Text field recognition* using AI-based tools to transfer unstructured offer data to a structured XML file
3. *Creation of purchase order* in SAP
4. *Check and booking of purchase order* in SAP

The first three steps were automated by cognitive RPA, while the last step remains a manual activity. A major challenge is the correct interpretation of the offer data due to the different formats, layouts, and content. After scanning the offer data (including attachments) by an OCR tool, an AI-based text field recognition is used. This tool maps the unstructured offer data to predefined fields (e.g., offer number and total amount) and generates an XML file. This structured XML file is used as input in SAP. The software robot automatically creates a purchase order and enters the relevant data from the XML file. The purchase order is forwarded to an employee of the purchasing department who checks and books the purchase order. From a risk and also legal perspective, this last manual step is important. If the AI-based text recognition does—for whatever reason—something wrong, this manual step allows a correction. Furthermore, the contract is still closed by a human entity. The whole design and implementation of this use case are illustrated in Fig. 5.

4 Results Achieved

Since the first RPA pilot implementation at DTSE in Q3/2016, a total number of 172 software robots have been successfully implemented across six different functional areas within finance and controlling, procurement, and HR domains. Those implementations resulted in measurable performance improvements, such as lead time reductions, full-time equivalents (FTE) reductions, and cost savings. Figure 6 illustrates the number of new software robots implemented per year in relation to the realized FTE reduction.

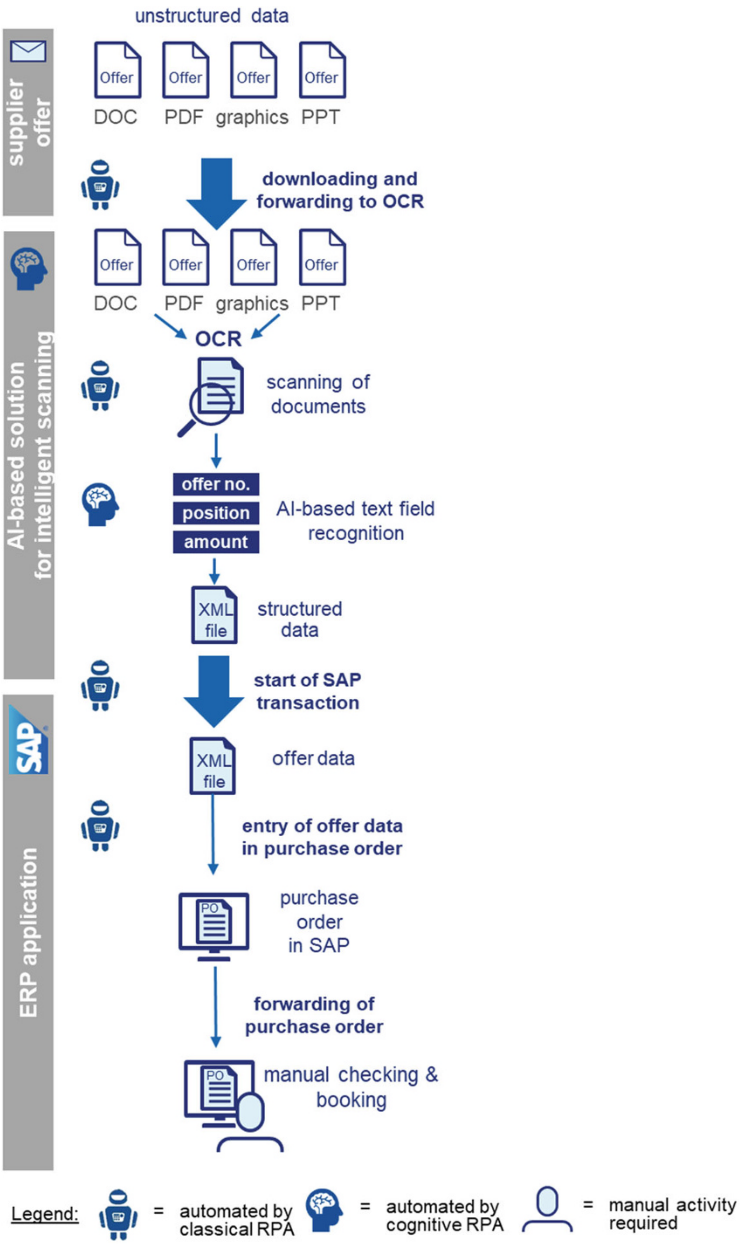

Fig. 5 Use case 2—Transfer of offer data in SAP

Optimizations that can be realized by implementing RPA solutions for administrative tasks are comparatively high. Administrative tasks are characterized by the fact that they are time-consuming, have a high repetition rate, and involve numerous

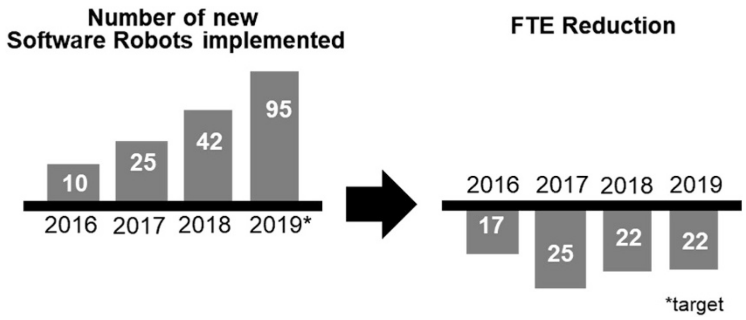

Fig. 6 Number of software robots in relation to FTE reduction

routine activities. Especially for administrative tasks, RPA solutions can be easily implemented. Hence, the implementation of classical and cognitive RPA solutions has led to tangible efficiency and effectiveness improvements for DTSE.

Through the deployment of classical and cognitive RPA, key benefits were observed in various different processes. Based on the two use cases described in Sect. 3, the following key benefit areas were identified. For the first use case "electricity consumption data extraction" (cf. Sect. 3.4.1), those areas are (1) *invoice scanning and validation* and (2) *invoice processing*, whereas for the second use case "transfer of offer data in SAP" (cf. Sect. 3.4.2), the key areas are (3) *request creation* and (4) *purchase order (PO) creation*. The four areas are therefore also the ones in which the highest number of RPA bots were recently implemented (i.e., 49 out of newly implemented 77 bots in 2019).

The key drivers for *improved invoice scanning and validation* through RPA deployment are mainly:

- Elimination of human errors—results are always the same.
- Full transparency on actions and validation results.
- Reduced invoice scanning and validation time.
- Automated application of predefined business rules for invoice scanning and validation.

The key drivers for *improved invoice processing* through RPA deployment are mainly:

- Automated invoice processing and forwarding to the billing
- Full transparency on actions and invoice processing results
- Elimination of human errors in invoice processing and payments
- Invoice processing by following predefined business rules

The key drivers of *improved request creation* through RPA deployment are mainly:

- Reduced time for request creation
- 24-h availability of RPA bots for 7 days per week

- Instant request creation avoiding long waiting queues
- Request creation without changing any underlying IT systems

The key drivers for *improved purchase order creation* through RPA deployment are mainly:

- Shorter purchase order creation time.
- Avoidance of errors through manual interference.
- System is available 24 h on 7 days per week.
- Immediate purchase order submission after creation.

In summary, the project at DTSE that was set up for the deployment of more than 170 RPA bots has reached the desired goals within a short timeframe. In all use cases, cost savings potentials ranging from 10 to 40% were identified and realized through the implementation and deployment of RPA. Through the significant cost savings realized, a breakeven for the investments was achieved as expected. These figures indicate the financial benefits of RPA. The exact financial figures related to the project are subject to confidentiality.

The overall success of the RPA project at DTSE led to the establishment of a continuous pipeline of additional processes to be optimized. RPA works well in environments wherein structured information and time-consuming activities with a high repetition rate need to be processed automatically. By means of simple RPA implementations, automation levels of up to 80% could be achieved.

5 Lessons Learned

The case provides concrete examples how RPA is used at DTSE. First, from a strategic perspective, RPA is identified as an enabling technology to achieve the overall automation objectives. Second, from a methodical perspective, an agile project approach is illustrated that resulted in various qualified RPA use cases, including simple and cognitive capabilities. Third, from an operational perspective, two exemplary use cases related to energy consumption and transfer of offer data were discussed in detail. The advantages shown in the case are increased flexibility and fast implementation, as RPA was mainly implemented by the business side without changes to the existing application landscape.

While some implementation details are specific for DTSE, most parts of the cognitive RPA concept and project approach can be used as a reference for prospective process automation projects:

- The general idea of RPA (i.e., automating manual tasks without changing underlying application systems) can be applied to various industries. Standard systems for RPA are available.
- The extension toward cognitive RPA using AI-based tools allows the automation of more complex tasks and can be applied to other use cases.

- The project set-up and agile approach allowed fast implementation results and integration of the business side that can be used as references for similar projects.
- Different benefit dimensions show that process automation goes beyond pure cost cutting.

From the general perspective of process automation, the case provides insights into the concept of (cognitive) RPA (e.g., Houy et al. 2019; Enriquez et al. 2020). As a contribution to future RPA projects, the following lessons learned were derived from the case:

1. *Close alignment with functional departments is a critical factor*. In order to understand actual process challenges and to really generate value for the business, functional departments with the respective process owners and users have to be included from analysis through implementation.
2. *RPA implementation requires specific solutions for each process*. Each process has different concrete automation requirements. First, a detailed analysis of the as-is situation is required. Second, the concrete solution design is necessary for each detailed use case.
3. *Differentiation between software robots and RPA systems is essential*. While the RPA system offers the general technical capabilities, the business logic is related to each software robot that acts within the different business processes.
4. *RPA requires a central governance structure*. Fast implementation is a key advantage of RPA, which results in high dynamics. Keeping track of all different use cases and software robots requires a central governance structure.
5. *Pilot-driven approach for cognitive RPA is a key success factor*. When means for cognitive RPA were first discussed within DTSE, a pilot-driven approach was chosen in order to better understand the technical capabilities and limitations. Otherwise unrealistic concepts are designed which will end up in a frustrating experience during implementation.
6. *Operating model for RPA is a prerequisite for long-term success*. In order to enable scaling up the use of RPA, DTSE has early in the process developed a multi-dimensional target operating model which has helped ensure a stable approach to governance, processes, roles, and technology. Otherwise there would be a high risk that RPA remains a short initiative that is long forgotten after a first hype.

As RPA is an innovative topic, the case offers various starting points for future research. Especially, if the software robot learns the process independently, concepts are required governing the compliance between RPA activities and defined business processes. Furthermore the process complexity still limits RPA. The concept of cognitive RPA is a new topic that requires further research on combining RPA with artificial intelligence. So far, RPA is seen as an independent software system that is added to the user interface layer. This offers the advantage of a fast implementation. Consequently, the integration between RPA and application systems and the standardization of interfaces are topics for future discussions. In addition, it can be expected that complex RPA implementations will require an overall RPA architecture as well as an RPA management system, controlling different technical use case realizations.

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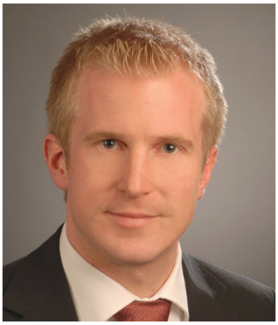

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Part II
Digital Business

Huawei

An Exceptional Example of Customer-Centered, Collaborative, and Decentralized Practices in the Telecommunication Industry

R. Guerrero, C. Lattemann, and S. Michalke

Abstract

(a) **Situation faced**: Huawei has surpassed companies such as Ericsson, Nokia Network Solutions, and Motorola Solutions and thus became the biggest telecommunication firm in China and the third world biggest telecommunication firm right after Apple Inc. and Samsung Group. Despite the success achieved by the company today, Huawei had a humble and rigorous beginning. In order for Huawei to become a worldwide recognized company with a high reputation, the company had to overcome four main challenges: (1) country of origin, (2) liability of foreignness, (3) latecomer effects, and (4) lock-in effects.

(b) **Actions taken:** Huawei encountered challenges such as having a negative image and reputation, developing basic ICT through reverse engineering, lacking on talented workforce, and relying on a centralized and governance structure as well as on interdepartmental activities. To become a global player and streamline the firm enterprise architecture, Huawei relied on three different strategies: (1) using operations in the periphery as a technological catch-up strategy to foster ICT-application systems by relying on business networks and customer-centered solutions, (2) creating and breaking routines to promote a decentralized and demand-driven supply structure, and (3) lowering innovation barriers throughout hiring international talent as well as relying on co-created and cross-departmental activities.

(c) **Results achieved**: Founded in 1987 as a distributor for telephone switches, Huawei is now recognized as one of the global and digital leaders in the telecommunication industry. By relying on managerial practices such as value creation, collaboration, and decentralization, Huawei has developed capabilities in different forms such as R&D, university collaborations, development of leading-edge technologies (e.g., 5G network, digital switching technologies,

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enterprise networks), and strategic mergers and partnerships. These actions have led the company to fulfill its meaning by developing pioneering technologies and services and becoming a symbol of innovation, inside and outside of China.

(d) **Lessons learned**: Today, the success of digitalization does not lie in the development of digital technologies individually. Instead, it stems from how companies integrate them to transform their businesses and how they work. In this context, the ability to digitally reimagine the business is determined in large part by having a clear strategy supported by leaders who foster a culture able to change and invent. To successfully ride the wave of change, companies need to evaluate how digital disruption is changing customer behavior continuously, rethink their business toward developing more individual and customized solutions, and redesign customers' roles to form co-creation practices.

1 Introduction

Digitalization has been identified as one of the major trends changing society and business in the near and long-term future (Parviainen and Tihinen 2017; Gimpel et al. 2018). Digitalization creates a business environment in which companies can learn fast and make early and rapid internationalization possible (Lee et al. 2019).

By integrating new digital technologies into the value chain and by adjusting old processes and implementing new management practices, firms are likely to seize new opportunities with innovative ways to reach potential customers and be instantaneously active on a global scale. In general, digitalization impacts internationalization processes of firms in terms of accessibility of resources, skills, and competences acquisition, as well as in terms of the potential for learning and knowledge-development in foreign markets. Other parameters, like entry mode choices or expansion rate, are also influenced by digitalization (Coviello et al. 2017; Hervé et al. 2020). In this context, digitalization also enables companies to overcome internationalization-related problems such as country of origin, latecomer and lock-in effects, and liability of foreignness (Johanson and Vahlne 2009; Kohli and Johnson 2011; Johansson 2017; Lee et al. 2019).

According to authors such as Johansson (2017), Kohli and Johnson (2011), and Urbach and Röglinger (2019), for companies to be able to overcome such internationalization-related problems and find their way to digitalization, not only technological changes must be implemented (e.g., adopting new and digital technologies), but also managerial changes accordingly. For instance, companies must empower new working modes and a mindset more based on collaboration as well as on challenge and learning seeking, discard obsolete and traditional business models based on product centeredness and instead adopt a more service- and customer-centered perspective, and also change roles in the ecosystem and consider your customers as co-creators instead of mere consumers, all across the entire business architecture.

In this chapter, digitalization is not seen as a *mere* change of just digitalizing existing work processes as well as products or services into digital variants. However, it is seen as fundamental changes that occurred in multiple layers of an enterprise architecture caused by the adoption of digital technologies and the coordination of vast management practices in an organization (Urbach and Röglinger 2019). This refers to changes at layers, including business models, business processes, people and application systems, data and information, and technological infrastructure. Whereby, for companies to be able to take advantage of the digital age, it is crucial for them to align such layers (Urbach and Röglinger 2019). This chapter will focus on digitalization, by referring to changes related to the business model, business processes, people, and application systems.

This chapter will take the Chinese telecommunication enterprise, Huawei Technologies Co. Ltd. (hereafter *Huawei*), as a case study to explain how the company tackled digitalization and overcame challenges related to the country of origin; the liability of foreignness; latecomer and lock-in effects, through the development of individual- and customized services adjusted to specific customers' needs; as well as on relying on management practices based on value creation, collaboration (e.g., business ecosystem network structure), and decentralization (e.g., breaking and adjusting routines). Additionally, our research builds upon using insights from the field of international business (IB) and combines them with information systems (IS) views to study the effects of digitalization within Huawei. It aims to contribute to IB and IS research by offering a better understanding of how adopting digital technologies and superb management practices can lead companies to new pioneering opportunities in foreign markets. This objective is grounded in the current need to contribute to the development of new theoretical foundations for empirical research on digitalization and its interface between IB and IS (Keupp and Gassmann 2009).

The remainder of this work is structured as follows: Firstly, we present the situation faced by Huawei. Secondly, we discuss the actions taken by Huawei to achieve its success and digitalization. Finally, this work ends with the results achieved by Huawei together with some lessons learned.

2 Situation Faced

Since the beginning of the Internet in 1983, the telecommunication industry has experienced a number of technological revolutions, leading this industry to become one of the most pivotal industries for the development of the socio-economy of a country (Kateja and Jha 2008). While in the 1980s and 1990s, the telecommunication industry was dominated by technologies from countries such as Germany, France, Japan, the USA, and Great Britain; countries such as China, for example, were considered "invisible" in this industry due to its low contribution. Today, 30 years later, China is by far considered the largest and most-advanced country in the world within the industry of telecommunication. Chinese telecommunication enterprises offer a vast amount of services, including hardware, software, telecommunication, and network, to most countries in the world, often by offering lower prices than their competitors. China's cost advantages, in combination with high production capacity and well-skilled workforce, have provoked meaningful challenges for international firms, even increasingly leading US and European firms to partner with them to be able to stay in the market (Privacy Shield, China Country Commercial Guide 2020).

At the commencement of China's economic reform in the beginning of the 1980s, also known in the West as the program of economic reforms termed "Socialism with Chinese Characteristics," the country's telecommunication infrastructure was exceptionally weak (Harwit 2007). Back then, one of China's core businesses in the telecommunication industry was to develop stored program-controlled switches (SPC switches). Over 99.7% of all office telephone systems across the country were computerized through SPC switches (Zhang and Igel 2001). SPC switches are defined as electromechanical switching systems that use computer programs and a processor to enable exchange features such as abbreviated dialing, call forwarding, and call waiting between telephones (Zhang and Igel 2001).

In 1987, thanks to the government call to improve the telecommunication industry, there was an impulse by a few core Chinese local manufactures and research groups, including the Chinese military, to develop SPC switches. It was in this particular moment in 1987 when Ren Zhengfei (hereafter *Ren*), a former veteran and former Deputy Director of the People's Liberation Army (PLA), decided to found Huawei with an initial investment of CNY 21,000 ($5462.00) (World Bank 1987).

The company had a humble beginning and started initially with him as a one-man sales agent selling imported private branch exchange (PBX) and telephone switches before manufacturing them (Low 2007). PBX consists of a telephone system that allows organizations to manage their outgoing and incoming calls and permits internal communication within a business (Junker and Noller 1983).

Back in the 1990s, Huawei's focus was based on reverse engineering adopting basic foreign information and communication technology (ICT) and on minimizing production costs (i.e., cost-effective strategy) (Cremer and Tao 2015). In fact, Huawei practically only focused on copying technologies offered by other competitors such as Cisco, Fujitsu, and others to the extent that it was known as the "Cisco of China" (Buderi and Huang 2007, p. 206). At later stages, in the mid-2000s, Huawei was entirely focusing on improving enterprise efficiency by making changes and adjusting its enterprise architecture. In this context, Huawei's transformation needed to be streamlined based on its business model, business processes, people, and ICT-application systems (Huawei, ICT Insights 2018). First, Huawei needed to transform its business model into one driven by user experience and based on customized solutions geared to customers' needs and desires (Drahokoupil et al. 2017). Second, Huawei needed to adjust its business processes, shifting from a centralized governance structure (e.g., employees only responding to the requirements of business departments as well as company's managers) toward a more decentralized and demand-driven supply structure that enables employees at the company's frontlines to have more responsibilities and authority to freely make

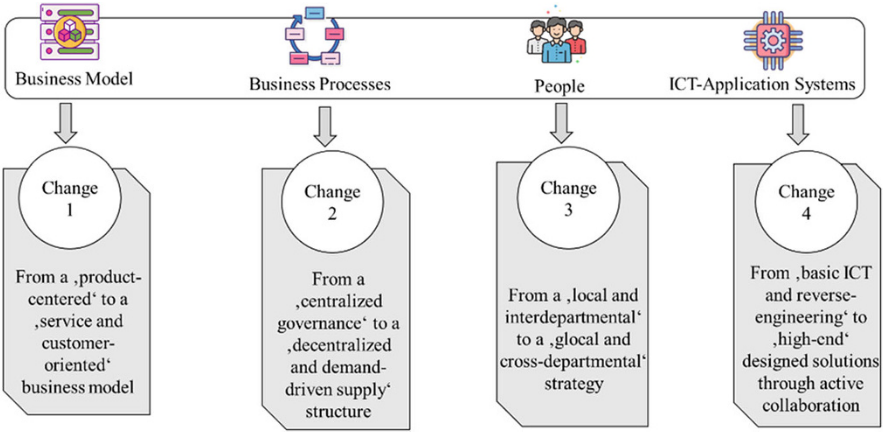

Fig. 1 Digitalization across Huawei's enterprise architecture. Source: Own source based on Urbach and Röglinger (2019)

decisions (Ahrens 2013). Third, due to its lack of innovativeness, mostly because of lacking international talent and relying on centralized governance practices, Huawei also needed to adjust its people, not only changing the company's initial mindset from "local first" to "glocal first" but also making internal employee adjustments between the different company's departments by enabling cross-departmental activities and co-creation practices to drive and support rapid transformation (Wu et al. 2020). Fourth, Huawei explored many ICT-application systems improvements, investing heavily in internal R&D and quickly shifted from applying basic ICT to producing customer-centered solutions through collaboration with local and international business and research partners, which eventually led to expansion into international markets (Cremer and Tao 2015) (see Fig. 1). By placing digitalization at the forefront, Huawei has expanded quickly over the years, and its products and services have been deployed in over 170 countries. Suo Kun and Lin Xin (both Strategic Planning Managers) at Huawei summarized it as follows:

> With consumer expectations on a constant upwards trajectory, all companies know they must go digital. In this time of digital Darwinism, companies that invest intelligently in digitalization will start pulling out ahead (Huawei, Huawei Technologies Communicate 2016).

However, what was the situation back then that led Huawei to become today a global market and technology leader? In order for Huawei to become a worldwide recognized company with a high reputation, the company had to overcome four main challenges: (1) *country of origin*, (2) *liability of foreignness*, (3) *latecomer effect*, and (4) *lock-in effect*.

Country of Origin The country of origin effect refers to the impact of a nation's image on how a particular product or service is perceived (Bilkey and Nes 1982). In this context, Chinese companies are often associated with the production of low-quality goods and with the well-known "Made in China" low-quality etiquette, which has created a negative image of Chinese products on the international market (Yi and Ye 2003; Kreppel and Holtbrügge 2012).

According to Urbach and Röglinger (2019), one of the key drivers of digitalization is to follow a customer value-centered business model. Thus, companies having a low-quality etiquette due to country of origin effects, such as Huawei, should focus on developing technologies that are customized and individualized based on customers' needs and desires (Carr 2003; Johansson 2017).

Huawei's initial actions in the early times of existence were not centered on developing high-quality solutions for their customers but rather in managing its own survival as the company faced fierce competition at the beginning from both domestic and international players (Murmann 2020). Unlike promoting the company's transformation throughout creating a positive image by focusing on R&D activities and collaboration to promote new ICT-application systems and technologies discoveries, Huawei's initial actions (e.g., adopting basic foreign ICT and copying other competitors products) led the company to be recognized as a "low-price manufacturer," and its products were as well considered to be of low quality (Chong 2013). Huawei's initial cost-effective strategy was mainly effective for business partners in rural areas in China as they benefited from the low prices of the products and services offered. However, it was not always effective for all worldwide customers, especially those located in highly developed countries such as the USA and Europe. In these markets, customers associate pricing as a "quality" and "reliability" indicator (Yi and Ye 2003; Kreppel and Holtbrügge 2012; Wu et al. 2020). Premium pricing infers premium products or services. Ren summarized it as follows:

> When I look back on how Huawei developed in the telecom market, we actually made some missteps. Our products were considered low quality for two reasons. First, as technology advanced rapidly, we initially did not manage to keep the track. Thus, we needed to work with what we had. Second, thanks to the Western management approaches we brought in, our operational costs were also kept low. As a result, we set out products at a relatively low-level quality with cheap prices. This made it easier to compete in the Chinese market. We have reflected on this a lot. (CNBC, Interview with Ren. 2019)

Finally, by following a customer- or value-centered business model and an ecosystem business approach (i.e., active collaboration), Huawei was able to improve its ICT-application systems and developed leading-edge technologies.

Liability of Foreignness At the core of the liability of foreignness phenomenon lies the so-called "firm-based liability of foreignness" concept, which involves extra challenges and additional costs for companies entering into new markets due to a lack of knowledge of the business ecosystem, market, cultures, languages, legal foundations, and market mechanisms, in the host country. These challenges have their origin in firm-specific characteristics, including ownership and management structures, firm-specific activities and processes, learning, and network based on linkages such as affiliation to a business group (Petersen and Pedersen 2002; Johanson and Vahlne 2009). For example, centralized organizations can suffer from the negative effects of relying on several layers of bureaucracy. These businesses often have multiple management layers stretching from the company's owner or managers down to frontline operations hindering decision-making processes. Business owners responsible for making decisions in the company may require more time to accomplish these tasks, which can result in slowing business operations as well as in not fomenting a culture based on openness and freedom (Schwer and Hitz 2018).

According to Urbach and Röglinger (2019), a company's digitalization on the management level requires new working modes (e.g., agile and flexible workflows, cross-functional work routines) structured around business processes, whereby such processes must be managed and executed by people. Thus, in the digital age, organizations need agile business processes that support decentralized operations and people who can work in a decentralized and autonomous way. In this context, companies suffering from a firm-based liability of foreignness issues are prevented to achieve digitalization due to their high dependency on centralized structures as well as on relying on several layers of bureaucracy (Davenport and Redman 2020; Johanson and Vahlne 2009).

Back in the 1990s, Huawei was suffering considerably because of lacking international talents and relying on very rigid management structures guided mostly by interdepartmental activities, which led the company to have few innovative outputs. Huawei's hiring policy rule was driven by the motto "locals first" rather than "global first," and the company's internal processes and activities were separated by independent departments (Wu et al. 2020). Employees needed to respond specifically to the requirements of Huawei's departments' managers. and there was little to zero exchange of information between one department and the other. For example, when designing function-oriented ICT-application systems, instead of involving employees from different departments to promote different perspectives, which might have led to designing a better system, the entire work was conducted purely by the technology department (Huawei, ICT Insights 2018). Ren summarized as follows:

> Overcoming the liability of foreignness was the biggest challenge for Huawei in its initial stage of internationalization. (Wu et al. 2020)

Finally, by later stimulating knowledge transfer with hiring new and competent international talents and enabling cross-departmental activities, Huawei was able to enhance flexibility and agility as they experienced more cross-company cooperation and greater decentralization.

Latecomer Effect Latecomer firms are those firms which face competitive disadvantages because of a late entry in already existing markets (Mathews 2002).

According to Urbach and Röglinger (2019), for companies to be able to meet the challenges and adversities of digitalization, they are forced to adapt their business models, e.g., change from product-centered to service-centered business models based on developing individual and customized solutions geared to specific customers' needs. Likewise, this is also true for companies suffering from challenges related to latecomer effects (Kohli and Johnson 2011). While first movers can already be digitalized and have a defined business model, latecomers can learn from them and thus adapt their business models by focusing on their competitor's weaknesses (e.g., offering individual and customized instead of generic solutions) (Kohli and Johnson 2011).

In the late 1980s, companies such as NEC, Motorola, Nokia, and Alcatel-Lucent started to penetrate the world markets of telecommunication through strategic local mergers and partnerships (Fransman 2001). As opposed to taking the international joint venture (IJV) route that was chosen by most of Huawei's competitors to achieve a higher global presence, Huawei's business model back then was mainly based on developing its own cheap technology in-house and on mainly targeting China rural townships far away from the centers of power and multinational attention (Hensmans 2017). Local Chinese operators, hotels, and factories needed customized gear and central office switches that could withstand local adverse conditions such as low transmission quality or variable power supplies (Ahrens 2013). Only after Huawei had already developed a strong rural presence, they decided to come to China's big cities (e.g., Shanghai, Beijing, Guangzhou, Tianjin) and eventually explored foreign waters by entering into the Russian market in 1997.

Finally, in the mid-2000s, by learning from the first movers and adapting its business model toward a more service-centered model based on developing individual and customized solutions geared to specific customers' needs, Huawei was able to gain recognition and prestige on a worldwide scale.

Lock-In Effects Central to the idea of lock-in effects is that due to the trajectories of certain technologies and network effects, companies experience lock-in effects. For instance, companies tend to rely on the same technologies for extended periods, even in the face of competition from potentially superior substitutes (Perkins 2003).

Urbach and Röglinger (2019) argue that one of the key drivers of digitalization is digital technology. However, they also emphasize the necessity that such technologies must be tailored to the customer's requirements. In this context, in this digital era, it is imperative for companies to make the necessary investments for developing suitable and high-quality technologies for their customers, thus avoiding firms to get locked in lock-in effects (Amit and Zott 2001).

In the early years of Huawei, the company purely acted as a Chinese sales agent for local Chinese operators by applying basic foreign ICT, reverse engineering, and developing cheap products. Investments in R&D toward new technological discoveries represented only a tiny fraction of Huawei's total sales revenues compared to other big telecommunication providers such as Motorola, Nokia, and Alcatel-Lucent (Low 2007). Ren summarized it as follows:

> We chose a tough road. The telecommunication industry had high requirements. Back in the 1990s and beginning of the 2000s, our company was very small and almost had no capital or technology. It was hard times. (Huang 2019)

For instance, Huawei's R&D spending in 2001 amounted to $340 million, compared to $4.3 billion from Motorola and $2.9 billion from Alcatel-Lucent.

Table 1 Huawei's R&D investments and other competitors from 2001 till 2004. Source: Low (2007)

	2001			2002			2003			2004		
Telecom manufacturer	Sales (US$ billion)	R&D (US$ billion)	% of sales	Sales (US$ billion)	R&D (US$ billion)	% of sales	Sales (US$ billion)	R&D (US$ billion)	% of sales	Sales (US$ billion)	R&D (US$ billion)	% of sales
Huawei	3,08	0,34	11,0	2,67	0,36	13,5	3,83	0,39	10,2	5,58	0,48	8,60
Motorola	30,00	4,30	14,3	26,70	3,80	14,2	27,10	3,80	14,0	31,30	3,10	9,90
Nokia	27,80	2,70	9,7	30,80	3,10	10,1	36,20	4,60	12,7	39,10	5,00	12,80
Alcatel	22,60	2,90	12,8	17,40	2,20	12,6	14,30	1,80	12,6	15,30	2,00	13,10
Lucent	21,30	3,50	16,4	12,30	2,30	18,7	8,50	1,50	17,6	9,00	NA	NA

Note: NA (Not Announced)*

These minor investments, initially, severely impacted Huawei's capacity and ability to globally compete in an industry where future growth and expansion rea heavily dependent on R&D, such as it is the telecommunication industry (Low 2007). Table 1 depicts a 4-year overview of the R&D investments by Huawei and other competitors from 2001 till 2004.

Finally, by relying on active collaborative practices such as developing co-created solutions with their customers and building up a business ecosystem with local research institutions as well as by investing no less than 10% of its sales revenues to R&D to do research on frontier technologies, Huawei was able to get access to customers on a worldwide scale, despite existing lock-in effects.

In the following chapter, we will describe in detail how Huawei ascended to a global player in the telecommunication industry by deriving actions from a digitalization strategy on a managerial level.

3 Actions Taken—Huawei's Ascendance to Global Dominance: The Digitalization Strategy

As industries around the world started to go digital with expectations of supporting innovative business growth through digital transformation on a managerial and technological level, the time also came to Huawei around the mid-2000s. In 2011, Tao Jingwen (Huawei CIO and President of the Quality, Business Process & IT Management Department) announced to all Huawei's employees that they would now be facing one of their biggest challenges in history, the so-called digital economy. In this context, he set a new company's goal based on generating more revenues and profits by improving capabilities and efficiency through adjusting Huawei's business architecture and by overcoming the challenges described in Sect. 2. Tao Jingwen summarized it as follows:

> The goal of Huawei's business transformation is to generate more revenue and profits, improving capabilities and efficiency while ensuring digitalization. To achieve this goal,

> Huawei must complete four changes. First, adapt the company's business model from a product-centered to a more service and customer-centered business model. Second, shift the focus from internal process operations toward a more decentralized and demand-driven supply structure. Third, increase international talents and fostering a company's culture based more on openness and freedom. Fourth, get rid of the "Made in China" etiquette by developing high-end solutions through digital services and collaboration to connect well users. (Huawei, ICT Insights 2018)

Nowadays, Huawei's ascendance to global dominance in the telecommunication industry has stumped the entire global market (Schaefer 2020). How did a company that was struggling to build its image in China suddenly rise to the pinnacle on a global scale in an industry sector where only the most competent could survive? To become a global player and achieve digitalization, Huawei mainly relied on three different strategies: (1) *using operations in the periphery as a technological catch-up strategy to foster ICT-application systems by relying on business networks and customer-centered solutions*, (2) *creating and breaking routines to promote a decentralized and demand-driven structure*, and (3) *lowering innovation barriers throughout hiring international talents as well as relying on co-created and cross-departmental activities*.

Using Operations in the Periphery as a Technological Catch-Up Strategy to Foster ICT-Application Systems by Relying on Business Networks and Customer-Centered Solutions A key for technological catch-up and for the development of ICT-application systems is the ability for companies to acquire technological knowledge from external sources such as business partners or customers (Fonseca and Picoto 2020). Consequently, according to Kumaraswamy et al. (2012), in emerging markets, compared to firms from developed economies, domestic firms are more likely to be technologically and even managerially backwards, without much variance in their capabilities and performance. As the firms with sophisticated technology and capability enter the market, domestic firms learn from those firms, therefore upgrading their skills and capabilities. Such a rapid catch-up in technological capability allows domestic firms in emerging markets to upgrade skills and capabilities, thereby enabling them to be competitive in international markets (e.g., Huawei).

Still, in the mid-1990s, China fully relied on its acquisition of telecommunication equipment through imports, and most major international telecommunication companies (e.g., Motorola, Nokia, Alcatel-Lucent, Ericsson) already had a presence in the country (Fan 2006). Normally, these companies, due to their high-technology advancements as well as expertise, penetrated the market in China and had a dominant presence in cities with advanced industrial sectors (Ahrens 2013; Chong 2013). However, they neglected rural areas, where conditions were poor and profit margins were thin. Here, Huawei saw an opportunity to introduce its own cheap reverse-engineered technology initially and made its first presence in the Chinese market. Huawei's initial mindset was based on building cost-effective solutions; thus, they began by taking advantage of their low labor costs and prices. As they prospered, Huawei started to change its mindset and strategy toward a more collaborative perspective, inspired by the importance of social, collaborative interaction and integration of partners' knowledge.

Huawei established JVs and partnerships with small local telecommunication companies to expand its business ecosystem and foster technological knowledge as well as to increase their customer base. This led Huawei to develop innovative solutions and ICT-application systems that did not yet exist for some of their international and Chinese domestic competitors (e.g., digital switching technologies). They also paid increasing attention to customer requirements and learned more about quality and differentiation (Ahrens 2013). While some of Huawei's competitors such as Nokia Network Solutions and Alcatel-Lucent set as utmost priority to develop high-end technology products while neglecting the needs and desires of the customers, Huawei in this sense focused not only on offering high-quality products or services at lower prices than its competitors but also focused on how to improve the customers' experience by developing individualized and customized solutions (McNally 2007). For example, Huawei began to offer new services and to offer them in new ways, i.e., providing service availability on a 24/7 scale along with equipment transportation, installation, and maintenance at no extra charge (Tao et al. 2016).

By growing its business ecosystem, Huawei gained the confidence and support of influential decision-makers in small cities and gradually conquered the Chinese market by the end of the 1990s. Through local partnerships and strong government ties, Huawei improved its portfolio of ICT-application systems and expanded its technological know-how capabilities and skills, which eventually led the company to reach internationalization. Instead of going after popular, high-margin markets such as the USA and Western European countries as it was the case with most of Huawei's competitors, Huawei focused on targeting emerging countries (e.g., Russia, Middle East nations, Latin America, South Africa), where the telecommunication industry lacked technical and innovative developments (Wu and Zhao 2007). In these regions, Huawei was able to exploit their still not high-tech but customer-centered solutions. Further, at that time, relationships to decision-makers in the governments were easier to tie in developing and emerging countries than in developed ones (Ahrens 2013). Ren summarized it as follows:

> In the past ten years, we have strived to change ourselves, modestly learnt from our experiences in emerging countries, improved efficiency, developed an exceptional human resource management mechanism, and motivated all our staff to remain dedicated. This was the only way for us to survive. (Huang 2019)

In 1997, Huawei entered into the Russian market and formed a JV with the BETO Corporation to produce switching equipment. As they already had the know-how concerning switching technologies gained from previous local experiences, Ren's main idea was to position Huawei in this market through an area of their expertise. In 2002, soon after reaching the Russian market, Huawei entered the Latin American market, making presence in countries such as Brazil, Mexico, and Venezuela. Given the fact that digital cellular network such as GSM were mostly established in Europe as well as in the USA by the time, Huawei saw an opportunity to exploit its expertise on GSM network in Latin American countries. Here, unlike Western European countries and the USA, the telecommunication industry was confronted by many challenges, especially due to the lack for governments to provide necessary financial resources for companies to establish digital developments (Mahrenbach 2018). Consequently, in 2003, thanks to Chinese government relationships with African governments, Huawei reached the African market making a $20 million business contract through a JV agreement in Ethiopia with ADDIS ABABA and a $200 million cooperation agreement contract with the Nigerian government to deploy nationwide wireless network covering remote areas of the country currently underserved by the local nation's operators.

By collaborating with local and international partners, Huawei explored many ICT-application systems upgrades and eventually led Huawei to build a robust business ecosystem to make presence in developed markets. The first impulse occurred in 2004, where Telfort BV, a Dutch mobile telecommunication provider, awarded a business contract for an undisclosed sum to Huawei. Similarly, in 2005, Huawei scored a major business deal in Denmark with Radiometer—a radiometer A/S multinational company—and with Vodafone, one of the largest mobile telecommunications providers in the world (Hensmans 2017).

Here, it is also very important to emphasize that many sources allege that over the 1990s and the beginning of the 2000s, the Chinese government also had a great influence on Huawei's business ecosystem expansion. For instance, in accordance with Chinese government sources, in 1998, the China Construction Bank (CCB) provided Huawei with $550 million in buyers' credit, representing 45% of the bank's credit that year. The next year, Huawei received another $10 billion credit from the China Development Bank (CDB) to push in Latin American waters (Ahrens 2013).

Creating and Breaking Routines to Promote a Decentralized and Demand-Driven Supply Structure According to Johanson and Vahlne (2009), decentralization plays a key role in favoring innovations. As innovation becomes a top priority for most companies, the company's leaders need to understand how to take advantage of decentralized processes.

Research has established that creating and adjusting routines are central when adopting decentralized business processes and when developing new technologies (Morgan and Davies 2018). Moreover, Pentland and Feldman (2007) suggest that if the use of digital technologies increases the number of routines, the increased rate of digitalization will necessitate firms to develop and adjust more business processes as well.

In Huawei's early years, the company's managers delivered a wide array of routines accounting activities in accordance with corporate rules and policies day after day. These rules and policies were applicable nationally (i.e., in Shenzhen headquarter as well as in other Chinese subsidiaries), so it was inevitable that some rules or specific requirements were not applicable in one location and the other. Huawei had a highly marked top-down approach, and its mindset and working modes were characterized as having a "silo" style. Business managers were mostly responsible for making business process improvements, and frontline employees needed to take only partial responsibility. Moreover, business managers also had the responsibility for preparing action plans for technology improvements, and employees had to obey by conducting what was indicated therein without having any voice. If complaints, the company's managers would stop providing assistance to these departments (Huang 2019). The company had a clearly defined centralized governance management structure to manage its business processes and activities. Ren summarized it as follows:

> We used to manage our business processes by having a highly centralized management model. Thus, it was impossible for us to meet future development requirements. (Huang, 2019).

Observation routines were implemented, whereby the company designated specific employees to monitor other employees during their day-to-day work. In this context, professional ethics and a job-specific code of conduct were at the bottom line (Huang 2019; Wu et al. 2020). Moreover, in 1996, the company introduced the so-called Huawei Basic Law. The document was composed of 103 articles indicating not only sets of routines to be followed but also how various business processes within the company were articulated (Wu et al. 2020).

Until the beginning of the 2000s, Huawei developed a reputation that it would require employees to work such long hours that they would routinely spend the night sleeping under their desks. According to internal sources, Huawei used to hand out blankets and sleeping pads to take naps, but employees would often also use them to sleep overnight (Tao and Chunbo 2014). In 2008, a few Huawei employees committed suicide, which eventually led the company to found itself in the middle of a public media storm for its alleged "centralized-governance" structure. This drastic event required the company to drastically change its internal process operations toward a more decentralized and demand-driven supply structure. Here, to guarantee long-term success, especially in the international markets, the company focused on adjusting its business processes to match the market and customers' requirements.

In 2008, due to the fact that more than 50% of Huawei's sales came from international markets, Ren started by allocating almost 100 mid-level and senior managers in many foreign subsidiaries around the world. Most of them were designated to occupy marketing and sales positions (Tao and Chunbo 2014). Back then, marketing used to serve as a bridge between sales and R&D, and their job was to identify customers' needs and requirements in each of the different markets to delegate this information to R&D further, leading the company to build customer-centered solutions.

Moreover, as the firm became more and more internationalized, business processes had to be adjusted at a strategic level to guarantee that the decisions being taken in the foreign markets were the correct ones. In this context, the company introduced the so-called "Blue Army" and "Red Army" departments. The "Red Army" were the managers who officially were in charge of the company. The "Blue Army" were a group of employees designated to review the strategic plans of the Red Army from a different perspective. In this regard, while in the beginning, each and every decision was purely executed by the company's managers without involving any lower management levels, which initially led Huawei to have few innovative outputs, the company now focused on organizing debates and discussions involving all management levels to seek disruptive technology alternatives (Tao and Chunbo 2014). Ren summarized it as follows:

> In recent years, we have instituted democracy first among senior management, and then the whole organization has become democratic. Decisions are now made collectively. The process is slower, but we have made fewer mistakes. Any idea must be marinated and communicated gradually throughout the company, and we do not expect any change overnight. It will produce great power if it is implemented after being accepted by all in the company. (Tao and Chunbo 2014)

Similarly, in 2011, Huawei also created new routines and adjusted its business processes to become less dependent on the founder. Perhaps, the most interesting example is the so-called System of Rotating Acting CEOs. In this system, three senior executives act as rotating CEOs for a tenure of 6 months, and Ren adopts a mentor and coach role for the rotating CEOs. This is done with the intention of promoting new ideas coming from different senior executives to observe if radical results occurred within the company from one time to another (Tao and Chunbo 2014; Wu et al. 2020).

Nowadays, Huawei's business processes and management model are driven by decentralization and an elite team-centric operations supported by intelligent algorithms (e.g., big data, machine learning). That is, frontline personnel must be capable and authorized to efficiently make decisions, whereby such decisions could be improved through the use and application of intelligent algorithms.

Lowering Innovation Barriers Throughout Hiring International Talents as well as Relying on Co-created and Cross-Departmental Activities A company's greatest potential and most important factor in successful innovation is its workforce. Beyond the idea that companies cannot be run by their people, it is even more important to reiterate that you cannot operate technology nor any business activity without people. Thus, if digitalization depends on the changes related to technology and managerial functions, digitalization cannot be achieved if it were not for its people making such changes possible (Urbach and Röglinger, 2019).

A balance of talented people among the domestic and foreign markets represents a key to underpin growth and secure greater efficiency within a company (Davenport and Redman 2020). Additionally, according to many researchers such as Manca et al. (2018) and Nguyen et al. (2018), knowledge transfer must be stimulated through cross-departmental functions that get people out of their "silos," leading the company to enhance flexibility and agility as they experience more cross-company cooperation and greater decentralization.

In the early stage of Huawei's development, simply hiring people was the most urgent activity. Later, as Huawei gradually developed, the focus shifted to motivating, staffing, cultivating, and other related tasks (Tao and Chunbo 2014).

In the late 1980s and beginning of the 1990s, Huawei's goal and orientation was to "capture the Chinese market" and adopt basic foreign ICT through reverse engineering. To accomplish this, the company purely hired Chinese employees, and the number of employees increased slightly because Huawei only hired workers to meet the minimum requirements for selling and assembling their products (Murmann 2020). Unlike learning from Western companies who mainly relied on international talents, Huawei mainly relied on Chinese talents till the beginning of 2000s, and as a result, Huawei was held back from further development (Murmann 2020; Wu et al. 2020).

In the same way, initially, Huawei relied on very rigid management structures guided mostly by interdepartmental activities, leading the company to have a few innovative outputs at that time. For example, Huawei's employees were only able to act very passively by just being able to respond to the requirements of Huawei's departments' managers, and there was little to zero exchange of information between one department and the other. When designing function-oriented ICT-application systems, instead of involving employees from different departments to promote different perspectives, leading to perhaps more innovative outputs, the work was purely limited to be developed by the technology department (Huawei, ICT Insights 2018).

As time went by, Huawei's hiring policies and human resource management (HRM) system started to change toward a more international orientation. In 2006, Huawei began to systematically hire new talents—with many holding doctoral qualifications—coming from either emblematic universities or companies all over the world. The idea behind it was to inject knowledge and expertise to foster new innovations and digital transformation among all different companies' areas, including technical services, supply chain, procurement, strategic cooperation, branding, human resources, and commercial affairs. Between 2006 and 2008, Huawei grew from 46.000 to 81.000 people (Huawei, Facts and Figures 2008). However, their reliance on interdepartmental activities persisted. Tao and Chunbo (2014) report that Ren already in 2006 "started to think that the company's talent was now the least of his problems, the question now was how to manage them" as the company still in the beginning of the 2000s was dominated by massive centralization and silos working styles (e.g., interdepartmental activities and strong hierarchical lines). Ren summarized it as follows:

> The Huawei Basic Law has become obsolete. The management practices learned from IBM are not anymore totally fitting for Huawei. (Tao and Chunbo 2014)

This was a clear declaration that Huawei was willing to de-routinize existing practices as well as working modes and replace them with new, frequently more coordinated routines. In this context, since 2008, Huawei adopted a more Western perspective, one that is struck by the willingness to embrace and foster cross-departmental activities and, at the same time, promote a culture based on openness and learning, which are essential skills needed to overcome the digital age (Dorozalla and Klus 2019; Wu et al. 2020). As Huawei's technology was also advancing, the development of new ICT-application systems and integrated product development (IPD) required cross-departmental activities. Cross-departmental activities would allow employees and multiple business partners to frequently interact during the product and service development phase and to prioritize what products and services were to be developed to avoid duplication (Huawei, ICT Insights 2018). For example, in the past, marketing had misgivings about this change in activities because under the old routines (e.g., interdepartmental practices), when a product failed, marketing could simply blame R&D as marketing was not involved in the product design phase. Under this new system, marketing was deeply involved in the design stage and could no longer pass the blame to R&D (i.e., co-creation), which led Huawei to significantly increase its efficiency when developing new products and services. For example, while under interdepartmental practices, the average time to launch a new product or service was of 74 weeks (e.g., in year 1999), and under cross-departmental practices, the average time to launch a new product or service decreased to 36 weeks (e.g., in year 2009) (Murmann 2020; Wu et al. 2020).

4 Results Achieved

Through Huawei's successful experience with local operations in China, the firm learned how to collaborate successfully with peers, partners, governments, and customers to provide individual and customized solutions all around the globe. This has enabled the company to create a synergic and robust business ecosystem conformed by over 25,000 partners and offering its products and services in over 170 countries (Huang 2019; Schaefer 2020).

Instead of keeping the thought that value should be created by the company closed and separate, and that digitalization is mostly achieved through technological improvements (Jallat 2004; Øiestad and Bugge 2014), Huawei drove digitalization by focusing on managerial aspects relying on collective success, collaboration, and co-creation. Huawei changed its business model and its mindset of flooding the globe with basic ICT relying on reverse engineering and cheap and unbranded products toward a more high-end customer-centered solutions. In the same way, Huawei learned from Western companies' practices and understood that to keep the pace of the digital age, the company needed to break, adjust, and create new routines based more on decentralization as well as on promoting a culture based on openness and learning. Since then, the company has grown in infinite ways, becoming a serious rival in the telecommunication industry, competing against other well-known companies such as Apple Inc. and Samsung Group. Huawei is today ranked as the third biggest telecommunication enterprise around the globe, and it has been catalogued and acclaimed many times as one of the fastest-growing companies in the last 10 years (Huawei, 50 Smartest Companies in MIT Technology Review 2019c) (Fig. 2). In continents such as Europe and Latin America, Huawei has been very well accepted, and its growth has given rise to more than 111,000 jobs in Latin America and over 11,000 in Europe (Huawei, Annual Report 2019a). In Europe, Huawei has invested more than $75 million in cooperating with over 150 universities and research institutes and has signed over 210 technology partnerships agreements to promote new technologies and research advancements in the field of telecommunication (Huawei, Annual Report 2019a). One exemplary example of Huawei's

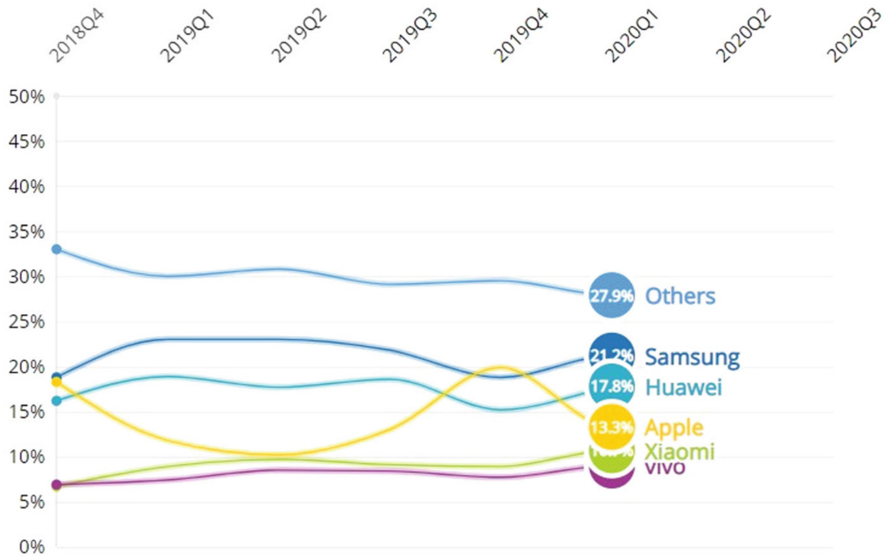

Fig. 2 Worldwide top 5 smartphone company unit market share (%). Source: IDC Corporate (2020)

research institutes are the so-called Joint Innovation Centers (JICs). The JICs are research innovation centers whose purpose is to provide collaborative support for managing customer-supplier relationships between Huawei and its customers and remove long-term uncertainties concerning the direction of capability development (Hensmans 2017). Consequently, in the African market, in the past decade, Huawei has risen to be one of the most important telecommunications markets, "disruptors." Huawei was the first telecommunication company to bring countries such as Kenya and Nigeria to the forefront of Africa's digital initiatives by increasing connectivity thanks to the implementation of 3G and 4G technologies (Tugendhat 2020).

Unlike other major international competitors setting as an utmost priority to develop high-end technology products while neglecting the needs and desires of the customers, Huawei has adopted a risky internationalization strategy making it difficult initially, but it became easier over time as the company gained reputation and paid attention to customers' requirements. Huawei's strategy of "using operations in the periphery as a technological catch-up strategy to foster ICT-application systems by relying on business networks and customer-centered solutions" has made the company do numerous successful business deals in emerging countries such as Russia and many African and Latin American countries. This is due to Huawei's capacity to respond to local and individual requirements by engaging in close collaborations with partners and customers (Huang, 2019). In China, people knew and trusted Huawei and took pride of its global success. In emerging countries, Huawei became a brand that people respected and considered worship. However, while Huawei gained the confidence of China, emerging countries, and part of the

European countries, other countries such as the USA and Germany have recently started to distrust the company due to its extremely close relationship with the Chinese government and due to strong accusations on the Chinese government using Huawei devices to spy on the USA and its allies (Hosain 2019). The company also faced similar challenges with international countries in 2008 when Huawei found itself in the middle of a public due to the suicide incidents. However, Huawei was able to handle the situation before international media, claiming that suicides are a major public health issue in China and that suicide rates in China have always accounted high numbers (e.g., 780.000 suicides in China in 2008) (Wu et al. 2020). Still, for many Huawei customers as well as employees, the brand has become part of their "identity" (Ahrens 2013). In Ren's view, people care about belonging to and being proud of a collective but also having the desire to differentiate themselves from others. In this regard, Huawei's core values satisfy both stakeholders and shareholders. Huawei's core values emphasize the idea that "serving customers is the only reason why Huawei exists" and "Huawei belongs to everyone, and thus, all employees should act like owners, with dedication and commitment" (Tao et al. 2016, p. 44). This entrepreneurial spirit has allowed the company to learn and innovate collectively.

Finally, although Huawei is considered a latecomer in comparison to other major international competitors, it represents one of the first telecommunication firms together with China Telecom ever to launch the so-called 5G wireless communication technology. Unlike Huawei's competitors, its R&D centers started years before to conduct research in this field. Nowadays, Huawei is recognized to be the global leaders of the 5G technology (Huawei, Committed to Leading Future 2019b). Overall, it represents an exceptional example of how a firm, by relying on managerial practices related to value creation, collaboration, and decentralization, is able to overcome serious internationalization-related problems and the challenges of digitalization.

5 Lessons Learned

While in most of the literature, digitalization is seen from a technological perspective, whereby digitalization itself is considered based on the implementation and adoption of digital technologies within companies (Øiestad and Bugge 2014; Brennen and Kreiss 2016), this chapter proposes a holistic perspective, whereby digitalization is seen as fundamental changes occurred in multiple layers of an enterprise architecture (i.e., *business model*, *business processes*, *people*, and *ICT-application systems*) caused by the adoption of digital technologies and the coordination of vast management practices in an organization (Urbach and Röglinger 2019). In this sense, the digitalization itself is reflected in Huawei's transformation in accordance to its business model, business processes, people, and ICT-application systems, from its beginning till today.

Established in Shenzhen in 1987, Huawei's story describes how Huawei, as a latecomer enterprise, could grow so rapidly till becoming one of the world largest ICT providers today. This growth catapulted the company onto the world stage, paralleling the rapid expansion of Huawei's sales revenues, technology advancements, and customers and partners worldwide.

Today, the success of digitalization does not lie in the development of digital technologies individually. Instead, it stems from how companies integrate them to transform their businesses and how they work. In this context, the ability to digitally reimagine the business is determined in large part by having a clear strategy supported by leaders who foster a culture able to change and invent new (Kane et al. 2015). The history of technological advance in business abounds of examples of companies focusing on technologies without implementing the necessary amount of management practices nor investing in organizational capabilities to ensure their impact. For instance, companies such as Kodak, Nokia, and Blockbuster are classic examples of companies that failed to innovate because they did not change their mindset and processes nor built a culture that fostered change.

Based on the example provided of Huawei in this chapter, we can conclude that three major pillars drove Huawei's digitalization: (1) value creation (e.g., creating value for the customers through individual and customized solutions geared to specific customers' needs), (2) collaboration (e.g., business ecosystem network structure), and (3) decentralization (e.g., creating new and adjusting old routines).

To successfully ride the wave of change, companies need to evaluate how digital disruption is changing customer behavior continuously, rethink their business toward developing more individual and customized solutions, and redesign customers' roles to form co-creation practices (Vargo and Lusch 2008). Especially in the telecommunication industry, which is considered an industry that has seen tremendous technological advances by most of the big international players of this industry over the last years, it is all about understanding customer requirements and preferences and delivering an outstanding customer experience at every touchpoint. Since most companies offer almost the same kind of technologies (e.g., enterprise networking, enterprise wireless, intelligent collaboration, storage, smartphones, smartwatches), the difference is in the details and on how to offer more for less. For example, this is reflected in the case of Huawei in ways the company provided service availability on a 24/7 scale along with equipment transportation, installation, and maintenance at no extra charge to all their worldwide customers (Cremer and Tao 2015).

Consequently, for digitalization to be a success, collaboration is crucial. While technology enables new ways of working, collaboration is the key catalyst for promoting the agile and management practices required to achieve digitalization (Camarinha-Matos et al. 2019). The need to share and combine information, knowledge, and other resources along the company and develop agile coordination mechanisms to support efficiency in businesses processes corresponds to important facets of collaboration. Additionally, the emergence of strategic long-term partnerships such as business ecosystems requires new organizational structures and advanced models of collaboration, in which the focus lays on the cooperation of different actors (i.e., service providers, customers) and stakeholders with the aim of applying collective knowledge to create value for the individual and the entire business ecosystem (Akaka and Vargo 2015). For example, this is well portrayed in the initial stages of Huawei when the company established JVs and partnerships with small local telecommunication companies to foster technological knowledge, which led to innovative solutions as well as ICT-application systems that did not yet exist for some of their international as well as Chinese domestic companies (e.g., digital switching technologies) (Tao et al. 2016).

Finally, digitalization is reducing demand for centralized and standardized routines, manual tasks, and silos working styles while increasing demand for decentralized routines and for problem-solving and cross-departmental skills (Rossi et al. 2020). Most organizations start with a centralized model, where a founder makes all the decision. As the business grows and diversifies, their environments become more complex. These businesses need to become more flexible and responsive, resulting in decentralized decision-making. In this context, nowadays, company's managers must question and re-evaluate traditional approaches to organize work and search for new organizational structures that can achieve efficiency but also have the flexibility for success in today's digital age. For example, this is clearly reflected in Huawei's action taken to divest itself from the "Huawei Basic Law." While in its initial stages, Huawei followed the Huawei Basic Law in all respects, as the company became more international making presence in multiple foreign markets, Huawei saw the need to de-routinize such practices and working modes established so far and replaced them with new, frequently more coordinated routines that embraced cross-departmental functions and at the same time promoted a culture based on openness and learning.

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Facing Digitalization in the Insurance Industry

The InsurTech Case of DEVK

Sara Schiffer and Jan Stockhinger

Abstract

(a) **Situation faced**: Given their long-established tradition and resounding success, digitalization brings unprecedented changes for insurance companies. Driven by the disruptive developments observed in comparable industries, DEVK, the company investigated in this case, realized their business model is at stake in the digital age. Due to a lack of experience with establishing and managing digital business models and an IT infrastructure and processes focusing primarily on stability and reliability instead of fostering innovation and creativity, the company faced a plethora of challenges.

(b) **Action taken**: Responding to these challenges, DEVK made "making use of digitalization" one field of action in its new business strategy. One initiative within this field was the founding of "Freeyou", a company-owned start-up. The name reflects the start-up's vision, which is to make insurance as easy as possible for the customers, to free them from tedious paperwork and to give them time for other things they would rather do. Since its foundation in 2017, the InsurTech has launched two products which are equipped with digital features and that can be purchased entirely via digital channels.

(c) **Results achieved**: Launching the products took Freeyou 4 and 8 months, respectively—an implementation period that would so far not have been feasible within the parent company. While the first product, a bike insurance, still had pilot character, Freeyou was able to achieve significant sales success with the second product, a car insurance. To implement the new business model, Freeyou has built up an organization which, unlike the parent company, is primarily focused on innovation and speed, allowing the group to quickly test new products and forms of customer interaction.

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(d) **Lessons learned**: Even though the initiative is still at an early stage and requires continuous development, the case investigated gives valuable insights for incumbent companies looking for ways to benefit from digital technologies quickly. The case has shown that for this, the underlying organizational model is at least as important as the changes required on the business model side. In order to build both on a "greenfield site," it was "mission critical" to reduce the dependencies to the rest of the group to a minimum.

1 Introduction

Coping with the ubiquitous presence of information technology (IT), the pace of technological innovations, and the resulting economic transformations we have been witnessing the last years is a particularly challenging endeavor for organizations in traditionally stable and conservative industries (Ross et al. 2016). Given their long-established tradition and resounding success, digitalization brings about unprecedented changes for many established companies in these sectors (Sebastian et al. 2017). For example, the banking industry has only recently demonstrated how fast new tech-savvy entrants ("challenger banks") might take over significant market shares, enforcing profound reactions from incumbents to keep up with the new level of customer expectations satisfied by these players (Staykova and Damsgaard 2019).

DEVK, the firm investigated in this case, is a primary and reinsurer and as such part of the traditional insurance industry. Founded in 1886, the company looks back at a long history of success. Serving about 4 million customers and holding more than a combined of 14 million insurance policies in all lines of business in 2017, DEVK is one of Germany's most prominent insurance companies. In particular, DEVK is the third-largest provider of household insurance in Germany, scores fifth in car insurance, and sixth in third-party-liability insurance. As far as primary insurance is concerned, the company is serving the German market exclusively and comprises a workforce of about 6000 employees, 3500 of which are working in the back office and 2500 sales agents.

Driven by the disruptive developments observed in comparable industries as, for example, the banking industry, DEVK management realized their business model is at stake in the digital age. Although not yet as prominent as in the banking sector, an increasing number of so-called InsurTechs had entered the market. The term "InsurTech" is composed of the words "Insurance" and "Technology" and refers to insurance-related companies whose competitive advantage is based on digital technologies. Despite its image of being a rather prudent and defensive decision-maker in general, the firm decided to engage with digitalization preemptively and proactively. To this end, a vital measure on DEVK's journey toward becoming a more digital organization was the decision of founding its own InsurTech—"Freeyou." However, given the lack of experience with establishing and managing digital business models, an IT infrastructure, and processes focusing primarily on stability and reliability instead of fostering innovation and creativity, and due to the peril of jeopardizing its established business model ("self-cannibalization"), the company faced a plethora of challenges and tensions during its transformation initiatives.

Rather than a project with defined starting and ending points, the development of an entirely new business model is an evolutionary and discursive journey demanding constant effort to be successful. The following case description focuses on the approach an established, old insurer has taken to use digital technology for quickly bringing such a new business model to market. We are convinced that the actions taken and lessons learned by DEVK also offer valuable insights for companies in similar industries that are about to take the plunge into the digital business world.

2 Situation Faced

From its inception, the insurance business has always been based on building trust and reliability. Since business models in this industry typically focus on creating stability and safety, insurers naturally tend to be risk-averse and rather slow when it comes to fundamental strategic changes. In contrast to this prudent stance, DEVK decided that merely sticking to its traditional business model is not an option anymore in the digital age. The challenges that led the DEVK management to arrive at this conclusion trace back to three domains of change in the business environment.

2.1 Technological Changes

Digital technologies, commonly subsumed under the acronym "SMAC" (social, mobile, analytic, cloud) to illustrate the most prominent ones, are the core characteristic and driver of digitalization (Stockhinger and Teubner 2018). The use of these technologies is essential for insurance companies to remain competitive, as they offer considerable advantages such as increased efficiency, reliability, and predictability and thus form the basis of operational excellence. The consequences that can be observed in the insurance industry are, for example, increasingly automated back-office processes or customer interactions via digital channels such as mobile apps or online portals. Although many insurance companies are still busy striving for operational excellence, the technologies mentioned are not particularly new developments. Instead, their revolutionary impact is due to the fact that they have now reached a level of maturity and societal adoption that makes their use vital in the insurance industry.

Besides SMAC, a set of "more experimental" digital technologies has caught the interest of insurance companies recently (Löffler et al. 2016). Specifically, the Internet of things (IoT) as an emerging global infrastructure for interconnecting physical and virtual things was determined as an enabler of new products and services. With the advent of the IoT, pay-per-use approaches have become viable; the so-called telematic products are a typical example of use. For these products, data about customer driving behavior is read out and analyzed via an interface of the car. Based on the individual driving style, the costs of the insurance policy are increased or decreased. IoT technologies also enable insurance products with a preventive approach. One example from the field of household insurance are early warning systems that use sensors to detect possible water pipe bursts. On suspicion, the systems automatically shut off the water supply and notify the user via a mobile app. This approach does not only spare the customer the damage but saves the insurance company the cost of settling the claim as well. Besides IoT solutions, artificial intelligence technologies also promise massive benefits for insurance companies. For example, using artificial intelligence technologies for image recognition could allow automated damage estimations, replacing human damage assessors and, potentially, enable fully automated claim settlements. A common example again comes from car insurance; various apps are already able to automatically generate an estimate of the amount of damage based on a photo that the user uploads to the app. Also, distributed ledger technology, as prominently used in blockchain applications, promises data to be stored in thousands of devices within a distributed peer-to-peer network, potentially enabling peer-to-peer insurances.

These novel technologies, although just representing a small selection of potentially disruptive innovations, gave rise to critical discussions among the DEVK management about the ramifications that these technologies bring along and ultimately about possible scopes of application within the current business model. However, the management also acknowledged that the challenges in the digital age are not limited to technological changes, as they have implications for the economy and society as a whole. We will describe these challenges in the following segments.

2.2 Economic and Competitive Changes

Digitalization, as a socio-technical phenomenon, has direct and indirect effects on organizations. The direct effects relate to digital technology itself and its organizational adoption. Digital technologies, however, also have indirect effects on organizations by changing the economic and social conditions under which they operate.

From an economic perspective, the insurance business used to be highly personnel and IT-investment intensive. DEVK, just like most other established insurance companies, operates a nationwide sales infrastructure, a large back office taking care of service and claims settlement and a complex on-premise IT. However, due to the technologies mentioned above, especially cloud and mobile computing, big data, IoT, and analytics, insurance has become a more and more lightweight business model: Sales may be handled via digital channels, back-office activities can be automated to a large extent, and cloud computing allows to obtain software and infrastructure as a service.

This progress has led to changes in the competitive landscape, as an enormous amount of so-called InsurTechs entered the market since 2017. Their business models range from ad hoc insurance coverage made possible by online distribution channels to IoT-based products designed to prevent damage wherever possible, to blockchain-based Peer2Peer insurances. Even though some of these firms were not able to assert themselves on the market and the founding boom has now clearly flattened out, the fresh and innovative approaches of these companies have at least awakened some of the incumbents, such as DEVK.

Still, not only innovative start-ups have entered the insurance market. Using their competitive edge regarding digital technologies and existing customer interfaces, big players from outside the industry such as Amazon or IKEA joined the European insurance market. In addition, international players started investing in the German insurance market, seemingly preparing a potential expansion. An example is the Chinese insurance company “Ping An” (the world’s largest insurance company by market capitalization) that invested heavily in the German company builder “Finleap” (Fromme 2018). In the past 5 years, Ping An has accumulated nearly 500 million online users, created 11 new digital platforms across industries, and increased its number of insurance agents to 1.4 million, all armed with the company’s digital tools and apps. Ping An’s commitment to investing in emerging technologies has been a particularly important driver of this expansion. It now directs 1% of its annual revenue—around $1 billion—toward tech investment (Feng et al. 2020; Fromme 2018).

Moreover, following the trend of other industries, digital platform business models gained momentum, especially in the form of vertical search engines hosted by aggregators such as the German portal “Check24.” While comparison engines had already been in the market for several years, in correlation with a growing digital literacy, digital sales channels are becoming increasingly popular. Since most established insurance companies, DEVK being one of them, do not have in place their own digital distribution channels, in the past, insurance companies had largely supported aggregators as they considered them as a welcome opportunity to address digital affine target groups. In retrospect, insurance companies have thus built up competitors in the battle for customer averages that have become indispensable in today’s market.

2.3 Socio-technical Changes

The preceding paragraph has already highlighted how changing customer demands can lead to a shift in the competitive landscape. Digital business model approaches, as pursued by the aggregators, for example, seem to satisfy the emerging customer demands in a superior way in the digital age.

This is also an essential issue for DEVK since customer satisfaction is the company’s most important key performance indicator and at the heart of the company’s strategy. Compared to its competitors, DEVK has an above-average

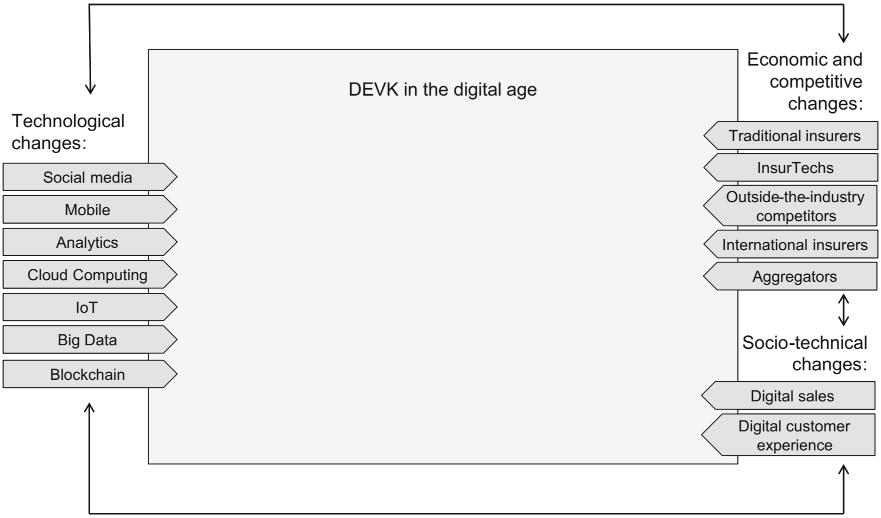

Fig. 1 DEVK in the digital age

performance when it comes to customer satisfaction. The company sees a key to this success in the high degree of personal interaction with the customers. To deliver such service, DEVK operates more than 1250 agencies all over Germany as well as 19 regional offices with additional customer service centers. However, this setting is not only very costly but also hinders the company's digitalization process.

Moreover, just recently one of DEVK's direct competitors, HUK Coburg, had launched a digital insurance company (HUK24). Contrary to the opinion held in the industry that a high level of customer satisfaction goes hand in hand with a high level of personal service, HUK24 was able to achieve a level of customer satisfaction comparable to (traditional) HUK Coburg and DEVK by offering online service[1] only. The waiver of personal service is not only the driving force behind the digitalization within the group but also enables the company to achieve massive cost savings and thus forms the basis for price leadership in the market. Being aware of the competitive advantage coming from digital sales and a digital customer experience, the HUK group is one of the few players in the market dominant enough to refuse cooperation with any aggregator.

Figure 1 sums up the major challenges induced by digitalization and their interrelationships that DEVK faced in 2017. The distinction between technological, economic, competitive, and socio-technical changes is an artificial isolation that intends to help structuring the complex phenomenon of digitalization but is not present in the real world. Quite the contrary is true: The progressive development of the technical changes leads to ever new changes in society and economy, which in

[1]HUK24 even renounces telephone service and thus differs from most other online insurance companies.

turn fuel the development of digital technologies (Urbach and Ahlemann 2016, p. 3). This results in a cycle that confronts companies with a multitude of complex challenges.

Regardless of the challenges mentioned, DEVK could not yet sense the impact of neither new entrants to the market nor changed customer behavior in its business figures. The opposite was the case: It was only in 2014 that DEVK has experienced the most successful sales year in the company's history.[2] On the one hand, this allows the company to undertake first digitalization efforts without the compulsion to succeed. On the other hand, this (seemingly) secure position made it even harder to foster change within the company, as employees did not see an acute need for action.

3 Action Taken

Despite only a vague sense of threat, in 2017 DEVK started setting up its new business strategy with "making use of digitalization" being a major strategic field of action. In the process of strategy development, DEVK decided to actively involve its employees, as they are the ones closest to the customers, knowing most about their needs. Concretely, each department was to send a certain amount of "Strategy Scouts" who, working together in cross-departmental teams, proposed cornerstones for the company's digital transformation.

The initial draft proposed by the team entailed a "digital" target image for the group, including business model and organizational aspects. The changes proposed on the business model side were rather marginal and focused on optimizing the existing one. This was firstly because it is not yet clearly understood how digital technologies will actually change the insurance company's business model and secondly because a business model based on digital technologies would require completely different resources than those currently available to the company. According to the team's analysis, the company in its current form would not be able to deliver a digital business model yet. Therefore, the focus was rather on the necessary changes to the organizational model. The organizational changes proposed by the team especially addressed three fields of action: culture, IT infrastructure, and organizational and processual structure. Knowing that the changes they strived for would take years to implement as they demand fundamental shifts in the company's core values, they were worried that by the time the transformation was realized, it would be too late to still benefit from the changes on the business model side. This concern was heightened as the emergence of InsurTechs had reached its peak at that time. Being small and much more agile, the new competitors were able to deliver new business models within short periods.

[2] As it would later turn out, only surpassed by the year 2019.

Given these circumstances, DEVK realized that transforming within the boundaries of the parent company would be too slow. Therefore, the team came up with an additional proposal—founding an InsurTech, technically and organizationally as independent as possible from the group. By doing so, the company would not lose time testing and gaining experience with new business models while the rest of the group was still busy transforming itself into a "digital-ready" organization and fixing technical debts.

Following the team's suggestion, DEVK founded an InsurTech in early 2017. In the customer surveys conducted by the Strategy Scouts as part of the idea development process, it was found that many potential customers find the topic of insurance annoying and want to invest as little time as possible in it. Following this thought, the name "Freeyou" was created. It should reflect the vision of the company, which is to make insurance as easy as possible for the customer, to free them from annoying insurance stuff and to give them time for other things they would rather want to spend their time with. One of the Strategy Scouts took on the role of the CEO. According to him, in order for the initiative to succeed, it would be essential to have as few organizational and technical dependencies between Freeyou and the mother company as possible. Only this way, Freeyou would be fast enough to keep up with the speed of digital competitors and prevent itself from merely building a more-digital version of DEVK instead of inventing its own organizational and business model. Following this maxim, the newly founded company intended building up a purely digital insurance from scratch.

The following section describes the actions that have been taken to establish a new, independent business and organizational model.

3.1 Business Model

In line with Freeyou's vision of making insurance as timesaving and straightforward as possible for customers, the core of the value proposition is that insurance policies can be closed purely digitally. Compared to other industries, this does not sound like a significant achievement. In the German insurance industry, however, there were only a few companies at that time that allow the customers to receive a policy exclusively digitally. Beyond handling the sales process purely via digital channels, contract closing should cost the customer as little time as possible. Thus, in the course of product development, great importance was attached to making the tariffs as simple as possible so that only little data has to be provided manually by the customer.

Another aspect of Freeyou's value proposition, which is also intended to help free customers from the issue of insurance, is the prevention approach. The idea behind it is to protect the customers from the occurrence of damages so that they do not even need their insurance in the first place.

Bike Insurance

The first product developed by the company was a bike insurance. Compared to other insurance products, it was considered to be relatively easy to build and came along with low financial risk. DEVK had no stand-alone bike insurance in its portfolio so that selling this product would not result in an immediate competition between Freeyou and DEVK. Within 4 months, the InsurTech launched a first version of the product using early customer feedback to improve it continuously. The product could be purchased via the InsurTech's website.[3] Freeyou also integrated preventive features in the product: To protect the bike from theft, the customer could purchase an alarm device when taking out the insurance policy. The device had to be attached to the bike and connects to an app on the customer's smartphone. The device reacts to movement, generates an alarm, and informs the customer through push notification on his phone when the bike is removed from its location without permission. If the customer opted for buying the alarm device, the price of the insurance decreased. The device was not developed by Freeyou itself, but by a start-up with which Freeyou entered a cooperation agreement. Besides, Freeyou developed an interactive map that showed the customer how high the risk of theft is in the region where the customer has parked its bike.

Even though the bike insurance perfectly met the company's vision, it was only able to assert itself on the market to a limited extent. After the first few months, the number of customers remained at a low level, leading to an income which did not justify the company's operating costs.

Car Insurance

The insufficient income of the bike insurance confirmed the company's initial plan that foresaw the need on a quick follow-up product. The decision was made in favor of car insurance. In contrast to bike insurance, the decision for this product was not only driven by Freeyou itself but also by the parent company. While bike insurance as a niche product had more of a "pilot" character, the situation with car insurance was quite the opposite: Firstly, due to many interfaces, for example, with the vehicle registration authorities, and many possible risk factors that can affect the tariff, car insurance is considered a very complex product. Secondly, particularly in Germany, the car insurance market is extremely competitive, because the product is regarded as entry-level insurance for many young customers and often decides where customers take out other products in the course of their lives. Thirdly, DEVK itself ranks among the ten largest car insurance companies in the German market. With Freeyou's entry into this market, the two companies were to become direct competitors, meaning that DEVK cannibalizes its existing business model. Since the

[3] In addition, the product was distributed by various bike dealers. However, in the first step the focus was on distribution via the website.

approaches of the two companies differ significantly in some cases, it will be extremely helpful for the further development of both companies to analyze the respective advantages and disadvantages. If it turns out that Freeyou develops significantly more successful technologies and processes, the question will arise in the long term as to whether and, if so, how these can be adopted by the parent company.

A specialty of the car insurance market is the changing season at the end of the year. Since many insurance contracts cannot be terminated during the year but expire at the end of the year, most customers only have the option of changing their insurance company at that time. Consequently, the majority of the car insurance business is realized between October and December. Freeyou's decision to enter the car insurance market was made in March 2019, leaving the company 8 months, if they wanted to profit from the changing season. By comparison, development times of up to several years were planned in the parent company for the launch of a completely new product.

The company would only be able to master this challenge if it were to focus exclusively on the most necessary core elements of the product. In the end, this meant two things above all. First, Freeyou had to part with the approach of integrating preventive mechanisms into all its products. This would not have been feasible in the short time available. Second, the question arose as to which distribution channel the new product should be offered through. In the case of bike insurance, the company had decided to sell the product via its own website. However, the car insurance market was much more competitive and Freeyou, as a start-up, neither has a high brand awareness nor the financial means for massive advertising campaigns. Consequently, as an increasingly large proportion of customers decides to buy their car insurance via comparison engines rather than on proprietary websites, Freeyou decided to sell its car insurance, in a first step, via Check24 exclusively. This decision enabled Freeyou to save the effort of creating a whole new sales section with the underlying processes on its website and instead allowed to optimize the new product entirely for distribution via Check24. Ultimately, this approach enabled Freeyou to launch its product on time and achieve significant sales success.

In the meantime, Freeyou has also created the option of taking out car insurance digitally on its own website.

3.2 Organizational Model

When Freeyou started its operations, the company's vision was to become a full-fledged insurance company. This embraces obtaining an insurance license from the German Federal Financial Supervisory Authority and thus not only selling insurance but also being allowed to cover the associated risks independently. However, this is accompanied by both a complex licensing process and high regulatory requirements. Both were difficult to reconcile with the company's goal of achieving speed and flexibility. Thus, in a first step, it was decided that Freeyou should act as a so-called underwriting agent, which means that the company may sell insurance policies, but does not bear the responsibility for securing the risks itself. Instead, this part was taken over by a company from the existing group. Nevertheless, the brand “Freeyou” is still in the foreground vis-à-vis the customers, while DEVK operates in the background. This setting enabled the InsurTech to launch its first products on the market quickly but also resulted in organizational dependencies on the parent company, which were originally intended to be avoided.

Half of the initial Freeyou team consisted of former DEVK employees, all of which had to quit their existing (secure) contracts at DEVK in order to start working for Freeyou. To Freeyou’s CEO, this was very important to create a start-up-like culture. He wanted all employees to be as committed as possible to the initiative. A side effect might have been that by forcing people to quit their old jobs in order to start working for the new project, Freeyou’s employees might generally be more risk-taking than the average DEVK employee. Compared to traditional insurance companies, Freeyou has only a tiny fraction of employees with actual “insurance” knowhow but rather IT and marketing skills. The team was located outside the DEVK headquarters—first in a co-working space and later in its own office building.

The employees are essentially divided into three teams, each working according to the Scrum Framework. The teams do not work independently from each other but develop partly together on the same products so that different dependencies between the teams arise. It is essential to coordinate these dependencies in order to align the delivery speed of the teams and thus ensure that delivery deadlines are met. Maintaining and living the agile values is a continuous challenge for the whole team and requires a permanent learning process.

To achieve high development speed, flexibility, and the lowest possible operating costs, the establishment of an own data center was never an option for Freeyou. Instead, the company’s entire IT infrastructure is hosted in the cloud. For the first product, bike insurance, Freeyou developed all core applications itself. The second product, car insurance, was much more complex and required many background processes (e.g., the transmission of the so-called electronic insurance confirmation to the road traffic licensing authority). These processes were necessary, but could not generate any significant customer benefit or differential value. For these reasons, it was decided to mainly purchase software for the second product. Functions from which one hopes to gain a competitive advantage, however, are developed by the company itself.

4 Results Achieved

In the first place, founding a company-owned InsurTech was already perceived as a major success by the initiators. In addition to the opportunity offered to test new business models and products on the market faster than previously possible, the founding of Freeyou had a signal effect for the entire group: It demonstrated the importance of digitalization and proved that the company was prepared to invest considerable resources in necessary changes.

In the following, we present the results achieved by Freeyou, structured in the same fashion as in the previous chapter. We focus on the results achieved on the business model side first, before switching over to the organizational model.

4.1 Business Model

In the past 2.5 years since its founding, Freeyou has succeeded in positioning itself as a digital insurance broker offering two products on the German market.

Bike Insurance

With the bike insurance, Freeyou has succeeded in placing its first product on the market in a short time, compared to development times in established insurance companies. By selling the product mainly via digital channels and promoting it on social media, Freeyou reacted to a socio-technological change brought by digitalization: People's lives are increasingly taking place in the digital world, thus offering new options for product placement and advertising. In addition, Freeyou leveraged emerging technologies such as IoT, Big Data, and analytics to equip the product with preventive features. Both aspects, digital sales and prevention, give Freeyou a potential for differentiation, not only in relation to the parent company and other established insurance companies but also to new entrants such as other InsurTechs or outside-the-industry competitors that emerge within the boundaries of the economic and competitive changes brought up by digitalization. The preventive elements in particular did not only help to distinguish the bike insurance from those products that had been common in the DEVK group and insurance industry up to that point, but it also furthered coming closer to the ultimate goal that the InsurTech had set for itself—relieving the customer from the hassle surrounding the topic of insurance through a simple product and prevention.

In addition to product development, the team also succeeded in building up various other elements that were necessary to create the most appealing digital customer experience possible. Further to the development of customer service and claims settlement processes, these elements include the necessary IT infrastructure and a portal where customers can view and manage all matters relating to their policies. Moreover, the InsurTech has built up the brand "Freeyou," especially by using social media. The effectiveness of these measures is reflected in particular in the very positive customer evaluations of the company. For example, the company has a Google rating of 4.7 out of 5 possible stars. In the reviews that the company receives, customers praise above all the uncomplicated processes and the fast reaction and processing times. Another side effect from which the company now benefits indirectly is the sustainable image that the InsurTech has built up with the help of bike insurance.

However, just by looking at the economic key figures, the company's first product, bike insurance, was only moderately successful. The number of reported claims was significantly higher than initially assumed, and the distribution via the proprietary website required high marketing efforts. When it became clear that the company would enter the car insurance market, all capacities were aligned toward this objective. Any development on the bike insurance was consequently postponed. For a while, the product continued to be operated, but since no further development was undertaken and the product was not further promoted, significant business success could not be achieved. At the same time, the expenses for operating the product remained the same. The team, therefore, jointly decided to discontinue the product at the end of 2020.

Car Insurance

The fact that the parent company had entrusted Freeyou with the development of a car insurance was perceived as both an enormous challenge and an "accolade" by the InsurTech. The team succeeded in developing the car insurance just in time for the changing season—a success in which the team itself temporarily no longer believed and which proved that the company had finally left the "pilot stage," since the car insurance market is more complex than most other. However, in order to bring such a complex product to market quickly, Freeyou also had to make compromises and, for example, initially refrained from integrating preventive elements into the product.

With the decision to opt for Check24 as the only distribution channel initially, Freeyou has reacted to a significant economic and competitive change in the insurance industry. With the advent of digital distribution, aggregators have gained massively in importance in recent years. By consistently aligning the product to this distribution channel, Freeyou is taking advantage of this development. However, the dependence on only one sales channel also harbors risks, so that the InsurTech has promptly created an opportunity to conclude contracts on its website. In contrast to the company's first product, car insurance exceeded Freeyou's own economic target figures and those of the parent company by multiples. For example, the company succeeded in achieving the sales result planned for the entire period of exchange business within only a few days. Besides, Freeyou was meanwhile declared as so-called price-performance winner by the price comparison portal Check24, which confirmed the high quality of the product. Customers also gave the new player positive feedback by rating it with 4.3 out of 5 possible points on the Check24 platform.

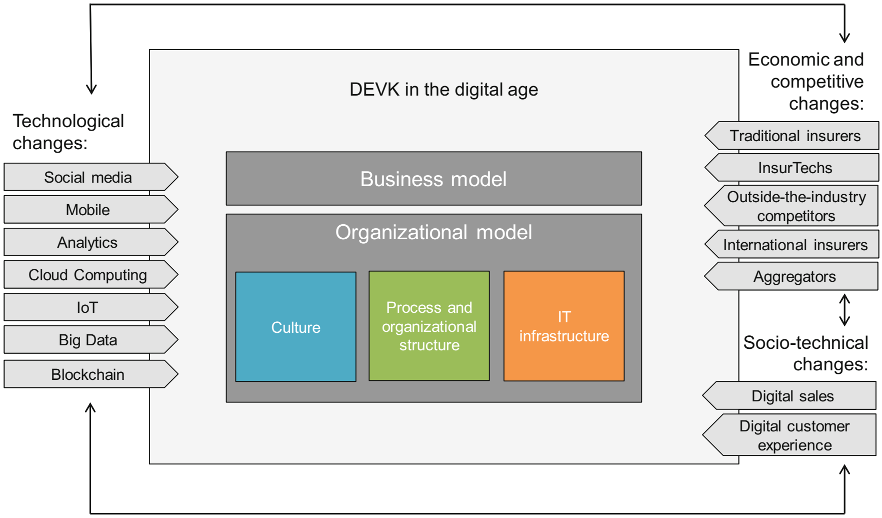

Fig. 2 Areas of change within the organizational model

4.2 *Organizational Model*

Bringing the two products presented to market within only 4 and 8 months, respectively, proves that Freeyou had achieved one of its most important goals set by the parent company, namely, to develop a higher delivery speed. This was only possible with an organizational model that differs significantly from that of the parent company. While the rest of the group built up an organization designed for security and stability, Freeyou's focus was on flexibility, speed, and innovation. The differences are particularly evident in three areas highlighted in Fig. 2.

Culture

Although Freeyou is part of the DEVK Group, the company has so far succeeded in maintaining a start-up-like culture. For the CEO of Freeyou, this culture is characterized by the high level of commitment of the employees to the shared goal. According to him, this results, inter alia, from the fact that the employees, in contrast to a classic project within the group, are more personally dependent on the success of the project. To maintain this commitment, the CEO of Freeyou considers transparency and joint decision-making processes to be essential. For example, all business figures (except for employee salaries) are accessible to all employees, and the company's objectives are decided jointly.

The fact that only a relatively small percentage of employees have a background in the insurance industry helped the company to question the status quo again and again and led to the fact that the employees could easily put themselves in the customers' shoes and adopt the customer perspective. This was particularly helpful in making the product and the various customer processes as simple as possible.

Furthermore, especially the experience gained in the development of the bike insurance has contributed to the establishment of a culture of continuous learning. Since the product was introduced to the market at a very early stage, there were still various functions that needed to be added gradually. The entire team found it very enriching to be able to use the first customer feedback for this, which ultimately also led to high customer satisfaction. This experience has contributed significantly to the fact that from the very beginning, the employees have acquired a culture of continuous improvement. In retrospect, according to the company's CEO, this experience has been essential to the team's current way of working.

Process and Organizational Structure

Regarding the organizational structure, Freeyou has not only succeeded in setting up individual Scrum teams. Above all, establishing coordination between the teams and thus building up a form of scaled agility is an essential building block for the company's fast delivery cycles. Except for the CEO, there are no hierarchies at Freeyou, which enables the company to make quick decisions and communicate with each other, since decision-making is decentralized. However, the CEO of the company points out that with increasing size, it will become more and more challenging to maintain this approach. The coordination between the teams will require a massive effort in the long run, and it is not yet clear what the organization will look like when the company continues to grow.

Regarding the process structure, it will be essential that the InsurTech takes advantage of its digital sales and customer communication processes to automate the underlying back-office processes as extensively as possible. Only by doing so, the company may become profitable with a narrow product portfolio and a relatively small number of contracts.

IT Infrastructure

The cloud-based infrastructure is equally essential for the company's high degree of flexibility and fast development cycles. Still, it is not only the product development cycles that are shortened by the company's focus on technology. Thanks to a high degree of automation, the operating processes should also run much faster than in the rest of the group in the long term. In the long term, this can lead to Freeyou having a significantly better cost ratio than other established insurers.

Freeyou does not offer an answer to all the technological, economic, competitive, and socio-technical challenges that are brought up by digitalization for DEVK (see Sect. 2). However, the company has succeeded in establishing an organizational model that is much more flexible than the parent company's and thus allows new products and forms of customer interaction to be tested quickly on the market. This allows DEVK to gain experience with digital business models without losing the time it would take to restructure the parent company's organizational model. This does not imply that there are no change processes initiated within the parent company; quite the opposite is true. But these processes can now take place in a more targeted manner since initial experience is readily available through Freeyou.

5 Lessons Learned

In the following, we summarize the lessons learned that have so far been gathered during the implementation of a new business model by means of a spin-off within a large corporation, knowing that the initiative is still at a very early stage and requires continuous development. In doing so, we focus on the insights that can be transferred to other old established companies aspiring to test a new business model in the market quickly.

5.1 Seize Opportunities to Build a New Organizational Model

DEVK was faced with the challenge of quickly testing new digital products on the market. However, the existing organization, like that of most traditional companies, is designed for stability and security rather than speed. On the one hand, this is necessary, at least in part, due to regulatory requirements. On the other hand, it would take an enormous amount of time to restructure the entire organization in order to achieve a higher delivery speed. In order to be able to deliver added value for the entire group, Freeyou thus had to create an organization that could bring new products to market quickly. This focus on speed is reflected in Freeyou's entire organization: The culture of the employees, which is characterized by an investigative approach and continuous learning, enables them to bring products to market quickly and to incorporate emerging customer feedback rapidly. The flat hierarchy promotes fast decision-making processes and enables short coordination paths. The modular and cloud-based IT infrastructure creates flexibility and fast development cycles. A high degree of automation enables extremely short reaction times to customer requests. Freeyou has thus established an organizational model that differs fundamentally from the one of the parent company.

Spin-offs do not only offer companies the chance to set up an additional business model. Above all, it is accompanied by the opportunity to create an organizational model that is different from the existing one. Only if this is implemented successfully, the spin-off is worthwhile—otherwise, the new business model could have been implemented in the existing company. To create the greatest possible added value for the group, spin-offs must not imitate the existing organization. This would simply make them a copy of the parent company—perhaps more modern or technology-focused. They must develop an organizational model that corresponds to the new business purpose and may be fundamentally different from the existing entity.

5.2 Consciously Managing Dependencies Within the Group

In the case of Freeyou, we described that the focus was on achieving the highest possible speed. In order to build this up and, above all, to maintain it in the long term, the CEO considers it “mission critical” to create as few interfaces with the existing organization as possible, both technically and organizationally. For example, Freeyou does not use DEVK’s IT systems and only falls back on resources from the parent company in an emergency. The company’s team is based at a separate location, and all employees who moved from DEVK to Freeyou first had to terminate their existing employment contracts. All these measures have so far turned out to be successful and allowed Freeyou to achieve high delivery speeds. However, there was one major exception: Freeyou does not have an insurance license and is, therefore, dependent on the parent company as risk carrier. This decision was made in order to avoid the time-consuming licensing process right at the start. While this initially meant Freeyou would be able to quickly launch its first product on the market, the corresponding interfaces to the group must now be considered on an ongoing basis.

Overall, it has proven to be beneficial to reduce the interfaces between spin-off and parent company to a minimum. The spun-off unit is thus forced to find its own solutions for existing challenges and does not run the risk of inheriting the mistakes of the parent company. In exceptional cases, a clever use of synergies can create competitive advantages. However, it is important to be aware of the resulting consequences. These must not exceed the initial benefit in the long term.

5.3 Building Transparency and Trust

Keeping the dependencies between Freeyou and (old) DEVK as low as possible also means that the InsurTech must be able to, in a defined frame, make its business decisions freely and independently from the parent company. With few exceptions, such as the introduction of car insurance, for Freeyou this has been the case so far. According to the InsurTech’s CEO, the decisive factor for this has been the trust of the parent company in the spun-off entity. In order to build up this trust, the CEO of Freeyou attached great importance to open and transparent communication right from the start. This had another advantage: It helped to ensure that the employees of the parent company did not perceive Freeyou as a threat. In the future, this can be an essential basis for exploiting learning effects between the two companies.

Creating a culture of trust is essential in order to give spin-offs the freedom to make their own business decisions and—in case of doubt—learn from their mistakes. Open and transparent communication has proven to be a valuable tool for building such trust.

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How RAPS Spiced Up the German Butcher's Trade

Introduction of Digital Services to a Non-Digital Industry

Karsten Glismann, Jan Jöhnk, Wolfgang Kratsch, Niclas Nüske, and Fabian Schmied

Abstract

(a) **Situation faced**: *RAPS* is a German spice manufacturer offering various top quality products to customers worldwide. Organized in three business segments, *RAPS* supplies large companies in the food production sector, caterers and restaurants, and the butcher's trade and food retail sector. Especially the butchers, one of the most loyal target groups of *RAPS*, face current challenges. Strong market consolidation due to the approaching food retail sector and increasing regulatory requirements are but a few examples. Addressing these challenges, *RAPS* pursued the following project mission: Leveraging digitalization's potential to expand *RAPS'* value proposition, to differentiate from competitors, and to increase market share in the butcher's trade.

(b) **Action taken**: In a joint project with the Project Group Business & Information Systems Engineering of the Fraunhofer FIT, *RAPS* devised, developed, and launched new digital services that specifically address the butcher trades' main challenges. In a customer-centric approach, butchers were included in the entire process. Starting with the identification of challenges, they tested and evaluated concepts and prototypes in various developmental stages. The new digital services, subsumed under the platform-independent application *myRAzept*, now support hundreds of *RAPS* customers in a formerly rather non-digital industry regarding food information labeling, recipe management and planning, and order management.

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(c) **Results achieved**: The project team achieved several notable results: By providing an intuitive and useful platform-independent web application, *RAPS* expanded its service portfolio for an important group of customers. The image of *RAPS* as an innovative company was improved. The project did not only delight customers and externals stakeholders but also the employees of *RAPS*. Due to the project's positive spirit, the collaboration between different parts of the company was further improved. Additionally, the project's scope matches perfectly with the efforts of the Adalbert-Raps-Stiftung as a charitable foundation and silent partner of *RAPS*.
(d) **Lessons learned**: The project revealed a variety of lessons learned that might help others when implementing digitalization projects in small- and medium-sized businesses, especially in the food industry. When introducing digital services to a traditional non-digital industry, the potential users' digital readiness must be considered. Incumbents' value propositions regarding quality in the physical world need to be transferred to digital services to maintain customer trust. Thereby, the integration of customers' opinions, wishes, and requests is extremely valuable. Further, providing digital services to customers requires the development of digital capabilities within the company.

1 Introduction

Driven by new emerging technologies, companies' competitive environment changes radically (Tanriverdi and Lim 2017). The term digitalization subsumes this paradigm shift, describing "the integration of multiple technologies into all aspects of daily life that can be digitized" (Gray and Rumpe 2015; see also Legner et al. 2017). Both existing competitors leveraging the potential of digital technologies and new market entrants challenge incumbents' past success and their established market positions, sometimes disrupting entire industries (Baiyere and Hukal 2020; Lucas Jr. and Goh 2009). Owing to legacy systems, dragging processes, an established company culture, and competing for organizational concerns to embrace digital innovation, incumbents, and especially small- and medium-sized businesses (SMEs) with their smaller resource base, often struggle to utilize digital technologies' potential and thus remain viable (Sebastian et al. 2017; Svahn et al. 2017). As such, digital business comprises the incorporation of emerging technologies into companies' strategic considerations to offer new value propositions (Legner et al. 2017; Ross 2017; Urbach and Röglinger 2019). For instance, digital services enable companies to establish new customer touchpoints, provide added value for customers, and complement former product-centric value propositions with digital service-based offerings (Wiesböck and Hess 2020). This enables but also requires changes to companies' business models, their ideation and innovation processes, and their operations, among others (Nambisan et al. 2017; Vial 2019). Thus, incumbents face the challenges of deciding where and how to move into digital business, ensure organizational and customer readiness, and create and maintain a competitive advantage through digital business.

In our case of the German spice manufacturer *RAPS GmbH & Co. KG* (hereafter *RAPS*), we describe the conceptualization, design, and implementation of digital services in a previously product-centric industry. *RAPS* is a family-owned company built on almost 100 years of industry tradition. As an internationally operating company and one of the market leaders in Germany, *RAPS* has more than 900 employees worldwide, 550 at the company's headquarters in Kulmbach, Germany. Considering its strong legacy, *RAPS* is dedicated to delivering top quality products from "the world of flavor" to its customers. With 7 production facilities in Europe, *RAPS* processes more than 1700 raw materials from all over the world using 20,000 recipes and dispatching up to 2000 deliveries each day to over 80 countries (RAPS 2020a).

In 2017, *RAPS* appointed a new managing director with prior experience in digital offerings in non-digital industries. Shortly after, *RAPS* initiated a project to identify potential digital offerings together with the *Project Group Business & Information Systems Engineering of the Fraunhofer-Institute for Applied Information Technology FIT* (hereafter *PG BISE*). An interdisciplinary project team of *RAPS* employees from IT, marketing, product management, and its sales force, as well as consultants from PG BISE, was set up. They collaborated closely to understand the challenges that *RAPS'* customers are facing. This approach was crucial to identify customer-centric requirements as potential levers that a digital offering may address (Wiesböck and Hess 2020). Subsequently, *RAPS* and *PG BISE* conceptualized and designed digital services to assist butchers in addressing their most pressing challenges, such as proper food information labeling, production and recipe management, and order management. After a thorough analysis, *RAPS* decided to realize these digital services in the form of a platform-independent web application, *myRAzept*. Closely engaging employees and customers in the development process, *RAPS* implemented *myRAzept,* which offers novel digital services to a predominantly non-digital industry. The application received overwhelmingly positive feedback, both from customers and sales representatives, reaching a considerable user base in the first months. Thus, *RAPS* positioned itself as a customer-focused, forward-thinking, and innovative company, and *myRAzept* combines customer-facing digital services that differentiate *RAPS* from its competitors in an otherwise relatively uniform and non-digital market.

In the following, we describe *RAPS'* starting point considering its organizational context and competitive environment (Sect. 2) and the approach *RAPS* has taken to identify and implement digital services in the form of a platform-independent web application (Sect. 3). Further, we summarize the achieved results and explicate their impact on *RAPS'* business (Sect. 4). Finally, we reflect on the lessons learned and synthesize recommendations for companies seeking to introduce digital services to non-digital industries (Sect. 5).

2 Situation Faced

RAPS organizes its business activities in three segments, in which *RAPS* claims the role of the quality leader: *Industry*, *Foodservice*, and *DeliCo*. While *Industry* supplies large companies in the food production sector, *Foodservice* specializes in caterers and restaurants. For *Industry*, *RAPS* primarily is a supplier of innovative technological solutions such as micro-encapsulation (i.e., the customized coating of raw materials) or ingredients facilitating hybrid meat production (i.e., minced meat products containing 30 to 40% less meat). In terms of *Foodservice* and *DeliCo*, *RAPS* offers individual spice mixtures and convenience products (i.e., kitchen-ready solutions). Serving more than 26,000 points of sale in the butcher's trade and the food retail sector, *DeliCo* is *RAPS'* most traditional segment. Within this segment, brand loyalty has often been built up over generations (e.g., in a family-owned business, the grandfather bought the curry sauce from *RAPS,* and the supplier has not been changed since). In general, this leads to a low willingness to change recipes or the products used. While *Industry* and *Foodservice* guarantee stable revenues, direct customer contact at customers' locations strengthens customer relationships to ensure business in the *DeliCo* segment. About 30 sales representatives cover all of Germany and visit each customer approximately every 6–8 weeks.

Recently, the customer structure in this important *DeliCo* segment is undergoing major changes due to strong market consolidation and changing customer requirements. For the butcher's trade, it is increasingly difficult to differentiate from the food retail sector, as the range and quality of goods and delicacies on offer there is continuously growing. Many butchers can no longer find a successor for their business as the upcoming generation often does not see any future perspective due to these massive challenges. Further, increasing regulatory requirements regarding food labeling or tax traceability are hard to tackle.

In contrast to the food retail sector, which gets massive support from its central departments regarding digitalization initiatives, butchers are mostly on their own to overcome these enormous challenges. The leading providers of scale systems and other butcher's supplies also provide digital all-in-one solutions for managing procurement, recipes, production, and administration of processes resulting in full-fledged ERP systems. However, most of these solutions are too extensive, complex, and expensive for small butcher shops. Consequently, many butchers already use well-adopted digital offerings in their private life (e.g., smartphones or tablets) but still work with traditional tools in their business (e.g., pen and paper recipe books). This explicates low business-related digital awareness in the butcher's trade. Given the low willingness to change in terms of products on the one hand and the strong need for support regarding digitalization capabilities on the other, a fast roll-out may establish a first-mover advantage regarding digital offerings for *RAPS*. Facing this specific situation, we identified the butchers' trade belonging to the DeliCo segment as the target group for our project.

RAPS has already made valuable experiences regarding integrating novel technologies from innovations in internal production processes (e.g., microencapsulation of CO_2-pressure-extraction). This also includes IT-based innovations, such as autonomous production robots that assist in mixing the spices according to recipes from the ERP system or an IT- and robot-enabled storage center. As a side effect, *RAPS* already stores essential and valuable data in the ERP system, which in turn feeds essential nutritional information to a recipe database. Food specialists and professionals develop the recipes drawing on many years of experience in the butcher's trade. This recipe database could assist the butcher's trade in developing and producing more innovative and competitive goods. However, the database lacks a user-friendly and contemporary frontend and has limited functionality (e.g., it is impossible to place orders of required goods for selected recipes directly). Thus, the number of accesses to date is relatively low. Also, *RAPS* already creates high-quality media content, such as images of prepared dishes, an illustrated lexicon of spices, and customer magazines. Thus, the potential of digitally available information and knowledge is not yet fully leveraged by systematically offering digital services at the customer interface. In fact, the customer interface is mostly covered analogously (e.g., order placement by phone or fax and manual transfer by the corresponding sales representative into the order tool). Although *RAPS'* competitors made timid attempts regarding digital offerings such as a recipe tool, this is still an open field in the market. Thus, *RAPS* has to make the first step—constituting both a challenge and an opportunity to spark digital interactions with customers.

In sum, the combination of the close customer relationship from personal direct sales and available digital information creates the opportunity to heavily strengthen *RAPS'* market position in the butcher's trade. Consequently, our project aims to draw on existing structural competitive advantages (e.g., *RAPS'* close customer interaction and available digital information) combined with leveraging digitalization's potential to expand *RAPS'* value proposition, to differentiate from competitors, and to increase market share in the butcher's trade.

3 Action Taken

Next, we describe the action taken to develop *RAPS'* digital services for the *DeliCo* segment. Based on innovation process models, we structure this section in three overarching steps consisting of a total of five components (Bretschneider 2012; Reichwald and Piller 2009; Soll 2006; Thom 1992) as presented in Fig. 1. This approach is also largely congruent with the reference process regarding the development of digital service systems described by DIN Deutsches Institut für Normung e.V. (DIN SPEC 33453 2019), which could be a helpful alternative framework for structuring related projects.

The project team started with identifying the current challenges of *RAPS'* customers and their digital readiness and used this as input for generating use case ideas to address the butchers' pressing challenges. Based on the evaluation of the use cases with customers, we created a concept of the prototype of a platform-independent web application. The project team then went through two iterations of the

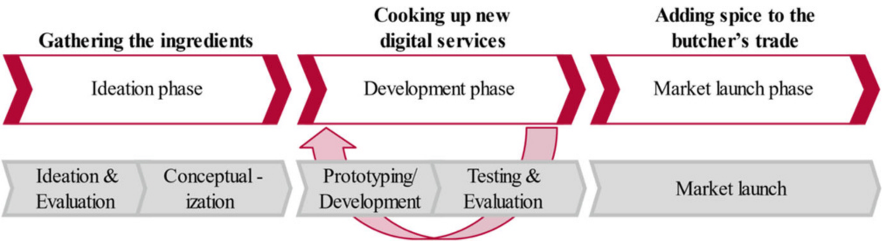

Fig. 1 Structure of the innovation process applied in the project

development phase. First, we selected and partnered with a software development company to jointly create, test, and evaluate a prototype. Second, due to very positive feedback, the project team commissioned the development of a full version and again tested and evaluated the resulting new digital services. Lastly, the application was launched. This included marketing activities parallel to internal training and adjustments to internal responsibilities and processes (e.g., establishing regular performance tracking).

3.1 Gathering the Ingredients

Ideation Foundation #1: Challenges The first step towards a strengthened value proposition of *RAPS* for its *DeliCo* customers through digital innovation was developing a thorough understanding of the butchers' challenges and their susceptibility to digital solutions. The close, regular contact between the sales representatives and the customers as well as the familiarity of *RAPS'* employees—who in large part are trained butchers themselves—with the market facilitated the process tremendously. *PG BISE* conducted several in-depth interviews with butchers while accompanying the sales representatives on their tours, consulted with internal experts, and complemented the results with extensive online research.

The following main challenges emerged: (1) Butchers face increasing requirements regarding food information to customers. The European regulation on the provision of food information to customers (The European Parliament and the Council of the European Union 2011) demands that, among others, labels of prepacked food contain a full list of ingredients in descending order of their quantity (sometimes including the quantity in percent), highlight allergens, and be clearly legible. This information combined will be termed "list of ingredients" in the following. Additionally, all prepacked food labels must include a "nutrition declaration" which lists the energy value and the amounts of fats, saturates, carbohydrates, sugars, protein, and salt per 100 g or 100 ml. The same information is to be kept available upon request by the customer for non-prepacked food. Butchers are often overloaded when faced with the challenge of calculating lists of ingredients and nutrition declarations for complicated recipes while adhering to a complex set of

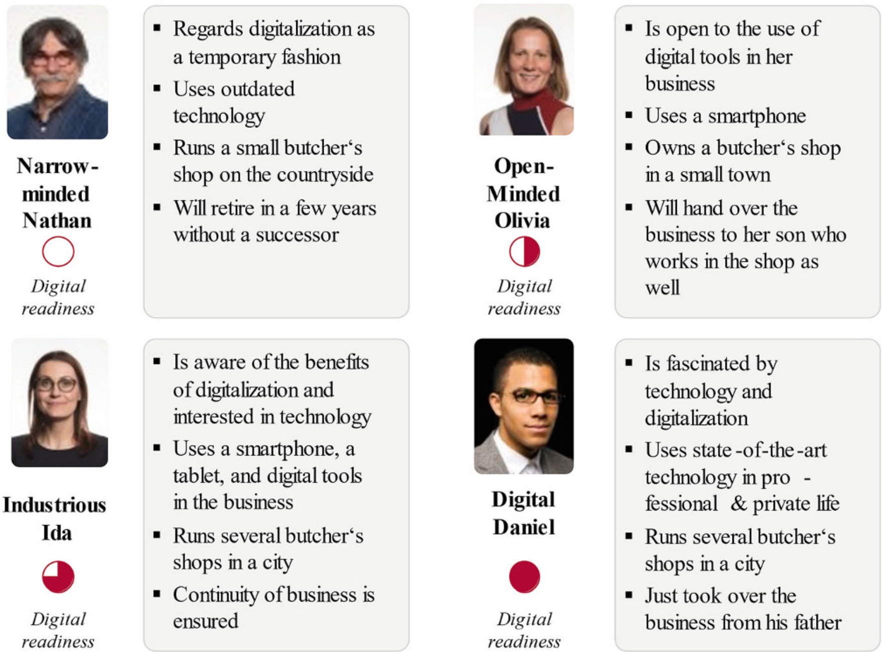

Fig. 2 Personas of RAPS' customers

rules and exceptions. (2) Recipe and product management is often non-digital and unstructured, or the handling of the utilized digital systems is highly manual. Together with (3) increasing difficulties with finding qualified personnel, this leads to (4) a severe load of bureaucratic tasks that do not contribute to the core business and often blend into the free time and weekends, especially for smaller establishments. This results in workarounds regarding the fulfillment of the food labeling requirements, which (5) regularly fall into grey areas or even outside of legality and make the butchers vulnerable to penalties. (6) Lastly, these additional tasks hinder the butchers from devoting time to other critical processes like developing and executing marketing strategies, which are generally rather modest in the industry.

Ideation Foundation #2: Digital Readiness Next to the butchers' most pressing challenges, the interviews and research yielded a picture of the digital readiness of *RAPS'* customers. Exemplified by a total of four typical personas characterized by the owners' attitude toward digitalization, their use of digital tools in their professional and private lives, and the size and future prospects of their businesses, a broad spectrum of digital readiness was identified (see Fig. 2). Drawing on this representative categorization, we focused on understanding potential digital service users among *RAPS'* customers.

Thus, while we did not classify all existing customers, we found that the persona "Digital Daniel" represents the minority of *RAPS'* customers. However, a predominant commonality among the butchers emerged: most of them already use a digital

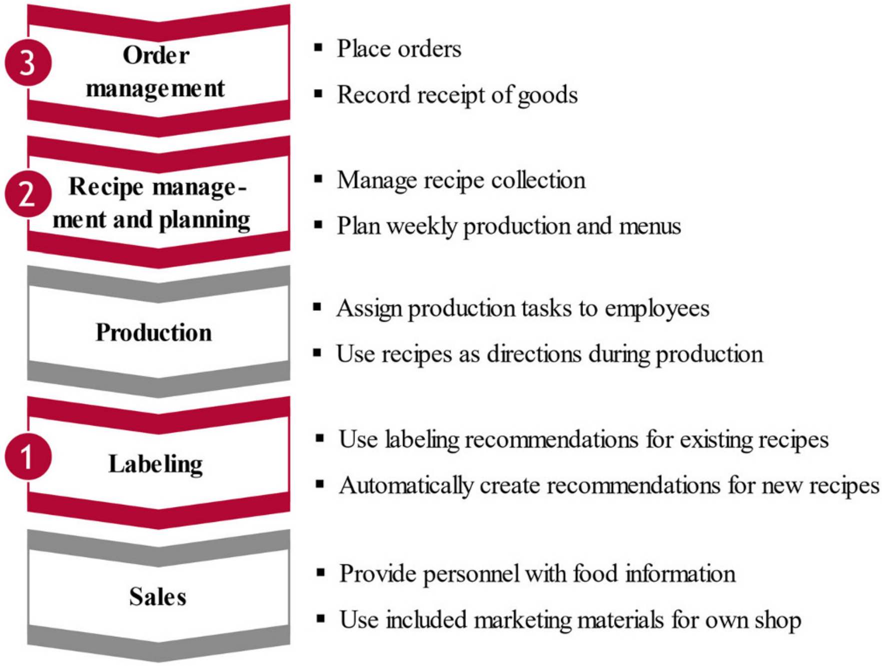

Fig. 3 Use cases and their prioritization as features in RAPS' new digital application structured along with the operational procedures of butchers

device such as smartphones or tablets in their private lives. Thus, the project team concluded that the best starting point for offering new digital services was a platform-independent application that runs on its customers' preexisting hardware and thus keeps entry barriers at a minimum.

Ideation Based on the previously identified challenges of the butchers, as well as the assessment of their digital readiness, the customer-centric ideation process could begin. The project team identified specific use cases for a platform-independent application to address the challenges of the butchers. Structured along with their operational procedures—order management, recipe management and planning, production, labeling, and sales—ten use cases to help butchers face their challenges and position *RAPS* as a partner who offers added value beyond its traditional physical products were found. Please see Fig. 3 for an overview of both the operational procedures and the identified use cases.

Evaluation In further interviews, workshops, and surveys, customers and *RAPS* employees evaluated the ten use cases identified in the ideation phase regarding the potential to solve current problems, facilitate daily tasks, the customers' willingness to use the services, and their desire for *RAPS* to implement the services. As a result, three areas were prioritized and used as building blocks of new digital services: food information labeling, recipe management and planning, and order management. The evaluators clearly saw support regarding legally correct and time-efficient creation and provision of food information labels as the most promising and beneficial use case. As *RAPS* with its preexisting comprehensive database of products and recipes was ideally positioned to provide aid in this regard, food information labeling was chosen as the main feature of the new application. The customers expected a recipe management and planning service to deliver additional benefits compared to the status quo. As this service is also based on the asset of the product and recipe database, it was included as a second feature of the application. Lastly, while the use cases regarding order management were not received as enthusiastically, they nevertheless represented easily realizable side features and were included as the third and last component of the new application. Figure 3 lists the identified use cases and the three prioritized areas, which are the building blocks of *RAPS'* additional value proposition through innovative digital services.

Conceptualization Built on the positive reception of the proposed use cases by the customers involved in the early ideation and evaluation phases, the new CEO greenlighted the development of a minimum viable product (MVP) prototype.

The following contents and functionalities were included in the MVP prototype conceptualized by the project team: Regardless of the utilized device, users were welcomed on a home page displaying a selection of news articles related to *RAPS* products and recipes and a variety of recommended recipes. On the second of four tabs, users could browse collections and categories of recipes and add them to their personal collections (see use case area two in Fig. 3). Each recipe was displayed, including a recommendation for the ingredient list and its nutritional declaration. Users were able to modify included recipes or create new ones. In each case, the ingredient list recommendation and the nutritional declaration were automatically calculated (see use case area one). The *RAPS* ingredients of all recipes could be added to a shopping cart, displayed in the third tab, and ordered from the application (see area three). Lastly, the fourth tab enabled users to search for recipes, collections, and categories.

3.2 Cooking Up New Digital Services

Prototyping The project team compiled a preliminary specification of the new digital services covering an introduction of *RAPS*, background information regarding the market and customers, the aim of the new digital services, and a detailed description of the required functions. *RAPS* and *PG BISE* then researched development service providers and invited proposals from a total of four companies. The project team assessed the tenders and initial calls with the service providers regarding price, proposed course of action, specificity of the proposal, profile and references of the company, and personal impression to achieve the best possible fit with *RAPS*. They lastly selected a medium-sized development service provider who persuaded as an innovative, promising partner on equal footing with reliable references.

RAPS and the development partner agreed to create an MVP prototype specified in the preliminary specification for a fixed price. The project was kicked off with a workshop of the interdisciplinary project team and the development partner on *RAPS'* premises. The participants developed a mutual understanding of the requirements, clarified open questions, and agreed upon a detailed configuration of the platform-independent application's functions and collaboration mode. In the following weeks, the project team functioned as the central interface between inquiries of the development partner regarding follow-up questions from various areas and the responsible departments of *RAPS*: Among others, the IT department contributed detailed information about the database, compatibility, and technical interface issues. The specialist recipe department provided guidelines regarding the presentation of recipes and the automatic calculation of recommendations of lists of ingredients and nutritional declarations for recipes. The sales force and representatives of a *RAPS*-dependent online shop for gastronomy advised on the included order management function's design, as did the customer service department. The legal department, as well as external lawyers, were included regarding juridical questions, e.g., about data privacy. The marketing department checked the user interface for compatibility with *RAPS'* corporate identity guidelines and started a complex parallel process to create a comprehensive database of appealing recipe images, including various internal and external stakeholders. The MVP development was thus a joint effort that involved nearly all *RAPS* departments and external partners.

Testing and Evaluation After completion, the MVP prototype was thoroughly tested by the project team and subsequently evaluated. At the end of the evaluation, the project team conducted a workshop on *RAPS* premises with about ten butchers from the region and sales representatives. Proximity to the *RAPS* premises, availability, and openness to participate were the most decisive factors in selecting the participants. However, at least one of the participants could be assigned to each persona described in Fig. 2, resulting in a rather heterogeneous group with a slight tendency to higher digital readiness levels. After a short introduction, they were handed an instruction pamphlet that asked them to explore the prototype following a narrative covering the platform-independent application's functions. The participants were free to choose a device from a range that included laptops, tablets, and smartphones. While trying out the application, every participant was attended by a project team member who asked the participants to think out aloud and took notes. Additionally, all actions were captured via screen videos. Subsequently, all participants completed a detailed survey covering the System Usability Scale in its refined version by Bangor et al. (2008) translated into German by SAP (2015), an evaluation of all functions independently, their self-efficacy regarding digital technologies following Beierlein et al. (2014), their usage patterns of digital devices, and open questions regarding positive and negative aspects as well as recommendations for improvements and additional functionalities of the prototype. The largely very positive feedback evident in the evaluation analysis results triggered the *RAPS*

CEO to commission the further development of an advanced full version of the application.

Development The further development was conducted in the same fashion as described above but in an agile and more flexible mode. This intensified the exchange between both the development partner and the project team, as well as the project team and the numerous internal and external stakeholders described above. During the weeks of creating the full version of the app, the main focus was on data quality and compatibility of the recipe and product databases, as well as the generation of a sufficient amount of adequate recipe images displayed in the application. During this second development phase, *RAPS* recruited a new digital marketing and product management specialist tasked with promoting digital innovations within the company, a function and responsibility that had not existed before. The specialist was designated to supersede *PG BISE* in its role as the project manager and thus onboarded as a project team member.

The advanced version of the application comprised all features of the prototype. Some functionalities, such as the calculation of ingredient list recommendations and nutritional declarations, were refined to allow for a broader variety of recipes and unique requirements of the butcher's trade. The new version contained a significantly larger number of recipes and high-quality recipe images. Also, it included a completely new shop tab that allowed users to browse and order the full range of *DeliCo* products. Lastly, the full version of the application required users to register using their individual *RAPS* customer number, limiting the full access to its content to *RAPS* customers only.

Testing and Evaluation Again, the application was thoroughly tested by the project team and evaluated by *RAPS* customers. This time, the project team visited butchers, who had already attended the evaluation as well as butchers completely new to the application, and conducted in-depth interviews that were structured similarly to the prototype evaluation process. The feedback regarding the existing content and functionalities was passed on for bug fixing to the development partner. The feedback regarding potential new functionalities was assessed and structured by the project team and added to numerous further ideas for further development that had emerged during the development process.

3.3 Adding Spice to the Butcher's Trade

Market Launch After completing the full version of the application—named *myRAzept*—and its approval by the CEO, a date was set for the go-live as a web application and applications available for smartphones and tablets in the Google Play and Apple App Stores. Various processes that had been prepared in parallel to development were initiated or intensified. These comprised marketing, training courses for several *RAPS* departments, creating a new function regarding the support of users, and internal arrangements regarding the content provision, technical support, the further exchange with the development partner, and performance tracking.

Marketing activities included, among others, articles and posts on *RAPS'* and related websites and social media channels, distribution of flyers and promotional stickers on *RAPS'* products in the order shipments, and contributions in internal and external print media. The marketing department also involved customers more directly by promoting the application at *RAPS*-held seminars or conducting interviews with lead-user customers, which were then used as testimonials. However, the most relevant marketing channel for *myRAzept* was *RAPS'* sales force having close and regular contact with the majority of German butchers.

Therefore, several training courses were held with the sales representatives to introduce them to *myRAzept* and its unique selling points, impart more in-depth knowledge regarding its functionalities, and clarify the related processes. The aim was to enable the sales force to promote the application, to answer questions by the customers (who most likely would address potential problems at the sales representatives rather than other *RAPS* employees), and to develop a long-term feedback channel. Similar training courses were held with the customer service department as the second-most likely channel for customer requests regarding *myRAzept*, especially order management and shipping.

Furthermore, a new digital specialist adviser function was created by *RAPS* and advertised to the customers. These employees were designated to support customers regarding questions that could not be solved by the sales representatives or customer service. Also, the digital specialist advisers were tasked with aiding customers in digitalizing their recipes to keep entry barriers as low as possible.

Regarding internal processes, an approach for continuous development of additional content—new recipes and recipe images—was developed, and binding targets were set for the involved departments. Superseding *PG BISE*, the IT department took the technical support and the exchange with the development partner about technical issues into its hands. The newly recruited marketing and product management specialist overtook the overall project management and the exchange with the development partner regarding organizational issues and the app's further strategic development. Lastly, performance tracking and regular performance check-ins with the CEO were established. The necessary data were collected from the Google Play and Apple App Stores, *myRAzept* itself, Google Analytics, *RAPS'* SAP system, and feedback from the sales force and the digital specialist advisers. It covered numbers of downloads, impressions of the websites, active involvement of the users with the different functionalities, and sales generated via the app. After the successful launch and the handover to *RAPS'* IT department, *myRAzept* is now a fully integrated part of *RAPS'* daily business.

4 Results Achieved

The efforts of *RAPS'* first customer-oriented digitalization project came to fruition in many different areas. As intended, the project primarily led to an added value for *RAPS'* customers from the butcher's trade. Furthermore, the efforts of *RAPS* were recognized by executives and employees within the whole *RAPS* group, including (international) subsidiaries, but also by different external stakeholders, including the company's shareholders.

First, by providing an intuitive and useful platform-independent web application (see Figs. 4 and 5), the company expanded its value proposition for an important group of customers, i.e., thousands of butchers across Germany. *RAPS* established an additional digital touchpoint that may be used very intuitively by its customers. From now on, digital content, such as information about new products, can be presented within the application and not merely on the corporate website. With the recommendations for the list of ingredients and the nutrition declarations generated by the app, the butchers may tremendously improve the quality of the labels printed on their products. Hence, the butcher's trade may benefit from the expertise in food legislation provided by an established medium-sized company from the food industry. Essentially, *RAPS* empowers the butcher's trade to act in accordance with the increasing regulatory requirements. By reducing the corresponding efforts, the butcher's trade is enabled to focus more on their core business. As far as we know, *RAPS* is the first company to offer the butcher's trade such a comprehensive range of digital content, thereby increasing the value of its physical products. Due to the high quality of the application and the availability free of charge (for customers only), customers' feedback was consistently positive.

RAPS' sales force reported that the customers are impressed by the various features provided within the app. For example, customers recognized the provided recipes' high-quality standard and that the application enables considerable time savings in their daily routines. In addition, *RAPS* integrates the application in new offerings for the butchers, such as the production of convenience dishes (RAPS 2020b). The number of users also reflects customers' satisfaction. Already within the first month, several hundred customers (out of approximately 10,000 German butchers) registered for the app, growing to over 1150 current users, a large percentage of which interact with the app regularly. The customers use the full range of the provided functions, especially the ones related to recipe management and planning. Furthermore, first sales were generated via the newly established channel.

Second, *RAPS'* image of being a "reliable solutions supplier" (RAPS 2020c) was further improved. Although several competitors equally supply German butchers, *RAPS* is the first company of the branch that provides a platform with hundreds of recipes and an automated calculation of ingredient list recommendations and nutritional declarations to butchers. Apart from customers, also industry associations and

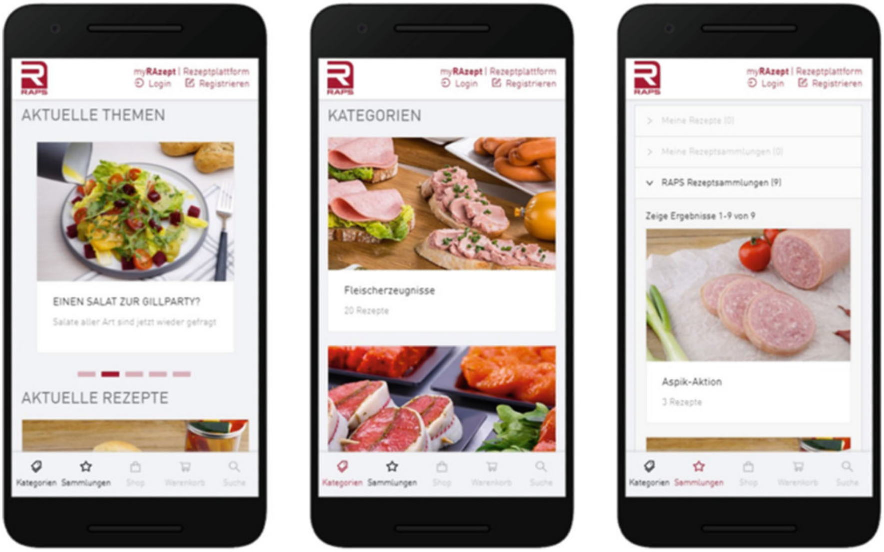

Fig. 4 Screenshots of the final app (home page, categories, and collections)

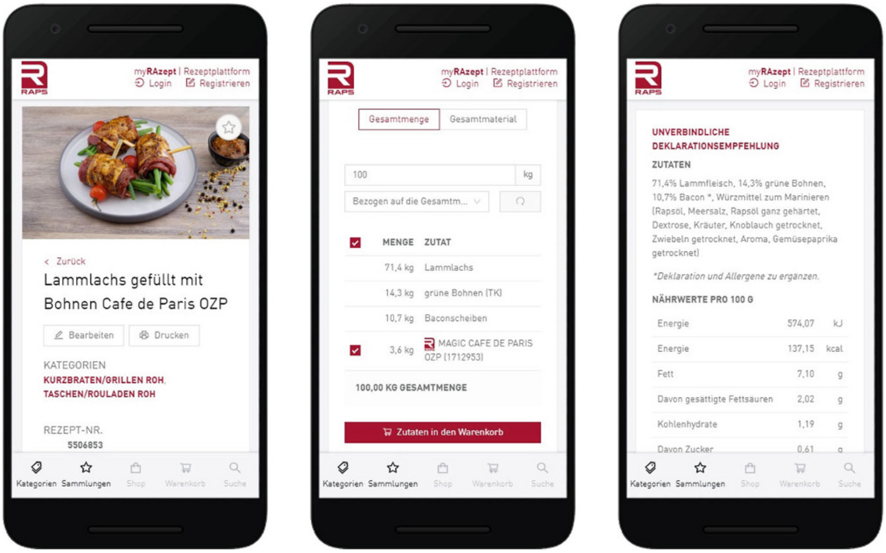

Fig. 5 Screenshots of the final app (recipe, ingredient list, and nutritional declaration)

respective journals acknowledged the efforts of *RAPS* (Marco Theimer 2019). *RAPS* is seen as a progressive company that accompanies traditional butchers to implement digital services in a non-digital industry.

Third, the digitalization project and the application did not only delight customers and external stakeholders but also the employees of *RAPS*. The full support for the project, publicly stated by the new CEO, was interpreted as an essential new digital service of the company at the interface to the butcher's trade and engendered a spirit of optimism within the whole company. Surprisingly, after a while, even skeptical employees got a taste of *RAPS'* efforts in terms of digitalization and showed a growing interest in the project's progress. For example, the CEO was asked about the progress of the project during a works meeting.

Fourth, as a direct consequence of the positive spirit, the collaboration between different parts of the company (e.g., departments, subsidiaries) was further improved. Interfaces between different departments were identified and clearly defined, digital content (e.g., recipes, images) was shared, and data quality regarding the recipes and their ingredients (stored within the company's ERP system) was improved. The development of the application even accelerated related projects, such as the definition of quality standards for images, the acquisition of professional photo equipment, and the implementation of a company-wide image database. Furthermore, *RAPS* established a guideline for internal photo shootings of their products and related dishes. Both the established guideline and the created images may be used not only within our project but also in many other contexts throughout the whole *RAPS* group. These successes were based, inter alia, on close cooperation between the project team and the marketing department.

Fifth, by striving for digital solutions that facilitate the butcher trade's daily business, the projects' scope perfectly matches the efforts of the Adalbert-Raps-Stiftung as a charitable foundation and silent partner of *RAPS*. The foundation itself recognized the butchers' challenges and developed several initiatives that empower the butcher's trade. For instance, Design Thinking workshops combined with excursions to varying European cities (and local butchers or other inspiring personalities from the food industry) enable participating butchers to think more creative, innovative, and customer-oriented (Adalbert-Raps-Stiftung 2020).

Finally, the project team identified several starting points for additional digitalization projects that may further improve the company's market position and the relationship with its customers and may be initiated during the next years. To enable these future projects, *RAPS* anchored the digitalization within the organization and hired a digital marketing and product management specialist who will be responsible, among other things, to realize respective projects.

5 Lessons Learned

Reflecting on the overall case, we derived a variety of lessons learned that might help others when implementing digitalization projects in SMEs, especially in the food industry.

When introducing digital services to a traditional non-digital industry, their potential users' digital readiness needs to be considered. In our project, focusing on the butcher's trade, we were confronted with a broad spectrum of digital readiness. Traditional butchers tend to dislike working in the office. Nevertheless, we found a predominant commonality among the butchers: most already use digital devices such as smartphones or tablets very intuitively. Given the large proportion of traditional butchers who are skeptical about digitalization, this was surprising for us. Based on these findings, we decided to develop a platform-independent application that may be used very intuitively not only in daily business but in daily life. As another advantage and direct consequence of the platform independency, the application may also be used by butcher's employees who do not have access to the butcher's regular IT infrastructure. In this regard, we benefitted from the phenomenon of IT consumerization affecting various industries (Harris et al. 2012).

Although MVPs are omnipresent in the digital world, incumbents' value propositions regarding quality in the physical world need to be transferred to digital services to maintain customer trust. As *RAPS* is known as a supplier of top quality products in the physical world, the project team decided not to launch a premature prototype. Even though *RAPS* and the development partner agreed on the initial development of an MVP, the prototype was only used to gather extensive feedback from the project team, other employees, and selected customers. The need for mature digital services was amplified by the fact that the key value proposition of the platform-independent web application is the provision of support regarding legally watertight food labeling. Therefore, the project team put a strong focus on the core functionality of the app, i.e., the automated calculation of recommendations of ingredient lists and nutritional declarations. Nevertheless, other important factors such as usability, performance, data privacy, and security, as well as a contemporary appearance, were not neglected. As a result, the launched version of the application complied with *RAPS'* high-quality standards known from the physical world. Even though we would have proposed another strategy a priori, we are now convinced that this approach was a key factor for the high number of users already within the first month after launching the app.

A further success factor was integrating customers' opinions, wishes, and requests already from the first days of the project. The project team conducted several in-depth interviews with butchers while accompanying *RAPS'* sales representatives on their tours and gathered expert knowledge from numerous *RAPS* employees who are trained butchers themselves. In this way, we got aware of the challenges butchers face in daily business. Based on these first impressions, we developed ideas for useful digital services that were further evaluated in interviews, workshops, and surveys with customers and *RAPS* employees. Also, during the development process, there was an intense exchange with *RAPS'* customers. Their feedback was consolidated by the project team and considered within the further development process. As a result, *RAPS* was able to launch an application that fitted very well with the customers' needs.

Providing digital services to customers requires the development of digital capabilities within the company. In the context of our project, the provision of digital content that may be used within the application was crucial. Therefore, *RAPS* revised several hundred recipes that were already used for a rudimentary (and meanwhile outdated) recipe platform embedded on the corporate website. Wisely, these recipes were already stored within the company's central ERP system. Additionally, the project team triggered the shooting of several hundred images that may be used within the application to illustrate the recipes. Concerning the high number of images, the project team and the marketing division of *RAPS* acquired professional photo boxes suitable for the shooting of dishes and established related shooting guidelines. Despite all efforts, the provision of sufficient content surprisingly turned out to be as challenging as the development of the application itself. On the one hand, this was caused by the necessary establishment of new processes. On the other hand, there were simply capacity problems within the responsible corporate departments. In future projects, we would put a stronger focus on content provision.

Finally, we learned that agile development might turn out differently than expected. The cooperation between *RAPS* as a family-owned German SME with almost 100 years of industry tradition and the 10-year-old development partner (ca. 70 employees) based in the surroundings of a German technical university held some surprises. For instance, the agile development was interpreted very dogmatically and led to a loss of customer orientation and flexibility, especially compared to the fixed-price-based development of the prototype. The development partner worked strictly within the structure of 2-week sprints, and *RAPS'* input would only be discussed once per sprint. Further, the project team was obliged to formulate requirements very accurately as they were sometimes developed and billed without any further consultation of the project team. Although the cooperation with the development partner was, for the most part, very harmonic and successful, *RAPS,* as a larger, traditional incumbent, sometimes seemed more agile than the development partner, which only a few years ago had been a university-originated start-up.

Overall, the project was a very successful starting point for *RAPS'* digitalization initiatives. On the one hand, customers are provided with a platform-independent web application that may significantly simplify their daily business. On the other hand, as a company, *RAPS* benefitted from the project in various ways.

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Digital Transformation of the Automotive Industry Through Collaboration Hubs

The Development of Mobility X Lab to Source Startups Through Matchmaking

Anders Hjalmarsson Jordanius, Gustaf Juell-Skielse, and Hanna Rydehell

Abstract

(a) **Situation faced**: The prospects of digitalization in the automotive industry are enormous with emerging technology concepts, such as electrification, autonomous driving, connected mobile services, and new business models. However, digital innovation has proven difficult for original equipment manufacturers (OEM) due to complex organizational structures, corporate cultures, and technological inertia associated with the automotive industry. In a recent rating of the 50 firms that best combine new technology with effective business models, only 2 were automotive companies. The obstacles to digital innovation are related to closed innovation processes and to deficient collaboration forms with external development firms, i.e., startups.

(b) **Action taken**: To overcome these challenges, a coalition of incumbent automotive and telecommunication firms set up a joint incubator, the Mobility X Lab (MXL), to engage with startups to support internalizing external technologies. Since its inception, the incubator has gone through several development phases and is currently transforming into a collaboration hub. So far, MXL has admitted 5 batches including 40 startups. An important distinguishing characteristic of MXL is that it only admits startups with two or more coalition partners involved.

(c) **Results achieved**: MXL started as an incubator with a mentoring-based accelerator program. As MXL has developed, it has transformed into a collaboration

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hub and a neutral partner for fostering startup collaboration and engagement in the automotive industry. Based on lessons learned from startup batches and partner discussions, MXL has advanced, from offering traditional mentoring support, to be a central node in the innovation ecosystem of future mobility in Sweden, thus becoming a matchmaker for startup collaboration, providing guidance and access for startups to incumbent automotive and telecommunication firms and at the same time providing the partners with access to external technology, supporting them to stay relevant.

(d) **Lessons learned**: Through the development of MXL, a coalition of established automotive and telecommunication firms have learned to manage some of the tensions related to digital transformation of their industry. By examining the case of MXL, a number of lessons can be learned: (1) Ensure partner interest through the "two partners" criteria, (2) initial emphasis on engaging startups and less focus on a complete process, (3) announce partner needs without disclosing partner pain-points, (4) coach startups and corporate partners simultaneously, (5) manage expectations early for both startups and corporate partners, (6) develop and implement sound collaboration measures, and (7) joint headship requires a consensus-based governance model.

1 Introduction

The automotive industry is a drivetrain for Swedish exports and accounts for a significant part of the Swedish industry's employment and value added. Three trends, with the common denominator digital technology, set out the preconditions for the industry's future development: electrification, autonomous driving, and mobility services. Although the opportunities for the electric and connected vehicle are amazing, tensions emerge when the mature, capital-intensive, and asset-based automotive industry start to collaborate with the high-paced and networking software industry (Dodourova and Bevis 2014). Innovation in the automotive industry is traditionally closed (Ili et al. 2010), focuses on IP rights, and is organized according to a stage-gate process (Cooper 1990). Innovation in the automotive industry is also organized according to the division of a vehicle in well-established subsystems and on shared responsibilities for innovation between vehicle manufacturers and suppliers (Cabigiosu et al. 2013). This division is efficient for production, and innovation processes are designed for the industrialization of ideas in a so-called performance engine (Govindarajan and Trimble 2010). However, when digital innovation builds on several of the vehicles' subsystems at the same time, tensions arise in established automotive firms and industry structures (Svahn et al. 2017). In addition, future trends in the automotive industry make emergent technologies such as artificial intelligence, cloud computing, and data analytics vital for the digital business transformation (Akter et al. 2020). This makes traditional organization of innovation insufficient (Piccinini et al. 2015; Steiber and Alänger 2020).

To cope with some of these tensions, a coalition of vehicle manufacturers and first-tier suppliers established Mobility X Lab (MXL) in 2017 with the goal to increase the inflow of externally initiated digital innovations to the coalition partners. The coalition consists of well-established blue-chip companies founded in the nineteenth century and early twentieth century mixed with recently founded tech companies as well as a science park hosting the lab. The coalition has a total of 250,000 employees, 90 billion Euro in turnover, and an annual output of close to a million vehicles, including private cars, buses, trucks, and construction equipment.

To prepare for the establishment of MXL, the coalition partners identified key problems with open digital innovation related to external software technologies of startups (Juell-Skielse and Hjalmarsson-Jordanius 2017). For example, there is a fear among original equipment manufacturers (OEMs) to disclose information about customer needs to the startups. The key problems are related to three thematic areas: (1) innovation process, (2) leadership and organization, and (3) product marketing. To solve the identified problems, a combination of a business accelerator (Cohen 2013; von Briel 2014) and an innovation garage (Chansanchai 2016) was suggested for the design of MXL (Juell-Skielse and Hjalmarsson-Jordanius 2017).

We examine MXL as a vehicle for digital transformation within the realm of automotive in four episodes from preparation and initial design as a mentor-driven incubator, through establishment and expansion into a collaboration hub. MXL is jointly owned and funded by the coalition partners, and, due to this setup, MXL needs to synchronize its operations to its partners' variety of innovation processes. As the operating model developed, we analyze how MXL managed to overcome the identified key problems in the three thematic areas and with new emerging problems and opportunities. Also, the number of startups recruited has grown over time, and we study how MXL has redefined its role from an incubator with a traditional mentoring-based accelerator program to a collaboration hub, focusing on matchmaking between startups and the coalition partners (Hjalmarsson Jordanius et al. 2019).

2 Situation Faced

In the mid-2010s, the established automotive industry in Western Sweden with close to a hundred years of company history was troubled by the increasing demands for digital innovation. The R&D departments were the homes of thousands of engineers focusing on the combustion engine and its future development, and purely software developers were rare. Although a vehicle included millions of lines of software code and close to a hundred distributed computers, they were not part of a common software architecture that would enable technical integration. In parallel, the telecommunication industry, spear-headed by Ericsson, pushed for the deployment of 5G technology offering vast opportunities for connected mobile services.

The demands and expectations for digital innovation in the automotive industry were not only increasing; they were also increasingly complex, as their solutions required the integration of the historically separated vehicle subsystems. Although Western Sweden is the home to both OEMs and first-tier automotive suppliers, there was a lack of ways to collaborate on joint innovation projects and a fear to engage in more open forms of innovation. Several internationally leading OEMs started to set up corporate incubators, often referred to as innovation garage, to attract startups. There was no similar incubator in Western Sweden and definitively not one with the competence needed for the automotive industry. The established automotive firms' track record of successful startup collaborations was poor to say the least.

From the perspective of startups, with new ideas for, e.g., mobility services, service infrastructure, big data, and machine learning, it was difficult to understand how to initiate collaboration with the automotive industry. As the CEO of one of the startups later to be admitted to the first batch of MXL put it:

> I think [Western Sweden] has an underdeveloped startup system in proportion to the proximity to all other major players represented here.

There was no clear interface for collaboration, and for a startup with a technology built on more than one vehicle subsystem, there were little chances to collaborate with several automotive partners in joint innovation projects. Moreover, making business with established automotive firms were known to be demanding and costly.

2.1 *The Context: A Lack of Digital Innovation Collaboration*

The case study is situated in a context with clear business opportunities with digital technology but a lack of collaboration for digital innovation. To describe this context and to support generalization, we introduce three contextual factors: product development process, leadership and organization of innovation, and product to market process. The contextual factors are informed by previous research by Juell-Skielse and Hjalmarsson-Jordanius (2017).

Product Development Process The product development process in the original context was characterized by closed collaborations between OEMs and first-tier suppliers, where first-tier suppliers had far-reaching responsibilities for innovation of specific parts of the vehicles. Also, the fear among OEMs to disclose information about needs prevented startups from developing effective digital solutions.

Leadership and Organization of Innovation OEMs emphasized mechanical engineering over software engineering, which meant that leaders and managers were unfamiliar with the requirements of digital innovation. Also, the closed culture meant that OEMs were uncomfortable with innovation collaboration outside established supplier relationships and were perceived by startups as difficult to collaborate with.

Product to Market Process OEMs were natural gate-keepers for digital innovations in vehicles. They feared to lose control of their products and had a tendency to make restrictive assessments of the market for digital products.

3 Action Taken

The actions taken include both planned and emergent activities; thus, we use the concept of episodes in order to organize and describe how the events unfolded (see Fig. 1).

3.1 *Episode 1: Preparation of a Joint Incubator 2016–2017*

In 2016, multiple actors within the Swedish automotive domain initiated a collaboration to connect externally initiated digital innovations to the core products developed by the OEMs. It was a response to the problem situation experienced by the coalition partners, where they found it difficult to absorb and coordinate externally initiated innovation of software functions in the areas of, e.g., autonomous driving, electric motors, and mobility services. The idea was to establish a new organization to unlock the OEMs' organizational borders to external software developers and to facilitate outside-in and collaborative types of open innovation (Gassmann and Enkel 2004).

The project used an action design approach to identify problems with externally initiated open digital innovation in the automotive industry (see Table 1). The project suggested an organizational design, based on a combination of a business accelerator and an innovation garage, to cope with the identified problems (Juell-Skielse and Hjalmarsson-Jordanius 2017). The organizational design included a blueprint for a joint incubator with a mentoring-based accelerator program synchronized with the development processes of the OEMs and the first-tier suppliers. A coalition of

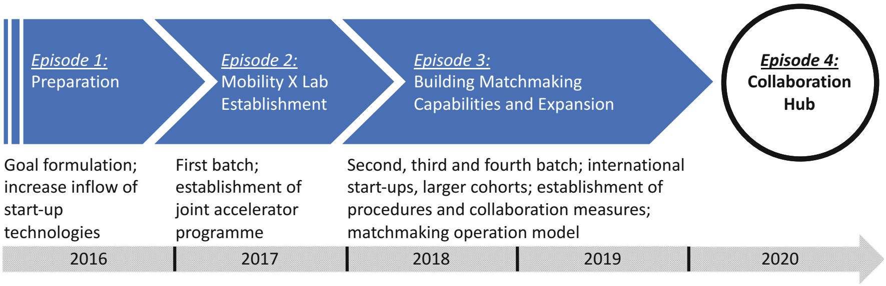

Fig. 1 Four episodes of development of Mobility X Lab, from preparation of joint incubator with an accelerator program to a collaboration hub with matchmaking function

Table 1 Identified problems, affected actors, and temporality in current innovation practices (Juell-Skielse and Hjalmarsson-Jordanius 2017, pp. 6–7). For each problem, temporality is indicated by positioning when the problem occurs in the innovation process: early, mid, or late. Also, affected actor is indicated: OEM, first-tier supplier (T1), and external developer (ED)

Innovation process	Leadership and organization	Product marketing
1. Closed and top-down technology planning process (OEM, T1; early/mid) 2. Time-consuming development process (OEM, T1, ED; early/mid) 3. Costly development process (OEM, T1, ED; early/mid/late) 4. Fear of disclosing information about development needs (OEM, T1; early/mid) 5. Not invented here syndrome (OEM; early/mid/late) 6. Closed IP processes (OEM, T1; mid) 7. Fear of idea being stolen (ED; early) 8. Extensive and costly IP process (ED; mid)	9. Lack of knowledge about digital technologies and digital innovators (OEM; early/mid/late) 10. Inadequate ability to develop and attract digital skills (OEM, T1; early/mid/late) 11. Internal resource availability, prioritization (OEM; early/mid) 12. No clear interface between the TPP and advanced software innovations that cross functional and organizational boundaries (OEM, T1; mid) 13. Complex internal decision-making process involving several functions (OEM; early/mid) 14. Low level of support and commitment from OEM to external development, except to T1 (ED; mid) 15. Fear of exclusive relationship with OEM disappears (T1; mid/late)	16. Restrictive assessment of the market for digital products, easier to say no than to say yes (OEM, T1; mid) 17. Fear of losing control of the product (OEM; mid/late) 18. Difficult to reach and understand the market (ED; early/mid) 19. Demanding and costly business relationship with OEM and T1 (ED; mid/late) 20. Difficult to share mature prototypes with other developers (ED; mid)

partners was formed, and the partner agreement was signed by the CEO of each company. At this stage, the partner coalition included Volvo Car Group, Volvo Group, Zenuity, Veoneer, Ericsson, and Lindholmen Science Park. The new organization was named *Mobility X Lab* (MXL), and a steering committee was formed together with a management team with representatives from each coalition partner.

3.2 Episode 2: Mobility X Lab Establishment 2017–2018

With the partner agreement in place, a director was recruited, and a first joint budget was allocated by the coalition partners for the establishment of MXL. Informed by the initial organizational design, the director set up a mentoring-based accelerator program in a building at Lindholmen in Gothenburg with office spaces, meeting rooms, and exhibition area. In this first version of the program, a key ingredient was onsite meetings between coalition partners and future startups. In October 2017, MXL was inaugurated with attendances of the CEOs and top management representatives from all coalition partners, as well as the Swedish National Minister for

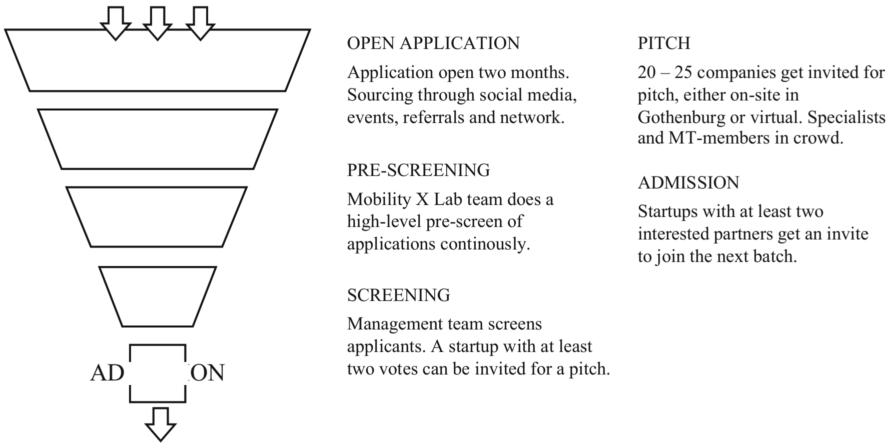

Fig. 2 Mobility X Lab selection funnel model (provided by Mobility X Lab)

Business, Industry, and Innovation. Processes and procedures were at this stage established on an ad hoc basis, including meetings for partner-startup coordination and selection and evaluation of startups. The priority was to get operations going by connecting relevant startups to the program. The management team representatives had the important role as contact persons in the development process of each coalition partner and as co-developers of the program. A first batch of startups was recruited in the autumn of 2017, following a selection funnel model (see Fig. 2).

The focus in the first batch was broad, which attracted startups on a broad level that could provide value to future mobility through digitalization—an area that MXL at this stage described as autonomous, connected, and electrified. As such, it would require new business models and enable new services. For the automotive and telecommunication industry to stay ahead of competition, they had understood the need to work in new faster ways, in closer collaboration with each other, propelled by startup partnerships. A key principle to ensure this was that startups admitted to MXL should have at least two coalition partners as sponsors. As one of the senior corporate managers put it:

> You can run many different combinations of collaborations here, and it is quite unique that you have [this opportunity] within such an association. ... And it's a basic premise that at least two parties are involved with a startup.

The first batch of recruited startups moved into MXL in January 2018. At this stage, the program followed a loosely structured and agile accelerator program with a mentoring function. The first batch included five startups specializing in machine learning training data, simulation tools for networks and sensing with radar signal processing. The majority of the enrolled startups were Swedish companies with a digital offer as a key part of their value proposition. A sixth corporate partner, CEVT, joined MXL in December 2017.

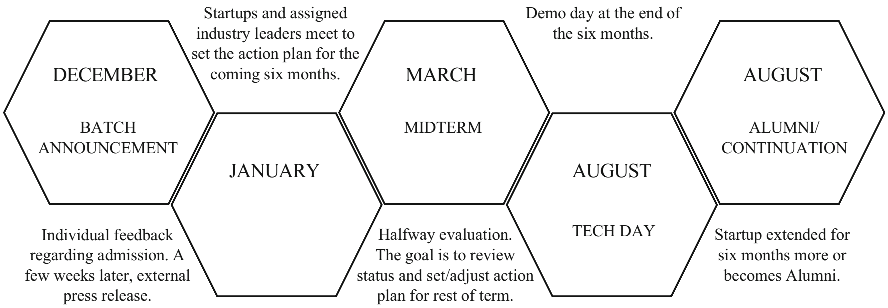

Fig. 3 The process of the accelerator program (provided by Mobility X Lab)

The program became 6 months long and included a phase to explore the startups' focus and how they could work with at least two of MXL's partner organizations (see Fig. 3).

Before summer 2018, a first demo event was organized. The demo event and the adjacent workshop with all startups and coalition partners resulted in proof-of-concept projects with three of the five startups. At the end of the first batch, the conditions for a second batch were developed by MXL's management team and representatives of the coalition partners. The experience from the first call, which had a broad focus, was a low corporate interest for the startups, particularly if the startup did not address a concrete business pain or a strategic need to improve processes or value offerings to end customers. So, in order to find the right target group of startups, future batches had to focus on a comprehensive and relevant area of need shared by all six coalition partners. Therefore, the focus of the second batch became artificial intelligence. The call for this batch was launched in May 2018.

3.3 Episode 3: Building Matchmaking Capabilities 2018–2020

Anchored in the experiences from incubating the first batch of startups, MXL made a strategic decision early on in fall of 2018 to focus operations toward *matching* startups' technologies with the coalition partners. This meant downplaying the incubator character of the joint partner-delivered accelerator program and instead focusing on the capability to (1) scout and market MXL toward startups relevant to the coalition partners and (2) reshape the accelerator program to facilitate startup-corporate relationship building through the 6-month program design. An important lesson at this stage was to create (1) a balance between a more structured accelerator process that could navigate startup collaborations through a set of checkpoints to create actable conditions for launching and operating joint proof-of-concepts and (2) MXL's capacity to stimulate serendipity innovations through offering a physical meeting space where partner representatives could meet the startups.

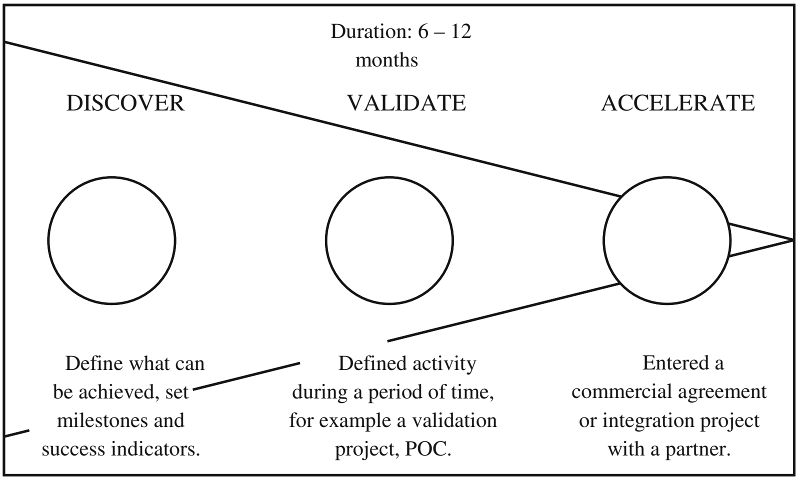

Fig. 4 Mobility X Lab's three phase accelerator program (provided by Mobility X Lab)

To execute this transformation, from incubator to matchmaker, MXL increased its organization with a program manager with the mission to transform the operation design, as well as the coordination of the enrolled batches of startups in the program. Based on this, a program manager was recruited with extensive understanding about startup operations and knowledge about the Nordic technology startup scene. The organization was also expanded with a marketing and communication team tasked with systematically promoting the lab both nationally and internationally.

Furthermore, the engagement of startups for the first batch had been a success. However, to move from incubating startups to better match startups with the coalition partners' needs, a more efficient outreach was necessary to spot and attract national and international digital startups. The offer that MXL proposed to the startups did not communicate itself, instead the MXL needed an enhanced capability to communicate its offer and, thus, attract startups that matched partner needs better. The communication and marketing team included staff from MXL and staff from each coalition partner to utilize the vast capacity that each partner could mobilize. One effect created through this move was an increased interest in MXL from international startups. This resulted in an international pitch event, hosted in Silicon Valley in November 2018. It marked a shift from recruiting startups in Scandinavia to recruiting startups internationally. Since this shift, the majority of startups, applicants and enrolled, has been international companies.

With the program officer as lead, the MXL management team in collaboration with the coalition partners' representatives adapted the original accelerator program to a three-step design including the phases discovery, pilot, and integration (see Fig. 4).

The revised program was launched with the second batch of startups at the first-year anniversary of operations in October 2018. The revised process changed operations to stimulate the creation of partnerships between startups and coalition

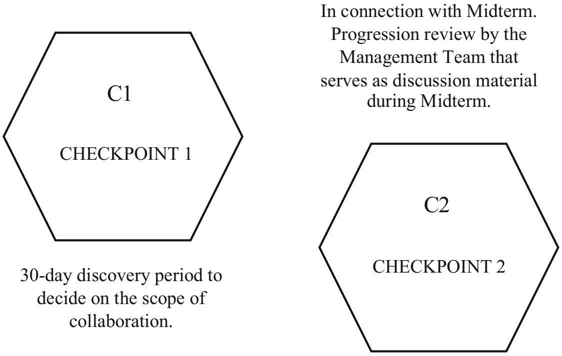

Fig. 5 Mobility X Lab's checkpoints (provided by Mobility X Lab)

partners. It further changed operations by building an environment with projects involving the MXL coalition partners and a vibrant onsite environment with ongoing projects with a focus on future mobility.

During the three phases, the enrolled startups interact with one lead person from each of the two or more coalition partners that have embraced the company. The main objective with the startup leads' activities is to manage expectations from both sides in the emerging relationship. To manage the program, different goals were developed, which are used during three checkpoints to follow up progress (see Fig. 5).

During fall 2018, the third batch of startups was recruited, once again with the common topic of artificial intelligence for future mobility. Six international and five Swedish companies were enrolled in the program. Furthermore, during fall 2018, MXL's first success was achieved in November when Annotell from the first batch signed a long-term business agreement with the coalition partner Zenuity. At this stage, another capability was developed for MXL. In collaboration with the Swedish Innovation Office "Vinnova," Swedish startups matched with one or several of the coalition partners could apply for project funding to cover costs associated with developing a proof-of-concept. This increased the range of services offered by MXL, and it became possible to fund partnerships between startups and coalition partners with long-term value without the requirement of a short-term return.

During this phase, MXL made a definitive move toward becoming a collaboration hub. Collaboration had been a core element of MXL operations since its inception; however, the shift toward a global market of startups transformed operations from a model where the physical interaction was key to a model where digital interaction between MXL, coalition partners, and enrolled startups became the first-hand choice.

3.4 Episode 4: Developing into a Collaboration Hub

With an increased proportion of startups and an intensified effort to actively support and reconcile their progress with the coalition partners, and to evaluate the startups earlier in the process, the need for a clearer process and structure between MXL and partners emerged. In August 2019, MXL received their first alumni who could contribute with their experiences of collaborating with incumbent firms. With the alumni network, MXL received increased attention as these startups could help spread the reputation of the lab to others. Yet, it created a further need to develop a clear structure in the process of how to manage the growing number of startups in the MXL network. Therefore, in the autumn of 2019, a project was initiated with Region of Västra Götaland (the governed geographical territory in Western Sweden where Gothenburg is the largest city) to recruit a person as ecosystems manager who would support building such structure to manage the growth of MXL. This person was recruited during late autumn 2019.

In connection with an increased need for structure to manage the growth, the shift of recruitment toward an international startup arena together with the focus on digital interaction affected the need for office space in Gothenburg. This meant leaving part of the basic idea to have many startups onsite, and thus, it was decided that financing of the startups' rent after the active period in MXL should now be outside the scope of MXL's operations.

At the same time, the fourth batch of startups were recruited, consisting of seven companies of which only two were Swedish, showing that MXL's effort to exploit an international startup arena was gaining momentum. Moreover, after focusing on artificial intelligence on the two previous batches, MXL now opened up and searched more generally. The reason for this decision was that it had been (1) too many similar startups applying for MXL for which the lab did not have the capacity for and (2) that MXL now wanted to get more unexpected technologies from startups that could contribute to partners' products and processes and, hence, the digital transformation of future mobility. This was also evident in the startups that were recruited for the fourth batch, for example, by companies that develop sustainable tires for electric vehicles.

With increased attention for the importance of startup collaboration within the partner organizations, and a more solid foundation to stand on for their matchmaking process, MXL organized an open house for partner employees in September 2019, the so-called Tech Day. At this Tech Day, about 500 people visited MXL to mingle with the startups, being "a 1-year anniversary on steroids in terms of visitors", as the program manager put it.

In order to create additional marketing for MXL and spread the reputation about the lab, the MXL team initiated a structured work to identify and reach out to potential ecosystem partners who could support marketing MXL in their networks. A network model to market MXL with the help of others was further developed.

During this time, the need for a multilateral agreement regulating IP in those projects involving one startup and multiple partners was also identified. It further demonstrated the importance for partner companies to identify how to work with startups, and such an agreement was being prepared and put in place during the first quarter of 2020. In addition to the issue about IPR, many of the startups in the new, more international batch had more experiences working with incumbent firms or going through other corporate incubations or acceleration processes with other leading companies within the automotive industry. These startups also clarified the need for not only a matchmaker but someone that could push the process further into the partners' organizations. To facilitate such a connection, the MXL team together with MXL representatives from the partners and with support from the Research Institute of Sweden (RISE) worked on developing innovation policies as collaboration measures to sync the MXL process with the partners' innovation processes. With these collaboration measures emerging, MXL starts to position itself not only as a matchmaker for startup collaboration but position itself as a central node in the innovation ecosystem to facilitate digital transformation by connecting digital innovations through a unique kind of incubator with incumbent firms' processes.

In early 2020, the process to recruit a fifth batch started after the corporate partners signed a 5-year continuation of the coalition agreement to operate MXL.

4 Results Achieved

During the years from 2016 to 2020, MXL transformed from an incubator with a traditional mentoring-based accelerator program to a collaboration hub with a matchmaking function (Hjalmarsson Jordanius et al. 2019). To achieve this transformation, the initial idea to overcome the challenges of digital transformation in the automotive industry resulted in a coalition of incumbent firms establishing an agreement of a joint incubator. Especially, the understanding that digital transformation would need continuous development as digital innovations evolve fast enhanced the need for startup collaboration (Piccinini et al. 2015; Weiblen and Chesbrough 2015; Steiber and Alänger 2020) and the establishment of the incubator. A setup of procedures and processes developed over the first years to establish the accelerator program to fit with the partners' needs for digital innovation, resulting in that the first batches admitted to the program needed to focus on relevant areas of need of the partners. To design the program to be successful, not only separation of the incubator from the corporation (Kohler 2016) needed to be in place, but as MXL should connect startups with several partners' needs, the reshaping of the program focused on adapting it to a three-step process, including the criteria that the startup needed two partners as sponsors showing that the need exists for the startups' technology. It also involved a growth of the MXL organization in terms of staff, together with adding resources from the partner organizations. Including corporate staff in the MXL team further resulted in support to startups tackling corporate complexity as these people could outline a first step of connecting startups to right stakeholder groups within the partner organizations. The adaptation was meant for facilitating startup-corporate collaboration and resulted in a change of MXL going from a traditional accelerator program to a matchmaker.

Having people from the partner organizations within the MXL team not only supported connection between the MXL process and the partners' processes but also outlined issues of resources needed within the partner organizations to manage the startup collaboration process. As also expressed by startups within MXL:

> MXL achieved the goal of getting us into the organizations. [But] are the people we are talking to [partners' representatives in MXL] the people that can actually move things in the organization?—Founder of a startup in batch 5

Some startups acknowledged the need to find an internal champion that could push collaboration further within the partner organizations:

> [To create a successful collaboration] to find our champion internally in the companies, someone who actually sees the benefit in what we do. Because you have to have someone internally who drives the issue and development further—Founder of a startup in batch 2

Reaching out to startups for supporting coalition partners with digital innovations provided the partners with increased need to refine how to manage the collaboration well (Steiber and Alänger 2020). The issues occurring over time made it clear that the MXL process needed to be synced with the partners' processes to larger extent, resulting in the emerging collaboration measures to connect the MXL's startup process with the different partner organizations. These collaboration measures should support the guidance of startups and partner representatives to create more successful collaborations. This further highlighted MXL as a neutral arena for startup collaboration, although connected to the coalition partners, resulting in a development of MXL into a collaboration hub for matchmaking. Matchmaking is one distinct operational model to be adopted by incubators and accelerators (Hjalmarsson Jordanius et al. 2019). Through this exploration in the development path of MXL, further insights of what constitutes this model emerges in terms of support for both partners and startups. From a perspective of startups, MXL created a unique arena and constellation to reach out to and get in contact with leading international companies within the automotive industry, thus opened up the door to these companies that had otherwise been difficult (or almost impossible) to achieve. Startup founders expressed the importance of going through the MXL process for branding and gaining a quality stamp:

> It has something to do with branding [. . .] even if people don't know what MXL is, they can guess that they are working with mobility and acceleration. You say Gothenburg and everyone knows that Gothenburg is the place in Sweden for the automotive industry. It has definitely helped with the branding—Founder of a startup in batch 3

> We felt that if we could be good enough to work with these companies, it would give us and our investors more confidence—Founder of a startup in batch 4

> . . . and then the quality stamp. That we actually have a track record with MXL. It is a quality stamp, absolutely—Founder of a startup in batch 2

From a partner perspective, development of MXL resulted in a creation of an arena to find relevant startups to collaborate with for supporting partners' product development and processes in the digital transformation. Akter et al. (2020) describe how the application of artificial intelligence, blockchain, and cloud and data analytics (i.e., ABCD technologies) support digital business transformation, adding increased value to companies by operating in combination with traditional processes. For the automotive and telecommunication industry, ABCD technologies played a role in creation of awareness of how to manage startup collaborations in order not to be outcompeted by others when future mobility moves into electrification, autonomous, and connected vehicles. This includes a need for startups with cutting-edge technologies to manage, for example, the huge amount of data from sensors and parts of a connected vehicle (IoT) and also with technology to develop safety in autonomous driving and handle security of data. Example of ABCD technologies that have been identified by the coalition partners in MXL as important for digital innovation, and that have played a role in the digital transformation, are:

- AI solutions such as machine learning training tools to analyze and predict how to drive autonomously, using sensors to help the vehicle understand position of pedestrians and road signs and calculate distance
- Combining machine learning and cloud computing with Internet of things (IoT) to reduce time and lower costs for connected, autonomous vehicles (vehicle systems) by optimization of real-time data closer to the source
- Machine learning or deep learning together with other technologies, such as for advanced driver-assistance systems (ADAS), to provide safety and security during vehicle operation
- AI solutions for cybersecurity applications, such as protecting ADAS system

Hence, continuous need for digital innovations to manage the transformation in the automotive industry toward electrification, connection, and automatization resulted in a fast scale up of MXL as recruitment shifted focus from national to include the international startup arena. An increased number of startups within MXL, and with a broader focus on digital startup recruitment, resulted in an expansion of MXL through marketing and network model to become a central node in the innovation ecosystem of automotive industry to foster startup-corporate collaboration. Thus, from the initial idea of an accelerator program, MXL developed into a matchmaker to support both incumbent firms (partners) and startups. It further created the awareness of the need for the partners to create new ways of working to stay relevant in a fast-changing digital transformation. As expressed also by startups:

> The car manufacturers in Sweden and in Germany and in Japan and in America, they are all competing with Tesla. And they are all competing with the Chinese car manufacturers, and these companies move quicker. If the car manufacturers in the rest of the world do not find a way to assess new technologies and incorporate them in a quicker pace, they will lose out to new car manufacturers—Founder of a startup in batch 5

The iterative development of MXL in conjunction with experiences from startup collaboration created an awareness of partner companies about the need for internal

Table 2 Results achieved in the four episodes of the development of Mobility X Lab

Result	Episode			
	Preparation	Establishment	Operation and expansion	Collaboration hub
# Batches	0	2	1	2
# Startups	0	*Batch 1:* five from two nations *Batch 2:* six from two nations	*Batch 3:* 11 from 6 nations	*Batch 4:* seven from five nations *Batch 5:* 11 from 8 nations
Type of innovations	–	From broad spectrum of innovation related to, e.g., machine learning training data and simulation tools to artificial intelligence	Artificial intelligence	Broader spectrum on digital technology related to electrification, connection, and automatization
Collaboration measures	–	Startup connected to a shared area of need	Match startup and two partners and checkpoints for follow-up	Innovation policies including guidelines for collaboration, network model, and sync between partners' internal innovation processes and MXL

processes to find the right people within the organizations and engage them. Consequently, MXL does not only match digital innovations to partner companies' needs but also create insight of how to "balance the speed of the cheetah and the punch of the elephant," thus moving these organizations further by being a central node, "the heart," in the innovation ecosystem of automotive and telecommunication cluster, supporting digital transformation and resulting in a collaboration hub for future mobility.

Over the period of less than 5 years, going from traditional accelerator program to matchmaking collaboration hub, the joint force of coalition partners to establish MXL has resulted in 5 batches of 40 startups in total with digital technology innovation within a range of machine learning and artificial intelligence to more physical technologies supporting electrification of partners' products in a digital transformation (see Table 2).

The 40 startups represent both successful cases, going all the way to implementation projects with partners, and less successful cases, where collaboration ended after proof-of-concept or even before. In the latter case, the reason has usually been due to partners' resource allocation or issues related to the ability to assess beforehand digital innovations fit with the companies' product or processes. This further resulted in collaboration measures developing through the episodes, from MXL establishing follow-up procedures for the innovation process to emerging collaboration measures consisting of strategic decisions to better sync MXL process and partner's innovation processes.

Among successful cases, the collaboration between Annotell and Zenuity can be mentioned. As one of the first startups invited and recruited to MXL, Annotell was also the first startup to sign a contract with one of the coalition partners, Zenuity. Through MXL's process, the possibility for a strategic collaboration between the startup and the partner became possible. Much was due to the fact that the match of novel digital technology and expertise from Annotell matched the need of Zenuity for achieving their goal with self-driving car in 2021. So, the timing was right, and by collaborating, a win-win situation was achieved for the two parties as Annotell received an important lead customer.

4.1 The Resulting Context: Improved Digital Innovation Collaboration

The case study of Mobility X Lab illustrates how incumbent firms influence the context of digital innovation through the establishment of a jointly owned collaboration hub. We have described the development of Mobility X Lab through the lens of three contextual factors: *product development process*, *leadership and organization of innovation*, and *product to market process*. For each of the three factors, we observe significant changes.

Product Development Process The establishment of Mobility X Lab meant that the partners tried to open up their product development processes toward startups and toward each other (episode 2). This process of opening up and extending the product development processes was further supported by MXL through building matchmaking capabilities and focusing more on international startups (episode 3). Then, as MXL developed into a collaboration hub (episode 4), the product development processes opened up further through a multilateral IP agreement and an ecosystem of international digital startups.

Leadership and Organization of Innovation The establishment of MXL created a need for a new form for leading and organizing innovation collaboration (episode 2). As the organization, roles, and working procedures of MXL became more formalized and geared toward matchmaking (episode 3), it provided better support for the coalition partners to lead and organize innovation collaboration. Over time, this was further formalized (episode 4) by attracting digital startups with a broader scope and on an international scale. New forms for leading and organizing innovation collaboration were also developed by strengthening the interface between startups and the partners' processes through policies and collaboration measures, together with a management team and new roles, such as program officer and ecosystem manager.

Product to Market Process The new forms for leading and organizing innovation collaboration enable the partners and startups to work closer together, removing some of the barriers of bringing digital products to market, e.g., easier access to information about needs, more informed assessments of market potential, and reducing collaboration costs for startups (through all episodes). Furthermore, with development of policies and collaboration measures, the understanding of the market among startups has improved, and the costs for collaborating with the partners have decreased, thus easing the process for product to market.

5 Lessons Learned

Through the development of MXL, a coalition of established automotive firms has learned to manage some of the tensions related to digital transformation of their industry. This explorative approach has resulted in a unique type of incubator—the collaboration hub—that enables collaboration across technical and organizational boundaries. MXL has helped the coalition partners to manage some of the tensions of digital transformation and the particular problems of collaborating with external startups. It increases the flow of externally developed digital technology to the coalition partners, supports startups to develop their digital products, and stimulates and eases collaboration among the coalition partners.

MXL has advanced into an interface between well-established companies and startups but also into a platform for easing up some of the problems related to costly and time-consuming technical development. This in turn is a consequence of long-term and capital-intense industrial development to produce complex automotive products comprising several and technically advanced subsystems.

By examining the case of MXL and its development, a number of lessons can be learned. The lessons learned are valuable when incumbents assess if and how to form partnerships to source digital startups of a specific industry sector:

1. Ensure partner interest through the "two partners" criterion.
2. Initial emphasis on engaging startups and less focus on a complete process
3. Announce partner needs without disclosing partner pain-points.
4. Coach startups and corporate partners simultaneously.
5. Manage expectations early for both startups and corporate partners.
6. Develop and implement sound collaboration measures.
7. Joint headship requires a consensus-based governance model.

5.1 Lesson 1: Ensure Partner Interest Through the "Two Partners" Criterion

MXL was established on the key principle to only admit startups to the incubator with partner commitment from at least two of the coalition partners. The reason for this criterion is obviously to ensure that the startup receives the necessary support from the partners to develop its digital product but more importantly to enable digital innovations that cross technical and organizational borders between vehicle subsystems and partners, such as breaking and steering. With at least two partners committing to the startup, MXL ensures that at least one border is crossed. From the perspective of the startup, this means that it does not need to establish and maintain multiple partner interfaces for digital innovations that build on multiple vehicle subsystems. Further, the criterion reflects the goal of the coalition partners to propel collaboration among themselves. In that sense, the startups admitted to MXL serve as joint projects for the incumbents to collaborate on digital innovation. Besides, through this "two partner commitment," it becomes easier for the startups to reach and understand a significant portion of the potential market for their digital products. This lesson learned relates to the contextual factors *leadership and organization of innovation* and *product to market process* as it eases several of the problems identified during the preparation episode (see Table 1), most prominently an unclear interface between the partners' technology planning processes and digital innovations that cross functional and organizational boundaries (12) and difficulties for startups to reach and understand the market (18).

5.2 Lesson 2: Initial Emphasis on Engaging Startups and Less Focus on a Complete Process

One approach to develop and launch an incubator is to focus the development of a well-structured and complete incubator practice. Instead, MXL successfully chose the approach to develop a sound and agile first version of the process in parallel to an active engagement of a first batch of startups. This does not mean that the operations of MXL was launched without any structure in place. Instead, as the episodes describe, the hub evolves over time through the mindful development of the original process, involved actor roles, checkpoints, and offers. The evolution of MXL also signals a change of operation mode in terms of MXL transcending from being a mentor-based accelerator program to a collaboration hub with a focus on matchmaking. The chosen approach is more explorative than exploitative in characteristics and eased some of the identified problems related to the contextual factor of *leadership and organization innovation*, primarily a lack of knowledge about digital technologies and digital innovators among the coalition partners (9) but also an inadequate ability to develop and attract digital skills (10).

5.3 Lesson 3: Announce Partner Needs Without Disclosing Partner Pain-Points

In order to successfully scout startups with high relevance as base for a possible partner-funded collaboration project, the batch announced need to be anchored in the needs that MXL corporate partners have. Such needs could either be so-called "pain problems" in current production or processes or needs related to the development of future value offers and capabilities. Regardless, as MXL is jointly driven by corporate partners, to disclose such needs requires that they are on one hand understandable and communicable and on the other hand so diffuse that they do not reveal challenges within a partner or a specific strategic move from the partner. To be able to manage this competing concern has been key for MXL and the involved partners. If the batches are not anchored in actual needs, this will hamper recruitment of relevant startups; however, to disclose too detailed requirements may create commercial advantages from competing actors within the automotive sector. The lesson learned is that it was possible for the coalition partners to find ways to work around the fear of disclosing information about development needs (4), ultimately affecting the *product development process* to become more open.

5.4 Lesson 4: Coach Startups and Corporate Partners Simultaneously

MXL as a collaborative hub connects two worlds. On one hand, we have the incumbent, well-established, and successful corporate partners, that follow the logic of blue-chip companies, e.g., strategic planning, management hierarchies, and rigid processes. On the other hand, MXL is a vibrant environment with startups that are driven by exploring and developing their idea in relation to future mobility, e.g., with short-term planning, agile procedures, and entrepreneurial cultures. Neither of these worlds are wrong; however, neither of these worlds are right if a collaboration should be matched between coalition partners and enrolled startups. An important lesson for MXL has been to develop skills that facilitate bridging work practice differences within the different constellations of partners and entrepreneurs for the admitted startups. This unique competence, related to *leadership and organization of innovation*, has developed over time and builds on a continuously increasing understanding of the complex internal decision-making processes (13) in the coalition partners, an increasing awareness of MXL as an interface for software innovations (12) in combination with an increasing knowledge about digital innovators and digital technologies in general (9).

5.5 Lesson 5: Manage Expectations Early for Both Startups and Corporate Partners

Another important lesson from MXL is that a unique characteristic of the operations within a collaborative hub such as this is the support by the hub to manage expectations. The startup is driven by the idea to explore their solution and eventually reach a market. Per definition, entering into MXL does not automatically generate a partner-funded proof-of-concept or a commercial agreement. Similarly, the coalition partners cannot expect to source technologies ready for implementation in vehicles. The first discovery phase is a trial phase to see if the initial interest from the coalition partner and the digital startup can evolve into an activity. Within this phase, representatives from MXL make crucial interventions to help the involved actors to manage expectations in terms of potential outcomes from both sides and timeframe of collaboration. This lesson learned is directly related to the characteristics of the partners' time-consuming and costly technical development processes. An initiative like MXL will hardly have any profound or disruptive impact on the organization of these processes, but by effectively managing expectations, it becomes easier for both coalition partners and startups to develop useful solutions within acceptable timeframes. The lesson learned here is that by managing expectation, MXL affects the *product development process* by easing the problems related to time-consuming and costly technical development processes (2, 3).

5.6 Lesson 6: Develop and Implement Sound Collaboration Measures

Initially processes and procedures were not key in the development of MXL in terms of operations. What can be learnt from the fourth episode is that, as MXL has found its appropriate modus operandi, an increased need of formal structure emerges. These are innovation policies to enhance the matchmaker operation model and can be described as collaboration measures. A measure can here be defined as any maneuver made as part of progress toward a goal. Collaboration measures are thus conceptual tools and procedures with the purpose to obtain good collaboration between corporate partners, startups, and MXL representatives within the incubator. The short-term effect is thus to create positive impact on the emerging collaboration between a startup and a partner company; however, mindfully designed, these collaboration measures also create the backbone for long-term commercial collaboration as they enhance thrust, productivity, and quality in the match made. This lesson learned relates to many of the identified problems related to *product development process* and *leadership and organization of innovation* (4, 6, 7, 8 12, 13, 14).

5.7 Lesson 7: Joint Headship Requires a Consensus-Based Governance Model

MXL is jointly created by the coalition partners based on the values of openness, trust, and collaboration. As a unique incubator initiative, it strives to be a world-leading collaboration hub nurturing a dynamic ecosystem where emerging companies (startups and scale-ups) work together, at the heart of a unique mobility cluster in Sweden, with global corporations to create novel future mobility solutions that will transform the automotive industry and improve the world. In order to succeed, this unique joint initiative requires a different governance model compared to other incubators. Key components of the governance model are the steering body, the management team, and MXL operation team. The steering body utilize a consensus logic to provide advice, ensure delivery of MXL's outputs and the achievement of outcomes by providing input to the strategic development, and provide advice in making decisions about changes to MXL as it develops and approve onboarding of new coalition partners. The management team is the key driving force that represents the partner companies and therein holds each other mutually responsible for the success of MXL. Members are nominated by each coalition partner and are responsible for delivering the mission of MXL successfully (as defined by the steering group) in collaboration with the director and MXL operation team.

The MXL operation team is in the nexus of MXL's capability to match startups with coalition partners paving the way to successful development projects. The operation team includes several functions, e.g., digital transformation leads, with the overall responsibility to coordinate the startup engagements among the coalition partners assigned to the specific startup.

The joint headship and the consensus-based governance model changes the characteristics of *leadership and organization* of innovation and collaboration among the partners.

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A Two-Sided Approach for Digital Innovation at SCHOTT

Combining Resource- and Problem-Oriented Innovation Methods for Digital Service Development

Anna-Maria Oberländer, Bastian Stahl, Laura Watkowski, Sabrina Braadt, and Peter Scherer

Abstract

(a) **Situation faced**: SCHOTT, a global player in the specialty glass and glass-ceramics industry, offers a wide variety of products, among which it's Business Unit Tubing (SCHOTT Tubing) focuses on semi-products for various industries, e.g., pharmaceutical packaging. By enhancing the production quality with initiatives like perfeXion® and dedicated data collection throughout the whole product life cycle, SCHOTT Tubing, driven by a sense of ambition rather than a sense of urgency, strives to shape the digital transformation of its business and the entire industry. Against this backdrop, SCHOTT Tubing launched the first B2B e-commerce platform and strives to leverage this digital infrastructure for creating additional digital services. Yet, exploring innovative digital services poses a significant challenge for established businesses in the B2B context that demand sound methodological guidance.

(b) **Action taken**: To face this challenge, SCHOTT Tubing applied a novel innovation approach that combined both problem-oriented and resource-oriented

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innovation approaches. This included an initial ideation phase with an international workshop format followed by a concept phase with iterative, customer-focused evaluation cycles in an interdisciplinary sprint team.

(c) **Results achieved**: The presented case shows a target-oriented approach for incumbents to combine both problem-oriented and resource-oriented approaches to develop and evaluate digital service innovation effectively. Throughout the ideation phase, 14 SCHOTT employees developed over 50 digital service ideas. By using the introduced innovation approach, five ideas were prioritized for the concept phase. These ideas were tested and further detailed in close collaboration with SCHOTT Tubing's customers. Besides, SCHOTT Tubing thereby enhanced knowledge of innovation methods and fostered an innovative culture among the participants.

(d) **Lessons learned**: Beyond commonly applied approaches that solely focus on the customers' problems, SCHOTT Tubing instead also paid attention to their resources, including customers, assets, or internal services as types of resources to drive ideas in the field of digital service innovation. In addition to the generated digital service ideas, this case provides valuable methodological insights: It reveals the strengths and weaknesses of the two-sided approach of the sequentially applied problem- and resource-oriented innovation methods.

1 Introduction

Digitalization challenges organizations dramatically driven by the emergence of numerous technologies (Legner et al. 2017). Rapid technological improvements imply altered customer demands, changing market conditions and accelerating and improving the way innovations are developed (Vial 2019; Urbach and Röglinger 2019). Against this backdrop, market leaders of any industry are in a favorable position. Nevertheless, such a position requires striving for valuable opportunities to assert against ascending competitors (Parviainen et al. 2017). SCHOTT Tubing, the case company, prompted the question of what digital services they can offer to customers besides their high-quality products to create a valuable experience and further differentiate from competitors.

The SCHOTT group offers a broad portfolio of high-quality glass products for various fields of applications. The Business Unit SCHOTT Tubing is engaged in premium glass tubes for conversion into primary packaging products such as syringes or vials. Thereby, SCHOTT Tubing managed to become a standard for many glass companies worldwide, offering pharmaceutical packaging materials that stand against quality issues in a highly controlled industry. Founded over 130 years ago and headquartered in Mainz, Germany, SCHOTT is a leading international technology group in specialty glass and glass-ceramics. The SCHOTT Tubing product portfolio ranges from glass tubes, rods, and profiles made of more than 60 special glass types. With a yearly production capacity of more than 150,000 tons, SCHOTT Tubing offers a wide range of glass products with outside diameters ranging from 0.9 mm to 460 mm and lengths of 0.3 mm to 10 m. In total, SCHOTT Tubing employs more than 1700 employees worldwide, of which around 1200 are located at its headquarter in Mitterteich, Germany.

SCHOTT Tubing's traditional business model focused on providing high-quality glass tubes to customers from diverse sectors (architecture to lighting, laboratory glassware, and pharmaceutical packaging) and offering these customers after-sales services (e.g., defect analysis). SCHOTT Tubing's ambition is to sustain and enhance its leading position in the industry, also in the context of digitalization. More recently, SCHOTT Tubing expanded its market offerings to innovative services such as a glass tubing explorer and an e-commerce ordering system. Following the prospering road of digital services, SCHOTT Tubing is engaged in creating innovative value propositions that customers and SCHOTT Tubing can profit from.

In the following, we present the case of how SCHOTT Tubing explored innovative digital services for the pharmaceutical primary packaging industry to enhance its digital infrastructure with valuable digital services. This case mainly sheds light on the factors driving SCHOTT Tubing's decision, the benefits realized, and the lessons learned from this project and applied methods.

The digital innovation project was conducted in cooperation with the Digital Innovation Laboratory (DIL) of the Project Group Information Systems of the Fraunhofer Institute for Applied Information Technology (FIT), the University of Bayreuth, and the Research Center Finance & Information Management (FIM) that is a multidisciplinary institution that supports industry partners in the entire digital innovation process.

2 Situation Faced

The glass industry and the core business model of SCHOTT Tubing can be described as very traditional, long-established, and technologically mature. Glass manufacturing within the SCHOTT company reaches back to 1884. Over the decades, processes have been optimized and increasingly automated by SCHOTT. Nevertheless, the production process for pharmaceutical glassware is highly complex and requires considerable know-how and technical experience. Furthermore, high investments are required for the construction and operation of the glass furnaces, which have to maintain consistent quality parameters over many years before they have to be rebuilt entirely. Against this background, the barriers to market entry in the glass industry can be considered high.

However, SCHOTT Tubing's very stable business model also has to face the changes that come with globalization and digitalization. Within the last decades, the industry turned to a globalized market with large multinational organizations dominating the most important branches. Thus, glass manufacturers face tougher market conditions through globalization and increasing competition. Furthermore, in most industrialized countries, the market for glass products shows satiety tendencies. Nevertheless, quality remains a crucial differentiating factor; but with fast-establishing glass manufacturers in emerging markets, quality loses differentiation potential.

To enhance its well-established market position, SCHOTT Tubing is taking advantage of digitalization and is striving to become a digital leader in the industry. Besides production-related initiatives like highly automated quality controls, e.g., perfeXion® (SCHOTT AG 2020), and dedicated data collection throughout the whole production process, SCHOTT Tubing also tackles digital opportunities to enhance customer interaction and services. In contrast to examples of digital disruption, e.g., Kodak (Lucas and Goh 2009), SCHOTT Tubing is committed to playing a vital role in shaping the industry's digitalization. Therefore, SCHOTT Tubing approaches digitalization based on a stable business model rather in the sense of ambition than in the sense of urgency (Kotter 2008; Baumbach et al. 2020).

This approach and the early investments in digitalization are underpinned by the fact that SCHOTT Tubing launched an e-commerce shop for its B2B customers as early as 2003. Until then, the system was continuously updated, refined, and gathered further functionalities (Fig. 1).

From practice and research, it is well known that the bare commercial transactions do not lead to beneficial effects associated with B2B e-commerce, e.g., cost reduction and increased customer loyalty (Balocco et al. 2010). Based on its first-mover strategy, SCHOTT Tubing began offering customer services in a digital form very early. To do so, SCHOTT Tubing, on the one hand, further enhanced internal digital transformation by stabilizing, optimizing, and digitalizing processes, and on the other hand, new digital customer services were created and rolled out. Hence, in addition to pure sales activities, customers could soon access services such as virtual shipment planning or quality data online.

Within SCHOTT Tubing, digitalization is perceived as an ongoing and overarching effort. To protect the business from disruption and take on a leading position focusing on radical digitalization initiatives, they yield to utilize novel digital technologies relying on agile innovation processes. Given their positive experiences with offering an e-commerce B2B shop to customers, SCHOTT managers started to ask themselves: What more services are there that our customers desire? What would make their lives easier? Asking these questions, SCHOTT is eager to further create valuable touchpoints, specifically digitalized service offerings. To do so, organizations need to stray from beaten tracks, challenge traditional knowledge, and deal with new technologies. In this digitalization context, organizational ambidexterity plays an essential role in enhancing the efficiency of existing business models while exploring new ones (Stelzl et al. 2020). SCHOTT Tubing's great strength lies in its ability to manufacture high-quality products and services. In particular, this is based on existing knowledge and continuous optimization that enable incremental innovations. These capabilities can be regarded as exploitative capabilities (O'Reilly and Tushman 2008). In contrast, the ability of exploration to identify new digital opportunities poses a particular challenge to established companies in traditional industries (Kriz et al. 2014; Lavie et al. 2010). Thus, the case is located in the initiation phase of digital innovations and focuses mainly on exploring new opportunities (Kohli and Melville 2019).

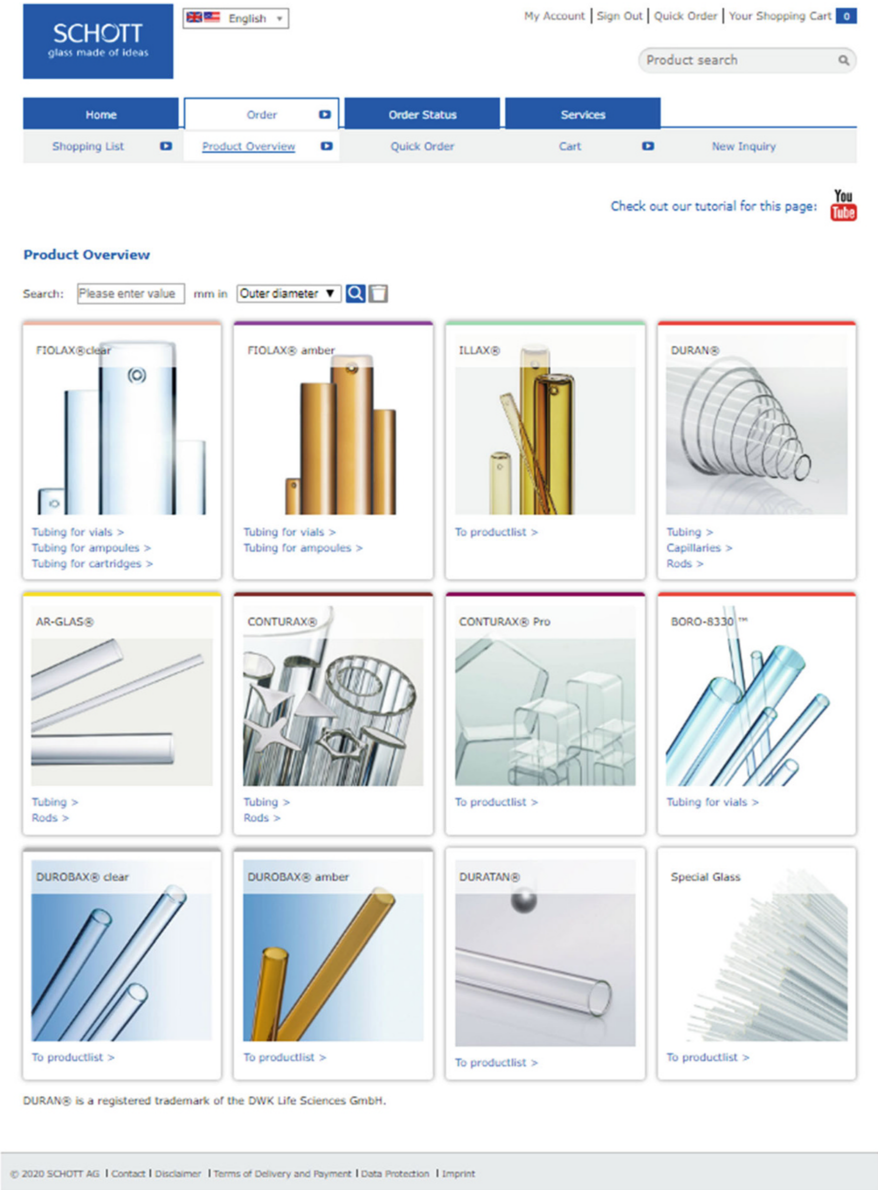

Fig. 1 SCHOTT e-commerce shop (June 2020)

3 Action Taken

To embark on digital opportunity exploration and develop new digital services, SCHOTT Tubing set up the digital service innovation project subject to this case. The joint project with the DIL was structured along with an iterative design thinking approach (Liedtka 2014; Tschimmel 2012; Kolko 2015) as illustrated in Fig. 2. For example, central principles of design thinking, such as customer centricity or interdisciplinarity, were applied throughout the project (Brown 2008; Brown and Katz 2011). Following the idea of Cooper (1990), design thinking elements were considered as stages, and assessments were implemented as gates to filter the most promising ideas at two points throughout the project. Therefore, the design thinking process (Thoring and Müller 2011) was iteratively arranged and formed a stage-gate approach with two main phases (Fig. 1). In the first phase, knowledge about SCHOTT Tubing's business model was gathered, and existing digital initiatives

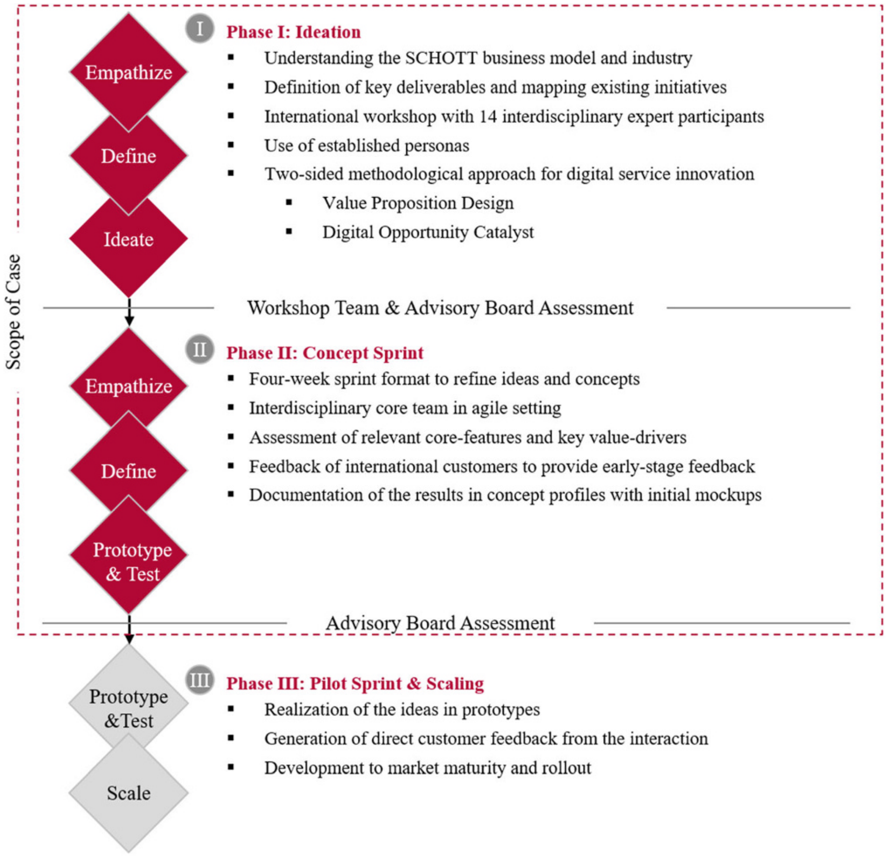

Fig. 2 Digital service innovation approach

were mapped. This first phase ended with a 2-day international and interdisciplinary workshop ideating on new ideas for digital services.

Within the second phase, the concept sprint, five selected ideas were further conceptualized and pre-evaluated. Unusual for the B2B context, this project involved customers in very early innovation phases to challenge customers' added value at an early stage (von Hippel 2009). Thus, this project follows Leavy's (2012) approach, which combines design thinking practices with the concept of co-creation. To do so, interviews with multiple customers from different markets were conducted in the concept phase. The responses were aggregated and built, together with each idea's concept profile, the basis for a second selection gate. Throughout the project, the key aspects of innovation (i.e., *feasibility*, *desirability*, and *viability*) suggested by Brown and Katz (2009) served as focal lenses on the work results. These aspects also served as guidelines for the Advisory Board's decision. According to the design thinking approach, a third phase concentrating on prototyping and maturing the ideas is conducted by the responsible departments at SCHOTT Tubing.

3.1 Phase 1: Ideation on Digital Service Innovation

In the first phase, the objective was to understand the business model and industry of SCHOTT Tubing, existing digital initiatives, and so far unused digitalization potentials to gain an utmost holistic picture. Subsequently, secondary research on the tubing industry was conducted, which included innovative e-commerce approaches, scientific publications, and studies. Underpinned with these investigations, a two-sided ideation workshop, including international participants that stemmed from diverse business areas within the Tubing segment, was prepared. Thereby, the participants' heterogeneity allowed to include various perspectives and stakeholder opinions into the ideation process.

Providing exemplary cases on how digital is changing the world and specifically the role of B2C incumbents in many business areas due to blurring company-customer and industry boundaries build the motivational background for the first workshop day. However, B2B incumbents face similar challenges due to more digitalized processes, products, and services. Thus the following steps aimed to thrive SCHOTT Tubing with a structured ideation approach to effectively identify and leverage digital opportunities based on key trends driven by digital technologies. To take advantage of these opportunities, there are two central starting points. On the one hand, innovation can be approached from a problem-oriented perspective that puts customers' needs and demands in the foreground. On the other hand, especially incumbents can use their established resource base to catalyze innovations. This case deals with a combined approach and straightforward customer-oriented elements to enhance exploration in the context of SCHOTT Tubing.

A well-established method to structure and design business models is the *Business Model Canvas* (Osterwalder and Pigneur 2010). Thereby, we predominantly focused on the value proposition part in the workshop using the *Value Proposition*

Design (VPD) (Kyhnau and Nielsen 2015; Osterwalder et al. 2014). The VPD stimulates the development of innovation ideas by focusing on customer needs, which are considered in the categories "customer jobs," "pains," and "gains." This customer perspective is matched with the existing value proposition and enables the identification of unaddressed customer needs, so-called value gaps. To further emphasize the customer's gains, pains, and jobs, we used the established persona concept. The used personas were provided by SCHOTT Tubing's marketing and elaborated on earlier projects based on empirical data.

Consecutively value gaps, i.e., customer needs unmatched by SCHOTT Tubing's value proposition, were identified. Based on the identified value gaps, ideas were elaborated to match the unaddressed needs. An idea template was used to visualize the key characteristics of each idea. At the end of each workshop day, the workshop participants could evaluate the ideas developed. Participants could score points for particularly good ideas in the category's overall value, feasibility, and value for the buyer persona. This crowd assessment was later used as decision-making support for the Advisory Board.

As an addition and counterpart to solely problem-oriented models, we proposed a resource-oriented approach, called the *digital opportunity catalyst* (DOC) (Oberländer et al. 2021), for the second workshop day. This view's central idea is that explorative transformation focuses on (business) opportunities in contrast to (customer) problems. In this case, the goal is to support an incumbent, SCHOTT Tubing, in developing digital innovations with a structured innovation approach focusing on its resources. The theoretical considerations behind this view state that competitive advantage can be achieved if a company's resource configuration is valuable, rare, imperfectly imitable, and non-substitutable (Barney 1991). Still, resources not only reside within an organization's boundaries, and customers should be considered for determining the value of resources. The DOC, on the one hand, accounts for *internal, shared*, and *external resources* driving digital opportunities (Oberländer et al. 2021). On the other hand, the approach differentiates between the empowerment of existing and the exploration of new value propositions. Figure 3 illustrates the elements of the digital opportunity catalyst.

Questions driving the discussion and idea generation accounted for either one of the proposed six fields of action by the DOC, as shown in Table 1. The workshop participants were again asked to evaluate the elaborated ideas using the DOC according to their overall value, feasibility, and value for the buyer persona.

In total, over 50 ideas for digital innovations were developed under the usage of both innovation approaches. Ideas that either already existed or did not address digital services were sorted out. At the end of each workshop day, the most promising ideas were pitched, discussed, and evaluated by the whole workshop team. To further guide the open evaluation process with the workshop participants, three categories of assessment were predefined by the project team: overall value, feasibility, and value for the buyer persona. After the two workshop days, a total number of 24 ideas remained to be the most promising.

To pass the first gate in the project's innovation process, an interdisciplinary Advisory Board was convened at the management level. The Advisory Board

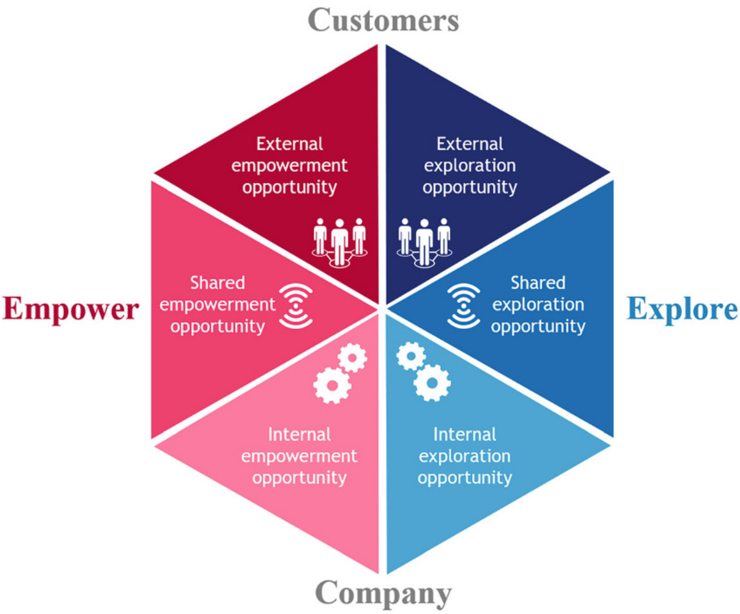

Fig. 3 Digital opportunity catalyst

Table 1 DOC fields of action

DOC fields of action	Question
Internal empowerment opportunity	How can you use your internal resources with the help of digital technologies to improve existing value propositions?
Internal exploration opportunity	How about offering your internal resources and capabilities as a service to existing customers?
Shared empowerment opportunity	How could you use link-based knowledge to improve existing value propositions?
Shared exploration opportunity	How could you use link-based knowledge for new existing value propositions?
External empowerment opportunity	How could you link your customers to build a community for better value propositions?
External exploration opportunity	How could you link your customers to build a community for a new value proposition?

condensed competencies valuable for a comprehensive assessment and was thus put in status to decide further. Specifically, the board had the task of reviewing the 24 previously prepared ideas and evaluating them individually using a multi-criteria analysis (i.e., strategic fit, feasibility/viability, willingness to pay, customer's value, differentiation to competitors, level of novelty, difficulty to copy). These criteria represent SCHOTT's operationalization of innovation criteria (i.e., *feasibility, desirability, and viability*) (Brown and Katz 2009). Further individual assessments were made according to which idea would be expected the least to be a product or service of SCHOTT Tubing, serves best to be strategic, and is the personal favorite to stimulate a fruitful discussion. The assessments of the workshop participants were also visualized as decision-making aids. In the meeting, the consolidated, previously submitted assessments of the Advisory Board members were discussed to generate a consensus of five ideas to be pursued further. In sum, an extensive evaluation, including quantitative and qualitative assessment, was used to determine the five most promising ideas for further development as the outcome. The idea range included known digitalization trends from other industries and organization-specific digitalization approaches and niche solutions, primarily focusing on identified customer needs.

3.2 Phase 2: Concept Sprint

To further elaborate on the five selected ideas, a core team consisting of interdisciplinary tandems of SCHOTT experts and DIL employees was appointed for the further course of the second phase. This constellation made it possible to combine a high level of methodological competence with in-depth technical know-how.

While the ideation phase was conducted in presence, the concept sprint phase described in this section was due to the COVID-19 pandemic conducted digitally within the core team using virtual connection tools (Fig. 4). The Concept Sprint phase lasted over 6 weeks in close cooperation with the appointed core team. During the first weeks, the core team was split into three groups to focus on single ideas. This intense collaborative phase aimed to create a concept profile for each of the five

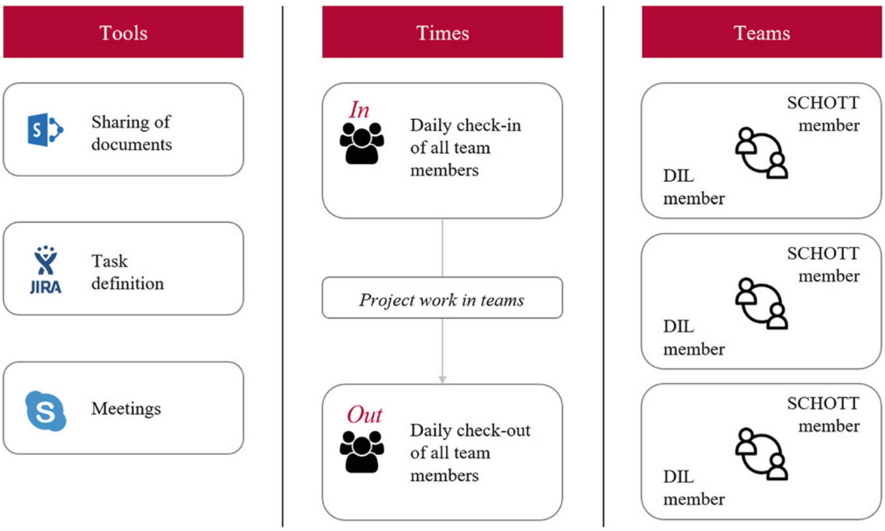

Fig. 4 Remote collaboration setting for innovation

ideas. The concept profiles followed a standardized structure, including a short initial description and a visualization (e.g., by mock-ups). The concept profile combines qualitative and quantitative information on the proposed ideas. It is perceived as a suitable tool to integrate customer's, internal, and market perspectives. Specifically, competency, competition, technology, and customer criteria are considered to gain a holistic picture of digital service innovation ideas. Thus the concept profiles could help to compare the very different ideas based on specific parameters. In the first evaluation, the ideas were challenged by internal expert interviewees and adjusted based on their knowledge of internal use.

Through a multi-perspective approach in a second iteration, the ideas were rigorously challenged and evaluated. This included semi-structured interviews with customers, strategy workshops, weekly alignment meetings within the core team, informal bilateral calls with SCHOTT Tubing experts, and other documentary evidence. Specifically, nine semi-structured interviews were conducted in May 2020, including representatives from eight different countries covering North America, Asia, and Europe. Through the interviews, practical insights were gathered, including valuable feedback to adjust the ideas toward more market conformity. As a result, we developed concept profiles that sum up our findings and create a basis for decision-making. To pass the second gate of the innovation process in the project, the interdisciplinary Advisory Board assessed the five remaining ideas based on the prepared concept profiles, which provided information on the value for the customer, strategic fit, feasibility, willingness to pay, novelty copyability, customer pain points, and required capability. Furthermore, a mock-up visualized the idea, and a spider net diagram consolidated the customer interviews. Based on the qualitative and quantitative information, three ideas were identified to be potentially further developed by internal departments of SCHOTT Tubing.

3.3 Phase 3: Scaling

An integral part of both phases was the steady involvement of all stakeholders, internal (i.e., Advisory Board, experts) and external (i.e., international customers). As an established tool for B2C innovation, customer integration also performed well in the context of SCHOTT Tubing. Therefore, the integration of customers in the early stages of the innovation process marked a novelty in this sector and generated valuable insights. Not only were the customers willing to share their knowledge, but they were even excited to be involved in the process. With its focus on effective exploration, the scope of the digital service innovation project ended with the second gate of the project process. Three of the ideas that had been further elaborated in the concept sprint and tested with customers were handed over to the responsible departments at SCHOTT Tubing to develop more sophisticated prototypes and scale them to market maturity. This phase is the starting point for SCHOTT Tubing's development processes to turn ideas that have already been validated into high-quality digital solutions.

4 Results Achieved

Two central results could be achieved in the digital service innovation project. On the one hand, the process flow of the project reflected an idea tunnel, which made it possible to enrich ideas with information further and to continuously reduce the number of ideas at the same time in a structured way. Thereby agile approaches and innovation methods could be applied and arranged in a practical process. On the other hand, innovative ideas developed also represent a central result of this project. In the following, these two results will be presented in more detail. As illustrated in Fig. 5, an initial ideation phase to boost the number of ideas was followed by a cascadation to crunch down the number and focus resources on the most promising ideas.

Both applied ideation approaches committed about equally to the idea generation of the workshop participants. Thereby, each approach was methodologically supported by various creativity techniques such as brainwriting. Starting with over 50 ideas after the ideation workshop, applying the two-sided approach, a crowd assessment of the workshop participants was conducted after each workshop day to evaluate the ideas according to three categories (i.e., overall value, feasibility, value for persona). Thus, 24 ideas were received as the most promising by the workshop participants. The workshop participants' assessments were also visualized as decision-making aids to be further considered by the first advisory meeting. Thereby, the Advisory Board's international and interdisciplinary setting was certainly of value to identify the most promising ideas due to market peculiarities in the field of digital service offerings. The Advisory Board assessed the remaining 24 ideas using an multi-criteria analysis shown in Table 2. The analysis comprised decision-making areas that enabled a pervading analysis of the proposed ideas. The Advisory Board identified five ideas to have the potential for further in-depth development.

As previously mentioned for the in-depth concept development, a core team consisting of interdisciplinary tandems of SCHOTT experts and DIL employees were appointed for the project's further course. Valuable insights on the ideas were collected from SCHOTT Tubing's internal experts and customers through interviews. The elaborated concept profiles and the feedback from customers built the foundation for the second Advisory Board meeting, which was attended equally to the first one. Besides, the ideas were rigorously assessed according to their

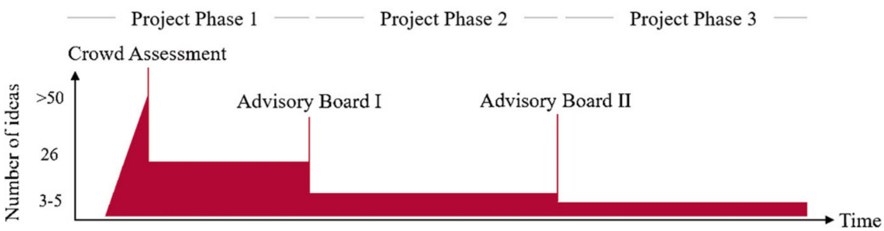

Fig. 5 Idea funnel

Table 2 Multi-criteria analysis for advisory board

Criteria	Factor in %
Strategic fit	10
Feasibility/viability	15
Willingness to pay	5
Direct customer value	20
Downstream customer value	10
Differentiation potential	15
Novelty of idea	5
Copyability	20

Table 3 Digital service ideas in concept sprint

					
Idea	Idea 1	Idea 2	Idea 3	Idea 4	Idea 5
Technology-base	Digital Learning	E-commerce Marketplace	Augmented Reality	Cyber-physical systems	Tracking and tracing
Anticipated benefit	Time- and location-independent transfer of high-quality content	Extension of the existing e-commerce competence to further product areas	Augmented reality may enable new service concepts by real-time interaction	Direct connection of the physical product with relevant digital information	Optimization of logistical planning through more precise information on the progress of shipments
Method	Problem-oriented	Resource-oriented	Problem-oriented	Problem-oriented	Problem-oriented

innovation value, strategic value, and cost-value relation in the meeting. In the second Advisory Board meeting, three ideas (Idea 1, Idea 4, and Idea 5) were prioritized (Table 3).

Additionally, we retrieved information on the Excitement ("Does the service excite the customer?") and Novelty ("How novel is the idea to the customer?") factors of each idea through the customer interviews and conducted a Kano analysis (Tontini 2007). The results from the Kano analysis showed—under the high level of satisfaction with the current processes—that most of the potential improvements based on digital technologies fall into the category of performance needs (Fig. 6 Kano model) (Berger et al. 1993; Matzler and Hinterhuber 1998). This includes "Idea 1," "Idea 4," and "Idea 5." While "Idea 2" is currently perceived as a basic need, according to customers, this potential improvement would diminish established supplier relationships. The "Idea 3" incorporates an attractive and not expected service offering to customers and thus falls into the category of delighters.

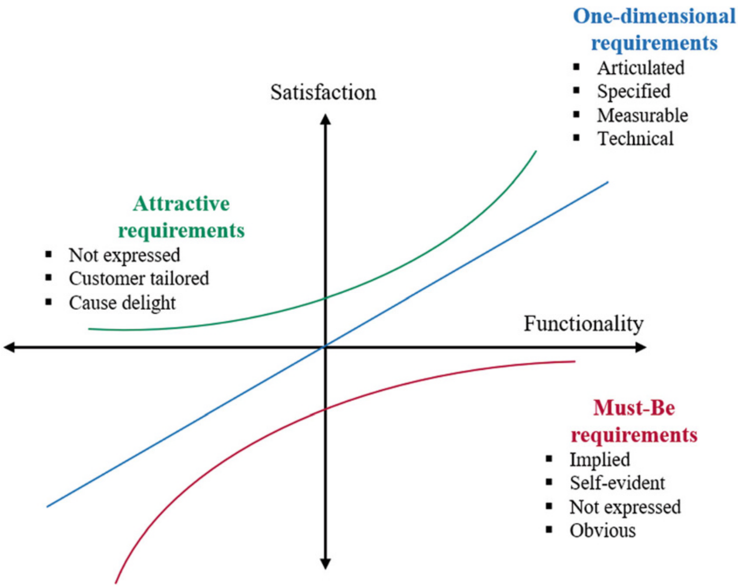

Fig. 6 Kano model

Besides the Kano analysis, we gained insights on the factors Willingness to Pay ("How much is the customer willing to pay for the service?") and Daily Value ("How much value does the service create for the customer's business?"). We aggregated the customer interviews' results into a customer value assessment (Homburg et al. 2009). The value assessment revealed that "Idea 1," "Idea 4," and "Idea 5" were perceived as successful differentiators, including a high-value offering and value perception by the proposed ideas (Fig. 7). "Idea 3" in comparison suffers in terms of value perception and ranges in a hybrid stadium between successful differentiators and value destroyers. Accordingly, to the Kano analysis, "Idea 2" can be characterized as a successful minimizer with low value perception and value offering. This is partially due to the skepticism customers have about the market dominance of SCHOTT Tubing.

Overall, customers were delighted to exchange views and had a high willingness to give detailed comments on the ideas and specific thoughts for improvement, which took the managers by surprise. Thus, keeping the customers in the loop will enhance the final project outcome. The project favors the approach for more integration of the customer's point of view (problem-oriented) into the overall digital initiative, which is also rewarded by the management decision on further developing ideas rooting in this approach.

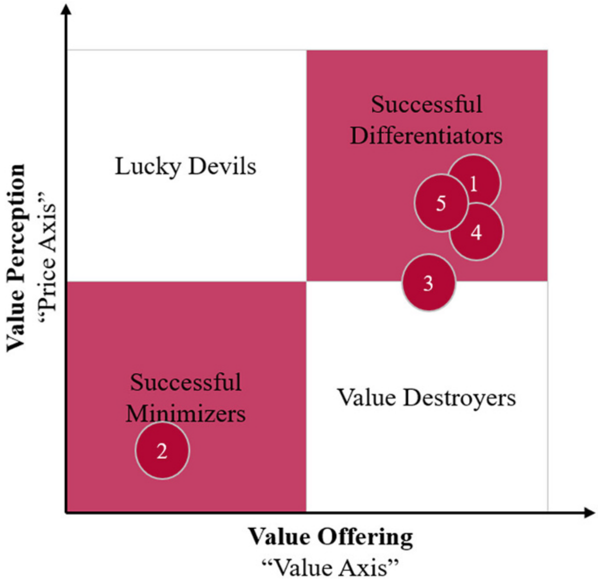

Fig. 7 Value map for digital service ideas

5 Lessons Learned

The two-sided approach of SCHOTT Tubing to develop digital opportunities entailed several learnings. First of all, the project represented a novelty since SCHOTT Tubing involved customers in this innovation project at an early stage. The well-known concept of customer integration and co-creation from B2C markets also poses an ever-increasing success factor for B2B manufacturing companies (Abrell et al. 2016). In the course of the project, we were also able to notice that customers also valued the close involvement in early innovation phases. The possibility of active participation in the design process for digital solutions was received very positively, and valuable input could already be incorporated in these services' early concepts. However, in the exchange with the customers, other lessons were learned in the project. In the case of SCHOTT Tubing, it was particularly valuable to establish digital services expectations based on customer feedback. It became clear that customers truly valued SCHOTT Tubing for their premium quality products. Against the background of the consistently high product quality, customers associate expectations with SCHOTT Tubing. Thus, digital services were also subject to these expectations. Discussing these expectations with customers in the early stages of innovation proved to be particularly valuable to achieve a high implementation quality later on.

Furthermore, the close exchange with customers revealed that industry peculiarities also play a role in digital solutions. SCHOTT Tubing's idea of expanding its e-commerce solution to include consumer goods initially appeared to be a precious idea to simplify customers' lives. However, during the early customer interaction, it

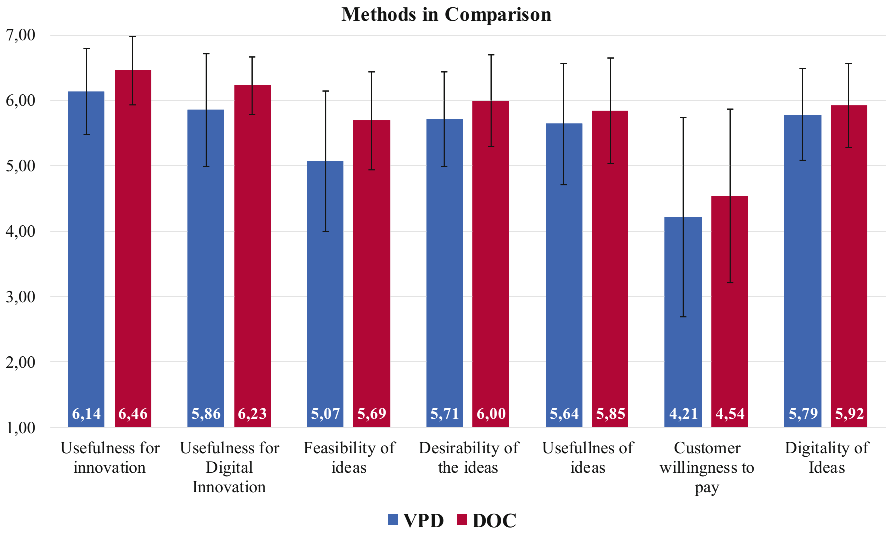

Fig. 8 Results from empirical data

became apparent that SCHOTT Tubing as part of the SCHOTT Group was perceived as a strong player in the industry anyway. Against this background, the solution envisaged by SCHOTT Tubing would not be accepted by customers, as there were dependency concerns. Another essential learning received through customer interaction was to focus on core competencies within digital services elaboration. SCHOTT Tubing is highly valued by its customers for its glass expertise and has therefore been able to establish itself as a premium manufacturer. New digital services should support this perception and not destroy the presumption of competence. Digital initiatives should, therefore, present a consistent picture together with the traditional business model to create synergies between the digital and analog worlds.

The case also provided interesting insights on a methodological level. The case discusses the idea to approach innovation from two different perspectives. Besides the very established, problem-oriented value proposition design that puts customer's jobs, gains, and pains in focus, a resource-oriented approach stimulated innovation through the novel use and combination of existing resources.

Nevertheless, these methods are mainly well established in the B2C context. To evaluate the performance of both applied methods in the B2B context, empirical data was collected in field observations, and all workshop participants filled out multiple surveys. A 7-point Likert scale was used to assess the 14 participants' agreement and disagreement with different items (Rahi 2017). For both methods, the same surveys were completed at the same time as the workshops. On the one hand, the survey addressed the general usefulness of the method for developing digital innovation. On the other hand, the performance of generated ideas was assessed in different dimensions. The mean values of the different items for both methods are depicted in Fig. 8.

Despite the small sample of 14 workshop participants, it can be seen that both methods achieved a high level of agreement regarding their usefulness for the development of innovations in the context of digital services. The DOC is seen as slightly more useful for the development of both classical innovations and digital innovations. Nevertheless, it is noticeable that both methods show a clear tendency to lack the willingness to pay for innovations developed with them. Yet, especially pricing and willingness to pay for digital services confront B2B contexts with major challenges (Docters et al. 2011).

Furthermore, the standard deviations indicate that the assessment of the DOC was less scattered across the participants. For all assessed metrics, the DOC achieved higher values with less variance. From this, it can be concluded that the DOC can be considered suitable for an application in the B2B context, as the method and its outcomes seem to be more tangible and predictable for the practitioners. On the contrary, only one of the selected ideas for the second innovation phase was generated using the resource-oriented approach. We conclude that the usefulness of the ideas developed with the DOC, as perceived by the workshop participants, was not shared by the Advisory Board. Based on our observations, ideas based on the resource-oriented approach often seem to be very tangible and highly feasible in the early stages of innovation. Ideas developed in this approach are based on already existing resources that are used in a novel way. Thus, the idea started with a high focus on existing elements and established concepts, which are only compared with actual customer problems during further processing. The feasibility is also more scrutinized with increasing knowledge build-up and iterative experiences.

In contrast, problem-oriented approaches primarily focus on customer needs and challenge them. Therefore, this approach offers the possibility of working in a non-solution-oriented way, especially in the early innovation phases. The solution to the question “What does the customer need?” is addressed without the help of established concepts and resources. Therefore, participants cannot lean on these resources and start far from existing solutions. The participant’s referral to established, well-known resources might cause the perception that the resource-based approach might induce more stable, innovative solutions in early phases. It builds on existing strengths and is very tangible. Yet, the subjectively perceived innovation potential decreases with this approach, the more information is available.

Overall, we consider the combination of both approaches to be promising for both practice and research. While problem-centered approaches allow an effective focus on actual and relevant customer problems in early phases, resource-centered approaches can efficiently support the use of existing resources to solve these problems in a targeted manner. Combining these approaches effectively and using them in synergy provide a high potential for research and application in practice.

Nonetheless, the findings of this case study are subject to some limitations. First, our observations are limited to small sample size in the digital services innovation project’s specific context. Second, the sequential arrangement of the methods over two workshop days entails dependencies that affect the methods’ performance and results. For example, it could be that the most apparent innovation ideas are raised on the first day of the workshop. This might indicate why especially ideas of the VPD method, which was applied on the first day, survived the first Advisory Board assessment.

To sum up, this case provides insights into a two-sided methodological approach to identify digital service innovation opportunities. SCHOTT Tubing, acting in the sense of ambition, changed how to approach innovation in the glass industry by synergetically using problem- and resource-oriented methods and integrating early-stage customer involvement to catalyze the innovation process.

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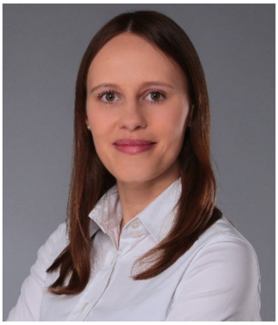

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LOHMAR | DIGITAL | FOR EVERYONE

The Development Process of a Digital Transformation Strategy and Its Fields of Action in Lohmar

Cindy Schaefer, Kristina Lemmer, Stephan Weber, Philipp Kukula, and Bjoern Niehaves

Abstract

(a) **Situation faced**: As a city of generations and living actively in the countryside, Lohmar is a rural municipality on the outskirts of Cologne and Bonn in Germany. According to Lohmar's slogan "Lohmar | Digital | For everyone", Lohmar aims to actively shape its digital future. This paper is not only focusing on the development of a digital transformation strategy but also on the challenges Lohmar faces in the field of mobility. Lohmar is facing a high level of commuter traffic with only a low utilization of 1.2 persons per car, due to the car as the main transportation vehicle.

(b) **Action taken**: To face its challenges, the city of Lohmar began developing a digital transformation strategy. With the involvement of various stakeholders, Lohmar developed its own online platform where citizens could share ideas on the digital transformation strategy and its projects. Thus, the fields of action administration, education, mobility, and entrepreneurship occurred. In the field of mobility, ideas emerged for organizing commuter traffic, with a focus on the idea of a dedicated smart mobility hub that combines multimodal mobility systems. With this idea, Lohmar responded to the smart cities call by the Federal Ministry of the Interior, for Construction and Home Affairs (BMI).

(c) **Results achieved**: By developing a digital transformation strategy in Lohmar, the city prioritized the topic of digital transformation in all areas of its municipality. With the engagement of different stakeholders and various citizens, Lohmar succeeded to make digital transformation processes omnipresent, through implementing a change management process. In different workshops,

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Lohmar encouraged its citizens and employees to rethink digital transformation processes supporting ideas, especially regarding commuters' challenges. Based on this, Lohmar was able to submit the project proposal of RBS.Mobil, multimodal mobility concept in the affluent suburbs of Cologne and Bonn creating a network for mobility, which is now being funded.

(d) **Lessons learned**: In its process of developing an own digital transformation strategy and submitting a project proposal for a smart multimodal mobility hub with the focus on commuters' traffic, Lohmar achieved six lessons learned, which can help municipalities facing comparable challenges (e.g., a strategic roadmap into a digital future, commuter traffic in a rural area). Lohmar's six lessons learned are described as followed: First, digital transformation is a joint task! Second, digital transformation processes need competences! Third, digital transformation processes need responsibilities! Fourth, learn from other municipalities! Fifth, there is always more than one solution! Sixth, asking for help improves your actions!

1 Introduction

Lohmar is a rural municipality in the outskirts of Cologne and Bonn. It lies between the river "Agger", with the "Wahner" heather in the west and the "Naafbachtal" nature reserve in the east. This explains the city's name, as "loh" stands for forest (nature reserve) and "mar" for waters (Agger). For its approximately 30,000 inhabitants (Table 1), the city of Lohmar wants to be and remains attractive and worth living in. For Lohmar, this can only be achieved in combination with digitization, as

Table 1 Key facts about the city of Lohmar (interviews with the CDO and MM of Lohmar)

Key facts		
Citizen	30,453*	
City area	6562 ha	
Recreational/forest area	158 ha (2.4%)/2100 ha (32%)	
Cycle way	122 km	
Employees of Lohmar	354 (160 IT)*	
Modal split	Private motor vehicle	68%
	Public transport	9%
	Walking/cycling	23%
Commuter	To Lohmar 4787 Out Lohmar 9379 Δ: 4592**	
Noise level (proportion of citizens who are exposed to noise levels above 65 dB)	Day 5.3% Night 11.47%	

*31.12.2019; **2017

the mayor Horst Krybus sees this as an essential part of the future and would like to transfer this to Lohmar as early as possible. That is why Lohmar has set itself an overriding objective: "Lohmar | Digital | For everyone" (Stadt Lohmar 2020).

This objective shall be achieved with four defined fields of actions, which were developed within the framework of Lohmar's digital transformation strategy 2025 (see Fig. 2).[1] Those fields of action are described as Digitally close (administration)! Digitally smart on the move (mobility)! Digital learning (education)! Digital into the future (entrepreneurship)! (Stadt Lohmar 2020), which we will be discussed in Chap. 3.

The administrative employees of the city of Lohmar are working together to achieve the objectives of the four fields of action defined in their digital transformation strategy: administration, mobility, education, and entrepreneurship. Even in times of the COVID-19 crises, when digital transformation became an integral part of all areas of administration, the employees did not ignore the objectives of the four fields of action. In the field of mobility, for example, Lohmar submitted an application for the "Smart Cities made in Germany" call by the Federal Ministry of the Interior (BMI), namely, "Rhenish.Bergish.Smart.Mobil" (RBS.Mobil), in spring 2020. The application was reviewed during the year and finally approved at the end of 2020. The realization of RBS.Mobil is scheduled to begin in spring 2021. In this article, we will take a closer look at the digital transformation strategy on the basis of RBS.Mobil and then take a closer look at RBS.Mobil itself.

This article is structured as follows. First, we will give an overview of the situation faced in Lohmar and will answer the questions of the reasons for a development of a digital transformation strategy. Second, we will show which actions were taken to (a) develop a digital transformation strategy and (b) develop the smart mobility concept of Lohmar. In this third chapter, we will also present the RBS.Mobil project. In Chap. 4, we will show the results which were achieved by Lohmar during both processes and will give an overview over lessons learned in our last chapter.

2 Situation Faced

Lohmar sees its countryside as an advantage. Rather, Lohmar wants to use this aspect as an advantage to emphasize its naturalness and attractiveness, especially in times when environment and sustainability are political issues. Lohmar's mayor Horst Krybus summarizes Lohmar's attractiveness as follows:

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[1]As researchers from the University of Siegen accompanied the development process of Lohmar's digital transformation strategy and the project proposal, a lot of data and information regarding Lohmar were collected during the workshops and interviews with the mayor, chief digital officer, the mobility manager, various employees, and citizens of Lohmar. We therefore inform the reader about the most important references used and want to apologize for missing references due to knowledge from interviews and workshops.

> The versatile offer of Lohmar's business and service world leaves barely any wish unfulfilled, as Lohmar is not only extremely attractive as a family-friendly city in the countryside, but also as a business location. This is due to, first, Lohmar's geographical advantages, such as the favorable transport links between Cologne and Bonn, and second, due to the future oriented urban development, which makes Lohmar a modern city with a high quality of life.

However, the problems of rural areas and specific problems of Lohmar cannot be eliminated by this—they have to be tackled much rather actively. In the following, we present the problems of the four fields of action (see Fig. 2) in more detail, whereby we will focus more on the field of mobility.

Administration With the increasing use of new technologies (e.g., mobile devices such as smartphones or tablets), the daily work habits of administrative staff must adapt to the demands of citizens. Citizens using mobile devices expect municipalities and their administrations to provide services that can be used anywhere and at any time. German municipalities are not ready yet to respond to these demands from citizens. Often, administrative tasks in the municipalities can only be completed when appointments are organized which have to be attended in person (e.g., passport renewal, or re-registration after moving). Simply organizing the framework conditions to provide the actual service requires time and human resources on both sides, on the part of the citizens and on the part of the municipalities. Another problem is that digital skills are lacking. On the one hand, the administrative staff of the municipalities must build up competencies for using digital services. The employees need to understand their processes in order to redesign them for digital use. They also require an understanding of what is technically possible to bridge the gap between their offered services and the administrative organization and the citizens' perspective on the use of the offered services. Citizens, on the other hand, need an understanding of the services available and user-friendly interfaces. Especially for smaller cities like Lohmar, building digital competencies for online service delivery is a key challenge.

Education Digitization is advancing further and faster, which is why continuous adaptation is important. No citizens should be forgotten in this process, independent of age. In the school sector, this means that schoolchildren must be prepared and possible for their future professions. These days, this also includes digital skills. However, some schools in Lohmar are not up to date with the latest technology. There is a lack of basic equipment and implementation possibilities. For example, the broadband connection is not sufficient for the new requirements, and new cables have to be laid. In addition, the skills of the older teachers are no longer up to date, and there is a need for further training. Another example is that schoolchildren are not given enough space for individual self-discovery in the form of offers, study groups, and special rooms. The German government's digital pact could help here. However, this is limited to €25,000 per school, whereby the monetary funding is not aligned to the number of schoolchildren per school and the type of school; thus, the city has to help out. Besides digitalization of schools, older citizens should also be included in the digitalization process. The main issue here is to make the new options and services easy to understand in order to ensure access. Especially in a rural region like Lohmar, access and the technical equipment must be operable independently.

Mobility Due to its rural location between Bonn and Cologne, a problem of Lohmar is that only a few employees work in the urban area of Lohmar. The majority (30%) commutes to regional centers, resulting in a high level of commuter traffic. Especially in the morning and evening hours, this leads to a high traffic volume and congestion, reinforced again by the low occupancy rate of cars, which are only occupied by an average of 1.2 persons per car. Since the main means of transport in Lohmar is car (the motorized individual traffic in Lohmar amounts to 68%), this leads to the consequence of a high load on the main traffic axes in the form of high emissions, congestion times, high noise pollution, and traffic accidents. One reason for the prioritized use of the car is the rural location of Lohmar, which means long distances within the urban area of Lohmar. There is simply a lack of possibilities to get from destination A to B without a car. The increasing number of inhabitants in the Rhein-Sieg district and thus also in Lohmar will further intensify this problem. The local public transport system does not provide a remedy, since on the one hand the lack of use by the citizens does not allow for an expansion and on the other hand the connection by a train line in the center of Lohmar is not available. This is a circular problem and must be actively interrupted. The first step here is the RBS. Mobil project. In summary, all the problems in the first and last mile bundle up to be solved.

Entrepreneurship In addition to the abovementioned problem of workers commuting to surrounding major centers, the lack of innovation in the direction of the future is also a disadvantage for Lohmar as a location for companies to settle there. There is a lack of area-wide broadband coverage, especially in the old industrial areas, that innovation and progress is feasible here. Actually, the location on the A3 highway offers many companies a locational advantage, but this is not being used. For this reason, the city of Lohmar sees an enormous potential here and would like to make Lohmar attractive as a business and work location.

The city of Lohmar actively tackles these problems and wants to be modern, open minded, and attractive for young people and families as well as for senior citizens (Stadt Lohmar 2020). Therefore, Lohmar has set itself the goals to overcome its challenges by implementing the measures from the digital transformation strategy in the fields of action: Administration, Education, Mobility, and Entrepreneurship. The implementation measures are presented in more detail in Chap. 3.

3 Action Taken

We divided this chapter into two parts. Part A describes the origins of the digital transformation strategy and its necessity, as well as the result. Part B describes the actions in the field of mobility (third field of action of the digital transformation strategy—marked in green; see Fig. 2) in more detail. Here we give an insight into the implementation plans of RBS.Mobil, which is funded by the BMI and will be realized from spring 2021.

(A) Development of a Digital Transformation Strategy for Lohmar 2025 Lohmar, as well as other cities, started early with their own digital transformation (Mergel et al. 2019). Aligned to Mergel et al. (2019), we use the term of digital transformation as it describes emphasizing "the cultural, organizational, and relational changes" and moreover the digital transformation as "more comprehensive than the mere digitization of processes and services" in this paper (Mergel et al. 2019). According to comparable cities in size, Lohmar started to digitize different services in the first step. With the current political movement and the German governmental pressure of getting all citizen services digital (Stockmeier and Hunnius 2018), Lohmar started to develop their own digital transformation strategy in order to transform itself digitally in a structured way (Bharadwaj et al. 2013b; Bharadwaj et al. 2013a; Matt et al. 2015; Hess et al. 2016; Roeding 2019; Roeding et al. 2019). Therefore, Lohmar's aim is to set their roadmap for the digital age developing and implementing a digital transformation strategy.

The overall process for developing the digital transformation strategy of the city of Lohmar (see Fig. 1) is managed by the mayor's office and the chief digital officer (CDO), with close coordination with the Executive Board. To set the right path toward a digital transformation strategy and the process of developing the strategy, researchers from the University of Siegen were invited to moderate workshops regarding their development of a digital transformation strategy. To monitor the strategic path planned in the strategy, a project management office (PMO) was established, led by the CDO. To manage the communication of Lohmar's digital transformation strategy, Lohmar enabled different teams and services to engage with citizens. For example, Lohmar introduced a social media team to communicate news and services to citizens. It also developed an online platform for citizens to share, ask for, and help shape project ideas around Lohmar's digital transformation strategy. These two services, for example, have helped to support citizen participation and the progress of digital processes around the city of Lohmar.

Looking closely at the development process of Lohmar's digital transformation strategy, the development of the strategy was closely aligned to the four structural features of digital transformation strategies found by Niehaves et al. (2018, 2019) always considering the Information Systems (IS) perspective. The four structural elements inhibit strategic alignment, strategy formulation, core themes, and fields of action (Niehaves et al. 2018; Niehaves et al. 2019). Lohmar decided to develop a visionary strategy starting first with a brief description of their vision and aims, followed by defining core themes and fields of action with a set action plan of projects. First, aligned with other strategies, the process of developing Lohmar's digital transformation strategy was designed to combine bottom-up processes with top-down development. Therefore, following previous regional strategies, the development of the strategy/vision was done through a multi-step process of a mix of different workshops combined with the opportunity to engage in an online tool to develop digital projects for the digital transformation strategy. In sum, eight

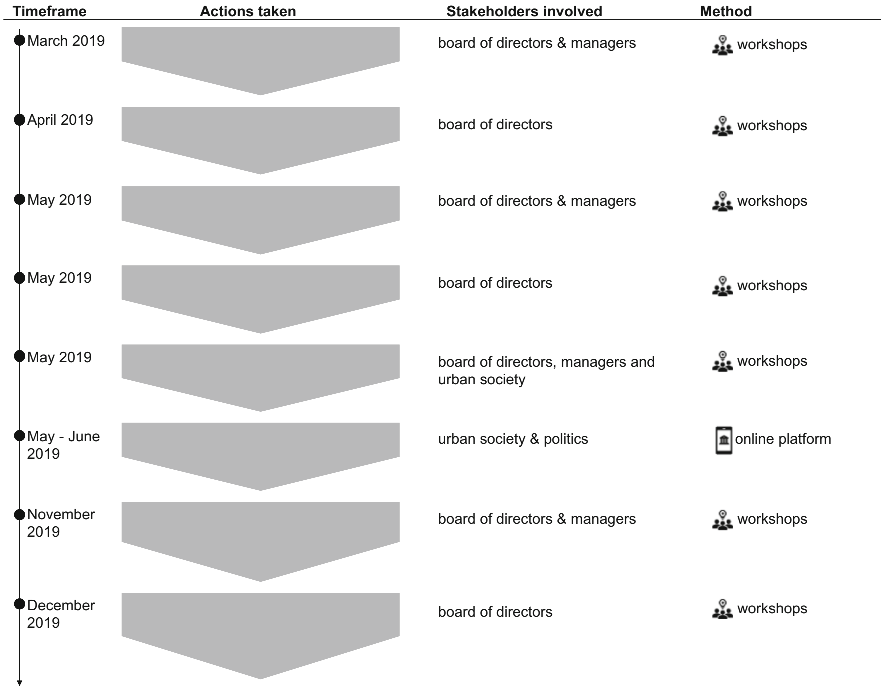

Fig. 1 Development of the digital transformation strategy

workshops with a variety of different stakeholders were conducted to develop the strategy. These workshops took place from March to December 2019 and included different workshop methods as round tables, world cafés, expert interviews, etc.

The first workshop contained the development of digital competences. Moderated by researchers from the University of Siegen, who provided support during the development process of Lohmar's digital transformation strategy, a workshop for all managers of the city of Lohmar was organized. The main topics discussed were "Digital Transformation: How can a future-proof administration be designed with digitization?", "Digital Leadership: How does leadership change in a digitized working environment?", "Digital City: How does digitization change the public space?", "Acceptance and digitization: What are the current and future drivers and obstacles with regard to municipal digitization (internal and external) and how can they be countered?", and "Special issues: What are the effects of digitization in other areas of the city outside the (core) municipal sphere?". It always started with a presentation giving theoretical background to the topics building digital competences with the managers. In the second step, group discussions and tasks were organized, helping to apply the learned content.

In a second workshop (April 2019), the vision, core themes, and fields of action for Lohmar's strategy were developed. Together with employees from the University of Siegen, the Executive Board, and the CDO, a first draft of the digitization

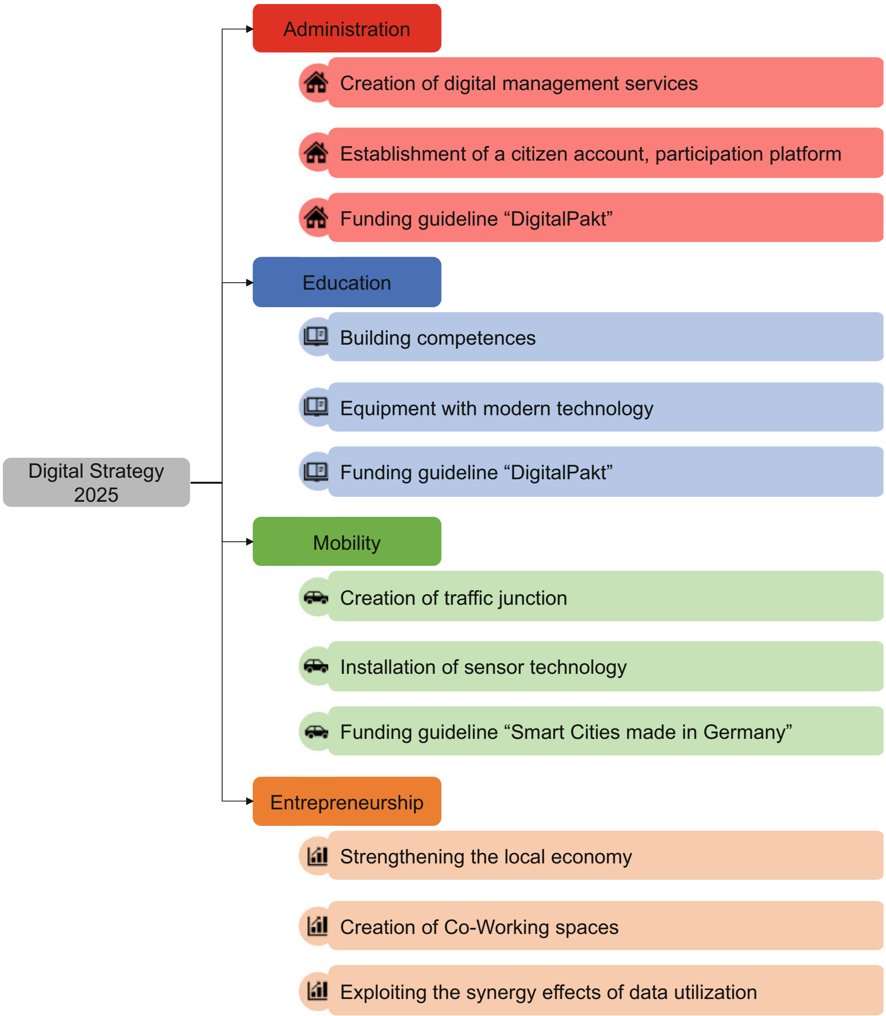

Fig. 2 Core themes and fields of action of Lohmars’ digital transformation strategy 2025

strategy, aligned to previous regional strategies, was developed (addressing structural features strategic alignment, strategy formulation, core themes, and fields of action).

The third workshop was conducted to further develop the vision. The draft of the vision was presented to all executives of the city of Lohmar. The managers were asked for feedback based on the following guiding questions: regarding clarity/comprehensibility (How do you evaluate the framework of the vision? Is there a direction resulting from it?); focusing motivation (Does the vision motivate you to participate in future digital developments?); and looking at participation (Please take the perspective of different stakeholders from politics and business—can you find yourself in the vision?). Afterwards their suggestions were incorporated into the vision.

In May 2019, a fourth workshop was developed, where the urban society was invited to help shape the digital future of the city. After a draft of the strategy was presented by the CDO, citizens were able to develop initial projects for each of the four defined fields of action at four thematic round tables, using the world café method.

A fifth workshop was initiated to actively involve politicians in the development of the strategy and its projects. In this workshop, members of the University of Siegen firstly presented an introduction of Lohmar's developed strategy. This was followed by a presentation of the strategy by the Lohmar's CDO and a presentation of the projects from the workshop with the urban society. After the presentations took place, politicians were asked to complement the strategy and projects.

In June 2019, a workshop focusing on the projects of Lohmar's digital transformation strategy took place. For this workshop, the executives of the city of Lohmar were asked to work out further projects together with the University of Siegen. These ideas were presented to the urban society using an online platform. Subsequently, citizens had the possibility to engage in these projects via the online tool and to present their ideas.

In July 2019, the resolution of the vision in the council took place. After the summer break, the ideas from the urban society were collected and again sorted. Once all the ideas and comments from the urban community on their project ideas had been implemented, measures for implementing the projects were drawn up by the management, the University of Siegen, and the urban community in a final workshop in November 2019.

In a last step, the digital transformation strategy of Lohmar was designed and presented to the council aligned toward Lohmar's design and present documented municipal strategies.

In the following, Lohmar's formulated vision, mission, and strategic aims are presented (Stadt Lohmar 2020): "Lohmar | Digital | for everyone"

Today and in the future, Lohmar is the city of generations and stands for active life in the countryside. We see and we use the chances of digitalization to create noticeable improvements for all local citizens. In Lohmar, we are shaping digitization for each other and work closely with local authorities and other partners. Digital security is our top priority. In 2025, we present ourselves as (Stadt Lohmar 2020):

- **Digitally close!**—Through digitization, we are making the city's services usage easier, faster, and more accessible.
- **Digitally smart on the move!**—With intelligent mobility solutions, we enable people more time and protect the environment.
- **Digital learning!**—By using smart technologies, we make education sustainable for all ages.
- **Digital into the future!**—In Lohmar, we are creating the necessary structures to ensure that entrepreneurial commitment benefits from digitalization.

In the following, the measures from the fields of action administration, education, mobility, and entrepreneurship are presented. The mobility field of action is discussed in more detail in Part B of this chapter.

In the area of administration, a citizen account was set up, which citizens can use to carry out their official business online. In addition, an online participation website was created so that citizens can pass on information directly to the city administration about flickering or broken streetlamps, ailing streets, overfilled garbage bins, illegal waste disposal, etc. or take an active part in new projects and give ideas. The city of Lohmar has presented an urban development concept for 2030, which offers more housing for the growing population. It is expected to be 1400 apartments will be needed by 2030 (Stadt Lohmar 2013).

Finally, it should be mentioned at this point that the city of Lohmar has introduced a job ticket for its core employees, because most of the employees (29%) live within a radius of five kilometers from the municipality. Resulting from this, motorized private transport can be greatly reduced. In the area of education, schools were equipped with digital blackboards, mobile devices, and small robots. In addition, an education day was established. In the area of mobility, Lohmar has adopted a parking space statute in summer 2019, to change the mobility of the residents. With the help of the parking space statutes, it is possible to reduce the number of potential parking spaces or the fees for the replacement of parking spaces by offering mobility measures. Mobility measures can be, for example, the provision of job tickets for tenants or the facilitation of car sharing. The implementation of these measures is aimed primarily at investors, who are realizing (larger) construction projects in Lohmar and can therefore promote sustainable mobility and save (construction) costs. In the area of entrepreneurship, especially the use of different data sources to support startups and companies is discussed.

(B) Development of a Smart Mobility Concept for Lohmar: RBS. Mobil "Digitally smart on the move!" describes the smart way of using modern digital mobility solutions, which enables protection of the environment while allowing its users an optimized transfer regarding time and distances.

To solve the mobility problems described in "Situation faced," the city of Lohmar applied in May 2020 for the project "Smart Cities made in Germany," by the Federal Ministry of the Interior, for Building and Homeland Affairs (BMI) in Germany. Within this project, the BMI supports municipalities that are actively committed to integrated and sustainable urban development in the interest of the common good of the citizens, focusing on digital transformation processes. The values of the Smart City Charta (Bundesinstitut für Bau- Stadt- und Raumforschung and Bundesamt für Bauwesen und Raumordnung 2017) and the areas of a smart city are to be represented in the best possible way. The aim is to make cities in Germany ready for the future by developing strategic, participatory, and integrated approaches that will help all German cities with their digital transformation during the project and after the project ends. Lohmar has laid the foundation for this in its digital transformation strategy described above and can therefore concentrate on the four fields of action. For the application, the service areas Smart Mobility and Smart Environment were the main focus, and the project RBS.Mobil was developed.

After the city of Lohmar decided to focus on mobility, a project consortium was formed consisting of the CDO and the mobility manager (MM) of the city of Lohmar, a digital transformation expert, and a mobility expert. The project consortium has developed a first project idea that meets the requirements of Lohmar and the needs of its citizens.

This project idea was discussed in a joint workshop with the urban society, the city employees, associations, and potential companies from the fields of digital transformation and mobility. However, due to the COVID-19 pandemic, the workshop could not take place in physical presence of everyone; thus, a digital format was chosen. The digital workshop was rated a success and was attended by over 60 participants. For many workshop participants, this was the first digital workshop using different digital tools, like Zoom and Mentimeter. Following the workshop, the project consortium used the impressions and thoughts from the workshop and participants to develop the project idea Rhenish.Bergish.Smart.Mobil (RBS.Mobil).

RBS.Mobil reduces or even solves Lohmar's mobility problems by the means of five smart measures. Measure one is the so-called RBS-IoT platform, shown in the middle layer of Fig. 3. This is intended to be an open-data platform for efficient, integrated data storage and provision, as a basis and interface for the planned applications of the digital transformation strategy, where all data from Lohmar and the surrounding area are fed in. The data platform is intended to be open for all data (e.g., dynamic and static data), and the data is prepared and made available in a standardized and data protection compliant manner. The data platform is also adaptable to future standards and requirements.

Based on this, three RBS.Hubs (measure 2a) will be created at well-situated points in the city area—in Donrath, Pohlhausen, and Siegburg (see top level of Fig. 3). Every hub will embody a focal technology. The first hub will be in Donrath, shown on the left side of the top layer on Fig. 3. Donrath is the area located next to the German A3 highway, which is why the focus here is chosen to be on cars. For example, the multimodal offers like car sharing, carpooling, Park & Ride possibilities, charging infrastructure, etc. are obtained. The second hub will be located in Pohlhausen, shown on the right side of the top layer on Fig. 3. Pohlhausen is an area bordering on the communities of Siegburg and Neunkirchen-Seelscheid. In this place are two main roads (B56 and B507) on which five bus lines are operating. Therefore, the hub with the main focus on buses will be established in Pohlhausen. In this concept, multimodal offers like expanded bus stops and roads, bicycle storage, charging infrastructure, Park & Ride possibilities, etc. are obtained. The third hub will be Siegburg, shown in the middle of the top layer on Fig. 3. At the train station of Siegburg, the hub with the main focus on public transport is located due to the already existing connection of Siegburg to the local and long-distance railway traffic. Multimodal offers in Siegburg are, for example, charging infrastructure, Park & Ride possibilities, car sharing, etc. Additionally, all RBS.Hubs are equipped with bicycle garages and communication units to ensure digital networking using the RBS-IoT platform.

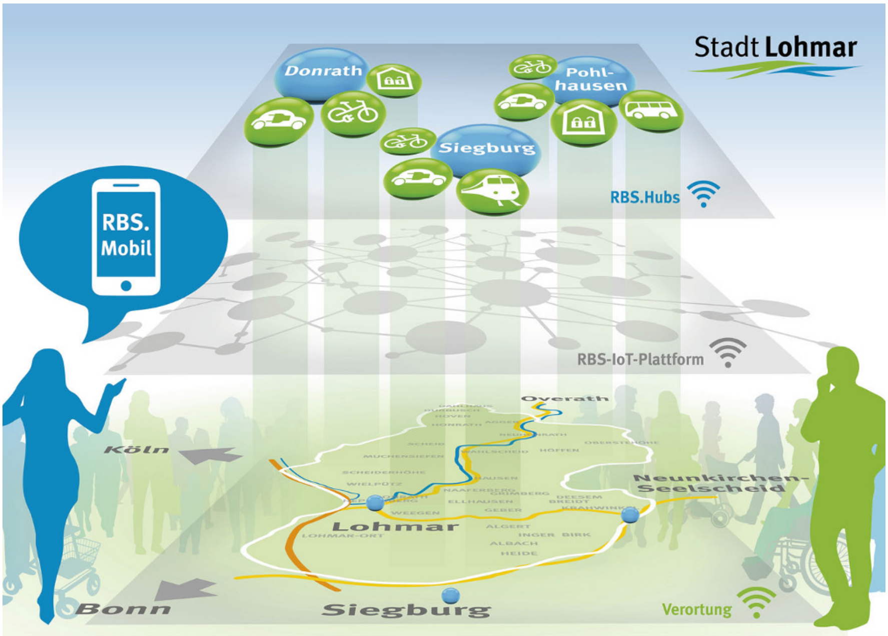

Fig. 3 Overview of RBS.Mobil (City of Lohmar)

Measure 2b is therefore the establishment of a location-based car sharing system (RBS.CarSharing) with mainly electric vehicles and other different types of vehicles (drive and body), shown as a car with plug symbol in Fig. 3. The locations are chosen in a way that they are easily accessible, and a smooth multimodal mobility route is always guaranteed. In addition, the city of Lohmar wants to try out different approaches, such as car sharing in neighborhoods or quarters, cooperatives, use of the municipality's vehicle fleet, or pulsating car sharing, to determine the best approach for the citizens. Access to car sharing will be possible via an app, a RFID card, and analogue booking systems to enable car sharing for both younger and older citizens. The aim of this measure is to enable citizens or families to be without their second car, thus reducing emissions and journeys.

Measure three is the RBS.Shuttle, which is an extension of the offer on the public transport side. This is shown in Fig. 3 with a bus symbol. It is a(n) (electric) minibus that picks up passengers at the desired location on request (RideSharing) and takes them to desired stops. AI-supported, connection times of public transport and traffic situations are taken into account. This way, a gap between villages/hamlets and the RBS.Hubs is closed regardless of local boundaries. Public, social, and cultural institutions are also served. The bus itself offers sufficient space for passengers and the transport of walkers or prams, and the RBS.Shuttle enables all population groups, whether they are restricted or not, to have the best possible mobility.

Measure 4a is a mobility app into which all newly emerging hardware and software solutions will be integrated according to the existing offers. This is shown in Fig. 3 with the speech bubble on the left, where you can see a smartphone with RBS.Mobil. It includes, for example, bicycle boxes, charging infrastructure, carpooling (measure 4b), or RBS.Shuttle including reservation options, booking options, payment methods, mobility budget, and a bonus system (measure 5). The new solutions will then supplement the existing train, bus, or call-collection-taxi schedules and bike and car sharing locations. Through this merger, all users of the transport association will benefit from the new measures and supra-regional, transparent, and easily accessible mobility, especially to Cologne and Bonn.

Measure 4b is the formation of carpooling schemes. Car pools are formed, which can be used at niche times of the public transport and on unused routes from the many villages of Lohmar to the centers or on commuter routes and routes of children, to supplement the public transport. In this situation, the aim is to enable multimodal mobility. The carpooling is a new component of the regional mobility system. The final measure five is the implementation of a bonus system that rewards the use of sustainable mobility options with points. The more environmentally friendly mobility, the more coins you can achieve. This applies both to citizens and employees with their employer's mobility budget. The mobility points can be exchanged in local shops or for tickets (e-commerce) like a voucher, which increases turnover.

4 Results Achieved

Results obtained in this study are presented in two parts. Part A takes a closer look at the achievements related to the digital transformation strategy, and Part B deals with the achievements related to RBS.Mobil.

(A) Achievements Related to the Digital Transformation Strategy of Lohmar 2025 The success of the digital transformation strategy is the creation of attention for the topics of digital transformation and the start of citizens to rethink digital transformation. Within the administration, the topic of digital transformation is now omnipresent. Training courses are offered, workplaces are made more mobile, and processes are getting digitally transformed. The aim here is to ensure that employees are aware of digital transformation processes and the possibilities for their daily tasks. In this way, the management of digital transformation processes should be perceived as "normal or standard" and not as a burden.

COVID-19 accelerated the digital transformation of the administration abruptly because all city employees had to work instantly from home. During this, laptops, webcams, and video conferencing softwares were purchased, and almost 40% of the workstations were fully mobilized. Typical tasks, such as those of the community center, were also eliminated and need now to be designed digitally. However, many employees have become acquainted with the many advantages of living and working digital from everywhere at any time and are now demanding its continuation. These are all good achievements in the administration field of action. This is confirmed by an employee of the citizens' office:

> Digitally, I can process many inquiries much faster and it saves citizens the trip to the citizens' office—a really good solution.

In the future, home offices in the administration should continue to be an option for employees. The process for applying for a home office has also been simplified and digitized. In addition, an office on each floor of the building will be converted into a desk-sharing office to give employees who work completely at home the opportunity to book a room in the office some days during the week or for meetings which need to take place in physical presence. The city hopes that this will minimize the workplace problems it is currently facing. Right now, the city of Lohmar has not enough workplaces for the employees working for the city of Lohmar. Home office is one solution helping the city of Lohmar to find proper workplaces for all its employees. This phenomenon is not unique to administrations; private businesses are now increasingly turning into home offices or alternative arrangements. Due to the lockdown at the beginning of the year and the low necessity of presence at the place of work, alternatives are becoming more popular—including the established co-working places in Lohmar, which can be assigned to the field of entrepreneurship.

Awareness for the digital transformation processes of Lohmar is being created outside the administration, i.e., in the city society, through web presence and social media channels. Many young citizens know what is currently being discussed in Lohmar through their subscriptions to Instagram, Twitter, or Facebook. The older citizens are informed about the activities with the local newspaper. In addition, they can get to know the digital offers in individual learning sessions. In this way, the city of Lohmar brings the whole city society closer to digitalization as a "normal" development or chance to improve the development of the city of Lohmar in the areas of climate protection, living together, mobility, and comfort. These offerings are part of the education action area.

(B) Achievements Related to the Smart Mobility Concept for Lohmar: RBS. Mobil The demand for more digital services continues to grow in Lohmar and so Lohmar has decided to be a driver for digital transformation processes. Especially in the area of mobility, Lohmar has shown great initiative and submitted the RBS. Mobil project to the BMI. The application was well received and approved for funding at the end of 2020. The project is scheduled to start in early 2021.The RBS.Mobil project already showed a positive response during the application phase, which the result that Lohmar was able to motivate the surrounding municipalities and regional companies to participate in the project.

Mobility manager of Lohmar, Mr. Kukula, summarized this as follows:

> Our goal in developing the digital transformation strategy was to bring together the many mobility projects and players in the region and work together on a solution to integrate them into a single system and thus strengthen sustainable mobility and the environmental network as a whole. A great success!

External participants felt the same way—the mobility manager of a regional mobility agency summarized the start workshop for idea generation, which took place online due to the lockdown, as follows:

> The digital workshop [on the RBS.Mobil project] was fun and really well organized. The organizing committee has my respect. It's a great way to collaborate remotely and it delivered a great result.

Especially the citizen participation and early stakeholder involvement was seen as very positive. Overall, this allowed Lohmar to focus on smart mobility in the region, and RBS.Mobil is just the start. After approval by the BMI, Lohmar held a press conference, and the RBS.Mobil project was thus brought to the wider public and has since received a positive response.

The COVID-19 pandemic has of course also had an impact on the RBS.Mobil project. Analyses by the local transport operator showed that despite the pandemic and concerns about contagion in public transport, guest numbers in Lohmar remained constant. This means that these groups of people actually rely on public transport on a daily basis and will continue to use it. Here, the individual measures, such as the RBS.Shuttle or the bike-sharing stations, can provide further benefits. At the same time, it could be concluded from the traffic situation on the roads during the lockdown that many Lohmar residents commute by car, because the critical traffic situations did not occur during the lockdown. However, how the influence of the bicycle vendor is or has developed cannot be seen at this point in time. In any case, these new circumstances will be taken into account at the start of the project and corrected to the new user behavior.

5 Lessons Learned

In sum, the case of Lohmar shows six lessons learned, which can be transferred to other municipalities in general and especially for cities with commuter challenges. The first three of Lohmar's lessons learned belong to digital transformation processes in general. Regarding the development process of digital transformation strategies, these three lessons learned can be aligned to the development processes of various municipalities in Germany. These three findings were also shown by Niehaves et al. (2018) who conducted a study with North Rhine-Westphalian municipalities regarding the development of digital strategies (Niehaves et al. 2018; Niehaves et al. 2019). The following three findings (number four to six) concentrate on the development of the field of mobility in Lohmar's digital transformation strategy. With developing a project proposal regarding a smart multimodal mobility hub focusing on commuters' traffic, Lohmar was able to develop a roadmap supported by different stakeholders for the field of mobility in its digital transformation strategy.

First, digital transformation is a joint task! Looking at digital transformation processes and especially while developing a digital transformation strategy, municipalities need the help of different stakeholders sharing their knowledge and their point of view. The invitation of different stakeholders into the development process gives municipalities the chance to address different needs of various stakeholders.

With the new public management movement, municipalities are beginning to focus on acting as service providers for their citizens. With the ability to recognize different interests and needs of different groups of citizens, digital transformation processes and projects can now be properly aligned.

Second, digital transformation processes need competences! Changing processes, developing new ideas in the digital age, and enhancing the engagement of citizens need digital competences. These competences can be divided in process-orientated and technology-oriented competences.

Digital competences are an essential part whether new digital transformation processes will be successful or not. If employees and citizens have no competences regarding the use of new technologies, they might not be able to use them. If they have no knowledge about digital processes and their adjustments, citizens and employees will not start to make use of new designed processes. Not having enough knowledge of the changes caused by digital transformation can result in dissatisfaction and the feeling of having been "left behind". To prevent these cases, webinars and workshops are opportunities to invite different stakeholders, giving them information and transparent insights about changes, building digital competences, and helping them to join the transformation processes.

Third, digital transformation processes need responsibilities! Digital transformation in municipalities requires clear responsibilities and should at best be made a matter of the management (e.g., mayors and CDOs). A study shows that 83% of participating municipalities state that mayors and/or councilor are responsible for developing a digital transformation strategy (Niehaves et al. 2018). When it comes to the implementation of the digital transformation strategy, department heads play a central role. Nevertheless, six out of ten mayors and councilors were responsible for this themselves (Niehaves et al. 2018). This study also shows that the designation of clear areas of responsibility makes it possible to turn employees into digital transformation drivers who are willing to push the topic of digital transformation forward in their municipalities. Individual personalities, as introduced by the mayor, the CDO, and the MM in Lohmar, pushed ahead digital transformation projects, put the topic on the agenda as top priority, and started a change in their municipalities' culture. To identify such personalities and to promote their personal commitment, suitable conditions should be created at the municipal level.

Fourth, learn from other municipalities! In Germany, there are other cities facing the same problem as Lohmar does. Municipalities can learn from Lohmar and others. There are more municipalities who are close to bigger cities in Germany, still being rural, facing commuters' challenges. These cities can learn from the development Lohmar started by introducing the project idea of RBS.Mobil. With getting different stakeholders together and letting members of the University moderate sessions and workshops, they were able to connect to every stakeholder in a neutral way. Talking transparently about challenging obstacles and letting stakeholders describe their fears and wishes helped Lohmar to communicate every step closely with their citizens and stakeholders, enabling intermunicipal projects to develop. Since mobility does not stop at the city boarders, this intermunicipal commitment helped develop multimodal mobility applications to create an easy and convenient way for citizens to get from destination A to B.

Fifth, there is always more than one solution! Looking at different ways of mobility today, there is always more than one solution, way, or partner municipalities can work with. Multimodality is the question and the answer at this point. Working with different stakeholder, organizations and municipalities gave the possibility to test different applications in the field of mobility. There is always more than one solution, and there is always someone who has already experiences using these various applications. Lohmar learned to enjoy the help and ideas of their stakeholders and to integrate them in their project proposal to be friendly with experimenting in turn to achieve the best solution and to accept mistakes on the road to the best solution as learnings. Another important topic is time. Being timely open, seeing projects and strategies as something alive helps to develop and adjust them along their way.

Sixth, asking for help improves your actions! Getting more partners together and being honest and open about the current challenges faced can help to find real solutions to problems. Partners can help financially and with personnel; they can build competences with municipalities and be of help when facing questions and challenges. Partners on your side like to help and to share their knowledge. With the intermunicipal exchange, Lohmar was able to define their way as common aim, searching for the best possibilities for their citizens. Including citizens in the process, asking for their opinions, especially with their knowledge on the most important geographical and technological challenges occurring in their surroundings, helps tremendously to develop a future-proof project in terms of acceptance and technical issues.

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Part III
Digital Transformation

Approaching Digitalization at an SME Manufacturing Service Provider

Customers at the Heart of Listemann's Digitalization Strategy

Michael Reiner Kamm, Charlotte Wehking, Lena Franziska Kaiser, Markus Otto, and Jan vom Brocke

Abstract

(a) **Situation faced**: Listemann Technology AG (Listemann hereafter), a leading industrial service provider for heat treatment, brazing, sintering, electron beam welding, and engineering in the manufacturing industry, invests in new digital solutions to increase the value of its services for its customers. Even though Listemann has a digital production process par excellence, its customer management relies on traditional approaches like telephone calls and emails. As its competitors are also fighting for customers and becoming digital, the importance of Listemann's maintaining and strengthening its customer relations and using digital technologies to generate business value increases.

(b) **Action taken**: The digitalization project was carried out in four phases, beginning with analysis of the current status and moving on to elaboration of digital potential for Listemann with a focus on processes that have a direct or indirect impact on customers, analysis of the prerequisites for the implementations, and the design and cost estimation of the new web portal and the corresponding data management solution. Several interviews and meetings with the company and external stakeholders were executed.

(c) **Results achieved**: The preliminary results include insights Listemann's current situation regarding customer contacts, a list of potential solutions and measures to put the customers at the heart of the company's digitalization strategy, and the new design of a web portal with a new data management solution to improve the company's communication and interaction with customers.

(d) **Lessons learned**: Major lessons learned from the Listemann case provide insights for other SMEs that face the challenge of keeping up in the digital age, in particular the challenge of digitalizing their customer processes. These

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six lessons learned can be summarized as (1) be aware of (multiple) context(s), (2) know your customers and manage your processes accordingly, (3) define your digitalization strategy, (4) get everyone on board, (5) create incentives to support the digitalization process, and (6) establish a stepwise approach.

1 Introduction

Digitalization is opening new opportunities for every organization that can fundamentally revamp how they work (Neff et al. 2014). However, because of their typical scarcity of resources, it is often difficult for small- and medium-sized enterprises (SMEs) to deal with digitalization and its multiple challenges. Large organizations can cope with these challenges more easily because of their significant tangible and intangible resources (Tumbas et al. 2017). SMEs must use their scarce resources efficiently and effectively to make a difference with small changes and to manage the technical and organizational transformation processes (Neff et al. 2014). They must be value-driven and focus on the cost-benefit ratio of every development step because SMEs can benefit from the new opportunities digital technology offers to strengthen their connection with their customers. Customer loyalty is particularly important for SMEs, as they often depend on only a few customers (Laforet and Tann 2006). Organizations in the middle of the value chain face an additional challenge since the end customers do not usually know that the organization's services are part of a particular product and, as a result, no emotional relationship with the organization develops. Therefore, SMEs must strengthen their relationships with their customers not only by providing excellent products but also by developing customer-oriented processes (Kreuzer et al. 2020).

Digitalization opens new possibilities for SMEs to retain customers, such as through emergent digital technologies that facilitate a distributed actor network (Nambisan et al. 2017; Yoo et al. 2010). Distributed actor networks refer to multiple organizations that interact and have various relationships to each other.

This paper introduces the case of Listemann, a leading industrial service provider for heat treatment, brazing, sintering, electron beam welding, and engineering in the manufacturing industry. Listemann employs fifty people in three locations, one each in Liechtenstein, Switzerland, and Poland. The company faces multiple challenges. First, its ecosystem is becoming increasingly digital as competitors compete for customers. In addition, since Listemann processes individual parts that are further processed by large customers in various industries, such as the aviation industry (e.g., special turbine components), the energy industry (e.g., fuel tanks for satellites), and the medical technology industry (e.g., special surgical instruments), end customers often do not know that Listemann was involved as an intermediate, making it difficult to establish relationships with these end customers. Another challenge is that planning for job orders can only be done in a short time frame, approximately 1 week, as the industry is agile and products and services vary. Therefore, the SME is highly dependent on the communication and interaction with the customers upfront and often during the processing steps. Missing or incorrect information can lead to insufficient service. In short, attracting new customers for Listemann's services, keeping existing customers, and ensuring effective communication are all considerable challenges.

Listemann's case is interesting because the company's communication with its customers relies on traditional calls and email, as is the case with many SMEs. Listemann has invested in new digital solutions to enhance customer communication and improve their approach to data management, but the company questioned how to use such technology to get the best value. Listemann teamed up with the University of Liechtenstein's Hilti Chair for Business Process Management at the Department of Information Systems in a joint project to address this question.

In course of the project, both internal and external processes were analyzed, and processes with a touchpoint to the customer were identified as important drivers for success. For Listemann, the case provided (1) a clear assessment of what digitalization means (and should mean) for the company's specific business. We have created (2) a list of potential solutions and measures to put customers at the heart of the company's digitalization strategy, including a new data management solution (DMS) and web-based services, and (3) designed a new web portal to improve the company's communications and interactions with its customers.

The case provides an example of how SMEs can approach digitalization. We started with an open assessment of the business case regarding processes and key strategic priorities and developed a list of ideas for projects that would advance the organization through digital technologies. After prioritizing this list, we identified web-based services as great new opportunity to enhance the communication with the customer. This potentially lead to design of a new web portal for Listemann that could be delivered on time and on budget and would create business opportunities for the organization.

The case may be particularly useful to other SMEs that also maintain a strong relationship with their customers and want to take their customer relationships to the next level with the help of new digital solutions. It also stands out because it is a case of digitalization in a business area in which the digitalization potential is not particularly obvious. In this regard, the systematic approach to screening the organization first for such potential is an aspect of the case that other SMEs may use as an example.

This case study contributes to the field of information systems, especially the field at the intersection of business process management and digital innovation (vom Brocke and Mendling 2018). The case also provides lessons learned for research and practice, particularly for SMEs in the manufacturing industries. For example, with the help of digital technologies, SMEs can connect with their customers at all stages (i.e., pre-purchase service, transaction related service, post-purchase service), without exhausting their limited resources. Often, digitalization does not require large changes, and even small measures can be very effective and offer new opportunities.

2 Situation Faced

Listemann's Organizational Environment Listemann is a small, specialized service provider for material and heat treatments for multiple applications. The company's services range from electron beam welding of turbine components for airplanes to brazing of injection molding tools. Thus, its services make up only a small part of an entire production chain that spans multiple organizational boundaries. Numerous norms and standards from various industries must be maintained, which makes the intra-organizational scope in which Listemann is situated especially challenging. Listemann operates in a competitive market environment and must assert itself against other market participants using its high level of domain knowledge and equipment to offer its specialized thermal processing services. In addition, the Liechtenstein location has high labor and fixed costs (Liechtenstein Business n.d.), which increases its prices. Since Liechtenstein is not part of the European Union, the company must manage customs regulations. Even though Liechtenstein is part of the European Economic Area, free movement of goods from Liechtenstein is not possible because of the contractual situation with Switzerland. Customers must deal with customs legislation and additional paperwork if they choose Listemann as a service provider, so sometimes they switch to competitors that are located in the European Union. Consequently, the need to keep existing customers and attract new customers has led the company to focus on putting its customers at the center and offering excellent, comprehensive service. Because of its long and close cooperation with its customers, Listemann is aware of the pain points, so communication and collaboration with customers play—and will continue to play—a central role in its success.

State-of-the-art Production but Traditional Customer Management Listemann operates an excellent digital production process for a small organization. When the goods arrive, they are registered in a specialized enterprise resource planning (ERP) system. The specialist batch system records every process step throughout the entire production. Thus, Listemann's digitalization potential does not correspond to its production process but refers to its customer relationship management, particularly by increasing the value of the company's service for its customers and providing them an adequate digital experience. For example, even though Listemann can track customers' products during the production, customers cannot follow up on their orders in an independent manner; if they want to know the status of their orders, they must call the organization or send them an email. The same holds true for creating a new order; customers have to explain their situation, what they want, and what they require (e.g., DIN norms) via telephone or email. Therefore, the collected information, which comes from multiple sources, is not saved in one database but is often hidden under multiple emails on the mail server or the database. Considerable time and resources must be expended to find and collect the information from multiple sources (e.g., employees, sticky notes, emails, notes from phone calls) to respond to the customers again. Processes related to customers are variable, and the process history is not properly documented. For instance, if customers want the same order as last month's order, they have to provide all the information again. This issue is further complicated by the customs requirements for the customs duty.

To sum up, Listemann's relationships with its customers is of utmost importance for Listemann, and therefore they wanted to invest in new digital solutions to improve their customer management. However, as a small organization, it could not invest a large amount of organizational resources into the digitalization of their customer management and customer processes. How Listemann approached the challenge of transforming its customer management digitally and building or increasing customer loyalty is described in the next section.

3 Action Taken

The actions taken to put Listemann's customers at the heart of its digitalization strategy were inspired by the body of knowledge in the area of business process management (Rosemann and vom Brocke 2015). These actions fell into four phases, each of which was characterized by tight collaboration among multiple stakeholders.

3.1 Phase 1: Analyzing the Digitalization Potential (Focus on Customer Touchpoints)

In the first phase, process models and descriptions were structured and analyzed. A quick and value-oriented assessment of the process landscape was deliberately conducted instead of an extensive process analysis (vom Brocke et al. 2014a). A distinction was made between management, core, and support processes, and the focus was set on processes that had direct touchpoints with customers or indirect influence on customer processes. Afterward, these processes were ranked in a workshop with company experts according to customer experience and digitalization potential. The expert team included people from the field and people who had technological and process-oriented knowledge. The outcome is shown in Fig. 1, which focuses on the core processes (i.e., upper right quadrant) as these contributed most to customer experience and also had high potential for digitalization.

The participants in the expert workshop determined that processes related to order, production, advice, and communication have contact points with customers. These processes make significant contributions to customers' experience and have significant potential to support the customer interaction through new digital solutions. While current touchpoints with customers are mainly through phone or email, diverse finance, core production, and procurement processes have little or no customer interaction or are already digitalized and have low potential for further digitalization.

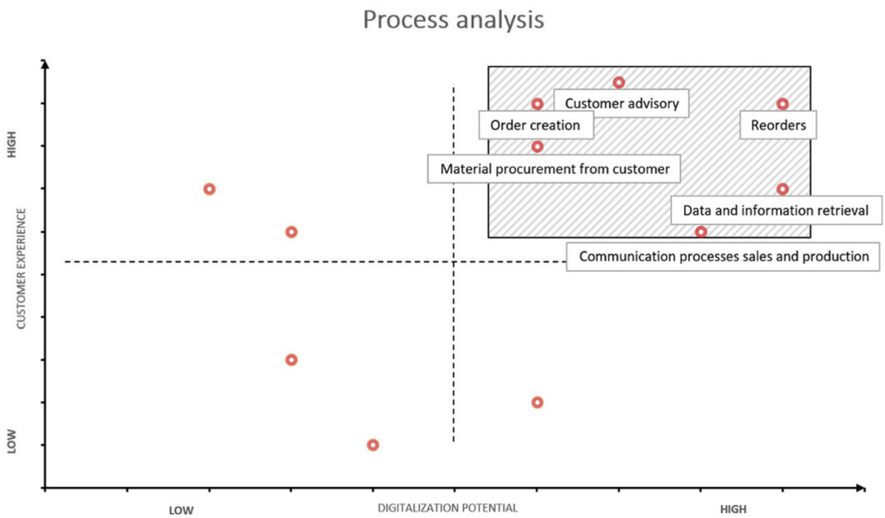

Fig. 1 Visualization example: Clustering of processes with the highest contribution to customer experience and digitalization potential

In the next step, the identified processes were again analyzed and ideas were collected on how to improve them and how Listemann could benefit from a digitalized solution in this areas.

3.2 *Phase 2: Defining Digital Solutions and Opportunities*

The second phase involved a deeper analysis of the processes identified in the first phase and the potential of the various types of digital solutions (Lehrer et al. 2018; vom Brocke et al. 2012). Additional information was necessary for the analysis to gain a holistic view of Listemann's capabilities. Since Listemann is a small, specialized service provider, it outsources its information technology (IT), websites, and other IT services, as well as some marketing activities. Therefore, we conducted multiple interviews and meetings with internal stakeholders (e.g., employees) and external stakeholders (e.g., IT partners) to establish an understanding of the company's outsourced customer-related processes. Employees were included in the development process because of their domain-specific knowledge (Müller et al. 2014), their experience with customers, and their expected work with the new digital solution. Listemann also involved external stakeholders and incorporated them in the development process because of their expertise with digitalizing customer processes (vom Brocke et al. 2012). External stakeholders included experts in inbound marketing, IT solutions, customer relationship management solutions, and web application development. Based on the identified challenges, potentials for digitalization

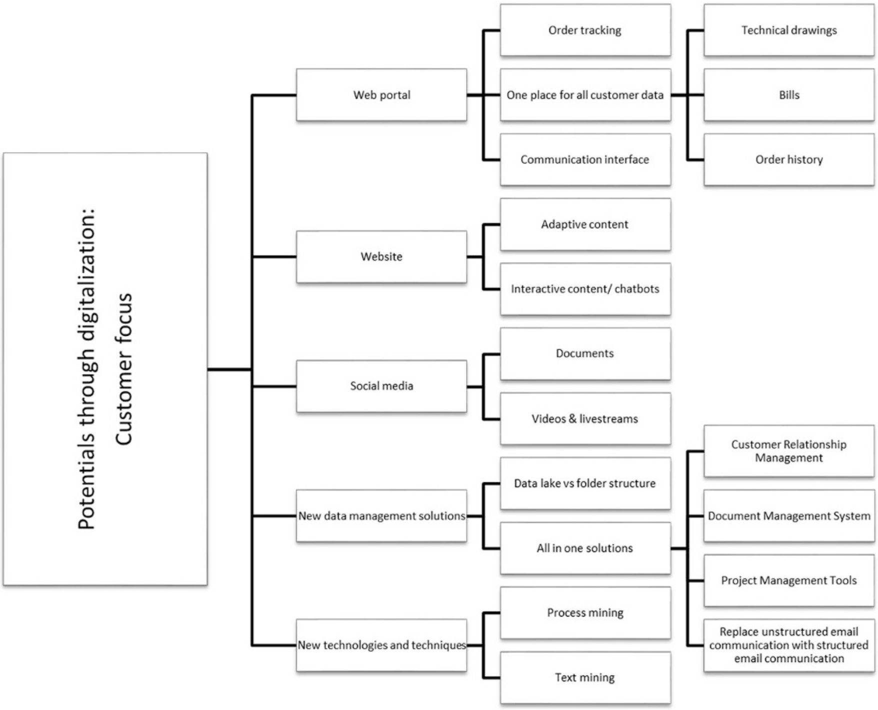

Fig. 2 Listemann's digitalization potential

were derived. Figure 2 summarizes some of the derived potentials for digitalization to improve the customer experience and value for the customer at Listemann.

Five major areas with potential for digitalization were the company's web portal, its website, digital media, new data management solutions, and new technologies and techniques.

Web Portal The project group found that a web portal could help Listemann to bundle all information and communications from its customers on one platform. Historical order data, bills, and customs documents could be stored on the web portal and made available to customers. Another option was to develop an order-tracking system to allow customers to see their orders' status at any time.

Website The company's website shows improvement potential for attracting customers online. By embedding adaptive content and developing an interactive website, Listemann could increase the use and visualization of the website. A well-maintained, appealing website with meaningful information would enhance the chance that new customers would become aware of Listemann and use its services.

Social Media By using social media, Listemann can distribute company-specific content like videos, live streams, and documents (Richter et al. 2009). Social media posts, for instance, can be fast and cost-effective advertisements for target groups, which enables another possibility to receive customers' attention (Richter et al. 2011). Listemann could enrich its digital presence by providing short informative and educational videos for websites and social platforms like YouTube, LinkedIn, Instagram, and Facebook. These videos could introduce Listemann and provide first-hand experiences with topics such as vacuum brazing and electron beam welding. Such videos are especially interesting for students and useful for customers who are interested in technological possibilities in this service area.

New Data Management Solution Like many companies, Listemann stores most of its documents in structured folders. This kind of data management has advantages but also weaknesses when it comes to redundancy, the number of documents saved in various folders, and the ability to meet requirements regarding data governance (Abraham et al. 2019). We sought to test a new DMS that works with data lakes and advanced data analytics. Such a new data management solution is a prerequisite for multiple digital services that can help strengthen the company's relationship with its customers.

New Technologies and Techniques New digital technologies like process mining could enable organizations to derive process models from event logs (Grisold et al. 2020). Such process models can indicate the variety of a process and show how processes are actually executed. Process mining could also enable Listemann to uncover hidden bottlenecks in customer related processes so they can improve them and increase the resource efficiency.

The derived opportunities for digitalization were then discussed and evaluated in meetings with Listemann employees and managers. The project's focus was determined as a new solution for data management, combined with an extended customer relationship management (CRM) system and the development of a dynamic web portal for customers. Based on this decision, the third phase of the project was executed.

3.3 Phase 3: Establishing Prerequisites for the Implementations

The third phase involved determining the necessary prerequisites for a dynamic web portal. For such a dynamic web portal, the availability and correctness of the required data is essential. In order to gain an understanding of the existing data structure, a few meetings were held that clarified the company's current processes and its existing data structure. The information was clustered into five core concepts: the core information system, data inquiry, data redundancy and data inconsistency, communication with customers, and special issues.

The Core Information System Listemann's core information system, a special ERP software for thermal processing companies, was rolled out 4 years prior to the project's initiation. This specialized ERP system sets the backbone and foundation of the whole production system, so it contains all information, from a new offer to issuing a bill via email or post. All production data is stored in the software provider's cloud, along with all customer documents that are uploaded during the production process (e.g., protocols, technical drawings, special customs documents) and other customer requirements acquired in the offer process. Even though the implemented ERP system is specialized to Listemann's purposes, it works like any classic ERP system.

Data Inquiry Because of its close contacts with its customers, Listemann knows beforehand what kind of goods will be sent to it for further processing about 95 percent of the time, so they can prepare the necessary material and machines upfront. When a new order arrives at Listemann, all production steps are predefined and described in job specifications and workplace descriptions. Each production step which is then performed is recorded through a batch system in the specialized ERP system. Employees who perform a task for the order scan their batches at the beginning and ending of the process step. As a result, all production steps are visible and accessible in the ERP system, which provides an overview of the process and helps to prevent mistakes in processing an order from the first to the final step. This system generates a great number of event logs that can be used for all kinds of applications, including process mining.

Data Redundancy and Data Inconsistency Customer data is stored in two repositories: Employees from the sales department store customers' data in various tables and documents and save files in a folder-based database, while some customers contact the head of production directly to place orders, in which case the production workers save customers' data in the specialized production ERP system. As a result, data is stored redundantly in two repositories, which leads to inefficiencies in exchanging necessary information within the company (Jaakonmäki et al. 2018). This user and application problem presented Listemann with an internal challenge regarding communication and coordination.

Communication with Customers Communication with customers takes place via multiple touchpoints, which presents Listemann with several challenges. When Listemann contacts customers via email, attachments like technical drawings, offers, and special-order details are often lost in the email system over time. In many cases, such information was stored redundantly in a folder-structured database, but it was difficult to retrieve after a long time because of missing keywords and unstructured savings. Employees were found that retrieving customers' order history was challenging. In addition, such a large volume of redundant data was produced that the important information could not be retrieved efficiently when it was needed.

Special Issues Since the company is located in Liechtenstein, it faces special customs regulations that can lead to extended waits and delivery times, higher administrative effort, and, therefore, additional costs. Listemann's location also challenges customers with regard to customs legislation, which has led to the loss of customers.

3.4 Phase 4: Design, Development, and Implementation

While Listemann had several opportunities for digitalization, they decided to put their customers at the heart of their digitalization strategy by implementing a new, all-in-one DMS combined with a web portal to support customer interactions and to collect all customer-specific data. Based on a long and trusting collaboration with the company's customers, Listemann's CEO knew that his customers wanted a new way to place their orders: ideally, one that was digital and could be done in a fast and straightforward manner without contacting employees every time. Based on these problems with the current approach (non-digital, employee contact), the CEO requested to start the platform-design process with internal and external experts, but not yet the customers. For the design process, we consulted multiple stakeholder groups, including employees because, as vom Brocke et al. (2014b, p. 533) state, research should "not neglect employee participation," as such inclusion fosters a "true sense of ownership and increases organizational performance" (p. 536). The company did not involve customers at the start but waited to show them a first prototype of the platform.

The following sections introduce the new DMS, the novel web portal, and their design and functionalities. After both solutions were designed, external vendors and developers were assigned to the projects, so both solutions are in the implementation phase at Listemann.

4 Results Achieved

New Data Management Solution To avoid redundant data and inefficient data retrieval, Listemann implemented a new software system that integrates CRM, groupware, email, project management, and document management in an all-in-one solution. This implementation lays the foundation for improved data storage and data retrieval processes. Changing from a structured-folder database system to collecting all data in one data lake provides multiple benefits for the company.

In the data lake, every element has a unique identifier in the form of a metadata tag. With these tags, data can be retrieved through search queries and assigned to projects, customers, or any keyword. Automatic text mining supports locating all kinds of digital documents, emails, and information that have been stored (Müller et al. 2016). Since the new system also contains the company's email system, all communications are stored in this central system as well. Content can be stored by assigning keywords or so-called activities so content can be clustered and assigned to a specific task, customer, or project. The assignment of information to activities can be done in the new DMS manually or automatically based on predefined rules. The new DMS also has a modular structure, which makes it easy to expand and offers Listemann new ways to store and retrieve data.

Web Portal The second part of the digitalization project was the web portal for customers. The goal of the new web portal was to provide Listemann's customers with useful individual information to strengthen customer loyalty. One of the main requirements of the web portal is the need for it to be resource-efficient in terms of time, employee involvement, and costs, so all data had to be available and updated automatically, and employees could not be in charge of keeping the web portal up to date. Therefore, the web portal was linked to the new DMS, where every customer is assigned a customer ID. Since all content can be assigned to an activity either manually or automatically, incoming information like an order or technical drawings can be assigned to an activity, for instance, called "order_webportal." Information within this activity is automatically published on the web portal for that customer. Assignment of the information to an activity can be done both manually and automatically based on predefined rules. In this way, the web portal can be hosted with minimal effort, and the data from a customer is centrally hosted. Moreover, the customer will be able to upload technical drawings, documents, and additional information directly from the web portal. Thus, major communications with customers are channeled through the new portal, enhancing the customer's process, as well as efficient use of resources.

Portal Design and Functionalities One customized solution was created during the web portal's design process to avoid a complex design and sophisticated implementation while making it possible to add new functions later on based on customers' and employees' feedback. Figure 3 shows a mockup of the new web portal with its seven functions.

The first function refers to the **customer's account**. The customer's account includes personal details like the customer's name, address, phone number, and company details. Customers can independently update all their personal details, so no employees need to enter customer data.

The second function ensures an overview of **all current and historical orders**. This overview supports communication between customers and Listemann, as neither customers nor employees need to search for old documents or past orders since all information is stored centrally. Furthermore, the order history provides employees information about past collaborations with the customer, order status, and the company's relationship with that customer. The process of reordering the same service is significantly more efficient for both Listemann and its customers.

The third function is a personal **communication channel** with an overview and records of past communication between the customer and Listemann. All emails and messages are saved and can be accessed at any time using this feature, so no email will be lost or forgotten between hundreds of unstructured mails.

The fourth function structures and visualizes **invoices and open bills**. The customer can see at a glance which invoices are already paid and which have yet to be paid.

The fifth function includes a **FAQ** section and the possibility for Listemann to share important information with customers. Frequently asked questions include those about product information, service updates, and current customs regulations.

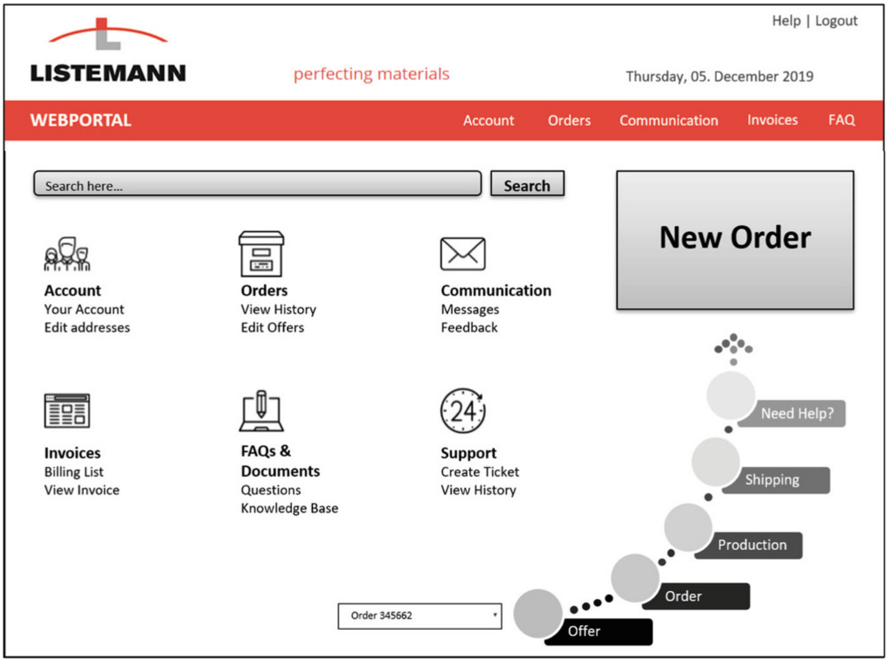

Fig. 3 Mockup of the web portal

The FAQ section provides instructions, examples, and support filling out the customs forms. In addition, an upload function allows sharing of technical drawings, customs forms, product descriptions, and any document that helps customers or employees handle orders.

The sixth function is a **customer service** landing page with support functionalities, such as a ticketing system and a communication platform (e.g., forum, live chat), that open new channels for communication.

The final function of the web portal **tracks customer orders**. Using this function, customers can independently monitor their order status without contacting Listemann so they can check whether their goods have already arrived at Listemann or they are retained at customs. Therefore, customers no longer need to be informed about their order status by phone or email, as it is automatically displayed in the web portal.

In the next step, the prototype and its functions will be iteratively tested and improved with the help of customers. The web portal's diverse features and properties centralize data, so they support Listemann's communication and relationship with its customers. Customers can store payment methods, addresses, contact details, and more without having to enter this kind of information over and over, so new orders can be placed or repeated without starting every time from scratch. Customers know their assigned contact person if necessary, and documents like customs forms and all helpful important information can be found in one central place. In short, the whole order process is designed in a way that is more efficient and convenient for the customers.

5 Lessons Learned

The Listemann case provides insights into the actions an SME can take to keep up in the digital age. The overarching take away is that every organization can develop a digitalization strategy that fits with its strategy and resources. To exploit digitalization's potential, organizations should involve both internal and external experts to access expertise and new ideas. For example, with the help of well-known and well-developed digital technologies, SMEs can connect with their customers at all stages (i.e., pre-purchase service, transaction related service, post-purchase service) without burdening their limited resources. Digitalization often does not require large changes, and even small measures can be effective and offer new opportunities.

In the case of Listemann, the following stepwise approach proved to be helpful and can be a good starting point for other SMEs and their digitalization strategy. The digitalization project at Listemann was carried out in four major phases, (1) the analysis of potentials for digitalization, (2) the creation of an overview of promising digital technologies, (3) the clarification of requirements and the selection of the suitable digital technology, and (4) the design, development, and implementation phase (Fig. 4).

Phase 1 is about the analysis of potentials for digitalization. Therefore, a graphical representation with the digitalization focus on the y-axis (in the case of Listemann was the focus on processes with customer touchpoints) and the digitalization potential on the x-axis helped to cluster processes with a high potential and high relevance (as described in Chap. 3).

Phase 2 is about the identification of suitable digital technologies and the creation of a structured overview of digital technologies. In the Listemann case, major areas

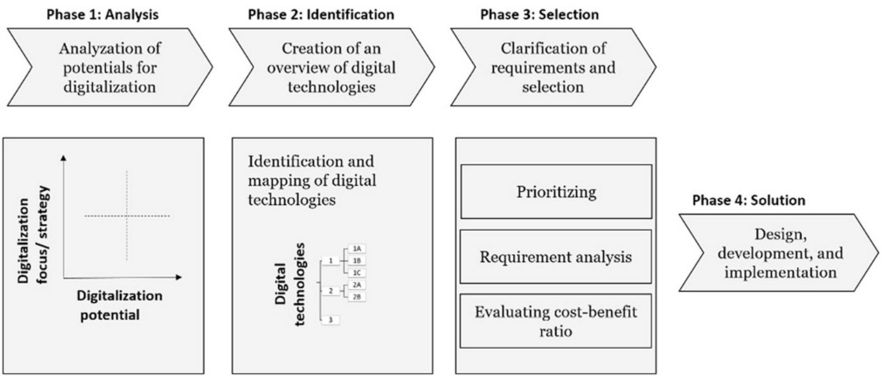

Fig. 4 Digitalization approach at Listemann

with potential for digitalization were the company's web portal, its website, digital media, and new data management solutions and techniques.

Phase 3 is about clarifying the requirements for the specific digital technologies and select the suiting technologies for the SME in regard to a good fit. Therefore, digital technologies should be ranked and evaluated based on their requirements and challenges in case of an implementation.

Phase 4 is about designing, developing, and implementing the chosen solution, with all the related byproducts and requirements. In the case of Listemann, it proved to be helpful to involve external experts in several fields and outsource specific tasks, such as some of the IT services to specialized vendors.

Furthermore, six key lessons learned from this case can provide other organizations, especially SMEs, insights into how to deal with digital innovations when only limited resources are available:

Be Aware of (Multiple) Context(s) To identify the right actions in pursuing the goal of increased customer loyalty, Listemann identified contextual factors that would affect its ability to meet its goal. For instance, its managers understood that they have a digital production process, but their service itself cannot be digitalized; they understood their customers' wish for a tool that would make handling orders easier; and they understood that their ecosystem is also striving for digitalization. By identifying the different context factors, the company took suitable actions given its circumstances, and processes were adapted and designed to meet its customers' needs. Thus, being context-aware can help managers guide a socio-technical change process in a resource-efficient manner.

Know Your Customers and Manage Your Processes Accordingly There are many ways to improve customer loyalty with little effort and few resources, which benefits SMEs. As innovation is ultimately developed to attract new customers or improve relationships with existing customers, customers should be involved in the innovation process. In the beginning, customers can provide valuable insights into which changes would improve the communication between them and the organization. Later, they can provide insights into the specific characteristics of an innovation that would simplify their work processes. Incorporating customers in the innovation process strengthens the trust between the two parties.

Define Your Digitalization Strategy Digitalization often has different meanings for different organizations. For one organization, going digital may refer to implementing a new web shop, while another organization refers to going digital as the introduction of a digital service that changes the entire business model. Especially SMEs, where resources are usually scarce, must find the solution that provides the greatest added value (Thomas and vom Brocke 2010). Even small changes that increase cost-effectiveness can have a big impact. In the case of Listemann, the service they offer could not be digitalized, so it sought to strengthen its customer relationships by digitalizing, centralizing, and simplifying its customer contact processes.

Get Everyone on Board Listemann found that it was helpful to involve all stakeholders from the beginning in the digital innovation process, thus shifting the locus of innovation from a centralized department to multiple distributed innovation actors. Top management emphasized the importance of the company's efforts toward digitalization in terms of their customer relationship, and internal and external experts were involved in the innovation process to pool knowledge and manage the socio-technical process of transforming the customer's process. The involvement of external domain experts was a particular success factor in this case, as the experts were aware of, for example, technological dependencies and so were able to accelerate the development process. A mix of practitioners and researchers from the field of interest helps to ensure successful digitalization projects.

Create Incentives to Support the Digitalization Process Employees, especially SMEs' employees, are limited in their resources and time to participate in the development of a digital innovation, so employees often must manage the development and implementation of an innovation in addition to their daily tasks. Therefore, employees must be flexible and motivated to meet these requirements, and their organizations should provide incentives to help motivate them, not only extrinsically but also by creating a supportive environment in which employees want to go the extra mile.

Establish a Stepwise Approach For many SMEs, it is not possible to digitalize in one go, so a step-by-step approach can be useful. In the Listemann case, the process map was first analyzed and structured. Then the processes were analyzed with regard to the input and output processes that strengthen the customer relationship. In the next step, a market analysis was carried out to evaluate competitors' current solutions. In the final step, with the focus on strengthening the customer relationship, potential digitalization opportunities that added the most value for the organization were identified and discussed.

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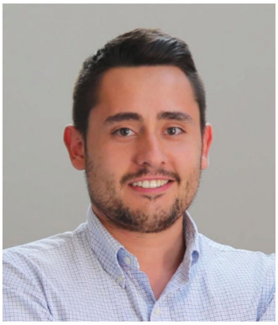

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Digitalizing Water Bill Payments

Introduction of Change Management at Ghana Water Company Limited

Ransford Mensah, Aileen Cater-Steel, and Mark Toleman

Abstract

(a) **Situation faced**: Ghana Water Company Limited (GWCL) is a public utility company undergoing a digital transformation. The company began transforming its billing processes in 2016. A vital component of the transformation agenda is the digitalization of customer payments, where customers can make water bill payments through mobile money and other digital payment platforms.
Management of the company has realized that some of its commercial department employees (customer-facing staff) are consciously or unconsciously resisting the change. Therefore, to increase adoption, and usage of the payment channels, management has decided to implement a change management program.

(b) **Action taken**: A mixed-method approach was used to obtain staff views on the ongoing digital transformation process at GWCL. This was achieved through a survey and focus group discussions. The study targeted to collect data from 200 staff. There were 160 staff who returned completed questionnaires.
The analysed data from the survey and five focus group discussions were used to develop a digital payment change management framework incorporating implementable action points that will enhance organizational appreciation of digitizing bill collection.

(c) **Results achieved**: The survey and focus group discussions showed that the ongoing digitization projects at GWCL have resulted in apprehension, anxiety and fear among many of the staff. Overall, the company staff understanding of change is characterized by operational practices rather than behavioural practices. The research resulted in a digital payment change management framework which has been accepted by the company senior management. The framework establishes how changes will be proposed, analysed, accepted/rejected, implemented, monitored, controlled and documented. Currently, the company

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has successfully implemented a series of pragmatic change initiatives using the framework to facilitate the usage of digital payments for bill collections.

(d) **Lessons learned**: The most important lesson is that it is not possible to manage change in this public sector organization using a checklist of change management steps. The lessons learned are as follows: (1) A transparent and systematic approach to change management enhances digitalization (increases usage and adoption). (2) An iterative approach allows failure and lessons to be learned. (3) Use a context-specific change management framework to establish sustainable change. (4) Use change champions to drive change.

1 Introduction

In August 2016, Ghana Water Company (GWCL) began transforming its billing processes, allowing customers to pay for their water bills through digital platforms. Digitizing post-paid water bill payments is part of GWCL's strategy to reduce consumption of non-revenue water (i.e. difference between the volume of water the company puts into the distribution system and the volume of water billed to the consumer), improve bill collection and offer customers more convenience when making payments. It is also a response to the Ghanaian Government's call for government agencies to digitize their payments. According to the Economic and Financial Data published by the Bank of Ghana in July 2020, there are 12.9 million active mobile money accounts (Bank of Ghana 2021).

The utility sector has changed; new companies have entered the market, which has threatened the monopoly GWCL has enjoyed since 1993. GWCL was operating in a secure monopoly market but has gained a considerable amount of competition due to market changes. People are finding ingenious ways to supply water to a few houses and surrounding community areas that are not covered by GWCL physical infrastructure.

To stay competitive, GWCL has embarked on a digital transformation journey, therefore implementing many changes in just a couple of years. This journey has resulted in a sharp learning curve for employees of the company, who are used to working in a secure environment with little or no change. There is a perceived loss of territory among GWCL employees. Tabrizi et al. (2019) stated that digital transformation is beneficial, but if people lack the right mindset to change, and the current organizational practices are flawed, digital transformation will simply magnify those flaws.

As of June 2020, GWCL has close to 770,000 customers, all in urban areas across Ghana, and this number is growing. A variety of payment options are available for customers to pay for their water bills, viz., mobile money USSD menu on their phone; GWCL app, which is free to download and available on both iOS and Android platforms; electronic funds transfer (EFT) between bank accounts; cash over the counter at the GWCL offices (or to GWCL field staff who visit properties during revenue mobilization efforts); and cash over the counter at bank branches.

However, GWCL has not seen widespread adoption and usage of the digital bill payment platforms (i.e. mobile money, bank transfers, mobile app). As of March 2020, only 6.1% of the total customer base paid their water bill through digital payment platforms out of a total of 764,463 customers.

Between May 2018 and April 2019, GWCL, in partnership with the United Nations "Better Than Cash Alliance" (BTCA), conducted a consumer insights study of water customers in Ghana's two major cities, Accra and Kumasi. The main objective of the insights study was to understand customer preferences and bill payment usability problems. One of the major lessons from the consumer insights report was that the staff of GWCL poorly understood change management. GWCL does not have internal operational processes to support change management. This could be remedied if the company set a well-defined change management framework in order to increase customer adoption and usage of the digital bill payment platforms.

This case study explores how GWCL implemented an extensive change management program to increase adoption of e-billing/digital payments among staff, hence improving overall customer perception of the alternative payment platforms. The first author of this chapter was a consultant for GWCL as the change management expert through the United Nations "Better Than Cash Alliance" (BTCA).

After this introductory section, Section 2 outlines the situation faced by GWCL (a public sector company) and details specific challenges. Section 3 covers actions taken by GWCL's senior management to overcome the challenges. Section 4 presents preliminary results of the transformation process, and Section 5 summarizes the lessons learned.

2 Situation Faced

Since 2016, the Ghanaian Government has embarked on numerous digitizing projects to grow the economy and enhance digital financial inclusion. Until recently, the private sector has been at the forefront of using digital technology to deliver services to customers, thereby becoming more efficient and ultimately increasing profit.

The public sector is approaching the standard set by the private sector when it comes to digitalization of services. The government has made digitalization a top priority, crucial to their Ghana Beyond Aid Agenda.

In 2017, the UN-based "Better Than Cash Alliance" released a report on Ghana's progress in creating a digital economy. The report is titled Building an Inclusive Digital Payments Ecosystem: The Way Forward. One key recommendation made by the UN was that the government should invest in infrastructure for digital public utility payments. The report stated that 80% of the population use essential public services such as water and electricity, but only 20% of the population have access to digital technology such as smart metres. By investing in smart distribution infrastructure that digitizes end-to-end delivery and payment, it can increase efficiencies and ease of use for citizens—ultimately increasing adoption.

GWCL in June 2016 started transitioning from paper to electronic billing. The company in 2017 launched its electronic billing and payment system to boost its operations. The new system allows customers worldwide to pay their bills electronically in the comfort of their homes and from any location worldwide. The platforms facilitating the GWCL's e-payment system include mobile money platforms, several banks and e-payment services (shown in Fig. 1).

Previously, water metre readings were manually recorded by the company's metre readers. GWCL prepared its customers' bills by manually keying into its billing system and printing bills to distribute to customers. Bill payments could take at least 28 days to reflect on subsequent bills of customers.

The GWCL digitalization project is driven by senior management which had delegated responsibility to a group of employees of the company to realize better ways to adapt to these new changes.

To ensure a smooth transition to the new digital environment and improve service delivery to its customers, it was crucial to introduce a realistic change management program to manage the people side of the project. This may enable staff to thrive in the transformed organization. Research by Kostenbaum and Dener (2015) stated that there is no widely accepted framework on the development of change management programs and action plans in the public sector. In fact, in most cases, project-specific solutions are being developed.

Currently, GWCL has been confronted with "wicked problems" as a result of their digitization project, that is, problems with many interdependent factors making them seem impossible to solve. To navigate wicked problems, the introduction of change initiatives is necessary to succeed with digital transformation. Figure 2 shows that there are unseen barriers to digital transformation in GWCL. The basis of change management theory lies in the fact that most managers tend to only focus on the apparent barriers such as cost, quality and time instead of giving attention to more important issues such as perception, beliefs, power and politics (Krüger et al. 2010; Stouten et al. 2018).

The absence of a clearly defined change management approach in GWCL has resulted in several challenges which affect the whole digitalization program. The focus of this case study is to develop a bespoke digital payment change management framework for GWCL to increase adoption of e-billing platforms in the company. This will be achieved by (1) assessing the current organizational change level, given the progress made so far in the transformation process; (2) based on the findings, developing a digital payment change management framework incorporating implementable action points that will enhance organizational appreciation of digitizing bill collection, as well as agree with senior management on key change management performance indicators; and (3) conducting a final assessment to establish the effectiveness of change management tools to the transformation process.

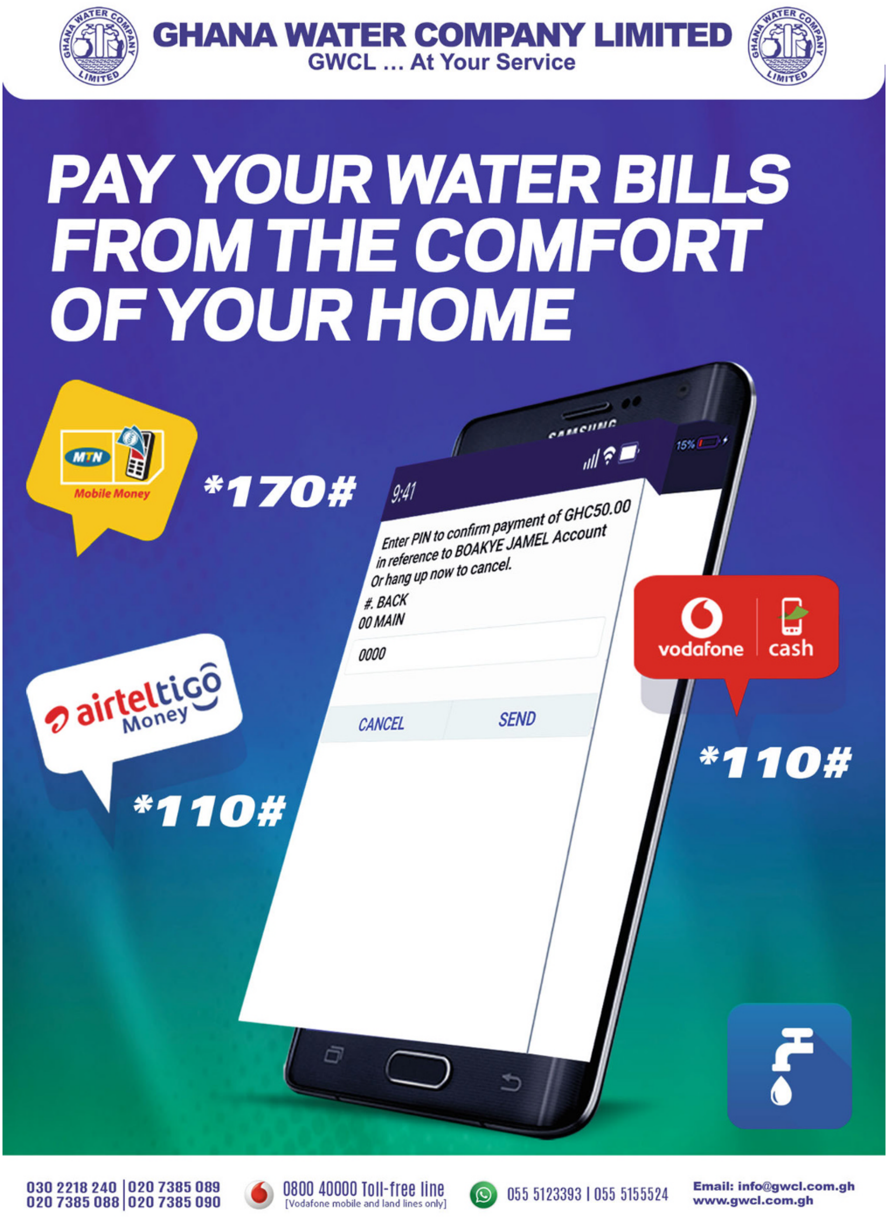

Fig. 1 Consumer guide to bill payments

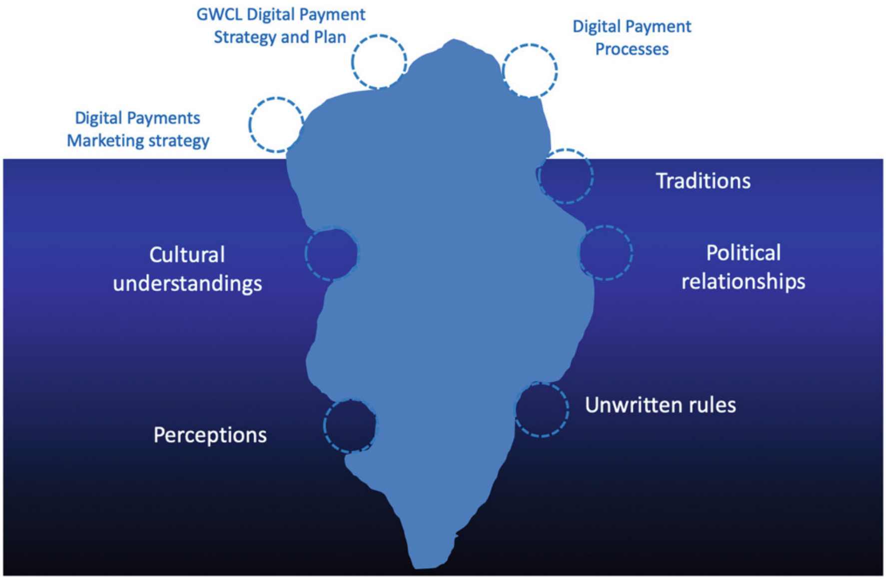

Fig. 2 Change management iceberg metaphor (developed for this study)

3 Action Taken

In the previous section, we described the situation faced by GWCL. To increase the usage and adoption of e-billing platforms in GWCL, the Commercial, Technology and Innovation departments of GWCL, guided by the change management consultant from the UN BTCA, developed quantitative and qualitative approaches to collect information from employees of the company. The data was collected through a survey, focus group discussions and semi-structured interviews. The data collection tool was built on the Awareness, Desire, Knowledge, Ability, Reinforcement (ADKAR) model which can identify why changes are not working.

In the ADKAR model, Prosci (2004) proposes that for successful change to occur at the individual level, people need to move through each of these stages:

1. Awareness of the need for change
2. Desire to make the change happen
3. Knowledge about how to change
4. Ability to implement new skills and behaviours
5. Reinforcement to retain the change once it has been made

The study targeted to collect data from a sample of 200 GWCL staff out of 5020, with 160 responses received representing a response rate of 80%. A total of 75 GWCL staff participated in the focus group discussions and 5 managers in the semi-structured interviews. Five (5) focus group discussions were held in two regions in Ghana, namely, Greater Accra and Ashanti Region. The GWCL staff surveyed and interviewed are district commercial officers, metre readers and client relations officers.

The study was interested in the length of time that the respondents have worked in GWCL. The findings showed that 44% of the respondents had worked in GWCL for over 7 years, 30% for 2–7 years and 26% for less than 2 years. This indicates that most of the respondents have been with GWCL for enough time to have gained a full understanding of the GWCL environment, how it works and its operations.

Although two-thirds of the staff were satisfied with the effectiveness of senior management, the consultant was able to identify the challenges regarding the e-billing system implementation. The challenges identified were:

- Limited GWCL staff understanding of change and change management processes and practices
- Employees' negative experiences of change and change management
- Resistance to change
- Inconsistent quality of communication
- The need for change and change management: a top-down driven policy.

3.1 Findings

Finding 1: GWCL staff have limited understanding of change and change management processes and practices
Two-thirds of the employees interviewed had limited knowledge and understanding of change and change management processes and practices. Staff were unclear on the definition of "change". Responses varied from complex explanations to simplistic understandings of the terms "change" and "change management". For example, a third of the employees stated that "change is a different way of doing your work"; "change could simply be posted to a new district or region"; and "changing your role in GWCL". Overall, GWCL staff understanding of change is characterized by operational practices rather than behavioural practices. The employees lack knowledge of what to do and what is expected of them in this new "digitization era".

Finding 2: Employees report negative experiences of change and change management
Some employees mentioned that the digitization drive-by GWCL senior management had a negative effect on them. According to these employees, this change has resulted in apprehension, anxiety, fear, disillusionment and shock. These emotions were evident in all five focus group discussions. Some employees stated they received instructions from the head office about requirements. They were not involved in creating "a change process". However, other employees felt challenged, excited and motivated by the impact of e-billing and overall digitization drive of GWCL. The lack of participation by some employees is attributed to a lack of understanding of the actions and decisions taken by management.

Finding 3: Resistance to change is not widespread
The data analysis from the survey and focus group discussions showed that GWCL staff are not against change. Rather it may be the lack of information on the objective and purpose of a change initiative that causes the resistance to change. Employees believe that "change" is an occupational necessity for GWCL to be profitable, especially now that its market monopoly is reducing.

Finding 4: Quality of communication is inconsistent
With regard to the issue of communication effectiveness within GWCL, employees echoed the following views:

- Management is always available to engage with staff whenever required.
- E-billing objectives were clearly communicated in an open and candid way.
- General communication within GWCL is effective in that employees are satisfied with the discussions on most occasions.
- Some employees felt less positive about how well their district/regional managers were keeping them informed about GWCL matters.

Employees were of the view that communication in the organization has changed due to the advent of new technology. They concurred that they had multiple tools for communication at their disposal. Employees cited the following modes of communication that were available to them: email, WhatsApp, SMS and Intranet.

However, while acknowledging these new modes of communication, employees stated that these could only be used effectively within the organization if all employees received proper training on the use of these modes of communication.

Another view was the need for the IT unit/MIS to conduct periodic training and development workshops across the regions and districts on how to use these technologies to enhance work productivity. For example, the use of email within GWCL was deemed to be a popular means of communication, but some staff are still not comfortable using email. Other responses from the focus group discussions indicated that communication within GWCL was appropriate but could be improved upon.

Finding 5: Managerial effectiveness is satisfactory
Most of GWCL staff interviewed stated that they were satisfied with the level of managerial effectiveness as most managers portrayed good managerial skills. They expressed the view that management has set clear and measurable objectives for e-billing. Senior management must ensure there is effective communication between all employees at the various regional and district offices.

Finding 6: Change and change management driven top-down
Change is perceived as a top-down approach. Some interviewees stated that they had little opportunity to contribute their professional expertise to change processes and practices. They see change as driven, dictated top-down by senior management, to be implemented unequivocally within the GWCL, thereby making change a "mandatory" top-down model.

Employees also raised the concern that on some occasions, they were asked to contribute ideas on a particular issue, but the GWCL management always made the final decision. This makes them doubt the authenticity of the exercise. Employees are recipients of policy directives.

4 Results Achieved

GWCL has successfully formed a change management team (CMT) to manage change steps. The CMT is governed by a change advisory council (CAC). Members have positions such as heads of departments/units and senior management with authority to make decisions.

A change advisory council (CAC) ensures GWCL ownership and sustainability of change activities. The committee consists of GWCL senior managers. It is responsible for providing guidance, advice and authorization to the change management team on change initiatives.

A change management team (CMT) was established to deliver approved changes. Members include representatives from GWCL regional and district officers referred to as “change champions”. The CMT manages activities of training and communications coordinator.

The change initiatives are implemented through a change authorization structure which provides governance around the changes. Figure 3 presents the change authorization structure.

The UN BTCA change management expert works with GWCL CMT to develop proposals for change, implement and assess impact. The GWCL change management framework (shown in Fig. 4) aims to accomplish the following actions:

- Guide GWCL how to effect sustainable change.
- Facilitate discussions by GWCL management on problem identification and possible scenarios for a solution.
- Introduce innovative concepts and ways in which effective change works.
- Help develop and highlight steps GWCL needs to take to make change happen.

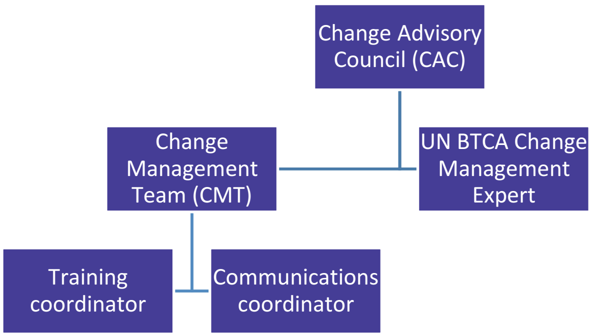

Fig. 3 Change authorization structure

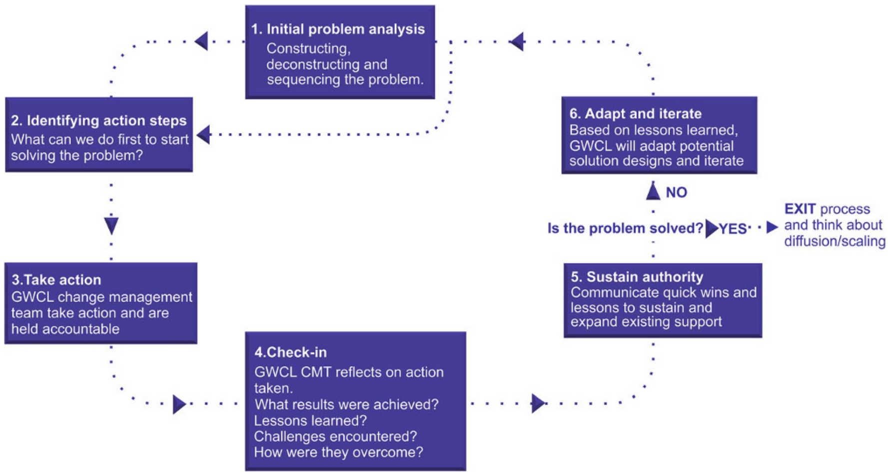

Fig. 4 Change management process framework adapted from Problem-Driven Iterative Adaptation (PDIA) (Andrews et al. 2013)

- Assist GWCL to analyse and break down complex problems into manageable components that can be solved more effectively.
- Support GWCL in recognizing and understanding the "people" element of managing change.
- Set up the change advisory council and change management team.

In managing the change process, the following areas are the focus of the framework throughout the process (adapted from PDIA [Andrews et al. 2013]). The PDIA steps provide a pragmatic approach to solve complex problems. The steps are:

1. Is the right problem being solved? Identifying the right problem.
2. Identify the benefits of the change.
3. Document the requirements for change (personnel/financial/political resources).
4. Solutions (the right solutions to these problems are being developed—based on requirements).
5. Impact/changes to policies/processes.
6. Alignment with GWCL digitization agenda.
7. Ensure that the change/transition process is undertaken in an effective, efficient and inclusive manner.

The underlying basis for the GWCL digital payment change management framework is Kurt Lewin's three-step model which involves three-stage processes, that is, unfreezing, changing and re-freezing. The framework also draws on elements of three models: Prosci ADKAR (Prosci 2004), Kotter's eight-step strategy model (Kotter 2012) and Problem-Driven Iterative Adaptation (PDIA) (Andrews et al. 2013).

The GWCL digital payment change management framework enables the GWCL change management team to iterate various change initiatives around their priority problems by repeating the process of identifying problems, identifying resources, creating solutions, implementing the solutions and then learning and adapting. The steps in the framework can be repeated until the broad objective of digital payments is achieved.

The GWCL change management framework involves iterative steps until the change is successfully implemented and yielding results. The steps in the framework are shown in Fig. 4.

Four months after the change initiatives were implemented, GWCL began seeing results. In April 2020, four (4) change concept notes were developed by the CMT and subsequently presented to the CAC for approval, thereby building the necessary legitimacy to mobilize support.

The first result is that in June 2020 the CMT developed a communication strategy that includes timelines to communicate change, the key messages and communication channels. Previously GWCL employees in the districts and regions were dependent on the regional and district managers for information about change. This led to poor communication resulting in rumours, thereby creating resistance to change. After the strategy was implemented, all messages are centrally coordinated through various channels such as SMS, WhatsApp, newsletters and Intranet.

Secondly, the CMT has built on the GWCL staff entrepreneurial orientation through training, guidance and coaching. During the focus group discussion, it was clear that some GWCL staff think of the company as theirs. At one of the meetings, an employee said: "*they are not a typical government agency, they generate their revenue, so it is in my interest to ensure customers are paying their bills*". There are signs of proactiveness among staff. This is in line with the transformational leadership style which is a key element of change management.

Thirdly, the CMT has been able to identify some GWCL staff members in the districts and regional offices who do not hold managerial positions but are highly regarded as leaders by their colleagues. These staff members have been made champions and went through formal change management training. They understand the operational details of GWCL processes. They can advise on potential problems and likely customer reactions with the ongoing digitization initiatives.

The fourth result is that the CMT developed a detailed training plan addressing the capacity gaps identified. With the change message out in the open, there was a feeling among some employees that they would be left behind due to lack of IT skills. Therefore, a digital literacy program was developed to teach the skills and knowledge required to operate efficiently and effectively as the change is rolled out. The training style is a blended learning approach incorporating face-to-face training sessions or on-the-job coaching and mentoring.

The communication committee in the CMT actively developed success stories to communicate the current achievements of the digitalization project, converting early wins, no matter how small, into success stories people can understand.

These stories reinforce that small contributions really do matter and create momentum for change.

4.1 Future Work

In November 2020, the framework is showing good results and has helped GWCL to own and implement their change initiatives. However, GWCL will require more time to institutionalize it as part of their operations more broadly. The initial focus was on guiding and coaching GWCL's CMT to fully utilize the framework and approach. In the next stage of the project, the authors will conduct a final assessment to establish the effectiveness of the change management tools to the transformation process. The change management approach will be deemed to be a success if GWCL can achieve the following:

- The CAC and stakeholders remain committed to the change management cause.
- The CMT is active and GWCL staff are attending trainings and workshops.
- Finally, and most importantly, there is an increase in the usage of digital payments for bill collections.

5 Lessons Learned

GWCL succeeded in setting up a change management team to lead the implementation of change initiatives. Change in a public organization is complex. It should be implemented following a plan and must be introduced iteratively; a single jump to change is a recipe for failure. The GWCL approach to public sector change management provides a practitioner approach to solve a complex problem. Table 1 outlines the key lessons. Below we further discuss the lessons.

Lesson 1: A transparent and systematic approach to change management enhances digitalization (increases usage and adoption)
This case study confirms the view that managing a successful change in the public sector can be challenging and difficult. It also supports the finding of Labianca et al. (2009) that discrepancies between an organization's ambitions and the received performances can motivate change.

Table 1 GWCL change management: key lessons

	Key lessons
Lesson 1	A transparent and systematic approach to change management enhances digitalization (increases usage and adoption)
Lesson 2	An iterative approach allows failure and lessons to be learned
Lesson 3	Use a context-specific change management framework based on good practice to establish sustainable change
Lesson 4	Use change champions to drive change

Change management efforts must be built on problems people care about. In addition, while planning for change, follow a change management framework. In this case, the framework uses principles from PDIA which refers to the identification of point of engagement, also referred to as "space for change". GWCL's change management team has successfully established a system for the implementation of change initiatives. Proposals, in the form of concept

notes, are solicited from various departments of the company for submission to the change management team (CMT) for approval and support. The CMT uses the criteria provided in the change management framework to establish the proposals criticality and feasibility, which then inform the discussion to proceed.

The proposal is then submitted to the change advisory council (CAC) for consideration. If the CAC agrees, then the CMT adds the change initiative to their portfolio. Changes which do not go through this process are not supported by GWCL senior management. GWCL change activities are now intentional and well managed. The CMT has invested time and energy into the process making sure it becomes part of the culture of the company.

Lesson 2: An iterative approach allows failure and lessons to be learned
GWCL's CMT approach to supporting change initiatives is a step-by-step discovery of what is possible in the near-term to progress towards aspirational goals and then working to achieve these possibilities. The process of digitizing GWCL is iterative involving experimentation, failure and setbacks, as well as shifts in direction. The digital payment change management framework supports learning while doing that builds confidence and encourages new behaviours. GWCL understands that to build an e-company, it needs to experiment and learn from its mistakes.

The experimental approach to change management has positioned GWCL as an organization that is open to various solutions. The new norm in GWCL is that it is "ok" to fail since that is the only way to learn.

Lesson 3: Use a context-specific change management framework based on good practice to establish sustainable change
The implementation of GWCL digital payment change management framework is time-consuming, initially may be seen as not really having any end point and takes time getting used to, but it is a worthwhile exercise in achieving sustainable change. Additionally, it helps to ensure that interventions are developed within the local context, and with support from stakeholders, and owned long after consultants have left. It requires all involved to move away from developing preconceived assumptions and move towards the goal of finding solutions that actually work for our specific problem. In a public sector organization, it requires political will, a commitment of time and personnel who are dedicated to engaging with the problem and resource commitment.

Lesson 4: Use change champions to drive change
GWCL has some staff members in the districts and regional offices who may not necessarily hold a management position or are even known to senior management but are highly regarded by their colleagues as a leader. These staff have personality,

competency and information, are politically astute and are trusted by their colleagues. It is crucial to identify these people and make them the change champions. Since they understand the operational details of GWCL processes and highly regarded by their colleagues, they can advise on potential problems and likely customer reactions with the ongoing digitization initiatives.

The intent of the transition to e-billing is borne out of the desire to improve the entire billing system of GWCL. All aspects of the company's operations that deal with billed consumption and its resultant revenue generation are being enhanced under the e-billing project.

As shown in this case study, employing an iterative change management system is a difficult approach to master. As going digital becomes the norm in GWCL, change management should lead the way. Because change management is very much based on the context and culture of the organization, every organization seeking to implement changes could tweak this framework to their specific needs.

The framework provides a disciplined approach to practicing change management in the context of GWCL. It is thus our hope that the lessons learned from GWCL experience can assist other public sector companies with their digital transformation.

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Impact of the Digital Transformation on the Transformation of the Workforce

A Methodical Approach by the Example of the Technical Development of a German Automotive Manufacturer

Nils Schaupensteiner, Sophia González, and Judith Borgmann

Abstract

(a) **Situation faced**: Traditional car manufacturers can no longer escape the pressure of digitization and automation. For the workforce, it is extremely challenging to face up to the need for the changes derived from this. These changes are induced externally, as customer needs and thus the requirements for the degree of digitization of products are changing (e.g., connected cars, automated driving functions, on-demand and sharing offers, etc.). At the same time, the pressure for change is induced internally, as employees' needs are also changing (e.g., digital workplaces, modern IT equipment, integrated systems and processes, digital collaboration, etc.). Our approach starts here and accompanies the technical development division of an automotive manufacturer in the development of a concept for the transformation of its very own workforce.

(b) **Action taken**: To enable the case study company to transform its workforce of the technical development division in a meaningful way, the division-specific constellation was considered. This constellation consisted of history, internal performance scopes, external performance scopes, and personnel strategy goals. Together with the relevant stakeholders (based on a stakeholder analysis), precisely fitting methodological approaches were selected (based on expert discussions) that met this specific situation. A transformation concept was developed that placed the employee at the center, provided room for individual problems and needs, and clearly relied on the participation of the workforce.

(c) **Results achieved**: The actions taken resulted in a ground-laying understanding of what digital transformation entails specifically in this traditional organization; what needs, obstacles, and interests reside within the workforce and towards management personnel; and how these can be tackled from different angles. With this knowledge, it was subsequently possible to develop targeted measures

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to sensitize the workforce to the necessary digitization change and to increase its acceptance. It was possible to give the management's quantitative transformation goals a practical relevance and to validate their feasibility.

(d) **Lessons learned**: Implementing digital transformation measures within the case company with its traditional business models and structures was a significant challenge. The holistic approach of the present paper has shown that a step-by-step approach with compact, purposefully communicated measures can lead to the goal of sustainable workforce transformation for the digital automotive age. Despite the involvement of all relevant stakeholders and those affected, both the company's expert team and management personnel must be prepared for delays or even failure of this transformation process at any time. At the same time, however, it was accomplished to learn and show that—contrary to expectations (and prejudices) in some parts of management—the absolute majority of those involved were ready for change.

1 Introduction

Grounding in one of the most significant industries in Germany, car manufacturers have been major players for decades. "With approximately five million jobs depending directly or indirectly on the automotive industry" (Haipeter et al. 2012), a major public interest in their actions follows. Since the known externalities such as climate change, ageing societies, and urbanization imply radical changes and digitalization in almost all areas of life and work, traditional businesses must find a way to deal with these changes. Frequently, this implies shifting their competencies, organizational structures, and even business strategies to reflect the needs of a digital society appropriately (Digital Society Index 2019). To date, car manufacturers have been able to achieve extremely successful economic development, not only in Germany. They have been the engine of society, mobilizing entire continents. In the exponential scaling of their product "car," they have managed to develop, manufacture, and sell an increasingly complex product in large quantities and at high quality.

For the car company in this case study, the focus lies on securing the long-term success based on a sustainable product and service portfolio. However, massive digitization and automation are threatening the previously successful business model. The digitization of society and the omnipresence of technology are changing people's needs in terms of mobility (usability, simplicity, availability, flexibility, cost-effectiveness) and communication (smartphone-centric lifestyle). Subsequently, this changes their needs as automotive customers or users of automobiles and as employees in automotive companies. This change in needs and desires leads to the necessary adaptation and redevelopment of the car and mobility products of the company under consideration.

The basic need for mobility still exists, movement from A to B. Nevertheless, the movement itself is more burden than pleasure (e.g., traffic jams, search for parking space, noise, other stimuli that are more interesting for many customers, such as social media, streaming, etc.). These changes (e.g., digitalization, traffic volume, and the needs of new markets) are changing the requirements for cars. Ultimately, these changes must be implemented by the providers. And thus, changes must be understood and implemented by the employees of our case company. This results in digitization- and IT-specific changes and challenges, such as:

1. Meeting digitization with analog methods to make complexity and abstraction tangible (e.g., with the help of Design Thinking, which is further explained in the following chapters).
2. Focus on user-centeredness and empathy—towards end customers, but especially also towards and between employees.
3. Existing IT solutions (e.g., HR [human resources] systems, CRM systems, file storage, collaboration software) are either not available, not integrated, or their functions no longer fit the requirements.
4. Ongoing (and quite functional) business processes are based on the existing IT landscape. As a result, significant barriers exist to evolve these IT systems, let alone replacing them with current, modern software. There may be reduced or no work capability, problems with training employees may arise, or a tight budget situation may put executives under pressure to justify their actions. This results in major concern on all ends.

Respective adaptions to this digitization-driven change require the reorganization of the core business of the case company, which has massive effects on the technical development division. New technologies and vehicle concepts as well as a significantly higher proportion of software and control units in the vehicle require new development processes and new competencies. At the same time, some competencies are no longer needed because of the digitalization and virtualization of the development process. The question arises as to how these new requirements can be implemented with the existing workforce, considering reasonableness, employer attractiveness, and the work council. Which changes are necessary in the organization and in personnel development? What are the challenges and deficits and what are the possible solutions and benefits?

As existing corporate cultures deeply root in hierarchical orders, perfectionism, and safety, it is difficult to establish concepts such as flexibility, courage, and openness. Nevertheless, these traits are crucially important for the organization to react as quickly as possible and catch upon the wave of radical change and transformation, be able to hire new talents, and motivate the existing workforce to co-create and design the organization's transformation. This becomes especially important as the forthcoming change will very frequently result in fear of loss and respective resistance. It is believed that this is dissolved with hard goal-keeping and top-down approaches.

The present paper addresses these aspects and presents findings from practice as well as solution concepts based on them, which make an employee-compatible, economic transformation possible. Embedded in a case study, this paper shows the dilemma of cutting jobs that are no longer needed while at the same time building up new areas of competence. Herein, transformation is key. Subsequently, the underlying case study is used to illustrate the importance of specific training concepts, self-regulated development, and employee experience.

The paper at hand provides answers to the question of how the transformation within the technical development as the core of the automotive OEM can be carried out successfully. To this end, a referential approach has been developed that not only incorporates scientific findings, practical experience, and organizational knowledge but also encourages all hierarchical levels to cooperate. In addition to conventional user research (Schumacher 2009), the approach includes a specific series of workshops and integrative, communicative activities.

The overall goal of this approach is to achieve a positive connotation of the term "transformation" by channeling the organization's focus to the maximum extent possible on its employees and their respective empowerment.

2 Situation Faced

The automotive company, in which the approach was developed and implemented, is based on a traditional organizational framework that includes numerous hierarchical levels and departments. These in turn pursue different goals and often do not have a common scope. Therefore, working in silos is fueled (Lencioni 2006). The central decisions of the digital transformation and thus for the transformation of the workforce show in their basis a sum of numerical KPIs (key performance indicators), which consider the human factor downstream.

The lack of translation of numerical goals into individual goals that reflect a meaning for the employees behind them suggests that there is a need for change in management methods and tools. Against the backdrop of constant digitization-driven change, it seems necessary to formulate HR policy goals in such a way that they place the employee at the center of the transformation. In concrete terms, this would entail that the goals should be flexible, soft, and adaptable. In practice, however, a different reality was encountered. The employees reported that most of the experienced transformations appeared to be associated with nontransparent, incomprehensible goals and restructuring. Corresponding actions seemed to have their origin in management and controlling decisions.

This is all the more surprising since technical development in particular has a very heterogeneous workforce. Indeed, a large part consists of academics with degrees in natural sciences or engineering who work, for example, on the development of components. However, a not inconsiderable proportion of employees are skilled workers who work on test equipment or prototypes.

This discrepancy between strategic goals and operational reality seems to increase with the growing complexity and size of the organization. This might have a considerable influence on the perceived distance between the workforce and management personnel and thus on the degree of mutual trust (see also Mayer et al. 2014).

What are the reasons for this discrepancy between strategic goals and the operational implementation of the transformation of the workforce? Usually, strategic goals are decided top-down and passed on downwards. They tend to be based on assumptions that in part do not match the reality of the operational level. At the management level, there is often a lack of empathy for the individual who is to be transformed, as their insight at operational levels is missing. This means that middle management strives to achieve its own goals (e.g., implementation of strategic top-down goals)—but the lower management levels may not always understand these goals, let alone implement them, as transformation requires individual, employee-related solutions. Thinking in cohorts, i.e., larger groups of people who can supposedly be transformed similarly, does not meet reality and fails.

In considering this transformation-related problems within the case at hand, the following three perspectives are observed: the organization as a whole (regarding the specific department), the organization's leaders, and its work force, where we were confronted with a middle four-digit headcount. It appears that goal setting often is not communicated "layer specifically," and hence, leaders and employees find themselves feeling lost, unconsidered, and left without the "right tools" to tackle, e.g., the impact of the digital transformation on their own work area. Hence, transformation is often described to be a fait accompli that is to be followed without questioning it. Possibly and as a matter of practicality, this originates from an overall orientation based on cohorts. The transformation of the company and thus the workforce is broken down into measures to be implemented for a specific group of employees.

While this simplification makes it relatively easy to view and discuss the large organizations as a whole, it is difficult to address the individual and its transformation fears and needs. Measures implemented on this basis may thus lead to idleness and demotivation based on anonymity. By orienting in relatively large numeric lot sizes and considering the transformation of an entire organization, a diverse ambivalence is spotted: employees may be simple "resources" as well as a "matter of expenses." The dilemma becomes clear: on the one hand, the company wants to and must commit itself to the existing workforce (also forced by strong work councils). On the other hand, it is the unconditional duty of management to ensure the future viability of the company, which is only possible by transforming (and possibly partially replacing) the workforce and enabling it to cope with digital change.

The organization under consideration tended to implement transformation programs top-down, which could be one reason why the term "transformation" has a strong negative connotation. Since the first question is always what and who should be changed and only rarely why and how, demotivation due to a lack of intrinsic incentives among employees could not be avoided.

Once again it becomes clear that there may be an interdependence between the factual and the emotional level—two inner perspectives, therefore, which must be considered parallel and synonymous. This complexity is extended by different "starting points" of the transformation where the employees initiate the journey of transformation. On this individual, personal path of transformation, each employee carries several different abilities, capabilities, needs, and challenges that should not be overlooked. Recognizing the importance of the human factor in the equation of transformation, the following question crystallized for the paper at hand:

How can the transformation of the workforce of the core of an automotive OEM, namely, the technical development division, be accompanied positively in order to master the resulting changes sustainably and successfully?

3 Action Taken

In order to be able to cope with the described challenges of the transformation of the workforce, an employee-centered approach was chosen in the context of the present case. To investigate the importance of individual experience and empowerment of employees and to obtain a resilient access to the workforce, this approach was carried out together with the HR (human resources) department.

Through the combination of scientific approaches, practical experience, and organization-specific knowledge, it was possible to address different levels of stakeholders such as management, work council, and operational work levels. In addition to traditional social and user research, the developed approach included a specific workshop series, which was individually conceptualized in order to meet this organization's characteristics. This series of workshops formed the basis for the derivation of concrete solution approaches and measures for a positive connoted transformation. The results were then processed, measures prioritized, and concrete recommendations for action derived. This, in turn, was evaluated with employees and subject matter experts to obtain a commitment for the implementation phase. The entire approach consisted of four stages, which are based on the user-centered method "Design Thinking" (Plattner et al. 2011):

1. **Understand**
   Explore the problem from different perspectives such as employees, market, and organization.
2. **Define**
   Collect and determine a set of information and reflect it in personas, need statements, and employee journeys.
3. **Develop**
   Co-create ideas and solutions in a team for defined needs as well as pains to answer the initial problem.
4. **Test**
   Validate solutions and hypotheses with employees in order to integrate feedback for continuous improvement and "fine-tune" knowledge about the problem.

Design Thinking has proven to be a great success factor in creating, maintaining, and sustaining a competitive advantage as it not only alters the way products and services are developed but even affects entire business strategies and scopes (Brown

VALUES
Building values as a core principle for everything within the new work concept

CULTURE & PEOPLE
Enabling employees to strive according to their strengths and needs

ORGANIZATION & STRUCTURE
Adapting business processes to the conditions of disruption

TOOLS & TECHNOLOGY
Using digitalization for positive change in the world of work

SPACES & ENVIRONMENT
Creating areas to bring people, technology and activities together

Fig. 1 Dimensions of New Work utilized for this case study

2015). Furthermore, it provides a framework to better understand, untangle, and solve complex concepts, problems, and issues (Clark and Smith 2008). To be more specific, by lying at the "intersection between technical feasibility, economic viability and desirability of the user" (Plattner et al. 2011) and hence considering a holistic perspective, an approach grounded in Design Thinking minimizes the risk of failure in the endeavor of solving a problem right from the beginning.

Complementing the Design Thinking and user-centered approach, the concept of "New Work" (Bergmann 2017) was considered. For the approach presented in this paper, this concept was subdivided into five different dimensions, which support practical-oriented measurements and actions. The concept enables a holistic view on how people work today and desire to work in the future (ibid.). Moreover, it was utilized as a general orientation for the following phases. The concept of New Work underlined research, workshop structures, and the presentation of the results. Figure 1 provides a detailed description of how the concept was understood in this case study.

In all phases of this project, the framework was supported by three principles. Firstly, the aim of all activities was a continuous focus on the employees, in this case the employees and managers. Secondly, the expert team that conceived and conducted the workshops consisted of interdisciplinary experts in their respective fields, including human resources, New Work experts, change managers, training offices, work council, engineers, and project managers. This ensured that the outcome was examined holistically by various stakeholders. Finally, the problem was approached iteratively in order to constantly question findings and implications and develop better solutions.

The corresponding phases of the project based on Design Thinking and New Work are described in more detail below.

3.1 Understand

Starting from the approach of focusing throughout on employees' needs and pains, it was necessary to understand, firstly, who the employees were exactly and, secondly, what their specific problems were. "Employees" in the present case meant employees of the technical development division of the car manufacturer. In order to better understand their actions and motivation, a deeper understanding of the people involved, their roles and fields of activity, and the effects of the transformation was first required. The resulting employee and stakeholder map formed the basis for the next steps.

After prioritizing employees and stakeholders according to their impact on transformation and vice versa (influence in terms of implementation and decision-making power), particularly relevant employee groups were identified. Subsequently, members of these groups were questioned by the expert team during expert conversations in which we oriented ourselves on the concepts of Meuser and Nagel (1994). The goal of this approach was to understand what factors affect these experts in the context of transformation and which respective needs are implied.

The expert conversations were extended by an analysis of the company-specific framework conditions. For example, an analysis of organizational charts, divisional goals, communication documents, strategy papers, and implementation maps for transformation measures was carried out. Parallel to this, a market research was conducted, which aligned with the initial problem definition and incorporated the investigation of how other OEMs were approaching and coping with the broad-based workforce transformation.

3.2 Define

Based on the findings of the understand phase, a specific set of information was collected and determined which formed the starting point for the subsequent define phase. This set of information was expressed in specific personas and "as-is scenarios" based on hypotheses. Validating the formulated hypotheses supported the expert team in defining what knowledge about the problem statement already existed and which "white spots" were to be examined and filled. In the following research phases, the hypotheses were further developed, sharpened, and evolved with new information.

3.3 Develop

After defining personas, "as-is scenarios," and hypotheses, the next step focused on validating such insights to create solution ideas. Therefore, the core of the approach

Table 1 Transformation workshop setup and dimensions for the case study

Agenda item	Goal description	Method
Transformation strategy	Giving an impulse in the context of digital transformation and the impact on car manufacturers	Presentation
Problem description	Explaining the organization-, skill-, and it-related problems and existing insights to set the frame	Presentation
"Transformation means for me . . ."	Gathering general thoughts about transformation by talking about chances, risks, pains, and gains to create a common understanding	Brain writing and group discussion
"What's important for me is . . ."	Retrieve individual opinions related to the transformation by asking questions regarding what someone says, does, thinks, and feels about it	Empathy mapping
Needs and pains collection	Collecting current needs and pains of the employees along the five dimensions of New Work	Group discussion
Areas of motivation	Offering different motivational factors in order to prioritize them regarding their influence on change ability and motivation	Card sorting
Ideation game	Ideating possible solutions to address the identified needs and solve problems	Brainstorming
Future scenarios	Developing the ideal transformation process from the individual employee perspective. Starting with an internal or external need for change until having new competencies or a position	Employee journey mapping
Outlook	Present the next steps and possibilities to give further feedback as well as to again involve the respective participants	Presentation

was the development of a validation workshop series for employees and managers. During the corresponding co-creation sessions, different aspects were elaborated within the workshop teams. In total, five-and-a-half-day workshops with each around 15 participants from different areas of the organization were executed. The workshops were promoted in advance on the organization's intranet and other internal company media. Participants could register independently and voluntarily. In summary, the content of the workshops concentrated on focal points such as personal experience with transformation, individual needs and pains, areas of motivation, and personal future scenarios. A more detailed description of how the workshops were set up is provided in Table 1.

During the workshops, the objective was to jointly design possible solutions. In order to do so, listening carefully to what experiences, feelings, and thoughts the workshop participants shared turned out to be crucially important. This was realized by introducing the participants to a method called "empathy mapping" (Gray et al. 2010). Herein, participants were provided with a printed grid on paper and were asked to share what they feel, think, say, and do about the topic of transformation. Consequently, participants not only were given the chance to openly discuss their points of view in the group. They provided with the opportunity to write down their opinions privately. The results of open versus closed sharing of opinions differed considerably.

Afterwards, the findings resulting from all workshops were clustered, prioritized, and framed into a total of 46 recommendations for action, which relate to different areas of the organization underlined by the five New Work dimensions. The recommendations target fields like processes, methods, trainings, events, and technologies, which in turn were derived from employee voices, impressions, and personal opinions. It should be stressed that these were consolidated and completely anonymous, highlighting the anonymity of each participating individual. It was especially important to the expert team to highlight that the results remained anonymous at all time to achieve the highest degree of truthful individuality from workshop participants.

After presenting and discussing the results, the final prioritization was undertaken. This involved jointly voting by focusing on two dimensions: the value for the employees and the feasibility within the specific organization. In the end, four recommendations for action were selected for implementation within the upcoming 12 months by setting up individual projects. The projects based on the recommendations are:

1. Leadership transformation toolkit
2. Transformation community
3. (Digital) leadership trainings
4. Transformation core team

3.4 Test

After the ideation phase, it was important to the expert team to validate the previously defined hypotheses by employees and managers. Subsequent decisions should be group decisions in order to raise respective acceptance levels. In line with this, the results from the develop phase were shared with the workshop participants. They were provided with the opportunity to see and understand which prioritization was made and which of the measures were selected for implementation and why.

Furthermore, a voluntary follow-up meeting was organized for the participants. The aim of the meeting was to increase transparency about everything that was derived and developed after the original series of workshops. Moreover, participants were given the possibility to comment on the prioritized recommendations for action. This involved adding additional information and ideas, collecting relevant contact persons that are useful for the implementation phase, and correcting details.

Furthermore, the initial hypotheses were questioned by the employees and evaluated as to whether they were fulfilled by the prioritized recommendations for action and the resulting projects. Lastly, it was possible to discuss who of the participants would like to take over operative responsibility in one of the transformation projects planned. Hence, they were provided with the possibility to engage and design transformation themselves in their organization.

After incorporating the feedback into the project profiles, a holistic documentation of the results with all findings, best practices, and possible solutions was created and handed over to the responsible management personnel. This document also contained recommendations on how to involve employees in the further process and future initiatives—and why this is of utmost importance for the long-term success of transformation measures. All in all, the approach and the respective employees' feedback have once again demonstrated how important it is to involve affected employees in the solution design process and that such processes are already coupled with positive connotation.

4 Results Achieved

The approaches and methods used within the different project phases led to various answers and results, which enabled the expert team to mirror the status quo within the case company. This was done from an employee as well as from a managerial perspective. Finally, the expert team and relevant stakeholders were able to build a broad understanding about what digital transformation means for affected employees and managers and their organization. Many ideas and solution scenarios were developed focusing on the future transformation of different target groups. These results provide the necessary basis for further actions. Precisely, these actions may involve employee-centric activity in the areas of employee-oriented qualification concepts, the development of existing and new IT qualifications, and a positive support of transformation and communication guidelines. In summary, five key results have been achieved:

1. **Substantiated as-is analysis**
   A detailed as-is analysis on how transformation is viewed by affected people and what needs and challenges employees and managers face
2. **Empathy as core value**
   A new employee-centric approach for the respective project-related department enabling them to think in an employee-centered manner and setting empathy as a core value for transformation
3. **Transformation target picture**
   A concrete and yet holistic target picture for the prospective "positive design" of the transformation
4. **Five-step transformation blueprint**
   A step-by-step blueprint for employees and managers on how transformation can ideally be approached in the future
5. **Transformation action plan**
   A derived target group- and topic-specific action plan including all recommendations for action to derive and implement the next steps

4.1 Substantiated As-Is Analysis

The core part of the developed framework focused on making the status quo visible. This was achieved by a detailed as-is analysis based on employee and market research, expert conversations, and workshops. In this case, the target group consists of employees who are significantly affected by the primarily quantitative transformation goals or who must implement them in their area. In doing so, the as-is analysis revealed that the greatest transformation challenges are centering around issues of organization and corporate structure, as well as human factors, such as company culture and the people behind it. In addition, the responsible employees realized that available tools and technologies as well as existing work rooms and the company environment are increasingly perceived as hygiene factors (Herzberg et al. 1993). Although a particularly good expression of these factors can motivate employees to support the transformation, an actual critical influence on its success could not be identified.

The respective transformational challenges stated by employees and managers include uncertainty, distrust, lack of transparency, distance, resignation, complexity, inertia, and inequality. Further analyses demonstrated that there is a similar distribution of needs across all areas, with a focus on values, culture, and people as well as organizational structure. The most critical needs mentioned by both employees and managers include trust, transparency, community, appreciation, employee-centricity, flexibility, and needs-based organizational orientation. It can be stated here that the greatest challenges reflect almost equally the formulated needs.

Additionally, great risks were seen to be in the fact that the shift of needed competencies in the affected departments could also result in new team structures and areas of activity as well as products and services and that such changes could endanger the success of the entire company, which in turn would lead to an omnipresent sense of uncertainty.

These necessary structural changes and the ambiguity about the future are additionally increased by the prevailing in-transparency of information, contact persons, and miscommunication. The complexity of the company and its accompanying lethargy rendered communication, clarity, and transparency even more difficult.

Nevertheless, opportunities emerged from these insights and findings as well. Changing and breaking up existing behavioral patterns promoted reflection and questioning of the status quo. In addition, the adaptation to change offered room for networking, personal development, and the exchange of information. Furthermore, the employees and managers described a newly acquired freedom to engage in new approaches and to experiment in former rigid structures.

4.2 *Empathy as Core Value*

During the case study, a new approach for the respective department has been developed demonstrating the active involvement of employees in contrast to previous approaches. This employee-centric approach enables the respective management personnel and highlights the importance of profoundly understanding the affected people and experiencing the added value of their involvement.

From the outset, "expert conversation" partners and workshop participants were glad to be offered the opportunity to share their own positive, as well as negative, experiences regarding the transformation. Sharing personal ideas and thoughts was considered an enriching experience.

Managers said they lacked suitable tools, structures, and resources. This would make it more difficult for them to be a significant driver and positive companion of the transformation. After the workshops and the direct dialogue with other workshop participants, a considerable proportion of the managers stated that they had achieved a better understanding of the employees' perspective on transformation.

As a further result, the desire for a more frequent execution of corresponding workshop formats should be established, and also the synchronization of hierarchical levels should be strengthened in other initiatives. It is precisely this positive influence on leadership and corporate culture that should be transferred to the entire organization, which is believed to be contributing ultimately to an overall positive connotation of the transformation.

4.3 *Transformation Target Picture*

Another result was a tangible target picture for the transformation, which aligns employees, managers, and the organizational perspective. The core of this target picture grounds on the concepts of transparency, participation, and guidance:

a) **Create transparency** regarding goals, structures, and possibilities in order to enable independent action and to lead those who are affected to new competencies and roles.
b) **Promote participation** by the ones who are affected in order to shape transformation in a self-empowered way. Consequently, measures and activities have higher chances to be accepted by employees, managers and the entire organization during the transformation process.
c) **Provide adjustable guidance** during individual transformation processes, in order to gain a holistic perspective and to support employees in everything they face (structurally and psychologically) due to the transformation.

These objectives are accompanied by three principles, which will be outlined in the following. Firstly, transformation should be perceived as an opportunity and should not be associated with a threat nor adversity by those affected. It should rather be presented and demonstrated to be a chance to engage in new areas of work. Secondly, it is important to make transformation accessible for everyone and to enable the entire workforce to develop and initiate changes. Thirdly, it should be explained clearly that transformation will never stop and changes should be perceived more and more as "something natural" in daily life. Only then, it is possible to free the term "transformation" from its negative connotations and to create links to concepts such as opportunity, curiosity, and trust.

4.4 Five-Step Transformation Blueprint

Based on the defined target picture and the related principles, a transformation blueprint was derived. In order to account for the differences in roles (employees and managers), two adapted guidelines were formed. However, it should be stressed that both blueprints were formulated by representatives of those groups (employees and managers) and only differentiate themselves by the practical execution of the respective phase. Hence, it was ensured that the blueprints continued the holistic and employee-centric character of the overall approach. Therefore, five general steps were identified to be laying the groundworks of the transformation blueprint for employees and their managers accompanying them.

To begin with, transformation is triggered by an impulse. These may involve various kinds of internalities and externalities such as information coming from external or internal media, or the direct confrontation with job insecurity due to restructurings. Nevertheless, the organization may be able to influence the absorption of the impulse by their employees advantageously by using positive and coherent language. In large organizations, as in the present case study, the work council should be involved from the first step to reconcile "hand in hand" employee-orientation and corporate goals.

Secondly, employees engage in an inquiry of transformational possibilities. They inform themselves about the possible qualification paths and job positions they could fill. At the same time, managers should be able to guide them through the process by having access to the necessary information and overviewing organizational structures accordingly. It should be stressed that also managers should be provided with the necessary tools, such as a clear and reliable organizational vision and mission, and respective competencies to be able to support their employees sustainably and authentically.

Thirdly, employees engage in personal planning. Here, they concretize their ideas and choices resulting from the second step and develop direct milestones. More precisely, employees, together with their manager or supervisor, opt for the possibility that deemed to be best suitable for them. It should be mentioned that a trail phase may be advantageous as this lowers the level of stress employees express towards their individual transformation and ensures a higher acceptance level of both welcoming team and transforming employee. After this, both the employee and the respective manager will be able to jointly discuss and decide on the further development and transformational steps of the employee.

As a fourth step, the employee will engage in the actual qualification, which is considered necessary for the intended new position or professional field of work. Qualification in this context means empowerment. On the one hand, individual learning offers must be made for a successful transformation, since individuals learn differently. On the other hand, entrepreneurial interests must be considered. This means that for financial reasons alone, one-to-one supervision is not possible. One possibility is the combination of online learning platforms and on-the-job training. Learners are given the opportunity to learn anytime and anywhere. Additionally, they gain direct insights into practice and first-hand experience (Wildgrube et al. 2019).

Lastly, after gaining the necessary qualification, the employee takes over the new occupancy. While doing so, they should be welcomed by their new team with practical advice and openness. Alongside this team effort, previous and potential new supervisors should jointly guide the employee into the new endeavor. It is important to mention this joint venture of previous and new supervisor, as this ensures that former employee goals and accomplishments are not lost but transferred to the new setting. Precisely, this entails that employees can build upon what they already accomplished and do not have to start from scratch. Subsequently, they may feel more valued which in turn is followed by a higher commitment and motivation to sustainably transform the organization in the future.

4.5 Transformation Action Plan

Another result achieved concentrates on the transfer of findings into concrete recommendations for action. The recommendations have been developed based on workshop results which have been clustered and prioritized by the expert team, experts, stakeholders, and employees. This resulted in 46 recommendations for action. Four of them were selected for implementation over the next 12 months, and five others were detailed via project descriptions. In addition to the transformation blueprint, this backlog of measures represents a tool for actively designing the transformation in the respective department (see Table 2).

The five key results show that the positive design and monitoring of transformations is not only about training employees but also about developing a holistic, future-oriented concept. In doing so, the individual employee potential should be encouraged and supported. This may help to move from individual, small spots to a concrete target picture. To achieve the target picture, role models and standards may help to manifest the culture and structures that support change to appear as something positive and widely common.

The results confirm that especially the individual's transformation and change often have negative connotations due to uncertainty and the lack of information. Secondly, the complexity and inertia of a large company leads to a large discrepancy

Table 2 Selected recommendations for action

Recommendation	Description
Leadership transformation toolkit	Empowerment of managers through information about the transformation and the defined process as well as methods for accompanying their employees. Managers must also be enabled to communicate goals, strategy, and timetable in a transparent and continuous, employee-centered dialogue
Transformation community	Guided networking activity and exchange of experiences to enable the sharing of lessons learned and success stories. Employees who are going through or already passed a transformation process can be supported by other involved employees which enables a supportive culture, solidarity, and increased confidence
Leadership trainings	Offering coaching and seminars on topics such as team building and employee development to positively lead and accompany the transformation from a leadership perspective
Transformation core team	Cross-departmental, interdisciplinary team as a contact point to ensure a transparent target picture and the communication of goals, structures, and contact persons
Agreement on objectives	Process-related, binding recording of old and new objectives in the exchange between employee and management in order to jointly shape the transformation. It also determines when a transformation process was successful in order to document the development and promote a sense of self-responsibility
Relaunch internal job market	Employee-centered update of the internal online job market and available training opportunities including the matching of vacancies and employee skills to promote transparency and create clarity for employees
Internship and mentoring program	Provide insights into the favored new areas to facilitate decision making, encourage exchange, and reduce fears. Also, a permanent reference person in the new area is defined who shares best practices and guidelines to help the sponsor to facilitate the transition phase
Role models and success stories	Promote employees who want to share positive experiences from their transformation process in order to have the courage to change and increase their confidence
Lessons learned and feedback transformation process	Introduce regular meetings, feedback talks, and other formats on the transformation process in order to identify problems at an early stage and continuously improve the respective approach

between management and working level, which increases the negative effects of transformation. Thirdly, the relevance of an individual is underestimated. Fourthly, the importance of clear communication, adequate information, and transparent structures and contacts play an immersive role to achieve a positive connotation of transformation. Lastly, there is no single recipe for making changes in large organizations like car manufacturers successful, but it has become clear that the involvement of people affected and relevant stakeholders is essential.

5 Lessons Learned

Bearing the actions taken and the results achieved in mind, the expert team formulated the following five overarching lessons learned.

5.1 Create the New Traditional

Enabling and creating fundamental change within a corporate structure may well be described as difficult and a delicate endeavor. It seems to get more difficult as the number of employees rises. On top of the perceived rising complexity that comes with company size, it seems to be even harder to induce change in businesses of "traditional nature" such as enterprises in manufacturing or automotive. As this would not be enough, it appears that invoking change in areas that are generally described to be the "beating heart of a company" (e.g., the technical development division) may well look absurd.

Standing up against suchlike barriers, the expert team decided to lower these impediments by targeting the lessening of the degree of abstraction that accompanies the concept of transformation. This entailed the unbundling of the studied meaning that "transformation" has among the workforce. By facilitating a continuous platform to discuss the topic, employees found themselves to be setting standards for a general (department- and company-wide) discussion about transformation.

Consequently, the expert team learned that despite this specific project setting, starting small "does the trick." Dividing the workshop series in small groups enabled the expert team to individually focus on the participants and grant them the attention they deserved for pioneering the design of their corporate transformation. In doing so, reflection and discussion was triggered within and among employees. Consequently, these participants are now able to multiply their recognitions and findings with colleagues and team members. This in turn led to a wider spread of the general awareness of and proximity to the concept of transformation.

The expert team learned that change may only happen if employees and managers find themselves in an environment where values such as trust, companionship, appreciation, openness, transparency, and communication have their definite set place. For these values to manifest themselves within the traditional corporate culture, multipliers and role models must be supported to widen and strengthen their field of action.

In a Nutshell

Start with small pilot groups and use their positive experiences to spark respective interest in other employees. Multiply positive employee feedback by encouraging role models to share individual experiences and stories.

5.2 *Fill Empty Expressions*

Trust, transparency, and openness may only then flourish as corporate values if corporate language reflects its workforce. The expert team learned quickly that company language was neither clear nor coherent regarding the painting of the picture of future corporate transformation. Subsequently, this renders the idea of transformation hollow and prone to misunderstanding. Previous approaches seemed to have failed to incorporate the actual language and ideas that employees speak and ideate. Especially, this was demonstrated by the prevailing sense of negativity, fear, and distrust among workshop participants regarding the subject of transformation. By actively engaging them in the shaping of corporate transformation and future qualification scenarios, employees started to lighten up, relax, and open themselves up towards new possibilities. This state is strengthened if it is a small group supporting each other in doing so.

In a Nutshell
Use coherent, easy-to-understand language to communicate strategic objectives and the corporate vision and engage employees while setting them. Strengthen employees by using their understanding of transformation as a steppingstone to individual transformation.

5.3 *Dare to Be in It for the Long Haul*

It takes time to light more than just a spark of transformation within the enterprise. Perseverance, resilience, and imperturbability are necessary to promote an employee-centric approach. This manifested itself in a considerable number of meetings dedicated to the planning of the workshops and getting permission to reach out to workshop participants. The expert team had to continuously highlight the importance of involving employees at the earliest stage possible. The resulting advantages had to be laid out to all the different stakeholders, sometimes twice.

Surprisingly, contrasting to what appears in the headlines of the press, the number of workshop participants that are among management levels was diminishingly small. The expert team learned that prioritization made by managers did not seem to involve a direct dialogue with their employees. A possible explanation for the low resonance of manager involvement might be their extensive workload. It seems that work that is done regarding the transformation is “on top” to daily activities and operating business.

In a Nutshell
Enable all relevant employees and stakeholders to actively participate in the process by creating capacities in the organization. Adequately distribute information and plan different formats over a long-term period.

5.4 Balance Conflict in the Face of Complexity

Not only has the high level of workload seemed to inflict a manager's attitude towards transformation. The expert team learned that there seems to be an area of conflict within the role of a manager. As sometimes no clear information is communicated from a strategic level, managers find themselves without the necessary corporate grounding to maneuver employees through the complexity of transformation. It was also learned that managers feel caught between the role of "the leader who guides the way" and "being lost in complexity as every other employee."

To overcome this ambidexterity, managers should, firstly, be provided with all necessary information, methods, and tools and, secondly, gain an understanding about their employees' needs and pains. This can be achieved by facilitating direct dialogue, as, for instance, done during the previously described workshops. Nevertheless, the frame for managers and employees to be able to participate must be set by the strategic management level, "hand in hand" with the work council.

In a Nutshell
Act as a mediator between different employee groups by creating a neutral space and foster the identification of needs and challenges, thus enabling all sides to develop mutual empathy.

5.5 Master Transformation Holistically

It seems to be a widely adopted approach to simply introduce quantitative transformation targets and hope for the rest to settle itself. However, in line with our initial expectations, this is far from reality. As the results have shown, the success of transformation seems to highly depend on the individual inclusion of the workforce. Especially in large companies, it seems that individuality is quickly lost due to rising complexity and inertia. But in the end, transformation is about altering existing approaches and related activities. It is about changing the environment in such a way that adaptation and change come naturally to the individual employee. Strongly advocating for employee-centric approaches to transformation, the expert team advises to bear in mind the target picture that was derived directly from the employees at stake.

In a Nutshell
Be transparent about where transformation-related objectives come from, why they are set, and how they are manifested and broken down among stakeholders. Also, be clear about the organizational structures surrounding these and outline openly what possibilities and risks are connected. Enable participation by all employees while setting transformation-related objectives. During individual transformation, provide guidance that allows for sustainable change.

6 Conclusion

The necessity of transformation is widely discussed and thus it seems to be legitimized. However, for the individual in large organizations, the perceived effects often seem negative. Especially in large companies, it seems that a discrepancy between strategic/quantitative goals (top-down) and individual/qualitative goals (bottom-up) exists. In other words, a decoupling between hierarchy levels "above" and "below" has established itself. Consequently, the relevance of the individual is continuously underestimated, precisely not only in the transformation of the individual but also in the multiplying effect of the individual's abilities to actively contribute to the digital transformation.

Until now, there have been no significant, scalable solutions to sustainably transform large parts of the workforce of traditional automotive manufacturers in order to be able to realize the project from "hardware to the software company." In this case study, we have shown that the focus must be on the individual and her or his needs. With our approach, we provide a starting point where the transformation for the individual can begin and gradually lose its negative connotation. Developing transformation into a real opportunity for the workforce and not just communicating it as such is the responsibility of all companies, their organization, and departments that honestly want to master the digital transformation *together* with their employees.

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The Springest Story: How IT Enables Holacratic Organizations

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Abstract

- **Situation faced**: How to include employees in decisions? How to keep the organizational design responsive to changes in the environment? And how to support all this by means of information technology? Ruben Timmerman, the founder of Springest, asked himself these questions as his company grew from a start-up to a medium-sized platform business.
- **Action taken**: Springest adopted Holacracy, a management philosophy that combines decentralized decision-making with high levels of formalization. To enable each employee to take action, Springest implemented the task management software ASANA that represents and allows modifications of the organizational structure at any point in time.

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- **Results achieved**: Today, ASANA plays an important role in all parts of Springest's organizing and serves as an important tool to monitor tasks and to clarify responsibilities. Since employees record anything that is unclear or might prevent Springest from functioning in an optimal way, ASANA is also an important companion for meetings, where these action items are processed. As a result, Holacracy does not only enable Springest to react more quickly to changes in the environment, but the actions taken also result in increased workplace happiness, which is higher than in most other tech companies. In the Netherlands, Springest has received the best employer of the year award in 2015, 2016 and 2017, respectively.
- **Lessons learned**: The use of information technology is key to support holacratic organizing. Only IT allows constant transparency of the organizational structure and to understand who is responsible for what. As a result, engagement in IT tools needs to be ensured and special attention should be paid to the fit of applicants with the organization.

1 Introduction

Springest is an Amsterdam-based, medium-sized platform business that mediates between buyers and suppliers of training programmes and courses. This case study discusses the development of Springest into a holacratic self-managing organization and the way Springest implemented IT tools to enable the self-management processes.

Ruben Timmerman, the founder of Springest, once summarized his ambition as follows: "We would like to be the Booking.com of courses". Just as Booking.com does for hotels, Springest hosts a comparison website for professional courses and other sources of personal development. Former course participants can post course reviews on the platform that guide users in their course selection. Springest also offers in-company platforms to help organizations provide courses for their employees. Importantly, Springest reviews and certifies the quality of offered courses. Since its foundation in June 2008, Springest has grown to a total of 60 employees by the end of 2019 and had a net revenue of approximately 4 million euros in 2019.

After the first 5 years of growth and a transition from a start-up to a medium-sized enterprise, Springest needed to take decisions regarding the governance of the organization. Ruben did not believe in a hierarchical organization with top-down control. Instead, he was looking for an organizational structure where each employee has the decision-making power and authority to take action and drive change. Such an organizational design would provide a vehicle for flexibility and swift adaptation in a dynamically changing environment.

During his search, Ruben learned about Holacracy, a form of self-management that combines high levels of formalization with decentralized decision-making

(Robertson 2015). A holacratic organization consists of self-managed teams, so-called circles. In turn, these circles have a set of roles with a clear purpose and accountabilities. The team members can adapt the circle structure based on tensions that they encounter. In this way, Holacracy promises high levels of agility and flexible responses to changing environments.

In January 2013, Springest formally adopted Holacracy. At the same time, the adoption was accompanied by the implementation of a set of IT tools that would make practicing Holacracy easier. Fundamental to how Holacracy is practiced at Springest is the task management software ASANA. Next to the actual management of tasks that are important for everyday work, ASANA keeps track of Springest's organizational structure in real time. Thus, it gives all Springeteers (employees at Springest) real-time information about who is accountable for what.

Holacracy, ASANA and other IT tools are not standard tools that can be implemented out of the box. It takes experimenting and fine-tuning, but also constant adaptation to changing circumstances. Today, ASANA is an integral part of all of Springest's operations. From meetings, when arising problems are discussed as well as projects and tasks are formulated, to changes of the organizational structure, ASANA allows employees to see and modify the organizational structure at any point in time. When tasks are discussed, the software helps to clarify who is responsible.

In the following, we will show how ASANA and other IT tools enable Springest to stay in control while at the same time provide all employees full authority and decision-making power over their roles in a fully self-managing organization, which is organized according to the principles of Holacracy. In this respect, we will discuss the questions "how does Springest use IT to support holacratic organizing?", "what did Springest learn so far?" and "what can still be improved in the future?".

2 Situation Faced

Springest was founded in 2008 under the name Eduhub in a building with other start-ups at Singel 146 in Amsterdam. The founder, Ruben Timmerman, had started an online computer franchise, where he already had gained experience with Internet-based services and IT, in general. The idea for Eduhub as a comparison website arose, when Ruben helped major clients involved in the education sector in the Netherlands. He noticed that there was no comparison website for professional courses and trainings. Indeed, there seemed to be a more general business need for such a site, but the potential of the Internet was not yet fully understood by many education providers. To foster this yet-to-be-developed market, Springest engaged in active blogging and started sending a biweekly newsletter to 1400 providers of educational services. The newsletter discussed best practices, tips to improve providers' online presence and how Eduhub could help them in utilizing digital communication channels. The business idea proved to be a success, and after a

Fig. 1 Springest during lunch

year and a half, Eduhub was profitable, growing to 9 employees and 250 paying customers.

In early 2011, the company moved to a new building at the Rokin in Amsterdam. The Rokin office is known as a hip place where everyone works in one large coworking space with an industrial appearance. You see cables, steel beams and concrete ceilings. There are electrically adjustable desks to sit and stand, and for relaxation, there are table tennis, table football, Wii and an Xbox. Employees eat their organic lunch at long tables, and there is the "at home feeling" with a couch, eight guppies and two goldfish (Fig. 1).

Offering a pleasant working environment and focusing on employee happiness is one of Springest's spearheads. Creating a learning environment is one of the means to achieve this happiness. Springest offers all employees a training budget of 1000 euros that they can spend freely. Employees train each other and share their knowledge by presenting what they have learned after attending trainings or a conference. In this way, Springest creates a culture where learning and sharing knowledge is part of daily work.

In July 2011, Eduhub was rebranded to Springest and the website was completely renewed. The reason for the name change was the international expansion to England and Germany where Springest already had operated under this name and where Springest was market leader. To reflect this, they decided to use the name in the Netherlands and Belgium as well.

Springest's philosophy in the early years is well expressed in the following statement by Ruben: "*Our mission is to help people grow in both their business and personal lives. To encourage new things, to get the best out of yourself and to look at the world fresh and open-minded. That's what Springest stands for*".

Ruben is inspired by business models such as Kaizen, which focuses on eliminating waste and continuous improvement, as well as humanizing work processes. Springest also focuses on continuous improvement of processes and working methods. The feedback from both providers and users of the website is a further driver for improvement and motivation.

When Springest was founded, they did neither practice Holacracy nor did they use corresponding IT tools. The goal in the early years was to grow from a start-up to a solid company and to professionalize the organization. The growth of Springest into a medium-sized company also entailed challenges in shifting the focus from economic survival in here and now to setting a long-term vision and strategy. As a result, efforts were directed to become the booking.com of training along with sustaining growth in the European market for educational services. Ruben wanted to achieve this while staying productive and transparent, avoiding several management layers and meetings that people would have to attend all the time preventing employees to get their real work done.

Management literature teaches us that people and structures in organizations have difficulties keeping pace with rapidly changing environments (Greiner 1989). Organizations are designed to carry out work in a specific way, but organizations are not built to co-evolve with their environment. In a world where change is the only constant, resistance to change will ultimately lead to economic failure. In bureaucratic organizations (Weber 1976), i.e. how most organizations are organized, there are a limited number of decision-makers. Information takes time to reach decision-makers and may become distorted in course of the communication process. In this regard, Ruben was aspiring to achieve control over the organization, without him controlling. He was convinced that Springest would be most successful, if responsibilities for making decisions stayed with the people that had the best knowledge and also were most affected by these decisions.

Developments in the field of self-managed organizations have influenced Springest in the search for new ways of organizing themselves. A collaboration with Diederick Janse from the consultancy firm Energized.org led to the elaboration of the concept of Holacracy by Robertson (2007, 2015) in combination with David Allen's (2015) *Getting Things Done* (GTD) method on a level that would support the overall organization. Springest was the first company in the Netherlands to experiment with this organizational form. Experiments were carried out with the use of IT tools to make the self-management process run smoothly and transparently. This search process resulted in the actions taken that we outline in the next section.

3 Action Taken

In light of these ambitions, Holacracy seemed to be a promising solution. In January 2013, after experimenting on a small scale, Springest decided to formally adopt Holacracy. Here, we describe how Holacracy works and the technological tools Springest implemented to support sustained self-organizing.

3.1 Principles of Holacratic Organizing

Holacracy is a form of self-management that combines IT-based regulation (de Vaujany et al. 2018) with decentralized decision-making. Proponents of Holacracy argue that extensive use of IT tools and the delegation of decision-making power from managers to executing employees are a way to achieve long-term organizational agility (Robertson 2015). A larger number of companies have adopted a holacratic organizational design. A prominent example for the adoption of Holacracy is the online retailer Zappos (Bernstein et al. 2016), but there are various other examples from a large variety of industries (e.g. see https://www.holacracy.org/whos-practicing-holacracy).

In Holacracy, employees do not have a fixed position but hold a set of changing *roles*. Usually, the number of roles varies between six and ten, but can also be more or less. Every role has a clear purpose and accountabilities. All roles belong to self-organized teams, so-called circles. Circles themselves are large roles that have accountabilities and a purpose. Circles can be nested (containing smaller circles), and all circles belong to the super circle that delineates the organization from its environment. To make sure that circles are aligned and contribute to the overall goal of the organization, circles have *lead links* and *rep links*. These special roles make sure that information can flow between super and sub-circles. These roles also represent circle interests in the respective other circles and thus carry key responsibility to coordinate and align circle interdependencies.

Circles in Holacracy are a whole and themselves part of a larger whole. This fact also explains the term Holacracy and its reference to the term *holon*, which means whole in Greek. Figure 2 schematically depicts how Holacracy works. Roles are the basic building blocks that provide clarity regarding the responsibility of tasks. While

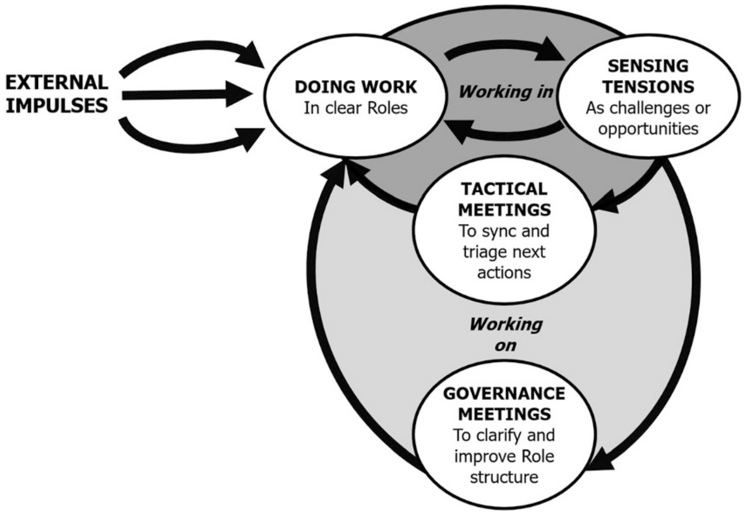

Fig. 2 How Holacracy works (adapted from Robertson 2015)

work is carried out, *tensions* may arise. Tensions are a specific term in Holacracy and denote a mismatch between the current state and what is ultimately desired to carry out operations as smooth as possible. Every role has the responsibility to reflect on and document tensions, as they are perceived. There are two types of meetings to process tensions that both take place at a circle level. The first type of meeting is a *tactical meeting*. This is comparable to everyday meetings in normal organizations. In this type of meeting, operational issues are discussed that need to be resolved to move projects forward. As a result, projects and next steps are clarified and can be addressed by employees. In Fig. 2 this is denoted as "working in" and makes sure that work can be performed efficiently. The second type of meeting is a *governance meeting* that processes tensions that relate to the structure of the organization. In this meeting, changes to the organizational structure, that is, circles, roles, their accountabilities and their purpose, are made, if required. Circles govern themselves, which means that they can create new roles, modify existing roles or abolish roles that are no longer needed. Proposed governance changes are accepted or altered in an *objection round.* The facilitator asks the following question: "Do you see a reason why adopting this proposal causes harm or moves us backwards? Objection or no objection?" If there are no objections, the proposal is accepted. If there are any objections, the goal is to craft an amended proposal that still addresses the proposers tension (https://www.holacracy.org/governance-meetings). Despite changes to roles, circles can also spawn off sub-circles when they realize that decision-making within a circle becomes too difficult or meetings become inefficient. Governance meetings thus allow the organization to adapt itself by modifying the system of roles. Consequently, organizational design is constantly co-evolving with the organizational environment and as organizational members feel that there is room for improvement.

Two special roles help carry out and document outcomes of meetings. On the one hand, the *secretary* is responsible for the organization of meetings and for capturing and publishing meeting results. On the other hand, the *facilitator* helps to carry out the meetings and may even conduct audits to control that holacratic practices are adhered to.

3.2 Holacracy at Springest

Springest has implemented Holacracy strictly following the principles outlined by Robertson (2015). Figure 3 depicts Springest's organizational chart as of 14 May 2020. In the figure, roles are visualized as white bubbles that are grouped in their respective circle. At this point, Springest had approximately 600 roles organized in 14 circles, covering a diverse set of functionalities. Circles are named in a way that allows one to quickly understand their main responsibility. There is a circle that is responsible for finance, for the product, for marketing and for the different markets Springest is active in, and one circle ensures that operations at Springest are running smoothly. Circles vary considerably in size, and one can observe that larger circles

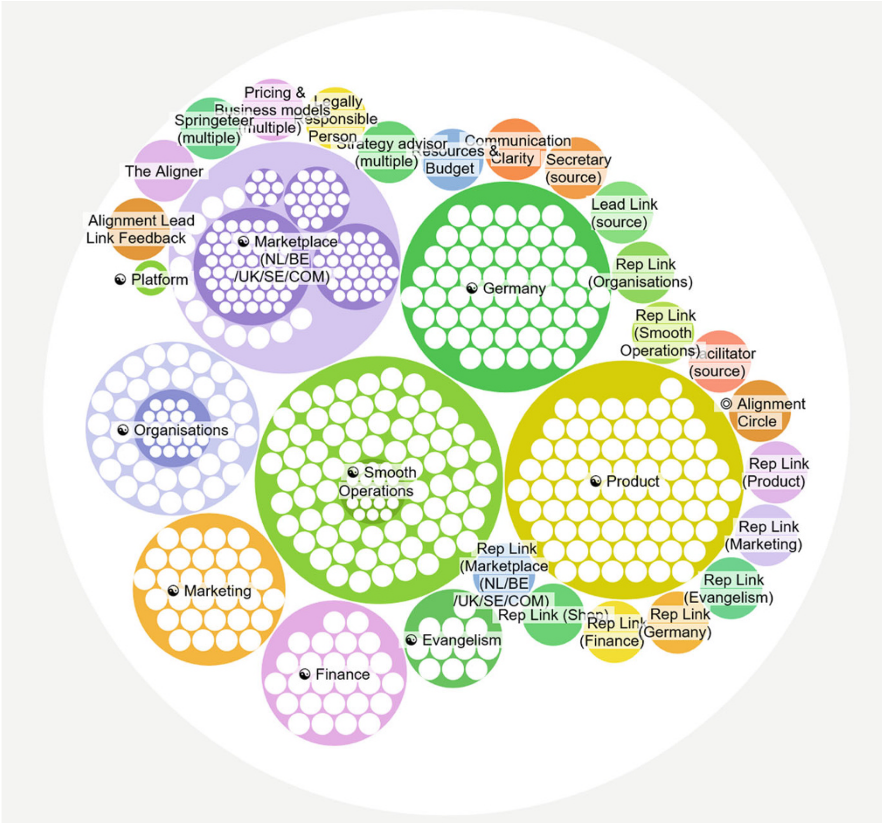

Fig. 3 Springest's organizational structure as of the 14th of May 2020

have a more elaborate structure (more sub-circles) to facilitate decision-making. For example, the circle *Marketplace* is organized in four sub-circles that reflect the different markets Springest is present in. Yet, the circle *Finance* only has a few roles that do not require separate sub-circles.

To make it more tangible how Springest is organized, we elaborate on the history of two circles as examples. The circle *Marketplace (NL/BE/UK/SE/COM)* has the purpose to support platform users in reaching their full potential. Accountabilities of this circle include supporting and selling services and rolling out product updates to direct customers or creating marketing materials and campaigns to create more provider awareness and interaction. While there are only a few roles that are directly assigned to this circle, the circle further consist out of four smaller circles such as *Learning advice*, *Go users*, *Providers* and *Shop (Agile, Lean, Six Sigma, Scrum)*. Another example is the *Evangelism* circle. This circle is relatively small with 11 roles and has the purpose to make "Springest famous for being the learnest company". In other words, this circle promotes Springest and how it makes use of Holacracy. Among others, roles in the evangelism circle include *Evangelism Events* that represents Springest at events, or *Holacracy Meetup* which is responsible to "show off Springest as a Holacracy front runner" at Holacracy meetups.

3.3 IT Tools to Support Holacratic Organizing

Information technology is central to the way that Springest organizes itself. Springest uses various IT tools, such as Slack, Sputr and ASANA. For all these tools, there are clear rules of engagement and expected response times. For Sputr, which is used to share general messages and posts, all posts should be scanned within 2 business days. Slack, which is the channel for direct communication at Springest, should be answered within a few hours, in case of a direct message or a message that mentions the respective username. Lastly, all inbox items in ASANA should be read and replied to within a period of 2 business days.

Among all these tools, the most important application is arguably the ASANA software. Designed as a task management software, ASANA is used by Springest to maintain its system of holacratic roles and circles as well as to manage tasks, i.e. all work items that need to be performed. Whether it is for creating tensions, discussions in meetings about responsibilities and the overall role structure, ASANA is the point of reference for all Springest employees to understand the current organizational structure (and even see how it evolved). Figure 3 that we showed before is directly generated from the tasks stored in ASANA. At Springest, employees have even come to say: "if it's not in ASANA, it doesn't exist". This statement shows the role that ASANA has within Springest and emphasizes that all organizing within Springest relates to the ASANA software.

ASANA is used in everyday work as well as for tactical and governance meetings. In what is captured as "working in" the organization in Fig. 2, ASANA helps to document the tasks and organizational roles. This helps to administer and manage projects as well as to clarify responsibilities and the organizational role structure. When someone is not sure, who is supposed to carry out a task, ASANA is the place to check. Since all roles have a clear purpose and accountabilities, the ASANA description should clarify which tasks are to be expected from which role. If there are any ambiguities with regard to responsibilities or tasks that should be carried out to achieve project goals, the respective employee is expected to create a tension in ASANA that can be processed in the next tactical or governance meeting.

ASANA is also the fix point for conducting tactical and governance meetings. At Springest, both types of meetings take place on a weekly basis. In each meeting, the secretary of the respective circle makes use of a large monitor to show the meeting-specific ASANA site, where the current tensions are bundled. These tensions are then processed as far as possible during the meeting and results are directly documented in ASANA. Thereby, the outcome of these meetings could take the form of actionable tasks or adaptations to the role structure. This closes the meeting and again allows employees at Springest to carry out their work.

4 Results Achieved

Today, Springest has relied on Holacracy for more than 7 years. In the Netherlands and beyond, Springest has become well-known for its implementation of Holacracy "by the book," and Springest employees regularly speak at events and participate in the Holacracy meetup. Springest even sells meeting participation in tactical and governance meetings on its platform.

Springest is a growth story. In terms of employees, Springest has grown to around 60 employees as of 2020. Growth at Springest is also reflected in the number of courses the platform covers. Today, Springest's platform allows one to enrol in around 100,000 courses with a total of more than 1000 learning providers. Information technology is not only an important part of Springest's product offering but also played a very important role in this growth story. By combining Holacracy and IT, Ruben Timmerman managed as he says to "realize control without controlling". Ultimately, this decision allowed Springest to transform from a small start-up to a technology enterprise. In particular, ASANA allows full transparency of the organizational role system and provides an overview of tensions that still need to be addressed. By following holacratic principles, decisions can be made in a decentralized way by those people that are affected by them.

For Springest it is clear that the best results of Holacracy come from its combination with various IT tools. The more tools that can be used effectively, the better. Springest is able to compare themselves with other holacratic organizations, as they also advise organizations about the use of Holacracy. When the operations of those organizations are less about IT, or, as Springeteers say, when the employees are less nerdy, the implementation of Holacracy tends to be more difficult. Sometimes these companies only use some Google sheets. The transparency that is needed so much to make Holacracy work is in these kinds of organizations way more difficult to achieve.

Transparency and a free flow of information is essential for Holacracy to work. It should be clear who is responsible for what and who is working on which projects and tasks. The failure of traditional organizations often comes from information asymmetry between management layers (Dunk 1993). In holacratic organizations the information asymmetry is minimal due to its transparency provided by the IT tools such as ASANA. Furthermore, within Holacracy there are no managers, but decisions are taken on a circle level by the very same employees that are affected by the decision. Because of this, decision-making is not only quicker, but also information does not become distorted while travelling from front-level workers to higher management. Since all information on roles and tasks is stored in an information system, this knowledge can be used to inform the decision-making process and, at the same time, to communicate its outcome. In that sense, organizational structure in a holacratic organization is never final, but is continuously adapted as new tensions in and outside the organization arise.

For example, the Alignment circle, which is responsible for all of Springest, first held meetings in private, and only the founders of the organizations were allowed to participate. This created an atmosphere among the other Springeteers that something happened there that was not "for them". It felt it was against the principles of transparency and full disclosure of information. Ultimately, it was decided that these meetings should be accessible to all Springeteers. Everyone can be a guest at these meetings, and they are even recorded via Zoom, so everyone can follow the meetings live. This took away the mystery and suspicion about the meetings. While, in the end, only a few employees really took the opportunity to visit these meetings, opening the meeting up emphasized the importance of free flow of information at Springest.

Springest is very conscious and reflective about employee happiness. While happiness is not an end in itself, it is perceived to contribute to Springest's long-term success. There is a role that is responsible to measure happiness and take action, if required: the happiness role. To make sure employees are satisfied in their working environment, Springest conducts a monthly happiness survey using the application 7Geese. The survey is completely anonymous, so employees do not need to shy away or be afraid of consequences when giving negative feedback. On average, 70% of Springeteers answer the questions in the happiness survey, while about 50% provide additional feedback in the form of comments. If anyone rates happiness lower than 7 out of 10, the person is asked to seek discussion with the person assigned to the happiness role. The happiness role is not only responsible for measuring and monitoring happiness among employees but also evaluates the fit of applicants with the culture at Springest. Holacracy is not for everyone, and thus, the happiness role has a veto and can reject an otherwise suitable applicant. In the past, Springest has quite consistently scored higher in happiness ratings than other companies in the tech industry. Finally, employee happiness at Springest is also reflected in various best employer awards that Springest received in 2015, 2016 and 2017, respectively.

To achieve these results, one crucial aspect of Holacracy is the onboarding process. In its first years, Springest did not pay much attention to onboarding, but soon realized that Holacracy principles and all the IT tools that come along with it are not that easily learned by new employees. You would like to have employees that are open for changes and make use of the system as best as possible. Employees should be trained and supported to do so. Also for this, Springest makes use of its structure and IT tools. They created a role, the Newbie role for new employees. This role is part of the Springest Academy circle. Within ASANA a stepwise list is created based on all types of tasks that the newbies must perform in order to complete the onboarding process. In this way, new employees get prepared for working at Springest and working the holacratic way.

This way of working also entails several risks. Working within a holacratic organization and with the many IT tools is not for everyone. Especially people who have been working in other, rather traditional environments seem to have more trouble in adjusting to this way of working. These people will not stay too long with the organization and must be replaced again. On the other hand, the people who do stay are very committed and tend to stay for a long time. Some people with whom we had the chance to speak could not imagine working for another organization and even more so without Holacracy.

5 Lessons Learned

Reflecting on Holacracy at Springest, Ruben Timmerman said in one of his interviews:

> The question is not if Holacracy is the solution, or the problem. The question is what we will create with it and its hopefully many forks, siblings and parents. Because we have enough data to show that the current systems of bureaucracy and hierarchy provide a fake sense of security and control and make people unhappy and unproductive.

Within a holacratic organization, IT enables transparency, decentralization of decision-making and continuous adaptation of the organizational structure. Of course, it is difficult to say if the effects that we can observe at Springest are because of Holacracy, or if they would have materialized without either way. An important part of the effect is due to the company culture at Springest. Nevertheless, there are some effects that can be observed at Springest and other companies using Holacracy. These effects provide important lessons.

For Springest, there are multiple lessons, resulting from implementing Holacracy and tools that support holacratic organizing. The lessons were learned the hard way, as Holacracy was new when Springest was founded and all aspects had to be learned by doing. Some things went wrong, and from that Springest learned to understand what works and what could have been done better. A key learning is the usage of IT tools to support Springest as a self-organizing business. In particular, IT tools provide real-time information about roles, circles, tasks and tensions, which together capture how the organization is structured and how work is carried out.

First, Holacracy makes it possible to adjust quickly to a changing environment. Because of the autonomy of employees and circles, changes can be made quickly when needed. In crises (for instance, the Corona crises) or when the outside world requires quick adaptation, Holacracy provides the tools to make this possible. If the need for reorganization arises, this can happen in days instead of months or years, enabling Springest to respond in a timely manner. In most traditional organizations structure is seen as something stable. At Springest, organizational structure is seen as a means to an end that requires continuous adaptation. This is only possible with information technology. To enable the decentralized decision-making processes that take place in each circle, information about the circle itself, its tensions and how the circle integrates in the overall organization is necessary. Furthermore, the outcomes of these decisions need to be communicated to the remaining members of the organization. This level of transparency and ease of communication is only possible through the dedicated use of information technology. It is not for nothing that Springeteers have come to say “if it’s not in ASANA, it doesn’t exist”. Indeed, IT is at the very heart of organizing at Springest.

Second, it is important to use tools to onboard new employees. In a holacratic organization, it is important that all employees have the same knowledge, so they can operate with the same capabilities. Only with absolute transparency, all employees know all the roles that exist and who is responsible for what. To train new Springeteers, Springest uses ASANA to assign them to the Newbie role and its respective accountabilities. Furthermore, in ASANA there is a project for new Springeteers that guides them through their onboarding process. The onboarding covers two complementary aspects: an onboarding in the role and an onboarding in the practices and rules of Holacracy.

Third, it should be made clear which tools are used for what purpose. Using many different tools sets expectations and these expectations need to be clarified. Springest created roles to address this and set rules and expectations around the different tools that are in place. In that way, all Springeteers know what they can expect and what tool can be used for what goal.

Fourth, the combination of Holacracy with a set of tools that enable transparency has resulted in high levels of employee happiness. Employees at Springest are happier than employees at most other tech companies; the results of this are being tracked in 7Geese on a regular basis. The thought is that more autonomy leads to less stress, more control and eventually to more happiness and productivity of employees. Springest is convinced of these strengths and has dedicated Evangelists roles to share their experiences with others.

In sum, Springest is a platform organization that has had different IT tools in the centre of its organizing practices from the very beginning. IT is in Springest's DNA. They chose Holacracy as an organizational structure, because of its philosophy towards autonomy, employee wellbeing and complete transparency of information. Transparency is only possible when an organization makes use of many IT tools to support free flow of information. With a holacratic organizational design, the hiring process of employees becomes even more important as employees should be proactive in raising and discussing tensions that they realize in their daily work. Holacracy is not for everyone and especially large organizations that change to Holacracy often face tremendous staff turnover (Bernstein et al. 2016). At the same time, Holacracy has so far not been systematically investigated. There are many things that we do not know about Holacracy, especially when it comes to its downsides. Further research is needed to address this limitation and investigate important aspects of organizing, such as power dynamics, organizational learning and compensation of employees, to name but a few. Also, there are other novel forms of organizing (Puranam et al. 2014) that we could not elaborate on due to space and scope of this chapter. For a discussion on how the novel forms of organizing differ from classic organizations, we refer to Puranam et al. (2014). Finally, we hope that the insights derived from this case help other companies in making the transition towards or the decision to adopt a holacratic organizational design.

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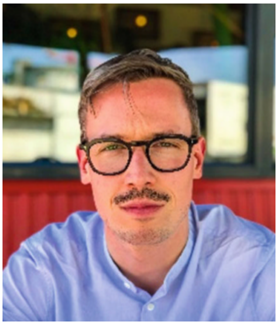

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Digital Kaizen at FPT Software: Principles and Practices for Digital Transformations

Duy Dang-Pham, Ai-Phuong Hoang, Diem-Trang Vo, and Quang Tran Duc Tri

Abstract

(a) **Situation faced:** While companies are leveraging technologies to improve their business performance, digital transformation is still perceived as an abstract concept. Most companies do not know where and how to start. FPT Software's lack of synergy prevents the company from reaping the benefits of its digital transformation activities. The large-scale transformation also requires a ready-to-change culture, which can be daunting to a company with more than 28,000 employees across geographies with different technological capabilities. This chapter explores the applications of Digital Kaizen methodology in guiding FPT Software's digital transformation journey and in helping them to commercialize their digital transformation solutions.

(b) **Action taken:** FPT Software tackles cross-functional pain points by implementing technological initiatives that improve business processes and increase employee engagement. These initiatives are well aligned with the company's strategic goals; thus, they are sustainable and scalable digital transformation solutions. First, cross-functional pain points are identified by both managers and working-level employees through conducting workshops. Second, a series of manageable digital transformations are performed to change business processes, the employees' mindsets, and work processes. Last, FPT Software commercializes its own successful digital transformation initiatives and sell them as solutions to the clients. Two digital transformation projects, MyFPT and AkaLink, are presented in this chapter.

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(c) **Results achieved:** The Digital Kaizen methodology has urged FPT Software to continuously optimize and improve their business operations through implementing innovative transformations. By implementing incremental improvements, MyFPT has resolved 22 strategic pain points until June 2020. AkaLink has addressed 19 pain points, resulting in approximately USD700,000 in terms of monetary benefits. It is projected to rise to USD2.5 million after 1 year. These digital transformation projects also produced spillover effects, i.e., driving people engagement and nurturing the culture of change, which benefit the whole company. FPT Software commercializes its digital transformation solutions by using successful projects as practical case studies.

(d) **Lessons learned:** FPT Software's digital transformation journey offers three main lessons. First, driving digital transformation through making incremental changes enables companies to realize the benefits quickly. This subsequently motivates transformation activities at large scale across the entire organization. By selecting the cross-functional pain points that are aligned with strategic objectives, FPT Software has solved operational issues without losing sight of its long-term vision. Second, companies should improve organizational change capacity by engaging their own employees who are the drivers of digital transformations. Third, as digital transformation is an ongoing process, a philosophy-driven digital transformation, such as that guided by Digital Kaizen, would develop a climate of engagement and creativity among organizational members at all levels.

1 Introduction

In recent years, the integration of digital technology has evolved into all industries such as music (e.g., Spotify), education (e.g., Zoom), or transportation (e.g., Uber) (Skog et al. 2018). New technologies such as cloud computing, artificial intelligence, and robotic process automation have rapidly changed the ways how we interact with and do business (Perkin and Abraham 2017). These emerging trends have created both opportunities and challenges for technology companies that are often believed to have adequate capabilities and capacities to engage with the digital transformation process. In fact, these companies may also receive the pressure of adapting with the fast-changing technological trends to lead this transformation (Horlach et al. 2016). In this chapter, we showcase how FPT Software, a large IT company in Vietnam, underwent a digital transformation, and we discuss the lessons learned from such transformation.

2 Background

FPT Software is a part of FPT Corporation (FPT–HoSE), a leading technology and IT services group headquartered in Vietnam with nearly USD1.2 billion in revenue and 28,000 employees (FPTSoftware 2020). The company was established in 1999 with the mission to provide technological innovations to its customers in international markets while contributing to national prosperity and enabling young Vietnamese employees to develop their careers in the IT field (FPTSoftware 2020). In 2020, FPT Software is one of Vietnam's largest and fastest-growing technology companies that provides digital transformation solutions to clients globally, such as the United States, Japan, Europe, Australia, and countries in the Asia Pacific. The company's success relies on its ability to recognize and adapt to changes. FPT Software proactively identifies and solves its internal business problems through a series of technological initiatives. The successful initiatives are then commercialized and offered to suitable clients. The company's client portfolio currently consists of key companies in diverse sectors, ranging from the automotive industry, e.g., Toyota, to the aviation industry, e.g., Airbus and Palantir. It now has more than 100 customers across 45 countries. In the next 10 years, FPT Software sets the ambition to become one of the top 50 technology service providers in the world.

FPT's principle of transformation is simple: "driving business and technological transformation through people engagement." Putting this into practice, the company transforms itself into a giant test bed where digital transformation solutions are rapidly experimented within short time frames of 3–6 months. This strategy allows FPT Software to improve internal capabilities while affirming the effectiveness of solutions that can be commercialized. Nevertheless, it is challenging to move such a large organization in unison. On that background, the company adopted a methodology called "Digital Kaizen" to facilitate the rapid experimenting process at large scale, while staying up to date with the latest technology development. Digital transformation is conducted as a series of continuous improvements, in the manner that prioritizes the achievement of the highest quality, maximum elimination of wastes, and improvements in efficiency in both terms of technological equipment and work procedures. The tactical mechanisms enabling the enactment of such philosophy consist of digital transformation workshops that identify cross-functional pain points and a ranking system to prioritize digital transformation solutions that aim at addressing these pain points. From the strategic point of view, Digital Kaizen transformations ultimately focus on increasing employee engagement that leads to sustainable and scalable digital transformation solutions.

To help illustrate the principles of the Digital Kaizen methodology, we analyze in this chapter two specific digital transformation initiatives/solutions that were implemented in FPT Software: MyFPT and AkaLink. These two applications aimed at addressing the pain points related to the management of human resources and the alignment between employees' needs and organizational goals. The outcomes of these digital transformation initiatives were increased profit, reduced turnover rate, and operational costs. Furthermore, the rapid implementation of successful digital transformation initiatives produced a spillover effect by improving the morale of FPT Software's employees and nurturing the high level of readiness for digital transformation within the company.

2.1 Kaizen Philosophy and Digital Kaizen

Kaizen is a Japanese philosophy for management that emphasizes making continuous improvements (Newitt 1996; von Leipzig et al. 2017). In 1986, Kaizen was introduced and applied by Toyota, a Japanese automobile company, in order to increase its competitive advantages (Masaaki 1986). Total quality management was a methodology developed under the concept of Kaizen, in which every employee was required to improve their standards of work continuously in all aspects of the company (Masaaki 1986). Another example is the company-wide quality control, the system in which various functional departments such as production, logistics, and marketing integrate their processes and technologies together to achieve customer satisfaction (Mizuno 1988). During that period, Kaizen became a critical part of the Japanese manufacturing system and contributed enormously to the manufacturing success (Ashmore 2001).

In the modern economy, Kaizen has been applied in various aspects of a business and industries. For instance, Doolen et al. (2003) presented the application of Kaizen for human resource management, where employees were found to improve their skills and behavioral responses to continuous improvements by participating in events that were part of the implementation of Kaizen. Kaizen techniques were applied to design a manufacturing system to reduce production costs and improve product's quality (Chen et al. 2001). In this study, a team of engineers and machine operators engaged in a brainstorming process to identify operational problems and design solution prototypes from different perspectives. As a result, this project helped to reduce 25% in unit cost and 44% in manufacturing cycle time, as well as improve workers' satisfaction and morale by allowing rotation of their tasks (Chen et al. 2001). Similarly, Chandrasekaran et al. (2008) showed the use of step-by-step Kaizen procedures for solving the part mismatch problem that occurred in the assembly production line of an automobile manufacturer.

Overall, organizations adopting the Kaizen philosophy focus on improving continuously the three aspects of process, standards, and people, to achieve organizational goals (Masaaki 1986; Suárez-Barraza and Lingham 2008). Kaizen philosophy promotes a process-oriented approach for managing processes rather than result oriented (Suzaki 1987a; Wickens 1990). In addition, Kaizen encourages organizations to review regularly their policies, guidelines, rules, and procedures so that these standards remain practical and relevant (Wittenberg 1994). By putting people at the heart of this philosophy, Kaizen further suggests that organizational improvements should be motivated by talent development and team cooperation (Malloch 1997).

While some scholars argued that the Kaizen philosophy might hinder organizational innovations (Kim and Mauborgne 1999; Wittenberg 1994), other studies discussed that the maintenance of infrastructures and operating standards, as provided by adopting Kaizen, is necessary for generating innovations in the form of continuous improvements (Imai 2007). In practice, approaches such as total quality management and company-wide quality control can be applied to facilitate the implementation of Kaizen, which encourages employees to come up with new ways of working in all aspects of organizational operations (Masaaki 1986; Mizuno 1988). As such, Kaizen philosophy would not be an impediment to innovations but rather the base for transformation that contributes producing desirable organizational outcomes (Macpherson et al. 2015; Newitt 1996; Singh and Singh 2009).

In line with the company's objective to "drive business and technological transformation through people engagement", FPT Software adapted the Kaizen philosophy and created their own methodology for digital transformation, which they named "Digital Kaizen." From the perspective of Digital Kaizen, digital transformation involves making a series of quick wins that build toward long-term success. Ultimately, Digital Kaizen aims to enhance organizational capabilities by conducting transformation in three areas: business, people, and technology. By adopting Digital Kaizen, FPT Software continuously identifies and resolves cross-functional pain points that are aligned with their strategic business goals, through implementing technologies that improve business processes and people engagement.

3 Situation Faced

The technology evolution has led to a titanic shift in the business landscape across different industries. While creating new opportunities for innovative start-ups to create value for customers, it sparks a fierce "digital transformation competition" among existing businesses. Most companies are familiar with using technologies to improve their performance. However, as technologies become more available and affordable, companies feel the pressure to transform themselves in an unprecedented manner or they will lose out eventually. For example, the marketing industry has embraced technology quickly. The marketing technology (MarTech) landscape experienced a 5.23% growth, from just 150 MarTech solutions in 2011 to almost 8000 solutions in 2020. Similarly, financial technology (FinTech) start-ups are becoming disruptors to the incumbent financial institutions with the help of social networks, smartphones, and artificial intelligence (Ghose et al. 2019).

By nature, digital transformation is an abstract and confusing concept. FPT Software's CEO, Mr. Tuan Nguyen, argued that many businesses claim they want to conduct digital transformation, but few would come up with the specific strategies and action plan for transformation. Businesses often express their interest in investing in digital transformation initiatives, but not many would be willing to accept the risks and wait for a long time before they can observe the transformation's results.

> On one hand, businesses often show their interests in digital transformation. On the other hand, they do not want to undertake digital disruption solutions as similar to what Airbnb and Uber do, as this approach requires large investments and prompts the question of sustainability. As a result, these businesses often get confused about how to start with digital transformation activities.—CEO of FPT Software

All companies, large and small, who embark on this digital transformation journey generally do not know where and how to start. Even for FPT Software, a company that knows technologies very well, that was still a daunting question. Internally, all departments have adopted different technological solutions to optimize their own operating activities. The company has transformed its core functions such as finance and human resource management, by moving from manual recruitment and payroll processes to automated ones, to manage more effectively the increasing number of employees and the company's expansion to different countries. Nevertheless, changes were made in organizational silos, making it hard to recognize the impacts on the entire organization. On the other hand, many large enterprises are understandably hesitant to commit funds and resources for major digital transformation projects. Those projects are large in scope and scale, with uncertain outcomes.

Digital transformation also calls for a process of continuous changes in which leaders and managers take an active role in shaping a vision for the organization. The project's goals and objectives must be communicated effectively and interpreted uniformly throughout the organization, given that FPT Software is distributed across many geographies and cultures. It is impossible to transform an organization without a culture that is ready for change. Thus, all employees need to be trained properly in their current and future roles.

After successfully implemented digital transformation within the organization, FPT Software as an IT consulting company needs to commercialize these solutions to its diverse customer portfolio. With clients in a wide range of industries having different needs and technical requirements, the company must customize its products and transfer the necessary knowledge to each client.

4 Action Taken

FPT Software starts off by identifying cross-functional pain points, i.e., the underlying issues in the company's business operations to be tackled by digital transformation initiatives. Ensuring the synergy between cross-functional teams in this identification stage is an operational challenge. It is easier for each department to recognize and address its own pain points, e.g., those falls within the department's scope of operation. But what pain point may quantify as a cross-functional pain point? Mr. Cuong Dao, COO of FPT Software, explained the concept of cross-functional pain point as follows:

> When it comes to cross-functional activities, people often think that the problem is caused by other departments; Department A thinks the pain points should be accountable by

> Department B and vice versa. Therefore, no one actually tackles the pain points. These pain points do not refer to the conflicts between departments; solving them will improve the links between departments and benefit the business process as a whole. In this sense, it is more effective when cross-functional teams work together to identify the pain points.—COO of FPT Software

Once the annual strategic goals are set, managers from different departments participate in workshops, where they provide feedback to each other about the issues encountered during the daily interactions between departments and reach a consensus on the common pain points. For instance, the pain points can be a delayed process caused by excessive work steps, or the errors that frequently occurred in a work procedure.

> The process of generating cross-function pain points is initiated by those at the working level who are involved in business operations. Every few months, FPT Software organizes a workshop that aims to understand cross-functional pain points. When the core mission of the business is identified, managers of all departments, who are related to that mission, gather and perform brainstorming to output a list of pain points. Subsequently, these pain points are ranked and prioritized based on some criteria. Tasks are then assigned to the relevant teams and digital transformation projects are created. The objectives and evaluation metrics of the projects are also discussed so that they can be reviewed thoroughly in the next workshop.—COO of FPT Software

Relevant stakeholders then assess those pain points and brainstorm ideas for digital transformation projects. The priority of these projects is determined based on three criteria: feasibility, urgency, and potential values. First, a project is deemed feasible if its life cycle, i.e., from implementation to evaluation, is within 3 or 6 months. A project that requires a year or more to realize its values is considered as low priority. Second, urgency is measured by the importance of the pain points or issues that are addressed by the proposed project. For example, a project that aims to implement new technologies and redesign business processes to comply with a new regulation has a higher priority than others. Third, the potential values of the proposed projects are evaluated based on their contributions toward achieving the business goals and especially the extent of how much the project's intended outcomes add to the human and technological resources of FPT Software. Once the projects are ranked, prioritized, implemented, and evaluated for their results after 3–6 months, successful projects are refined and packaged as digital transformation solutions to be sold to FPT Software's clients.

> The rule of thumb is that no project is allowed to last longer than 6 months. In other words, after six months, we should be able to evaluate and realize the project's ROI (return on investment). Not only does the project must support the company's business strategy in the next three to five years, but ideally it should also yield enough revenue to sustain itself, or this revenue can be reinvested in other projects. Apart from solving the pain points, the project is considered as valuable when it also benefits the personal development or increases technological capital, which then contribute to other projects.—CEO of FPT Software

Digital transformations involve utilizing technologies to change business processes and, more importantly, the people's mindsets and work processes (Urbach and Röglinger 2018). For instance, the implementation of a new automation technology would require employees to update their skills, adapt to new job requirements, or even change their job roles (Jones 2016). Although the core and majority of FPT Software's workforce comprise members of Gen Y (the "Millennials") and an increasing number of Gen Z employees, who are often perceived to be more adaptive to changes, not all of them would be ready for the rapid digital transformations within the company. In fact, digital transformation activities that are initiated by top management may not be congruent with the employees' goals and values, which in turn leads to resistance (Garmann-Johnsen et al. 2018). The disruption of normal work habits and procedures, as caused by radical changes resulting from digital transformations, also contributes to employees refusing these changes.

The next challenge for FPT Software is to commercialize its own successful digital transformation initiatives and selling them as solutions to the clients. Although digital transformation and its promises about the desirable outcomes often sound appealing to businesses of different sizes, most would find the actual implementation of digital transformation to be quite difficult. From its client database, FPT Software identifies and approaches the clients that potentially have the issues or pain points that can be addressed by its digital transformation solutions. It is worth mentioning that FPT Software does not offer off-the-shelf software packages but bespoken digital transformation solutions that are tailored to their clients' specific business context and needs.

> When selling digital transformation solutions to our clients, FPT Software would sell the methodology rather than the software package. While digital technologies are just tools, Digital Kaizen is a methodological framework that guides the whole transformation process. When working with the clients, FPT Software serves as a consultant or advisor and not as a one-time seller. Through conducting workshops with the clients, FPT Software identifies the issues and come up with the solutions based on the clients' context and needs. This approach, therefore, encourages the clients to embrace continuous improvements rather than sticking to one fixed solution.—CEO of FPT Software

The next sections will present MyFPT and AkaLink—two notable digital transformation projects that were highlighted by the interviewees. These examples are selected due to their importance, as recommended by the interviewees, and their outcomes. Both projects contributed considerably to the company's business-critical operations. MyFPT is an employee engagement mobile app that focuses on increasing employee retention, and AkaLink is a solution for managing the company's skill inventory. The design and implementation of these projects were the result of following the Digital Kaizen methodology, from identifying the cross-functional pain points to implementing the digital transformation initiatives. These projects have also resulted in some outcomes, thereby providing a complete account of the digital transformation process.

4.1 MyFPT: A Mobile Application for Improving Employee Engagement

Between 2017 and 2018, FPT Software faced a major issue related to employee engagement. As the company was growing fast, the management team found it difficult to maintain good engagement with the new employees and retain them. During this 1-year period, 1500 of 5000 new employees have left the company, resulting in a surprisingly high turnover rate of 30%. Losing talents is not the only damage to this turnover issue but also the loss of time and other resources spent on the onboarding processes and training for these new hires. A further investigation into this matter revealed that at one time, a manager had to manage 200 employees on average, and the lack of a system to evaluate the performance of these employees led to the inadequate engagement between the organization and the employees. With so many reports under one manager, social interactions to facilitate effective team engagement such as coffee breaks and social eating became impossible. Furthermore, it was estimated that each new hire would need approximately 14 days to familiarize themselves with the new work environment, e.g., understand the systems and procedures or get along with key supporters, before they can perform effectively their main tasks. These processes do not only prompt the challenge to any single department, but it elicits the participation of all related teams. The lack of adequate employee engagement methods and the onboarding process that could be further optimized were identified as the cross-functional pain points between multiple departments, including human resources and finance, and across organizational levels.

MyFPT, an all-in-one mobile app that aims to facilitate the engagement between FPT Software and its employees, was created to address the identified pain points. This mobile app provides functionalities of an enterprise social network and an online marketplace, where employees can receive “company golds” as a type of reward and use these company golds to buy lunches at work or other goods. Personalized performance feedback from managers to employees can be sent via this mobile app, and employees can also send each other appreciation and congratulations on special occasions. Moreover, the app provides multiple features to improve the employees’ work experience at FPT Software. For example, they can give ratings and reviews for the foods served at the company’s cafeteria, and the recommending function is also implemented on the app to suggest new or matching dishes based on each employee’s unique dining patterns and needs.

Although the Gen Y and Gen Z talents at FPT Software preferred social interactions on digital platforms over traditional social interactions, not every employee was willing to adopt the app when MyFPT was first launched. To encourage the employees to use the app, top management has posted various social events on the app, such as the “Run for Green” event, in which the company pledged to plant a tree for every 10-km run by each employee. Top management also integrated the use of the app into the employees’ daily activities, such as employees earn points that can be converted into “company golds” when they commute to work by bus. The COO of FPT Software explained the approach to persuade employees to adopt MyFPT as part of this digital transformation project:

> While the Digital Kaizen as a framework instructs us on what and how to implement digital transformations, top management needs to be creative in designing every implementation step. On one hand, MyFPT is created to serve the essential needs of the employees to engage with the company, therefore the initial adoption of some employees can be anticipated and understandable. On the other hand, when the app as part of the digital transformation needs to be adopted at a larger scale, the app needs to be flexibly changed to promote itself.—COO of FPT Software

4.2 AkaLink: An Online Platform for Skill Inventory Management

Another major issue faced by FPT Software during this period was related to managing the company's skill inventory. Traditionally, human resource department is responsible for developing the workforce through recruiting and staffing services. Human resource management activities involve assessing and updating the current skill inventory of the organization, evaluating the availability of the core skills that are required by the business, and sourcing talents to meet business needs in a timely manner. However, these activities are often performed a few times a year, whereas FPT Software needs a solution to monitor and update their skill inventory in real time, in order to stay relevant in the fast-changing technology industry. Provided the plethora of specific skills and knowledge domains in the technology field, such as different programming languages and the skill sets required for working on different parts of an information system, the issues related to who should be in charge of evaluating the skill inventory and determining which skills are needed in both short term and long term were identified as cross-functional pain points that needed to be addressed.

The system AkaLink was developed for FPT Software to address the identified pain points related to the skill inventory management. When using AkaLink, employees can update their skills when a project is finished, and their colleagues and managers can endorse these skills. Moreover, AkaLink can recommend new tasks within the company that match the employees' nominated skills and job preferences. Employees can register to participate full time or part time in any project, and they can also volunteer to become a trainer or mentor. While the employees' career development needs and goals are supported by AkaLink, the system also creates a shared database of skills and resources within FPT Software that is updated regularly by the employees themselves. Taken together, AkaLink provides a new digital platform that empowers employees to make decisions on their career development. The system also provides top management with more accurate information about the employees' participation in projects and an overview of the skills that are available in the company, so that they can plan the training programs and hiring strategies accordingly. In line with Digital Kaizen, these changes represent the transformations in the three areas of technology, people, and business process, respectively.

5 Results Achieved

The adoption of Digital Kaizen methodology has urged FPT Software to continuously optimize their business operations and increase efficiency through implementing innovative transformations. By addressing the company's cross-functional pain points, FPT Software is tackling digital transformation uniformly and collaboratively throughout the organizations to achieve the organization's strategic objectives, rather than making small changes in organizational silos. For example, in 2019, based on 110 cross-functional pain points that were collected and categorized, MyFPT and AkaLink were selected as the digital transformation initiatives as they aimed at solving problems related to the strategic objectives of improving resource fulfillment, resource retention, and process enhancement. The metrics for evaluating the effectiveness of such digital transformation initiatives were quantitative and measurable in terms of monetary value and the number of pain points that can be addressed.

By using MyFPT, the human resource department and top management are now able to engage better with the employees and retain new hires more effectively, which leads to a significant decrease in the company's turnover rate. With the database of frequently asked questions (FAQs), new employees would take less time to get familiar with the systems and work procedures in FPT Software. For instance, these new employees do not need to spend time to find the right persons to ask for instructions, but they can easily and actively seek information through the MyFPT mobile app. Looking back from June 2020 to when MyFPT was first implemented, more than 22 strategic pain points were recorded to be resolved by this mobile app. The time it takes to finish the onboarding process at FPT Software was also reduced from 14 days to only 5 days, which removed the need for a significant amount of work hours that are equivalent to a large saving.

There are 15,000 employees who currently use MyFPT every day for various purposes, from booking the bus and ordering food at the cafeteria to reviewing their evaluations and communicating with colleagues. The large number of active users who use the app daily suggested a high level of engagement between the employees and FPT Software. On the other hand, the AkaLink project addressed the strategic goal related to resource fulfillment. By addressing 19 pain points, the monetary benefits that resulted from AkaLink were estimated to be approximately USD700,000 and were projected to rise to USD2.5 million after 1 year. The top management at FPT Software also forecasted that after tackling 16 more pain points next year, AkaLink would optimize up to 5% of idle human resources in FPT Software, which approximated 600 employees.

It is worth mentioning that the digital transformation projects have not only created monetary values but also produced spillover effects that benefit FPT

Software as a whole. By involving in the digital transformation projects, employees working in different functions also had various opportunities to become more skillful in utilizing technologies and improve their adaptability to organizational changes. The identified cross-functional pain points affected directly operational staffs in their daily works. When the digital transformation projects successfully addressed the pain points, the employees' morale increased and top management gained trust from the employees, which in turn motivated their participation in the next digital transformations. Consequently, this created the cycle of inspiration toward digital transformation activities.

> It should be noted that digital transformation projects must benefit employees at the operational level first. Digital transformation projects should not be about creating new tasks for them but offer new solutions to increase their productivity and performance. This will make the employees find the digital transformations more relevant to them and actively get involved in the transformation activities.—CEO of FPT Software

The short time frame of only 3–6 months to evaluate a digital transformation project is also beneficial since it allows the quick realization of the transformation's results and returns on investment. Prior studies suggested that when employees perceived the objectives of organizational changes as clear, achievable, and meaningful, they would feel motivated to work with a higher level of concentration and achieve job satisfaction more easily (Islami et al. 2018; Bhatnagar 2012). These results supported FPT Software's Digital Kaizen strategy to create quick wins that became a sustainable source of motivation for the employees while nurturing the vitality of the digital transformation culture and reinforcing the effectiveness of the philosophy that focuses on making continuous improvements.

Besides creating the desirable effects within FPT Software, the company also uses quick wins as practical case studies to pursue potential clients into purchasing their digital transformation solutions. As discussed, digital transformation is perceived as an appealing trend across different industries in Vietnam. Many businesses would want to conduct digital transformations, but they do not have a clear idea of how to begin the transformation and hesitate to invest resources in such an unclear initiative. In this regard, the digital transformation solutions of FPT Software are advantageous since they have been successfully tested and proven to produce desirable results within short time frames. Moreover, FPT Software offers Digital Kaizen as a rigorous methodology for implementing digital changes, as part of their digital transformation solutions, and not just the technologies alone. By selling such a methodology that meets the tailored needs of each client, FPT Software is pursuing its strategic goals of "understand the clients thoroughly" and "provide the perfect service quality."

6 Lessons Learned

In this chapter, we explored the concepts and implementation of the Digital Kaizen methodology which is an adaptation of the Kaizen philosophy and created by FPT Software. From the interviews with the company's key informants and their accounts of two notable digital transformation initiatives, MyFPT and AkaLink, the adoption of Digital Kaizen brought several benefits to FPT Software. Furthermore, the findings showed the connection between the Kaizen philosophy and Digital Kaizen methodology, as illustrated by the two digital transformation initiatives. Table 1 compares Kaizen, Digital Kaizen, and the two initiatives, MyFPT and AkaLink, by the activities that belong to six general steps of the original Kaizen framework (Smalley and Kato 2010).

In summary, the idea of generating continuous improvements is the key factor that links Kaizen philosophy to digital transformation. While Kaizen focuses on continuous improvements, digital transformation refers to the changes that are enabled by deployment of innovative technologies (Newitt 1996; Vial 2019; von Leipzig et al. 2017). Reflecting on the two digital transformation initiatives, the company's pain points are the starting point of such continual changes. After that, detailed plans for implementation with several smaller goals are developed, and digital transformation can be implemented as part of a rapid experimenting process. In addition to our reflection about the connection between Kaizen, Digital Kaizen, and the case study, we summarize below three lessons learned that are drawn from the interviews with FPT Software's key informants.

It is also worth noting that the findings and lessons learned that we reported in this chapter are based on the perspective of FPT Software's management. To the best of our knowledge and of the key informants, the Digital Kaizen methodology was only implemented at FPT Software. Therefore, it will be helpful for future studies to investigate into the benefits and challenges of Digital Kaizen for implementing digital transformation, especially from the perspectives of different stakeholders such as employees or clients. Ethnography and action research methods would be particularly suitable for studying the Digital Kaizen methodology in greater depth, by having the investigators interact directly with the relevant stakeholders during the process of adopting the methodology.

6.1 *Lesson 1: Driving Digital Transformation Through Incremental Digital Changes That Address Cross-Functional Pain Points*

Despite the emerging digital transformation trend, many companies do not have a plan in place for such transformation (Eswaran 2017). On one hand, some do not fully grasp the current state of their own digital maturity. On the other hand, companies may struggle to formulate and execute their digital transformation

Table 1 Comparison between Kaizen, Digital Kaizen, and the case study

Kaizen	Digital Kaizen	Case study (MyFPT and AkaLink)
Step 1: Discover the improvement potential		
Organizations pay attention to the daily issues and opportunities that can bring process improvements	Cross-functional pain points are identified during formally organized workshops attended by department managers	Department managers discussed cross-functional pain points to come up with digital transformation initiatives that are aligned with the company's strategic objectives
Step 2: Analyze the current methods		
Use various techniques to analyze problems for potential process improvements	Managers exchange feedback about daily operational issues between departments	Inadequate employee engagement and inefficient onboarding process were identified as cross-functional pain points
Step 3: Generate original ideas		
Apply creative and analytical thinking to brainstorm on the problems	Department managers develop digital transformation initiatives that focus on people-centric technologies to address the identified pain points	Department managers came up with the ideas to develop MyFPT and AkaLink software applications
Step 4: Develop an implementing plan		
Focus on deciding who will do what, where, how, by when, and why	Digital transformation initiatives proposed by managers are ranked and prioritized by a steering committee	MyFPT and AkaLink were selected to be implemented based on their feasibility and potential contributions to address human resource issues that are urgent and aligned with the strategic objectives
Step 5: Implement the plan		
Put emphasis on coordination between implementation teams	Apply flexible change management techniques to implement digital transformation initiatives; focus on delivering quick wins that are observable to increase employees' morale	Programs and change management techniques were deployed to motivate the employees' adoption of MyFPT and AkaLink
Step 6: Evaluate the new method		
Benchmark results after improvement against pre-implementation conditions, then standardize the solution if successful	Digital transformation initiatives are evaluated based on clear metrics that are aligned with strategic objectives; successful initiatives are refined, packaged, and commercialized	MyFPT and AkaLink were both found to achieve monetary gain and successfully address the identified pain points; AkaLink is advertised and sold to clients

strategy. By its nature, digital transformation is an abstract concept that extends beyond merely implementing technologies such as enterprise resource planning (ERP) systems or applying data analytics to analyze large data sets. Without fully understanding digital transformation, organizations may risk committing tremendous resources to adopt sophisticated technologies that fail to deliver the anticipated benefits, if not damage the current business by disrupting current work processes or creating a digital divide within the workplace.

The Digital Kaizen methodology of FPT Software provides a conservative and safe approach to materialize the abstract digital transformation concept, which puts emphasis on making rapid and manageable digital changes. By solving operational pain points that are aligned with the company's strategic objectives within short time frames of 3–6 months, top management and employees can quickly realize the outcomes of digital transformations, which in turn motivate them to continue participating in further transformation activities. The implementation of digital innovations that result in incremental and practical operational improvements helps to explain clearly the meaning of digital transformation to organizational members at all levels and thus gains their buy-ins for transformations at large scale.

6.2 Lesson 2: Improving Organizational Change Capacity via People Engagement

Although FPT Software has implemented successful digital transformation projects that create measurable outcomes such as MyFPT and AkaLink, they still tailor these digital transformation solutions to fit the clients' specific business context rather than offering off-the-shelf software packages. As seen in the discussed transformation cases in FPT Software, the personalization of digital solutions stems from engaging with the employees and understanding their needs. The employees play several key roles in the digital transformations within FPT Software—the pain points are identified from their daily work, and their active adoption of the digital transformation solutions determines whether the transformation's benefits can be realized. In other words, employees are the drivers of digital transformation, and solving operational problems that are meaningful and relevant to the employees is the key to a successful digital transformation.

Among the realized benefits that resulted from the two digital transformation cases in FPT Software, the employees' increased exposure to digital technologies and adaptability to digital changes were mentioned as a spillover effect of the digital transformations. First, this finding suggested that change management techniques are important for digital transformation projects since not all employees would be ready to adopt the changes at the beginning, especially when transformations are conducted rapidly as in the case of FPT Software. Second, it highlighted the importance of achieving a high level of digital maturity within the organization to ensure successful digital transformations. From the case of FPT Software, digital maturity is achieved by and evident in the integration of digital solutions such as MyFPT and AkaLink into the employees' daily activities. The Digital Kaizen methodology, which focuses on making incremental improvements, plays a key role in gradually building up and sustaining the digital maturity of the organization.

6.3 Lesson 3: Selling Philosophy-Driven Digital Transformations

The Kaizen philosophy has been the interest of organizational studies due to its positive influence on productivity and the production of high-quality productions with minimum efforts (Singh and Singh 2009; Macpherson et al. 2015; Newitt 1996). As organizations are dynamic entities in an ever-changing environment, most of them are in a constant state of flux. Such a highly competitive and changing environment brings significant managerial opportunities and challenges, in which the Kaizen philosophy is adopted by companies to stay ahead of competitions (Deming 2018). The Kaizen philosophy emphasizes the key idea that there is no end in making a process better by leveraging good teamwork and flexibility in performing work (Suzaki 1987b; Wickens 1990).

The Digital Kaizen methodology of FPT Software was built on the principles of the original Kaizen, which employs a similar approach to implementing digital transformations. In creating Digital Kaizen, FPT Software has made a few changes to the original Kaizen philosophy to make it fit the digital transformation context. The original Kaizen is primarily applied in production to reduce costs, minimize wastes, and increase productivity, whereas Digital Kaizen aims at facilitating the implementation of digital innovations that transforms people and business process. The focus on solving cross-functional pain points and implementing digital innovations to achieve quick and small improvements in the organization expand beyond eliminating waste and improving efficiency in the production line.

Besides the focus on making continuous and incremental improvements, Digital Kaizen develops a climate of engagement and creativity among organizational members at all levels. In FPT Software, digital transformations involve both top-down and bottom-up efforts, and the alignment between the employees and top management is considered as the key success factor. This alignment is achieved by identifying and solving the cross-functional pain points that contribute to the strategic objectives set by top management and to the daily work processes and tasks handled by the employees. According to the CEO of FPT Software, the company's motto is "think big, start smart, and scale fast," which clearly illustrates the principles and approach of the Digital Kaizen methodology. By incrementally solving operational pain points without losing sight of the long-term vision by aligning closely with the strategic objectives, the digital transformations at FPT Software result in both short-term operational success and long-term organizational enhancements.

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Cultivating Digital Transformation at Arcadis

A Global Expedition into the Digital Universe

Lieselot Danneels, Stijn Viaene, Joachim Van den Bergh, and Carolyn Moore

Abstract

(a) **Situation faced**: After a wake-up call by a digital native, over 130-year-old Arcadis decided that a digital transformation of the global firm offering design and consultancy in the construction industry would be necessary. Arcadis realized that its fragmented organization with different business lines, expertise areas and services for each region could not respond to changes in a turbulent environment with the same speed as a digital native. A deeply rooted organization culture would have to be disrupted, taking 27,000 Arcadians worldwide on a digital journey.

(b) **Action taken**: Arcadis appointed a corporate digital team whose main aim was to lead an inclusive digital transformation. They took on the challenge to cultivate a common language for digital transformation and new skill sets. The centrepiece of their approach was Expedition DNA, a multitiered voluntary program that would build a foundation for involving all of the talents in the company. Alongside more technical skills development, the program, which was continuously evaluated and revised, provided people with new skill sets in their

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function. An internal communication plan ensured that the same common language was used consistently in all company efforts and appropriated by all digital ambassadors.

(c) **Results achieved**: By November 2020, 2 years after the launch of the Expedition DNA program, 16,221 employees had taken the voluntary online training. By complementing Expedition DNA with other actions, and by constantly focusing on the same digital transformation tenets, Arcadis managed to spread a common language throughout the company for discussing digital transformation. Along with new digital skills, this led to new forms of client engagement and more digital business development. The cultivation of a common language and the community-building efforts had a positive impact on employee engagement, collaborations within and across regions, employee retention, and the employer brand.

(d) **Lessons learned**: The case provides inspiration for how to make cultivation a key part of digital transformation programs: put learning and belonging centre stage in cultivation, go for an inclusive digital transformation with a layered degree of involvement, build in a community aspect, acknowledge the importance of data-based decision-making and deal with paradoxes in decision-making.

1 Introduction

Companies in the midst of a digital transformation adopt different views on how the existing business relates to the new, digital business—some promote isolating digital transformation in a separate, newly established department or lab environment (Maedche 2016; Sia et al. 2016), while others advocate the transformation of the company as a whole (Svahn et al. 2017). Organizations opting for the latter view do not treat digital transformation as a project or a time-limited investment, but rather as a continuous capability-building exercise, an 'enduring digital innovation factory' (Westerman 2019). Such firms aim to build new organizational capabilities for successful digital transformation (Li et al. 2018). Organizational capabilities are 'a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end' (Amit and Schoemaker 1993). They look at the existing business and the employees as acceleration mechanisms for spreading a new way of working and thinking throughout the organization, rather than as something from the past holding back or slowing down new digital possibilities.

Building such an enduring digital innovation factory depends on constant cultivation efforts rather than on a large-scale change plan (Kotter 2012). While large-scale change efforts are fit for responding to episodic change, digital transformation comes with environmental turbulence in the form of new technological possibilities, digital natives entering the industry and ever-changing customer expectations (Viaene and Danneels 2015). This type of environment requires an approach that is less rigid and predetermined and that does not transfer responsibility to a small core group only. Instead, cultivation, which connotes creating a fertile soil for growing something, is a much better-suited approach for such a turbulent environment. Cultivation installs change by ensuring that employees are empowered with a digital mindset and by forming an 'army of volunteers' (Kotter 2012). It is characterized by core principles such as many change agents instead of a few appointees, a want-to and get-to mindset, a focus on head and heart and much more leadership at all levels.

Kotter (2012) suggests moving away from an either/or to a both/and mindset, where the cultivation of a volunteer army is combined with the existing, more hierarchical, operating model. The existing operating model, focused on incremental changes and efficiency, is needed for the daily demands of running the enterprise. In parallel, the cultivation efforts set up a network-like structure with a higher agility to respond to bigger changes in the environment. Combining both operating models ensures that organizations can successfully perform in the current business and prepare for the future. But how can organizations set up this parallel cultivation track and create a network of employees at all levels?

We selected a critical or 'least likely' case (Flyvbjerg 2006) for making the cultivation of a network of employees work: a large organization with a lot of fragmentation in its existing operating model and employees in a diversity of roles spread around the globe. We share the case of Arcadis, a global design and consulting firm in the construction industry, headquartered in Amsterdam with Dutch roots dating back to 1888. In 2019, it employed some 27,000 employees who generated 3.5 billion euros in revenues. Arcadis has grown through multiple acquisitions, resulting in a fragmented organization: five continents, hundreds of offices delivering projects in more than 70 countries, each with different business lines, expertise areas (buildings, infrastructure, environment, water) and services (design & engineering, program management, consultancy, project & cost management, architectural design). In addition to its fragmented operating model with a lot of freedom for regional responsiveness, Arcadis is also characterized by a people-centric culture. This is reflected in the 'people first' core company value and the explicit choice to take along and further develop the talent already in the company instead of hiring new people alone. In this chapter, we focus on the cultivation approach in the critical case of Arcadis for taking all 27,000 employees on a global expedition into the digital universe.

2 Situation Faced

In 2017, Arcadis lost the bid for an urban development project at Waterfront Toronto, not to one of its familiar competitors in the construction industry, but to Sidewalk Labs,[1] a subsidiary of Alphabet and a sister company of Google. It served

[1]In 2020, Sidewalk Labs cancelled the Toronto Waterfront project; see https://www.bloomberg.com/news/articles/2020-05-07/alphabet-s-sidewalk-labs-abandons-toronto-waterfront-project

as a wake-up call that the construction industry—up till then often seen as a laggard when it comes to digital transformation (Kane et al. 2015; Yokoi et al. 2019)—was being disrupted by new players that could not differ more from the incumbents. While Sidewalk Labs was founded in 2015, Arcadis is over 130 years old.

In addition to the external trigger coming from new entrants, Arcadis also had internal drivers propelling its digital transformation. Later in 2017, Arcadis' CEO, Peter Oosterveer, stated that the company wanted to become a digital frontrunner by 2021 (Arcadis 2017). Arcadis introduced three core values that set the ambition on how it wanted to drive its digital transformation forward: together, outside-in and radical. The need to blend the existing organizational capabilities as an asset-oriented company with more and more human-centred design was translated into a vision statement: 'We improve quality of life by better understanding the human experience and connecting it with our scalable asset knowledge'. To bring the vision statement to life, the existing operating model—which was characterized by different regions, products and services—was replaced by key areas of focus (mobility, resilience, places and resources) representing customer-centric themes. To realize all of this, Arcadis introduced a focus on three investment horizons with a different impact in time (today, tomorrow and after tomorrow). Investing in all three investment horizons simultaneously would ensure that the company would survive and reinvent itself.

While some organizations choose to set up separate ventures to experiment freely with digital (Maedche 2016; Sia et al. 2016), an important part of Arcadis' program was that it aimed for a digital transformation of the company as a whole (see, e.g. Svahn et al. 2017): '*We should be an integrated business, one Arcadis from a service provision and vision standpoint. One global firm. [This includes] sharing best practices and a stronger global operating model, break[ing] down silos, [and the] consolidation to one vision and identity'* (Arcadis workshop, Amsterdam, 2018).

However, as an executive leadership team member explained at the end of 2018, the fragmented state of the company turned out to be a major hurdle for driving the digital transformation program forward:

> It is most difficult because we are very fragmented and diverse, and always have been, and fragmentation is our biggest enemy, but at the same time the reason why we exist. We need to understand that we can only be successful if we develop a 'one Arcadis transformation program', but on the other hand 70% to 80% of our business is very local and client-driven. So, 'how do you connect those two?' is probably the biggest challenge we have.

For driving the digital transformation program forward, Arcadis aimed to maximally involve and further develop the talent in the company. It is a people-centric organization at heart, which is reflected in the 'people and culture' strategic pillar and in the 'people first' core company value (Arcadis 2020): '*We differentiate ourselves through our talented and passionate people, our unique combination of [organizational] capabilities covering the entire asset lifecycle, our deep market* *sector insights, and our ability to seamlessly integrate health and safety, sustainability and digital components into the design of our solutions around the globe'.*

In the actions taken, Arcadis aimed to balance a globally driven digital transformation program with enough degrees of freedom for local responsiveness. It took an approach to driving radical change that allowed for inclusiveness and empowerment of all employees worldwide, rather than setting up a huge change program led top-down by global leadership. The core question was: how can Arcadis take along all 27,000 Arcadians from the beginning on a digital journey?

3 Action Taken

Pretty soon after the inflection point of the lost Toronto deal, Arcadis established a team of internal talents and new hires to lead and structure its digital transformation efforts, under the leadership of a chief digital officer (CDO), a previously inexistent function. While the digital team was starting its operation, they quickly noticed how expectations in the business were high, and, at the same time, understanding of what digital transformation entailed was very diverse.

The digital team assessed the capability gap between the organization's as-is skill set and the required organizational capabilities for a digital future. They concluded that the company needed to accelerate its efforts in order to bridge the gap. Acknowledging that the gap would not be bridged by hiring new people alone, they considered how to get as many of the present employees on board to develop the required skills. They decided not to focus on creating new functions with fancy titles but instead on providing people with new skill sets in their function.

In parallel with the actions to increase the company's digital organizational capabilities, Arcadis' digital team organized an internal communication plan ('Dare to be digital' campaign) stressing the importance of a learning mindset and raising awareness of the need for digital transformation. The Toronto Sidewalk story was used as an anecdote to get the organization's attention: 'This threat is real and it's here already. Digital transformation is not playing out in a distant future, it starts now'.

At first, the slogan to raise awareness was 'survive and reinvent'. It was chosen for its powerful message of urgency and strong call to action. 'If we do not move into the digital era now, the company's future might be at stake'. However, feedback from the organization showed that the wording of the message was perceived as somewhat pessimistic, and so it was changed into a more appropriate forward-looking message—'thrive and reinvent'—which holds a more positive tone and focuses on opportunity rather than threat.

In a first phase, the need for a shared mental image of digital transformation was addressed by organizing a global training program for executives that offered a digital transformation glossary and frameworks while opening the floor for discussion and the 'what and how' of digital transformation at Arcadis. Over the course of a year (2018), roughly 300 executives from the corporate and regional units went through the 3-day **'digital leadership' program**. It exposed the participants to two main frameworks serving as a holdfast for Arcadis' leadership to discuss the need for digital transformation as well as how that would impact the company. One framework proposes 'four realities' of the digital age—(1) customer experience-centric, (2) data driven, (3) ecosystem supported (4) platform based—that ask for specific new organizational capabilities to be developed in any business. The second framework then proposes organizational capabilities that serve as accelerators of organizational change and digital transformation. In other words, it explains the new world in which Arcadis will operate and aspire to be a frontrunner, what it will take to get there, and, finally, the role leaders are expected to play in that transformation. As reported in Arcadis' 2019 annual report:

> Market needs are rapidly changing. Arcadis is aware that it must innovate based on the changing market demands and not based on its existing [organizational] capabilities. It is developing the knowledge and the technical capability of its people to match those market needs. The evolution of Arcadis' business helps it to maintain a sustainable future, but this is being achieved quickly and it must maintain a comprehensive understanding of what is needed to achieve this transformation, and by when. (Arcadis 2020)

The program not only provided theoretical concepts and frameworks, but it also involved all participants in committing to actions to get their act together in function of Arcadis' digital ambitions. Regional CEOs, who also participated in the trainings, would address their fellow participants at the end of the intensive 3-day courses, give their summary of what they had learned and engage their fellow managers to commit to putting what they had learned into action.

As the executive digital leadership trainings progressed, the digital team and the HR department acknowledged the need to involve not just the top layer of the organization but also its larger group of professionals. That audience is a very diverse group of employees, including many highly specialized profiles, support services, engineers and consultants. The sheer size and diversity of the group called for a different approach that ensured effectiveness, reach and affordability for the company. At this point in time, they involved the Arcadis Academy (i.e. Arcadis' corporate learning and development competence centre) to develop a solution to bring digital transformation to the masses, alongside the Academy's usual offering of management skills programs such as project management and leadership development.

The solution was a three-pronged effort, baptized Expedition DNA, to introduce the same concepts that were now familiar to the leadership team to the whole company. The first pillar, dubbed Base Camp, provided an online course. The second pillar consisted of a deep-dive regional boot camp, known as the Expeditions. And finally, the third pillar, named Hike DNA, centred around applying design thinking concepts to create and develop valuable business ideas for Arcadis and its customers through a train-the-trainer format (Table 1).

Base Camp was structured around the same realities as mentioned in the set-up of the digital leadership courses. Not only does it provide insightful concepts and light theory, but it also tests the course takers' knowledge and shows—by sharing company use cases—how Arcadis is already applying those concepts and trying to

Table 1 Digital transformation cultivation at Arcadis—actions summary

Action	Target audience	Description
Global digital leadership training program	Global (HQ) and regional executives	A comprehensive 3-day training program on the essence of digital leadership and organizational capabilities for digital transformation
Expedition DNA (Base Camp, Expeditions, Hike DNA)	Base Camp: open to any Arcadian on a voluntary basis, regardless of position or function Expeditions: for selected Base Camp graduates only Hike DNA: regional change agents, Expeditions alumni	Base Camp: an online course to create awareness of the need for digital transformation, providing entry-level materials on terminology and applications of digital transformation at Arcadis Expeditions: deep-dive regional boot camps focused on developing specific digital skills such as design thinking, machine learning, . . . Hike DNA: globally consistent curriculum designed to be delivered locally with a focus on application of digital technologies to build value for Arcadis and its customers. Train-the-trainer sessions.
Other initiatives (technical skills trainings, Deep Orange, Code Orange, Global Shapers, communities of practice, start-up incubator)	Technical skills trainings: BIM and data translators, design thinking experts Deep Orange and Code Orange: co-creation with external stakeholders Global Shapers: young professionals Communities of practice: organic, bottom-up network Start-up accelerator: young tech businesses in the construction sector, selected employees	Technical skills trainings, most prominently a building information management training program, to develop sector-specific digital skills Deep Orange and Code Orange: co-creation formats with external stakeholders to stimulate open innovation at Arcadis Global Shapers: developing Arcadis' young potentials into internal challengers and digital ambassadors Communities of practice: bottom-up communities of employees who share common interests in skill sets such as BIM, who organize virtual knowledge sharing sessions Start-up accelerator: in collaboration with Techstars, Arcadis hosts an incubator to support promising start-ups in its sector. Employees are cross-pollinating solutions as mentors and jury members

achieve its digital frontrunner ambition. The course is open to everyone in Arcadis on a voluntary basis and is actively promoted by the company's leadership team. The Base Camp awareness course was first introduced at the end of 2018 and takes about 8–10 h to complete.

The content of the course is not theoretical. It applies digital transformation to Arcadis and also highlights which actions are already planned, which use cases are in place and how Arcadis is reacting to the digital era realities. Course takers are addressed by fellow Arcadians in concise video clips explaining what digital transformation means and how people are central to the answers Arcadis is formulating. Participants are challenged by regular built-in 'battles', short quizzes that test the knowledge they've gained in each section of the online course, ranking them among all participants and thus adding a gamification element.

A select group of Base Camp graduates has the opportunity to go more in depth on the topics touched upon in the online course in an off-site multiple-day program. The number of candidates exceeds the available places by almost 10 to 1, so getting in implies a high level of commitment. The **Expeditions** gather diverse groups of Arcadians. A virtual preprogram phase serves to build a sense of community feeling with the Expedition members. Participants split up into several skill labs that provide workshops in specific skills that are needed to thrive in Arcadis' digital realities. There are skill labs in design thinking, data analytics and machine learning, building information management and ecosystem thinking and partnerships—which correspond to the aforementioned 'four realities' framework. Also, the Expedition provides sessions that are focused on the overlaps between the various realities and skill sets, stressing the importance of internal collaboration. Next, the group applies the newly acquired skills to real Arcadis business challenges, with customer value creation in mind.

The Expeditions pillar deliberately aims to create a network of digital transformation ambassadors, which in turn creates a 'ripple effect' to engage those employees who have not taken the course or do not immediately feel the heat of digital transformation in their environment. Upon completion of the Expedition, participants are eager to go back to their respective regions and functions and take some of that enthusiasm and concrete ideas to their team. Together they form a powerful community of digital transformation change agents, who share a common language and drive for digital transformation at Arcadis.

Hike DNA was developed to fill an apparent gap between Base Camp (the scalable online 'awareness building' program) and the Expeditions, which are more focused on skills development and transformation. Hike DNA is a globally consistent curriculum, designed to be delivered locally, with a focus on applying digital technologies to build value for Arcadis and its clients. It is delivered in a train-the-trainer approach: Day 1 focuses on developing the future trainers, and Day 2 is a regional pilot in which the aspiring trainers co-facilitate with the corporate team to ensure that they understand how to deliver the curriculum. The trainers are drawn from the Expeditions alumni, which even adds to the 'ripple effect' (i.e. the indirect impact of one initiative transcending its direct impact).

The set-up of the Expedition DNA stack is not static. All elements are evaluated on a continuous basis and have been updated to be in line with newly acquired insights and strategic decisions. New modules on business models, legal aspects and digitization of solutions have been added. As of 2020, the company announced that it would increase capacity for the Expeditions in order to get an even bigger community of digital transformation change agents going. In fact, the third pillar 'Hike DNA' is the result of an internal evaluation identifying an opportunity to start a train-the-trainer program in addition to the other pillars.

The training programs form the frontline of Arcadis' digital transformation cultivation and are complemented with several other cultural interventions and trainings that amplify the message of the communication campaign as well as the stack of training opportunities. In addition to the digital transformation skills offered by Base Camp training and the Expeditions and Hike DNA sessions, more **technical digital skills** were supported as well. Arcadis has placed building information management (BIM), its sector-specific data management capability, central to its digital transformation from the start. One thousand LinkedIn learning licenses were acquired for the internal BIM community.

Furthermore, the Global Digital Team launched the so-called **Deep Orange** sessions. Deep Orange is a format in which a regional team of Arcadis employees, customers, partners and suppliers are invited to an innovation sprint. These co-creation sessions are an energizing mix of methodological interventions, problem identification and design thinking. Apart from the direct output that could lead to new business or innovative ideas, its format is a deep dive for the involved Arcadians into new ways of working in a digital context. Similarly, the company has introduced the **Code Orange** concept, which takes a similar co-creation approach but centres specifically around data analytics. Again, there is a direct output effect, in terms of concrete projects or product and service ideas, but the indirect impact on the cultivation of digital transformation and its importance for Arcadis is just as influential. Social media was used to add a viral layer to the interventions. Whenever a Deep Orange session or Expedition had taken place, the organizers would send out an after movie showing the vibe of the session and increasing awareness levels internally as well as externally.

In 2017, the annual edition of the **Global Shapers** program was dedicated to digital transformation. Global Shapers brings together 100 young Arcadis professionals from all over the globe to work on a thematic challenge to improve the company. Turning these leaders of the future into ambassadors for digital seeded the growing community of digital transformation enthusiasts.

In collaboration with Techstars, Arcadis hosts a **start-up accelerator** (Arcadis City of 2030 Accelerator) for young tech businesses in the construction space. Employees become acquainted with the fascinating world of these digital natives as mentors or jury members, which in turn inspires them to think about Arcadis' own digital transformation.

Finally, several informal **communities of practice** have arisen around the building blocks of Arcadis' digital transformation approach. For example, there is a very lively analytics community, linked to the internal BIM push, that organizes monthly calls, has a collaborative workspace on Microsoft Teams and organizes data analytics skills trainings.

Keeping track of all these initiatives, digital projects and their outcomes was dearly needed, because employees would sometimes feel lost in the flurry of digital transformation interventions and how it all connected. Vision 2030, the company's most recent formulation of its near-future strategy, is the result of an internal co-creation strategy process. It clarifies how Arcadis wants to realize the ambition to be the reference for digital transformation in its sector and translates how this impacts the organization. Articulating that vision has helped put even more consistency into the message to Arcadians around the world. Of course, now the question is: how has all of the above resulted in mobilizing Arcadis employees for digital transformation?

4 Results Achieved

In Table 2, we give an overview of the reach and impact of each of the individual actions listed above. Collectively, the actions were also intended to have a broader impact on client engagement and business development, employee engagement and retention and the employer brand. In this section, we will discuss, in more detail, to what extent these upfront expectations have been met.

It was expected that cultivating digital transformation throughout the company would have a positive influence on client engagement and business development. Arcadis' CEO described the impact of Expedition DNA as follows (Arcadis 2020):

> In Digital, more than one third of Arcadians have now completed our Expedition DNA basic digital training module. Employees now have different conversations about the business amongst each other, and with clients, which translates into winning and delivering more digital work. Our global solution leaders now fully own the digitization and automation of our existing business, resulting in a client-focused acceleration of the transformation, and various wins around the globe.

Anecdotal evidence shows that clients recognize that the push for more digital work has resulted in better insights. One client in the energy industry shared the following:

> Our relationship with Arcadis for environmental management is advancing opportunities to establish more connections digitally. Arcadis brought in people from around the country and from their offices in India to discuss data governance and the creation of a data lake. They asked us to participate in their opening meeting since we are a model for what they expect many of their clients will be looking for in the future. We have had additional meetings since the opening session, and more are to come, including a data science collaboration we are framing.

Also, a positive impact in terms of employee engagement and retention was expected. The awareness of digital transformation has certainly grown, as evidenced by the large number of people reached with all actions (see Table 2). Through the

Table 2 Reach and impact of the actions

Action	Reach	Impact
Global training program for executives	278 people or 66% of senior leadership	Introduction of a common language at the top layer of the organization, a shared mental image of digital transformation glossary and frameworks (‘four realities’ and organizational capabilities) Top-level commitment to digital ambitions and concrete actions
Expedition DNA (Base Camp, Expeditions, Hike DNA)	Base Camp: • Users: 16,221, or 59% of total workforce • 8636 people completed Base Camp 1.0 • 5534 people completed Base Camp 2.0 (new modules launched in November 2019) Expeditions: 326 graduates Hike DNA: training of 12 trainers and 30 digital advocates in the pilot held in November 2019	Based on an impact assessment with 108 digital ambassadors (who followed both Base Camp and an Expedition) in October 2019[a] Developing digital skills and innovation savviness across different levels in the organization: • 75% are applying skills developed at Expedition DNA • 72% want to receive deeper skills-based digital learning • For 82% digital has become part of their future career path projection Building a global digital community and starting a movement: • 98% have encouraged others to get involved in the digital transformation • 90% have met other digital ambassadors within their region; 50% have worked together on ‘ripple effect’ activities • 70% have met other digital ambassadors outside their region; 24% have worked together on ‘ripple effect’ activities • 60% have actively engaged with communities of practice (COPs) on average attending two COPs Arcadis received the 2019 industry leadership award in digital transformation from the *Environmental Business Journal*.[b]
Other initiatives	10,957 BIM translators Over 150 data translators 220 design thinking experts 100 Global Shapers	Train more specialized digital skills in a client-facing and project delivery approach: for example, percentage of net revenue resulting from 100% BIM projects globally has risen from 25% in 2018 to 65% in 2020 (Q3) Consistently spread the same digital transformation language and message through different channels

[a] A survey was sent to 322 digital ambassadors and their line managers, with a response rate of 1/3
[b] https://ebionline.org/2020/01/23/2019-ebj-business-achievement-awards/

global training program for executives, roughly 300 people at the top layers of the organization went through a 3-day digital leadership program. The Expedition DNA program, even though it runs on a voluntary basis, led to a much higher adoption of the common digital transformation language throughout the company. Together with the more specialized BIM, analytics and design thinking trainings, more than half of the company has been reached. A member of the executive leadership team acknowledged that: '*Expedition DNA has dramatically helped us to create a better foundation of understanding and engagement*'.

The actions were not only intended to create awareness among employees but also to create a digital community and a 'ripple effect'. Almost all of the graduates of Base Camp who also went on an Expedition, called digital ambassadors, have encouraged others to get involved in the digital transformation. This included giving presentations, encouraging the use of digital tools on projects, driving digital change and collaborating with people in their own team, outside their team and with clients. One digital ambassador said: '*I made a movie for colleagues about my experience in Expedition DNA, and why new people should join it*'. A large percentage have met other digital ambassadors (90% within their region and 70% outside their region), and half of them have actually worked together with others in their region on 'ripple effect' activities. Ambassadors who want to set up new digital activities individually seem to run into some hurdles, especially across regions, where the number of collaborations drops to only 24%. The communities of practice (COPs), which have been attended by 60% of the digital ambassadors, actively contribute to connecting digital ambassadors.

The actions have succeeded in engaging employees to learn new digital skills, with 75% of the Expedition DNA graduates applying the newly acquired skills. Most of them (72%) are in fact looking forward to receiving more and deeper skills-based digital learning, and for 82% digital has become part of their future career path projection.

A final indicator of employee engagement is the attrition rate—i.e. the number of employees voluntarily leaving the organization—which is much lower for Expedition DNA graduates (6.2%) than for employees who have not followed the program (attrition rate of 15%).

The actions also had a positive impact on the employer brand. Internally, digital ambassadors see their region gaining digital maturity, and 85% of the digital ambassadors have noticed an increase in digital activity in their region in the last 12 months. Furthermore, externally, clients and new hires now recognize Arcadis as a digital-savvy company. This is recognized in the 2019 industry leadership award in digital transformation which was awarded to Arcadis by the *Environmental Business Journal*, which praised how Expedition DNA was designed to engage all employees with a gamified digital training module and an immersive in-person experience.

Yet there were also a number of important hurdles in terms of achieving impact on cultivation. Arcadis' aim was to go for an inclusive digital transformation, but for some employees the frameworks were too abstract to get started with. The intention was to build a global digital community, but the number of collaborations among digital ambassadors across regions remained low, with the exception of some ad hoc communities of practice that were launched bottom up. Measurements of how well initial objectives were met only started after a while and were not consistent across all actions. Despite the global character of the actions, speed differences between regions in terms of digital transformation sometimes hampered the inclusive character of the actions. The fragmented operating model continued to cause organizational tensions, including an us-versus-them mentality between regions and headquarters.

5 Lessons Learned

We share the most important lessons learned from what worked and what did not work in the critical case of Arcadis. This serves as advice for others—including those with less fragmented operating models and with less employee diversity—who also want to build an 'enduring digital innovation factory' (Westerman 2019) for cultivating digital transformation.

Put learning and belonging centre stage in cultivation
Learning and feedback cycles are imperative for coping with a turbulent environment characterized by changing customer expectations and continuously evolving technological capabilities. Digital ambassadorship at all levels is equally important. Ideally, cultivation efforts create a learning organization to which everyone can contribute. At Arcadis, the digital transformation program engaged people at all levels to continuously share learnings in a network of ambassadors and communities of practice. Arcadis took a belonging perspective by co-creating Vision 2030, the company's strategic response to digital disruption, with different parts of the organization. The compelling vision focuses on creating a better quality of life and creates a sense of urgency around a big opportunity (Kotter 2012), which brought the energy and enthusiasm to mobilize a volunteer army to be part of the digital transformation. Arcadis also stimulated empowered teams to work towards their own (often regional or business line-specific) goals in addition to company-wide goals. Instead of only promoting globally driven digital transformation projects, this approach also allowed for local responsiveness and contributed to an inclusive project portfolio.

Go for an inclusive digital transformation with a layered degree of involvement
An inclusive digital transformation aims at involving more employees compared to a very exclusive approach where only one dedicated department or an external incubator gets to experiment with new digital opportunities. Still, even in digital transformation programs characterized by broad involvement of employees at all levels, not all individuals should be, or want to be, involved to the same extent. How can companies involve everyone to the desired extent? Arcadis addressed this by

explicitly building in layers of involvement into its training programs. Base Camp contributed to a broad awareness and a baseline of understanding for everyone. It enabled the use of a common digital transformation language throughout the company. For those who needed or wanted to be more actively involved, following an Expedition led to further training in one specific digital aspect and served as a stepping stone to becoming a digital ambassador in the company. Ambassadors then became part of a network of influencers in the company—for example, through communities of practice. Where needed, additional trainings complemented this approach by adding further and deeper skill development necessary for certain functions. It is important to note that most of the trainings were voluntary, but the company actively reached out to any employee willing to be involved.

Train for lasting impact and build in a community aspect

If training efforts are checkbox exercises and everyone is engaged only that one time, the lasting transformative impact is low. Arcadis ensured that this was not the case by spreading the same message through different channels. The same digital transformation language (based on the core framework with 'four realities') was used in all internal communication and served as a blueprint for Base Camp and the Expeditions. Also, existing training programs, such as Global Shapers, included a focus on the same digital transformation tenets. The new strategic focus and the progress made in the digital efforts were shared in external communications too (see, e.g. the 2019 Annual Report). Although the same message was spread repeatedly, it did not remain static. The language used also evolved over time (e.g. from 'survive and reinvent' to 'thrive and reinvent'), and Arcadis kept reflecting on how the digital program stack itself should be transformed (developing Base Camp version 2.0 and experimenting with Hike DNA pilots).

Building a community aspect into the trainings is a way to guarantee that the efforts do not end up as a one-off activity. This allows the organization to stay constantly alert to new evolutions by empowering people to drive change rather than being explicitly told what to do. Moreover, the community building promotes an attitude of curiosity, self-learning and networking. Arcadis set up networks between digital ambassadors, organized monthly calls for all analytics enthusiasts and promoted working in communities of practice across organizational silos. However, there is still room for improvement. Although almost all digital ambassadors have met with others within or outside their region, the number of people who have actively worked together on 'ripple effect' activities has remained quite low, especially across regions. It will be key to activate the people that are part of the communities to go beyond networking to set up concrete activities that stimulate digital transformation.

Do not consider the use of data as an afterthought, go for data-based decision-making from the beginning

In many digital transformation programs, although companies often start with certain objectives in mind, measuring them usually happens after the fact, if it happens at all. In the case of Arcadis, the objective of the cultivation program was to have a positive impact on client engagement and business development, employee engagement and retention and the employer brand. In many cases, as was the case at Arcadis, companies only afterwards translate the objectives into numbers. We advocate going for a data-based approach from the beginning, which will also allow you to make data-based decisions along the way.

Deal with paradoxes in decision-making

Working with a dual operating model by installing a network-like structure in parallel with the existing operating model requires companies to adopt paradoxical thinking. They need to move from an either-or to a both-and mindset. At Arcadis, for example, the decision not to create new functions but instead provide people with new skill sets in their current function collided at times with the lack of available time for learning new skills. As the global head of data analytics said: '*When we plan a training, we often struggle a little bit with the business lines on the ground, because we have to free up [billable] time to get people into these trainings'.* Even when companies go for an inclusive digital transformation and focus on belonging from the start, natural organizational tensions still surface (Danneels and Viaene 2020). At Arcadis, some digital ambassadors found it hard to use what they learned in their day-to-day jobs. The global head of data analytics explained: '*With Expedition DNA, with Global Shapers, with our analytics on-hands-calls... You never find out that people are not excited. [...] But they become disappointed when they're not getting involved in this kind of stuff'.* Additionally, Arcadis' operating model, fragmented into regions with different business lines and services, led to an us-versus-them mentality between regions and headquarters.

Adopting a paradoxical mindset, and moving from focusing on either-or dilemmas to both-and paradoxes, helps one deal with such natural organizational tensions. Bringing paradoxes to the surface, and acknowledging that they exist, is a first step towards managing them.

At Arcadis, these lessons contributed to setting up and running a digital transformation cultivation program fit for the organizational context. The program fitted well with the people-centric organizational culture. The enterprise-wide approach was continuously balanced with enough room for local responsiveness. With these lessons learned, we aim to inspire others to set up digital transformation cultivation programs adapted to their own organizational culture and operating model.

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Becoming a Data-Driven Company

How medi Has Laid the Foundations

Christoph Buck, Christopher van Dun, Rocco Huber, Jan Jöhnk, and Markus Birkel

Abstract

(a) **Situation faced**: *medi*, a leading provider of medical aids, is a German-based manufacturer, making it its mission to help people feel better. *medi's* product portfolio includes compression, orthoses, and other medical products as well as sports and fashion products. With its impressive success and rapid growth, *medi* has faced the challenge of transforming itself into a digital and data-driven company. In particular, the historically grown structures in its infrastructure, data management, and missing data strategy were major obstacles to its transformation. At the same time, evolving customer demands and technological developments offered great opportunities to differentiate and optimize.

(b) **Action taken**: In an effort to become a data-driven organization for better use of data for evidence-based management decisions, *medi*, in close cooperation with the Project Group Business & Information Systems Engineering of the Fraunhofer FIT, conducted a thorough analysis of the existing process and application landscape as well as its data management. In-depth interviews with internal and external experts, as well as a detailed analysis of existing systems, revealed the status quo and provided the basis for analyzing future development paths. *medi* used these findings to prioritize existing digital transformation (DT) projects, to identify new data-based services, and to improve internal processes and services.

(c) **Results achieved**: The approach adopted by *medi* lays the fundament for becoming a data-driven organization and, thus, delivered two major contributions: First, by unveiling the process and application landscapes and the currently existing data logic, *medi* identified starting points for future development,

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such as current redundancies and weaknesses. This transparency forms a solid foundation for *medi's* digital initiatives and development of a data strategy. Second, through a series of in-depth interviews, *medi* collected and prioritized important ideas and expectations for numerous exploitation and exploration projects as inputs for its data-related understanding, as an organization and at the individual level, as well as for its data strategy conception.

(d) **Lessons learned**: In all divisions involved, *medi's* project approach has led to a better understanding of the need for a uniform data structure, which in turn leads to a better match between management expectations and operational feasibility. In addition, the documented processes, application landscapes, and data logic act as a common foundation for the development of project roadmaps, enabling higher effectiveness and efficiency in business operations. As a result, *medi* has particularly benefited from a common understanding of what being a data-driven company means, which prerequisites need to be fulfilled, and which roles are involved in the management and usage of data.

1 Introduction

In recent times, emerging technologies and the resulting paradigm shift towards digitalization have had a significant effect on companies' strategies and business models, as well as on their processes and routines. Companies must explore ways to utilize digital technologies and exploit their benefits to remain competitive. Technology trends, therefore, require a thorough understanding and adaptations of the organizational context (Jöhnk et al. 2020). For example, the rise of big data and analytics questions previous assumptions and practices regarding IT infrastructure provisioning, necessary organizational capabilities, data governance, and data management (DalleMule and Davenport 2017; Dremel et al. 2017). Consequently, companies are forced to engage with digital transformation (DT) as a "process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial 2019). Within this process, data-driven insights play crucial roles in guiding companies' decisions or exploring new value proposals (Haffke et al. 2016). In addition, data increasingly constitutes a decisive differentiator from competitors and is, therefore, a valuable source for competitive advantage (Constantiou and Kallinikos 2015). Thus, companies must, now more than ever, make data (e.g., customer data, product lifecycle data) focal factors in organizational decisions, actions, and innovation processes. However, the success of becoming such a data-driven company greatly depends, among other things, on establishing the necessary foundations regarding employees' joint understanding for working and deciding based on data, top management support, and an elaborate strategy to guide the organization.

However, developing and realizing such foundations is a rocky road that poses several challenges and bears common misconceptions. Small- and medium-sized enterprises (SMEs), with their grown legacy systems, heterogeneous application landscapes, often inadequate knowledge management, and lack of data expertise, face the challenge of building a solid foundation, especially in terms of reliable and consistent data structures. These challenges are typical for SMEs, which are often unable to provide the manpower, governance, and methodological expertise in their IT departments needed for sound data management.

Our case of *medi*, a German manufacturer of medical aids, describes the actions taken to derive such understanding, vision, and planning of initiatives to lay the right foundation. With approximately 3000 employees worldwide, 1700 of them are headquartered in Bayreuth, *medi* is devoted to helping people feel better. Building on a strong legacy since its inception in 1920, *medi* has become a world-leading provider for a wide range of products and care concepts such as compression stockings, adaptive compression for wound care, bandages, orthoses, anti-thrombosis stockings, and insoles. In addition, *medi* develops sports and fashion products based on more than 65 years of experience in compression technology. With offices in more than 20 countries, *medi* has become a global company, exporting its products to more than 90 countries around the world.

Historically grown structures in data management and software applications, inappropriate roles and responsibilities in data management, and a missing data strategy were major challenges for *medi's* DT and hindered the exploration of emerging technologies' potentials. Thus, in a joint project with the *Project Group Business & Information Systems Engineering of the Fraunhofer Institute for Applied Information Technology FIT* (hereafter *PG BISE*), *medi* set up a joint task force. By establishing the necessary preconditions towards becoming a data-driven organization, *medi* specifically sought to address prior neglections and to create the necessary foundations as a starting point for future DT initiatives. In many companies, the formulation of a data strategy, "for organizing, governing, analyzing, and deploying an organization's information assets" (DalleMule and Davenport 2017), has proven to be a successful step in this direction. However, as has been often proved in practice, only the development of a data strategy alone does not guarantee a successful transformation into becoming a data-driven organization. The taskforce set up a five-step approach of in-depth interviews, qualitative analysis, analysis of technical documents, structuring and merging technical information, and modeling the status quo of *medi's* process, application, and data landscape.

In the following, we introduce *medi's* starting point for the project considering organizational and environmental challenges (Sect. 2). Next, we describe the approach and important structuring elements during the project to map the process, application, and data landscape (Sect. 3). Further, we elucidate the achieved results and their impact on *medi's* business and its subsequent DT projects (Sect. 4). Finally, we synthesize our experiences and learnings from the project to derive recommendations for the necessary prerequisites to develop and implement a data strategy (Sect. 5). Thus, our case contributes to a better understanding and includes actionable steps for companies seeking to become data-driven.

2 Situation Faced

medi is one of the typical German success stories that form the backbone of the German economy. Its outstanding product quality and technical expertise in product development are important components of *medi's* success. However, the rapid growth from a 400-head business to a globally active organization with more than 3000 employees over the last two decades has brought several significant changes within the company (e.g., for the organizational structure). In addition to the challenges of organizational growth, the emergence of digital technologies and digitalization of its suppliers and customer behaviors, as well as the opportunities that have become possible for the organization with business model innovation and operating more efficiently, the top management has made *medi's* DT as one of its top priorities.

As the top management approached *medi*'s DT, two major decisions were taken to provide the necessary starting conditions. First, they externally recruited a new head of IT & DT with years of experience gained in one of the world's leading fashion brands. The new head of IT & DT's mission was to transform *medi's* IT from a mere service provider that builds and operates IT into an enabling business partner. Second, the top management and newly appointed head of IT & DT decided to hire *PG BISE* to assist *medi's* DT with methodological guidance and to develop a digital strategy by adding an external perspective.

Intending to shape *medi's* DT for long-lasting and sustainable success, *medi* was consciously taking a step towards a holistic analysis. More than 30 in-depth interviews were conducted across all company divisions and hierarchy levels, not only to analyze the chances and challenges of digitalization but also to include the employees' perspectives, wishes, and fears in the transformation process. This enabled the task force to gain a very profound picture of the entire company concerning *medi's* DT. Following this mixed-method approach, the task force was able to gain a holistic understanding of the opportunities and challenges.

The identified challenges faced were manifold and serious. For example, *medi's* growth and its high-tempo business environment resulted in many technical solutions created with a lack of governance or, specifically, with almost no documentation and only implicit knowledge gained by external developers. In addition, IT has often been perceived as a bottleneck in the company that limits *medi's* pace in the market. This led to momentum in the departments, solving technical issues on their own. Unknown or redundant system solutions were just one consequence that the company had to deal with. In addition, the task force identified emerging silo structures in *medi's* data storage and lack of data governance as major challenges for *medi's* DT. Although the experts tended to focus more on the current (operative) challenges that *medi* had to overcome, they and especially the managers also named promising opportunities that, if exploited, would help *medi* to remain successful and retain its market position. To name a few, several sales managers claimed that B2B customers asked for state-of-the-art e-commerce solutions and Amazon-like delivery processes. In addition, there was a growing need for data-based decision-making, in

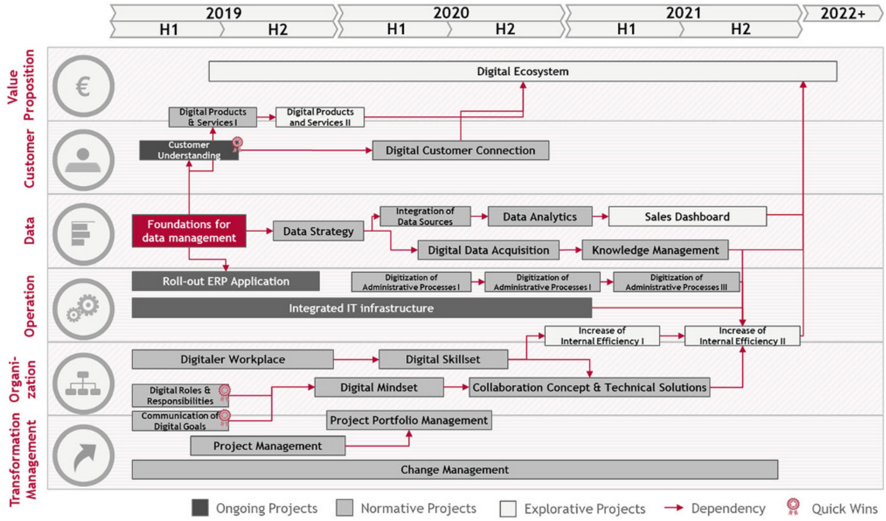

Fig. 1 Medi's digital project roadmap

particular, among the top management. For example, the head of sales asked for real-time analysis of market and customer data, or the head of marketing wished for data-based and more personalized marketing approaches.

By identifying and analyzing ongoing projects and discussions with managers and experts, the task force developed a digital strategy and operationalized it by carving out a digital roadmap (see Fig. 1) to pave the way for *medi's* transformation over the next 3 years. The roadmap was structured along the DT framework developed by Gimpel et al. (2018) that consisted of six action fields: value proposition, customer, operations, data, organization, and transformation management. The roadmap consisted of ongoing and planned projects and their interdependencies. It was important for the management to illustrate that projects depend on each other and build on each other.

After discussing and iterating the roadmap within the task force and with the top management, the head of IT & DT was convinced that *medi's* DT required a new strategic outlook first on data because data management was at the heart of most DT projects. Without a solid foundation for data and data management, most projects that are grounded on data-based decision-making or data-based customer marketing would have no chance of realizing their expected benefits. To first understand and later restructure the current data management practices of the company, the head of IT & DT has set data management as one of the top priorities and set up another project team consisting of *medi's* data experts and *PG BISE* data specialists. The project team agreed to take a five-step approach to fundamentally review and analyze the status quo and provide the necessary prerequisites for *medi's* data strategy. This case study describes the actions taken, results achieved, and lessons learned during this project, which serves as a basis for developing *medi's* data strategy in the future.

First, interviews with data experts and related managers were conducted and transcribed. Subsequently, important findings from the interviews were identified and structured. The interviewees also provided important documents (e.g., presentations, data sets) that were analyzed in the next step after the interview. After important findings from the documents were put into context with the interviews, the results of the analysis were finally reflected in suitable models. The insights were then presented to the top management and discussed to draw important implications for enabling the organization to become data-driven and prerequisites for the data strategy. In the next section, the action taken for each of the five steps is described in detail.

3 Action Taken

At the start of the project, *medi* had limited knowledge about their data and data management, especially about what data existed and where it was stored. Also, *medi* wanted to know which data were relevant to them and which IT applications and systems accessed the data, as well as how these systems supported certain core processes for the value creation of the company. In summary, *medi* needed to know where they currently stood. Therefore, creating and developing an understanding of the status quo for relevant data, IT applications, and processes had to be the goal of the project and would then pay off directly in preparing a data strategy and indirectly by supporting strategically relevant projects and goals.

medi worked with the *PG BISE* to carry out a thorough analysis of the existing process, application, and data landscape and to create a shared understanding of *medi's* current data management practices. Figure 2 shows the actions taken during the project.

The project team (consisting of data experts from *medi* and *PG BISE*) first conducted in-depth interviews with 33 process, application, and data experts and managers from all relevant business units producing or consuming *medi's* product and customer data (step 1). These personal interviews helped to understand not only quantitative facts but also qualitative aspects: how people feel about the availability and usage of data at *medi*, what they have experienced in the past, and how they behave in their everyday routines. The interviews focused on data acquired, produced, or consumed in the business units, covering IT, product management,

Fig. 2 Actions taken to analyze the status quo of medi's data management

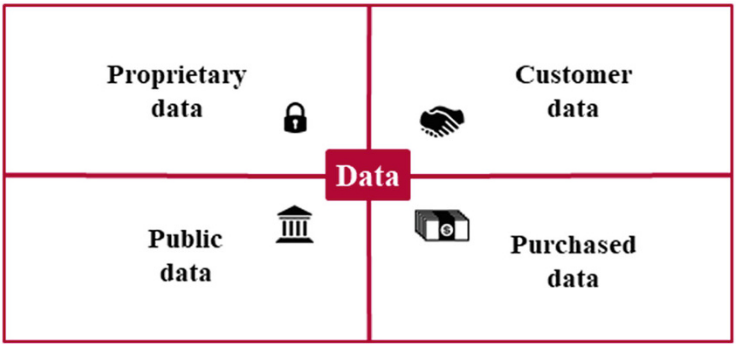

Fig. 3 Data source canvas

research and development, procurement, marketing, e-commerce, logistics, sales, controlling, and organizational development and consulting. Thus, the interviews provided an overview of the production and consumption of data across all divisions of the company. During the interviews, the canvas (see Fig. 3) helped to structure the data topic.

To better understand not only the nature of the relevant data but also its utilization over the entire data lifecycle, the project team followed an interview guideline addressing the processes involved in the data and the IT applications used to produce or consume the data:

- **Processes**: How is your business unit integrated into *medi's* value chain? What subprocesses do your business unit handle? How do you collaborate with neighboring business units?
- **Applications**: Which applications do you use for communication, file storage, project or group work, everyday processes, reporting, etc.?
- **Data**: Which kind of data do you produce? Which (internal or external) data sources do you access in your everyday work? What is your overall impression of data quality and availability?
- **Vision**: Which data-based opportunities do you identify in your business unit? Which are the most pressing challenges regarding data in your business unit?

The interviews were transcribed and analyzed (step 2). Subsequently, the basic models of the processes discussed were drafted, and application systems were sorted into categories. Further, the data attributes mentioned during the interviews were sorted into a canvas (see Fig. 3). For proprietary data, that is, internally generated data, the interviewees identified data sources such as quality tests or event logs from the production process. This was a major topic during the interviews regarding *medi's* potential to increase internal efficiency. Since *medi* is in close contact with medical supply stores and hospitals, which are their most important B2B customer groups, customer data was another important topic during the interviews. In this context, purchased data was sometimes mentioned, as the organization had contracts with several data suppliers. Complementing the data helped to better understand

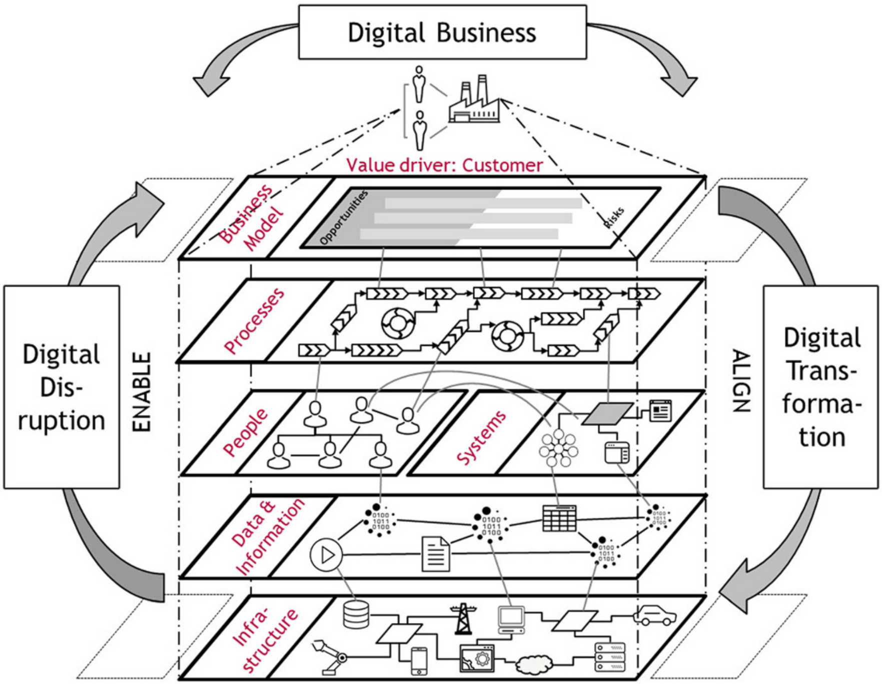

Fig. 4 Layered model of enterprise architecture (based on Urbach and Röglinger 2019)

regional markets or to target valuable customers. Public data was of less importance and only mentioned a few times. In addition, the interviewees were asked to provide documentation of the discussed processes, IT applications, and data attributes. From this, the project team received and sorted several hundred documents containing stand-alone process models, entity-relationship (ER) diagrams of data objects, product identification schemes, IT architecture maps, spreadsheets (containing lists of data attributes or IT applications), and many more (step 3).

To consolidate all gathered information and present it clearly and concisely, the project team structured it along with five typically used layers for describing enterprise architectures (step 4, see Fig. 4). Specifically, the project focused on the three layers of processes, applications (or systems), and data. The overall goal of compiling all this information was to create a foundation for discussing and deciding on future architectural developments. To facilitate exchange and collaboration between the IT department, business units, and top management in planning the future data management architecture, this foundation had to meet three criteria. First, it had to be understandable for laymen not familiar with IT architecture languages. Second, it had to be visible in the entire company. Third, it had to be adaptable to keep up with evolving circumstances. Thus, the project team chose to compile the information as graphical landscape displays built from plain, easily understandable

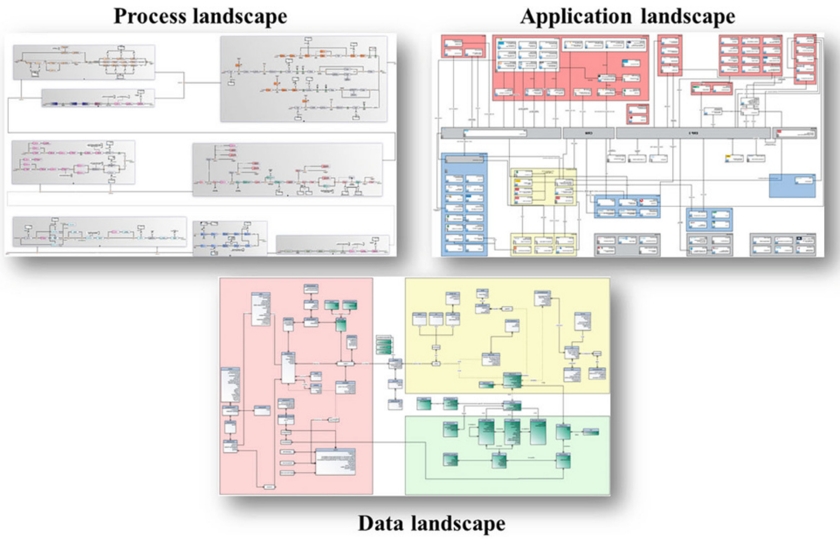

Fig. 5 Process, application, and data landscape (redacted)

modeling languages (step 5). Specifically, BPMN 2.0 was chosen for processes, system architecture modeling for applications, and ER modeling for data objects.

These landscapes, in combination with several related object dictionaries and detailed drill downs, describe the status quo of *medi's* data management (see Fig. 5). The process landscape displays an overarching view of *medi's* core product process (from developing, testing, and piloting a new product, hosting it in its e-commerce systems, and selling it). Process steps are annotated with IT applications used in executing the respective process step and data attributes generated or consumed in the process step. The application landscape displays all existing IT applications relevant to *medi's* core processes. Data flow between applications is represented by connecting lines. The data landscape displays all data entities relevant to the core processes and their relations to each other. It contains customer relationship data (e.g., information on medical supply stores, hospitals, and end customers) and product data (e.g., product identifiers, descriptions, media content, and characteristics).

4 Results Achieved

For developing the necessary foundations to become a data-driven organization, *medi* had decided to take the first step in this direction. Thereby, *medi* deliberately took a step back first and analyzed its existing processes, applications, and data (Fig. 5). The process, application, and data landscapes describe the status quo and build the foundation for creating direct operational impact on the one side and also change *medi's* mindset and awareness regarding data-driven entrepreneurship on the other side. Both lead to immediate savings of (financial) resources and form the foundation for the implementation of a long-term data strategy.

This analysis of the status quo is an important step in the development of data-driven decision-making and business models because assessing the organization's status quo—while fairly complex—is necessary to appreciate the available resource base and to derive appropriate and tailored measures for transformation. Due to insufficient documentation, a low level of cooperation between different departments, and the low visibility of IT projects, *medi* was unable to initiate a comprehensive transformation. Typical for successful SMEs, historically grown structures and processes have led to redundancies in IT applications and saved data. Both have made it difficult for *medi* to consciously implement a data-driven entrepreneurial mindset and enable the transformation of internal processes or customer-facing services. Through a detailed analysis of the status quo and fine-grained modeling of the process (end-to-end core business processes), application, and data landscape, *medi* has made it possible to use its data as a valuable resource and to develop itself in a targeted manner.

At first glance, the results of this project might seem relatively simple and straightforward. However, with the results of the project as the foundation, *medi* is already able to achieve notable results by transforming itself into a data-driven organization. We group the results that have already been achieved in two main categories: **technology-related** and **culture-related** results (see Fig. 6).

Although the most obvious results are certainly on the technological side, *medi* has also achieved significant positive results at the cultural level. Both areas are mutually dependent and influence (i.e., reinforce) each other in the company's DT. Thus, creating transparency triggers central self-reinforcing effects for DT both on the origin and use of data and on the technological implementation and possibilities.

4.1 Technology-Related Results

First, the analysis undertaken made it possible to create a holistic picture of the process, application, and data landscape as well as their interrelations. This representation, culminating in **comprehensive technical documentation**, enabled *medi* for the identification of IT systems and isolated applications used within the company. Only by taking this step *medi* could identify existing redundancies, digitizable processes, and potential for working and decision-making in a more data-driven manner. As a result, *medi* identified several media breaks, non-digitized subprocesses, and the potential for collecting and using more internal and external data.

Further, the technical documentation enabled thorough analysis of *medi's* IT system in two ways: the **identification of dependencies** and the **identification of redundancies**. For one thing, the analysis of the application landscape represents an important step towards a homogeneous IT infrastructure that is indispensable for a

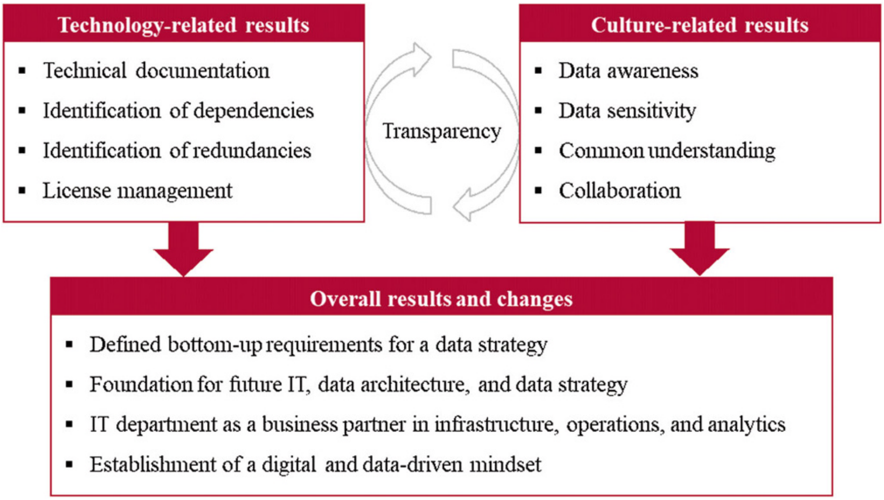

Fig. 6 Results achieved

data-driven company. Analyzing existing IT systems and their relevance to *medi's* core processes builds the basis for designing a uniform application landscape and deriving corresponding requirements. Further, this stimulates future development scenarios by analyzing existing system features. Additionally, by identifying and eliminating redundancies, *medi* generated direct financial savings and thus freed up valuable resources for crucial DT projects.

Due to the transparency in the existing IT landscape, *medi* was able to initiate **efficient license management** on an ad hoc basis. IT systems that were no longer needed or used were shut down, and the number of individual licenses was reduced to the required level. These measures led to significant savings in license fees. In addition, the associated maintenance for the often old and redundant IT systems was reduced, and service processes could be carried out more efficiently.

Based on the illustrated core processes as well as the applications used within the processes, *medi* was able to model the existing data logic of the company. This allowed the identification of various barriers to the evolution towards a data-driven company and the initiation of their removal. Thus, media breaks, reasons for poor data quality, and redundantly stored and managed data could be identified.

Among others, the existence of redundant or unconnected data is one of the biggest challenges for becoming a data-driven company. For example, at *medi*, the acquisition and analysis of supposedly identical data from different external sources not only led to a heterogeneous data structure but also differing analysis results and interpretations, making evidence-based decision-making almost impossible. By harmonizing previously redundant data sources as well as consciously connecting data from several sources, *medi* was also able to considerably diminish the various instances of the use of manual data and processing. As a result, numerous person days for redundant data processing were saved. Based on a transparent data structure, *medi* was able to develop and establish uniform data logic and governance.

In sum, *medi* was able to achieve both structural, strategically relevant results (e.g., building a foundation for IT and data architecture) and immediate financial savings (e.g., license management).

4.2 Culture-Related Results

medi has already attached great importance to the openness, transparency, and commonality of its digital strategy and the digital project roadmap and had thus achieved great success in terms of a broad acceptance and willingness to change within the whole company. In line with this overarching change management strategy, the described project focused heavily on culture-relevant aspects of data management. The culture-relevant results subsume progress that is primarily aimed at the digital and data-driven mindset of the employees, the increasing willingness to cooperate, and building a sense of solidarity and community spirit in driving the DT.

The most important and fundamental result of the identification of *medi's* data management status quo was increasing **data awareness and sensitivity** in *medi's* work culture and communications. These results were achieved through an open and transparent approach throughout the project. The interviews involved all departments of the company in the procedure of creating the process, application, and data landscapes. This made it possible for all departments to contribute their views and needs, which, on the one hand, created a high level of understanding of the need for data structures and, on the other hand, reflected the direct added value of the results for the departments themselves. This open approach enabled the project team to achieve a higher quality of results through a higher willingness to participate. In addition, a high level of understanding of the added value of this IT-driven groundwork was increased among the business departments, enabling the long-term strategic goal of the data-driven company to achieve both growing relevance and growing support from all areas of the company.

By involving the departments in a **common understanding**, it was not only possible to create awareness for the relevance of a uniform and well-founded system and data architecture but also to develop a common language and shared vision. On this basis, project and departmental dependencies could be recognized, colleagues with similar challenges were identified, and **collaboration** was facilitated more effectively. To this end, the results (see Fig. 6) were also publicly exhibited in the company, shared on *medi's* collaboration platform, and displayed in the IT department hallway, making the result visible and usable for further projects and discussions.

Further, the process, application, and data landscapes eased the onboarding of new internal and external project partners for all projects of the digital roadmap, leaving the already busy data and system specialists with more time for other work.

This resulted in direct savings for faster onboardings and especially fewer project days for external specialists (e.g., IT consultants).

4.3 Overall Results and Changes

Overall, *medi* was able to achieve numerous short-term and long-term goals by conducting this groundwork project. The preparation of a uniform process, application, and data landscape produced immediate results such as more efficient data and project work, a greater willingness to cooperate across all departments, and a cost-optimized system and license management.

Strategic relevance is achieved by building on a solid and clear **foundation for future developments in IT and data architecture,** which will help *medi* to become a data-driven company. One elementary contribution of the project was the integration of all available data sources and applications, not necessarily on a technical level but rather on a conceptual level. This leads to better visibility of all data and systems across department lines, helps eliminate redundancies and silo structures, and supports cross-linking of data and insights between departments. As a direct next step, the project team proposed to draft a full-scale **data strategy based on the bottom-up requirements** identified in all of *medi's* departments during the project's interviews. A data strategy could then act as a framework for organizing and utilizing *medi's* information assets and as an umbrella concept for aligning all individual DT projects.

The project also strengthened the perception of *medi's* **IT department as a business partner** and an increasingly **digital and data-driven mindset** among all employees of the company. This enables *medi* to lay the foundations for creating a strategic competitive advantage from the sustainable creation, integration, and consumption of data in the future.

5 Lessons Learned

In summary, *medi* faced several data-related challenges for their DT. Common for SMEs, *medi* had to cope with historically grown and complex processes and infrastructure, in particular, applications and data structures. In addition, data needs from business units were rising to corroborate and guide decision-making. As a result, *medi* had decided to first capture the status quo and derive a sensitivity for the topic to establish a solid fundament to path the way towards becoming a data-driven company. Following a five-step approach, *medi* and *PG BISE* took measures to foster other DT projects and to provide the necessary prerequisites for a holistic data strategy.

Reflecting on the case and abstracting *medi's* approach to establish the prerequisites for becoming a data-driven company, we propose five learnings. These learnings will help to better understand the crucial facilitating factors during the project and can prove to be useful to other companies when engaging with similar activities. In the following, we first describe and explain each learning, followed by some evidence from our case and recommendations on how to convert each learning into practice. Thus, we seek to provide concise and actionable lessons learned on how *medi* laid the foundation for becoming a data-driven company.

5.1 Learning 1: Create a Common Understanding to Join Forces

Explanation To convince all departments that they benefit by participating in the project, provide tangible deliverables, and describe the intended value add. Every department and every employee involved must feel that the investment (e.g., time) is worthwhile. Appreciate prior achievements, integrate them where reasonable, and provide the possibility to engage. Also, open and continuous communication increases the transparency of the project.

Case insights Not every expert and manager at *medi* were initially convinced that analyzing the status quo is the right thing to do. Some claimed that there was no major benefit in doing such a project; others claimed that they tried to do so and failed in the past. For example, some department heads insisted on deriving requirements and goals for a data-driven company first before analyzing the status quo. While both approaches have their charms, the project team explained their choice and tried to convince all involved parties. Also, carefully and jointly choosing the tools used to document the project results helped in empowering the employees to work with but also to spread those throughout the organization. Resulting landscapes, visible as posters, emphasized the direct (i.e., tangible) and indirect benefits of thoroughly understanding the starting point first.

Implementation Present your goal and the resulting benefits unambiguously and understandably. The goal and the added value of the investment must be clearly recognizable, individually experienceable, and, in the best case, measurable (e.g., time saved) for each participant. Also, discuss and decide together how the project results are documented and made accessible.

5.2 Learning 2: Appreciate What You Have to Better Understand What You Want

Explanation Becoming a data-driven company is not only a matter of establishing the necessary prerequisites. It is also a matter of linking the dots and integrating the understanding of processes, applications, and data in the overarching DT. Also, digital projects that affect fundamental business objectives and IT infrastructure are not always directly accessible to every department. Such projects are often viewed as very biased due to their complexity and often critical perception of IT in business departments. For this reason, they should be implemented with empathy. Project participants should have the opportunity to express their perspectives, wishes, and fears. This allows the project team to better understand and integrate them into the project and helps in receiving sensible and important information much faster or knowing poisoned ground beforehand.

Case insights Regarding the employees, owing to the perception of the IT department as a pure service provider, many involved colleagues were not very open-minded at the beginning. However, the project team was able to experience a rapidly growing openness by revealing their understanding during the interviews and by integrating project supporters. Regarding the top management, starting from and returning to *medi's* digital roadmap provided the necessary framing to the project. Thereby, the project results were immediately connected to *medi's* other DT projects.

Implementation First, get a holistic overview of the DT projects and understand data's roles in it, such as data needs, existing data, data structure, as well as roles and responsibilities. In addition, map processes/applications/data landscapes and analyzing their interplay. Second, do not give the interviewees and project partners the feeling that you know it better and just drain important information. Enter an open dialogue on the overall topic and give your counterpart the chance to present his/her perspective.

5.3 Learning 3: Let Others Join to Draw the Big Picture

Explanation A representative sample of interview partners is a good start to get a holistic perspective and draw reliable conclusions. Nevertheless, do not only rely on experts, but complement your big picture by participating in relevant meetings (e.g., project kickoffs) and screening important documents (e.g., reportings). Choosing the right sample of interview partners can be difficult because complex topics, such as data management, afford effort and many perspectives to truly understand its challenges and chances. At the same time, the project schedule and available capacity limit the number of interviews. Finding further possibilities for integrating complementary perspectives and valuable insights is key for a reliable database, the foundation for the project's success.

Case insights First, *medi's* management questioned the long-term added value of conducting interviews. However, with time and after presenting the first insights from the interviews, they understood the value of those insights and even insisted on including further departments and experts. Also, they clearly stated the wish to the project team for finding further possibilities of participation. Conducting workshops, opening up project presentations, and communicating possibilities for sharing insights and documents helped a lot in further integrating participants and winning supporters.

Implementation Try to get a holistic perspective by covering all relevant functions, departments, or teams. Talk to managers as well as to experts. Quickly present first insights and prove their value. Also, think upfront about other ways than conducting interviews to integrate further participants. For one thing, this enriches the database for strategy development and its reliability. For another thing, this increases the awareness and support for the project and its underlying need for transformation.

5.4 Learning 4: Dig Deep Wells for Clear Water

Explanation Achieving clear recommendations for a company's data strategy requires access to diverse and extensive data sources. This ensures to cover all relevant perspectives on processes, applications, and data from both documents and interviews. However, often such data sources are limited and scattered across the company resulting in tacit knowledge that must be brought to the surface. Among others, this requires the legitimation of the project sponsor and top management to facilitate data elicitation.

Case insights At first, experts and database owners hesitated to provide access to relevant information. Some were afraid of providing access to the crown jewels of the company and taking the risk of sharing sensitive information. Others feared losing their importance to the company because the documentation and the conception of new solutions could endanger their daily work and unveil mismanagement in the past. However, with the backing of the head of IT & DT, such concerns were addressed by the project team. Thus, the support of focal experts was won by providing access to important domain-specific knowledge.

Implementation Validate interview insights and the emerging understanding with supplemental documents. Request access to relevant documents already during the interviews, and create a constructive atmosphere to facilitate follow-up questions. Constantly reflect on the information available, and cross-check the analysis results in discussions with experts. Explicate the importance of the information for the project's success, and ensure management backing to dispel any upcoming concerns.

5.5 Learning 5: Act on What You Need to (Gradually) Achieve What You Want

Explanation DT is often a long and tedious journey, placing high demands on employees to make the necessary changes and binding valuable resources, especially in SMEs. Thus, project deliverables must be hands-on and provide, at least in part, immediate value to the company to justify the effort. Further, finding clear recommendations for application and identifying quick wins helps companies to maneuver in an environment that is in constant flux and to be one step ahead of the competition.

Case insights A major part of the final project presentation focused on recommending possible applications of the deliverables. This proved to be useful to both the IT department and the top management to better grasp the value of the deliverables. Thus, *medi* gained a comprehensive overview of its interplay of processes, applications, and data, as well as action fields on how data can fuel other DT projects. Besides, several quick wins were proposed to make immediate use of the project results and deliver value in return for the resources and commitment that the stakeholders invested.

Implementation Consider the invested resources and provide adequate value in return. Guide decision-makers to recognize the project results and the implications for their decision areas. Distinguish data action fields according to their content and focus, implementation period, and implications for other DT projects.

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Governance for a Multinational ERP Program in a Decentralized Organization

How Arbonia Doors Set up a "Glocal" Governance Enabling Both Local Differentiation and Global Consistency

Caroline Kiselev and Patrick Langenegger

Abstract

(a) **Situation faced**: In 2019, Arbonia Doors, the door division of Arbonia Group (a multinational building supplier corporation), decided to implement SAP S4/HANA to realize global harmonization and integration across four highly autonomous local subsidiaries. In the early phase of the program, it became clear the program can only succeed if the gaps that exist between the aims of the four local subsidiaries and the aims at the division level can be bridged or even closed. This called for governance measures that address the tensions evoked by a decentralized organizational context.

(b) **Action taken**: Armed with an understanding of governance as a means of control and coordination to deal with contrasting objectives within a program, the program manager and program sponsors decided that the identified tensions should be tackled through a set of appropriate governance measures. From the outset of the ERP program, Arbonia Doors set out to design, implement, and evaluate nine "glocal" governance measures ranging from program structures to community building measures.

(c) **Results achieved**: Through the "glocal" governance measures, Arbonia Doors enabled both local differentiation and global consistency. Not only was it possible to define a consensual degree of process harmonization, but a boundary-spanning sense of community and collaboration was also established. This is expected to be valuable for future digital transformation programs in the group.

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(d) **Lessons learned**: A joint reflection with the program team on the designed "glocal" governance framework resulted in seven lessons learned that promise to be projectable to digital transformation programs in general: (1) Continuously frame an ERP endeavor as a major step in the digital transformation journey rather than as a large, complex IT program. (2) Actively strengthen the understanding and handling of tensions as a both-and rather than an either-or decision. (3) Start early and allow developing of governance measures by trial and error. (4) Foster co-creation of governance. (5) Cover formal as well as informal governance mechanisms. (6) Develop a clear strategy on how to include external partners. (7) Systematically demonstrate the effects of governance measures.

1 Introduction

Digital disruption has forced many well-established organizations—successfully operating in the pre-digital economy—to embark on a digital transformation journey in order to stay competitive (Chanias et al. 2019). They do so by investing a substantial share of capital into programs that aim at transforming both IT and business processes and sometimes even entire business models (Barthel and Hess 2020). ERP system implementations or upgrades often constitute a major step towards digital transformation as well as one of the biggest programs the organization has ever launched (Moon 2007). Unfortunately, the majority of these endeavors still fail and—in the worst case—lead to considerable financial and organizational disasters (see, e.g., Kolf and Kerkmann [2018]).

The reason for program failure often lies in insufficient or inappropriate governance rather than poor management (Kiselev et al. 2020).

There are various definitions of governance in literature and practice, which vary in scope and focus. We understand governance not only in the narrower sense as the monitoring and control activities of specific governing actors such as program owners or steering committees (Lechler and Cohen 2009) but also in a broader sense as a set of governance measures of control and coordination that ensure "the right things are done" (e.g., regarding program goals) and "the things are done right" (e.g., regarding program processes) (Ahola et al. 2014; Turner and Keegan 2001). This set of governance measures (i.e., governance framework) defines the program structures allocating rights and responsibilities to various actors within the program. It defines how goals are set, decisions are made, and program progress is monitored and coordinated. Moreover, governance aims at addressing contrasting demands that threaten to impede the realization of goals and benefits of an endeavor (Williams 1999).

The challenges surrounding ERP programs and possible governance solutions have been a major concern for executives across industries. ERP programs implement a strategic tool, which integrates not only information and processes within and across organizational functions but also across organizational boundaries, for

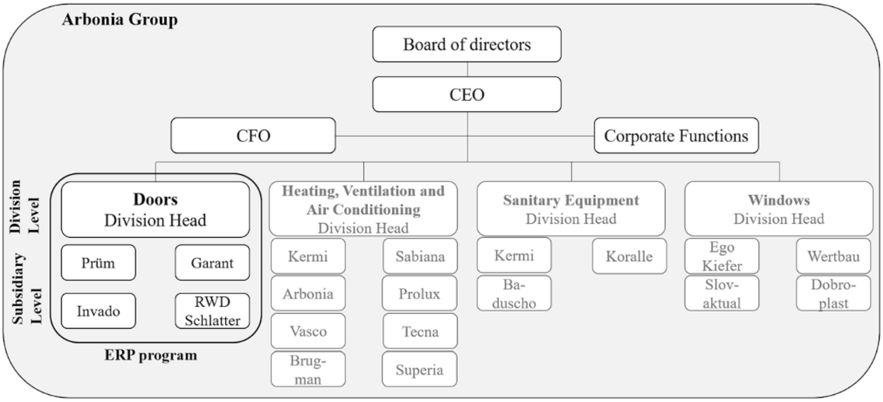


Fig. 1 Organizational structure

instance, across a group's subsidiary companies. Therefore, such programs are rife with tensions arising from the different, often contrasting intentions and expectations of the many stakeholders involved (Wiener et al. 2016; Warner and Wäger 2019). A well-governed ERP program is able to accommodate these tensions.

In the case at hand, Arbonia Doors decided to implement SAP S4/HANA to realize global harmonization and integration of information and processes across four highly autonomous local subsidiaries.

Arbonia Doors is a business unit of Arbonia Group and—as in practice—in the remaining book chapter also referred to as the Doors Division (see Fig. 1). Arbonia Group is a publicly listed European building supplier with headquarters in Switzerland. The group is active in 70 countries worldwide with around 8400 employees. Arbonia Group consists of four divisions: heating, ventilation and air conditioning, sanitary equipment, windows, and doors. Each division comprises three to eight subsidiary companies.

Arbonia Doors comprises four subsidiary companies, Prüm, Garant, Invado, and RWD Schlatter, with production sites in Germany, Switzerland, and Poland. These companies manufacture interior doors, functional doors, and frames. In all three domestic markets, Arbonia Doors holds a leading position. Moreover, it boasts an average headcount of 1960 (as of 2019, in FTE), and with net revenue of 356.4 million CHF, Arbonia Doors accounts for around 25% of the Group's net revenue (as of 2019).

From the outset of Arbonia Doors' ERP program, it was clear to the Doors Division's management that the decentralized organizational structures with highly autonomous subsidiaries, which had proved successful for business operations for many years, would be a challenging organizational context for a cross-subsidiary ERP project aiming at integration and harmonization. Therefore, at the outset of the program, the program management sought to identify and analyze the tensions within the program that were evoked by the organizational context. Furthermore, they decided to set up appropriate "tension-aware" governance measures to deal with these tensions and move the whole Doors Division in a strategically aligned direction, allowing local differentiation and global consistency and facilitating the required organizational change for further digital transformation within the whole group.

The present case (1) shows how a set of governance measures enables both local differentiation and global consistency in goal definition and realization and (2) how the corresponding risks for an ERP program in a decentralized organizational context are addressed and (3) sheds light on the foundations laid for the successful ongoing digital transformation journey of the whole group. Thereby, this chapter addresses researchers interested in a better understanding of tensions in organizational contexts and governance of ERP programs. Moreover, it addresses managers and members of program steering committees looking for appropriate governance measures in a global ERP endeavor within a large decentralized organizational context.

The case description promises to be valuable for companies that are seeking to upgrade or implement a new enterprise-wide information system but may not be aware of the tensions and corresponding program risks awaiting. Moreover, the case presents "glocal"[1] governance measures as a solution to align the different and often contrasting demands and perspectives of the various stakeholders involved in such an endeavor.

2 Situation Faced

In 2019, Arbonia Group management and Arbonia Doors' management decided to implement SAP S4/HANA across all four subsidiary companies to replace existing local systems and harmonize processes. They knew that a heterogeneous systems landscape will prevent them from keeping up with changing requirements regarding functionality, automation, division-wide process management, data quality, and integration in the digital age. At that time, the division head said:

> To achieve data-driven digital innovation, increased efficiency and lay the technical foundation for the digital transformation and growth across the whole division and beyond, we need consistent transparency and accountability through standardized data and harmonized processes and new functionalities across all business units. The base of this is a clear understanding and implementation of end-to-end processes.

In the same year, the Doors Division launched its ERP program, which was to be realized in an ambitious time and budget frame. Their ambition is to implement an ERP based on SAP best practice scenarios according to the different manufacturing logics (i.e., make-to-stock, make-to-order, make-to-engineer) to achieve standardization and harmonization of the systems and process landscape and realize the

[1] We understand "glocal" as an approach that balances global and local interests through aligning local and global measures/goals or mixing up local and global representatives in teams.

following benefits: (1) increase efficiency and process reliability, (2) increase data quality and transparency, (3) improve control of operations and costs, (4) improve decision-making (efficacy and speed), (5) improve information dissemination, (6) strengthen innovation, (7) foster automation capability across all subsidiaries, and (8) ensure a consistent basis for further division- and group-wide implementations of, for example, a manufacturing execution system and e-commerce platforms.

Although the subsidiaries' management teams and division management were in agreement that many of their outdated systems needed to be replaced to generate a solid digital backbone, they all had great respect for this large-scale ERP implementation—not only because they had all seen such programs fail miserably elsewhere in the industry but also because of the boundary-spanning character of the program. With both the scale (i.e., number of organizational functions and subsidiaries involved) and scope (i.e., number of processes standardized) of the program being large, the subsidiaries were reticent about the prospect of a global SAP solution achieving standardization and harmonization because they already anticipated that striving for the best boundary-spanning solution would encompass tough decisions and some concessions and even a loss of flexibility in doing business.

When looking at functional processes, global representatives of procurement, material management, production, sales, logistics, and finance management showed divergent design and performance goals when compared to their counterparts on a local level (i.e., other subsidiaries) and when compared to the division's aim of global harmonization and standardization to ensure the comparability of information and realization of synergies. As a senior manager of one subsidiary put it:

> I totally agree that our systems need renewal to stay competitive in our market, but I don't see how we should strive for global harmonization in, for example, contribution margin accounting, when we mainly follow the manufacturing logic of engineer to order and others mainly follow make to order or make to stock. Doing the right things for markets and customers.

Furthermore, some representatives of the subsidiaries started to suggest specifications to maximize adjustments of the ERP system in their favor, while the division representatives promoted maximal standardization and their intent to implement a more or less "one-size-fits-all" solution for each manufacturing logic.

One senior manager of the division's management explained the challenge for the ERP program as follows: "The implementation demands a mind shift. From our—typically for decentralized structures—individualistic, subsidiary-centric way of doing things to a more joint, division-wide perspective on what we are doing together and what separately and how we are doing it. To understand the balance will be the key for future profitable growth."

As they were commencing the process harmonization phase (Fig. 2 shows the program phases with their corresponding activities), which is set to be finished by the end of 2020 with a defined global template, both the program manager (the division's CIO) and the program sponsors (division head and Group CEO and Group

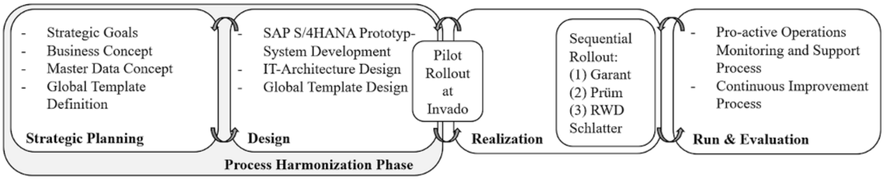
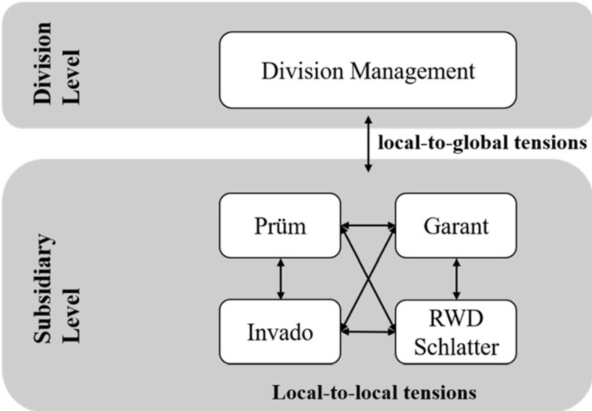


Fig. 2 Program phases

Fig. 3 Tension arenas



CFO) were well aware of the abovementioned contrasting intentions and demands and started to frame and manage them as tensions.

The transformation from four local ERP systems to one global ERP solution will give rise to various tensions between stakeholders within the program: for example, between the functional business units (i.e., finance, material management, production, logistics, and sales), between business and IT, between the subsidiaries (i.e., local to local), and between the subsidiaries and the division (i.e., local to global). Due to the existing decentralized organizational structures, the program manager and the program sponsors reckoned that there should be an emphasis on proactively tackling the latter two tension arenas to ensure successful program progression (Fig. 3 shows the two tension arenas in focus).

According to existing theory (Jarzabkowski et al. 2013; Smith and Lewis 2011), tensions are inherent to organized change as many competing, and often conflicting, demands come together. Tensions particularly become salient in change endeavors that imply a wide range of stakeholders and high complexity, such as ERP programs (Mandal and Gunasekaran 2003; Akkermans and van Helden 2002). In practice, tensions often have a predominantly negative connotation. They are seen as disruptive factors only bearing conflicts and risks and, thus, need to be removed by favoring one side over the other (i.e., either-or decisions). However, tension theory has also brought forward a different, more positive understanding of tensions. It posits tensions as a valuable source in finding the best solution to a complex

Table 1 Identified tensions and program risks

<table>
<tr><th colspan="3">Identified tensions</th><th rowspan="2">Identified program risks</th></tr>
<tr><th>Arena</th><th>Type</th><th>Subject</th></tr>
<tr><td rowspan="2">Local to local</td><td rowspan="2">Performing</td><td>ERP implementation goals of subsidiary X vs. ERP implementation goals of subsidiary Y</td><td rowspan="7">- Difficulty in setting and prioritizing local and global goals
- Difficulty in aligning local goals and local and global goals
- Difficulty in defining appropriate standards and achieving the right degree of harmonization
- Bypassing of program structures and falling back into behavioral patterns used in the daily business context
- Unclear roles and responsibilities
- Lack of trust and mutual understanding
- Rise of hidden agendas and unclear communication
- Lack of readiness to compromise
- Missing boundary-spanning perspective
- Misunderstandings between program members
- Decreasing project efficiency and speed
- Lack of sense of need for joint change efforts
- Lack of commitment towards the program
- Lack of sense of community across the whole program team
- Difficulties of seeing business changes as chance</td></tr>
<tr><td>Specific process design requirements of subsidiary X vs. specific process design requirements of subsidiary Y</td></tr>
<tr><td rowspan="5">Local to global</td><td rowspan="3">Performing</td><td>Subsidiary-specific performance optimization vs. division-wide optimization of performance</td></tr>
<tr><td>Maximal subsidiary-specific ERP system adjustments vs. maximal division-wide standardization of ERP system</td></tr>
<tr><td>Subsidiary-specific design of processes vs. division-wide harmonization of processes</td></tr>
<tr><td rowspan="2">Belonging</td><td>Representation of subsidiary-specific interests vs. representation of division-wide interests</td></tr>
<tr><td>Being part of a local program team vs. being part of a global program team</td></tr>
</table>

endeavor. Properly understanding and addressing tensions can even help organizations to improve an endeavor's outcomes (Wong 2005).

Against this backdrop, the program manager and program sponsors launched the first round of workshops with representatives of the four subsidiaries and the division's management to distill the most central tensions between the subsidiaries (i.e., local-to-local tension arena) as well as between the subsidiaries and the division (i.e., local-to-global tension arena) and proactively derive the corresponding program risks to get a better grasp of the challenges associated with the tensions (see Table 1).

Regarding Arbonia Doors' ERP program, the tensions identified are classified in terms of their arena (i.e., local to local and local to global) and their type. In the present program, *performing tensions* refer to the clash of contrasting goals and strategies of the subsidiaries and the division, while *belonging tensions* refer to the program members' contrasting identities and perspectives towards the program depending on their affiliation to the subsidiary or division level.

Apart from the two tensions over contrasting ERP implementation goals and contrasting process design requirements between subsidiaries, all other tensions can be located in the local-to-global arena.

During the workshops, it soon became clear that representatives of all subsidiaries were gatekeepers of their company's interests (e.g., regarding ERP implementation goals, process design requirements, or performance optimization), not only against their counterparts on the subsidiary level but also against the division-wide interests regarding most process and system changes by the division-level representatives.

After having identified the performing tensions, the workshop group derived the corresponding program risks. They concluded that these tensions would make it more difficult to set, align, and prioritize local and global goals as well as define appropriate standards and the right degree of harmonization.

Along with the performing tensions regarding goals and strategies, belonging tensions regarding the program members' identities and perspectives were identified in the local-to-global tension arena. A distinct understanding of belonging could be identified among the majority of actors on both the local and global level: either to a local program team (with predominant local ambition) or to a global program team (with predominant global ambition). Furthermore, the tension between the representation of subsidiary-specific interests and division-wide interests could be identified. This was connected to the risk of unclear roles and responsibilities of actors within the program and a possible fall back from a boundary-spanning program structure to a classic program structure, reinforcing the traditional decentralized organizational structures from daily business. This would be inappropriate from both the global ERP systems' perspective as well as the boundary-spanning project process' perspective.

Other derived risks were the uncertainty regarding roles and responsibilities among program members, lack of trust and mutual understanding, a rise of hidden agendas and unclear communication of intentions and goals, misunderstandings between program members, decreasing project efficiency and speed, lack of sense of need for joint change efforts, lack of readiness to compromise, missing boundary-spanning perspective, lack of commitment and motivation towards the program, and lack of sense of community across the whole program team.

In sum, thanks to the workshops, many tensions could be identified and the corresponding challenges better understood in terms of program risks. As a consequence, the program manager and sponsors and their team were not only aware of the tensions and corresponding challenges but also keen to find an appropriate way to tackle these tensions. Despite the prevalence of ERP programs that could serve as a learning ground, they could not fall back on comprehensive, off-the-shelf guidance from practice or literature. Hence, they decided to develop their own solution.

3 Action Taken

With an understanding of governance as a means of control and coordination to establish order and deal with competing demands within a program, the program manager and program sponsors decided that the identified tensions should be tackled through a set of appropriate governance measures.

The design of these measures was then based on a positive tension understanding, suggesting that to find the best solution, tensions should not be addressed by favoring one side over the other but by striving for the alignment of both sides (i.e., both-and decisions) (Smith and Lewis 2011) (see Sect. 2). Hence, Arbonia Doors set out to design governance measures for its ERP program that enabled both local differentiation and global consistency.

The intention was to start as early as possible with the design and implementation of governance measures because goal and strategy alignment is a particularly important early milestone in an ERP program, and a program conducive sense of belonging among the whole program team is a prerequisite for its progress.

Finding a way to align and enable local differentiation of the division's subsidiaries to progress with the program and global consistency of the division regarding how and to which extent this progress can take place became a top priority in setting up the governance framework in the strategy phase and building a solid base for the subsequent program iterations.

Therefore, both the program sponsors and the program management took on the task of establishing appropriate governance for the ERP program during the ongoing strategy phase. The aim was to iteratively develop "glocal" governance—enabling both local differentiation and global consistency—by activating formal and informal governance mechanisms. Formal mechanisms are formal structures and processes that are documented and apparent, while informal mechanisms are not documented and are less visible.

Table 2 summarizes the governance measures that were established and the corresponding, activated formal and informal governance mechanisms. The measures were designed during the 18-month-long process harmonization phase.

Through the first goal definition and alignment iteration of the ERP program, key topics (e.g., variant configurator) and processes that were rife with competing demands, such as contribution margin accounting, could be identified. This then led to the setup of a "glocal" program organization with shared responsibilities and mixed teams consisting of representatives of the different subsidiaries and the division. Figure 4 illustrates the "glocal" program organization with the corresponding mixed teams enabling both local differentiation and global consistency.

The program is structured according to the core business process streams and the implementation programs at each subsidiary led by a local IT and a local business representative. While the program sponsor, program management, and strategic topics lead were retained in the hand of division representatives and external partners, ownership of core business processes was shared primarily by a team of

Table 2 Governance measures and governance mechanisms activated

	Governance mechanisms	Governance measures
Formal	Program structure Role allocation and responsibilities Decision rights Resource allocation	- Set up of "glocal" program organization with mixed teams - Role profiles with shared responsibility and similar decision rights between the representatives of the subsidiaries and the division - Composition of steering committee and change board with senior management members of each subsidiary and the division - Definition of a global budget and local backfilling processes
Informal	Trust Common ground and shared understanding Joint commitment Participation	- Joint development of a target vision map (incl. ambition and mission) overarching division-wide goals and subsidiary-specific goals - Joint goal specification within dedicated "glocal" process teams - Joint identification and further development of key topics within dedicated "glocal" teams - Development of program ambassadors coming from subsidiaries and the division level - Regular program community-building meetings organized according to processes or roles to exchange experiences

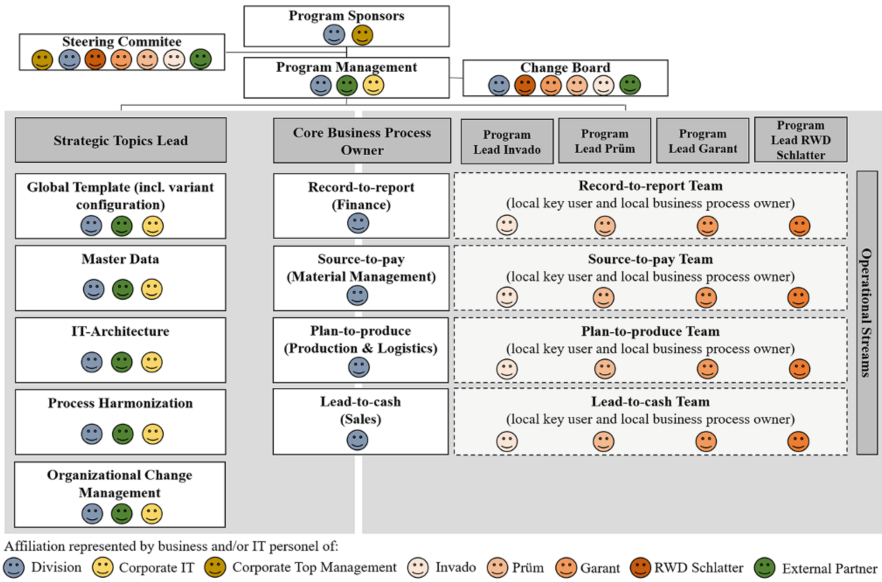


Fig. 4 "Glocal" program organization

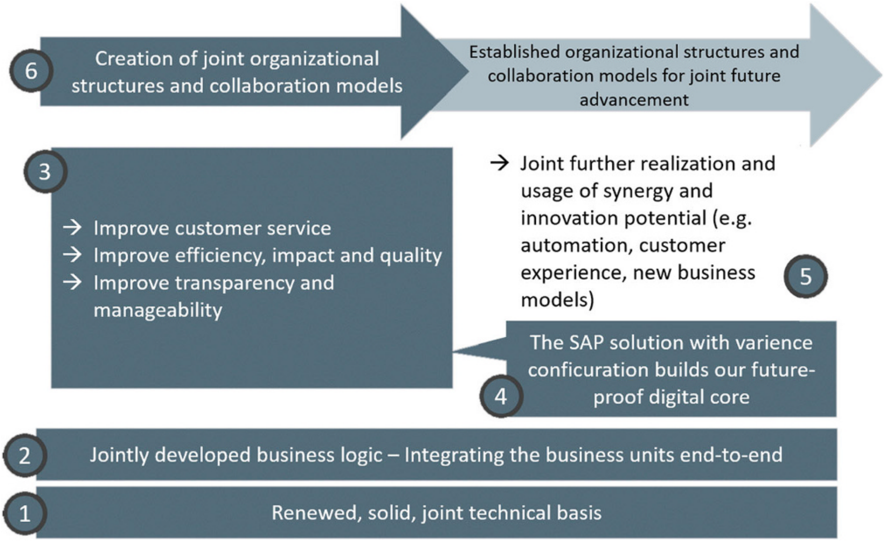


Fig. 5 Program mission

division and subsidiary representatives. Moreover, the installed change board consisted of representatives of both levels to ensure "glocal" decision-making. Key roles for integrating not only different functions (e.g., finance, sales, etc.) but also harmonizing the division-wide processes are the global core business process owner, local business process owner, global master key user, and local key users that were consciously assigned to representatives of both subsidiary and division levels and formally specified by role profiles.

The "glocal" teams were installed to foster and eventually institutionalize collaboration between the subsidiaries and between the subsidiaries and the division.

Another governance measure was the joint development of a target vision mapping overarching division-wide goals and subsidiary-specific goals. The vision mapping included the program mission and ambition.

Despite the many doubts regarding how a global template would fit the subsidiaries and represent their specific local interests, the target vision map helped to find common ground, establishing a joint understanding and commitment from high-level goals to low-level objectives. As an illustrative example of high-level goals, Fig. 5 shows the overall mission.

Another example is the program ambition regarding process harmonization (illustrated in Fig. 6). Both the program mission and ambition were jointly developed and used as communication tools within the ERP program and also in the local-line organizations and the division offices.

As soon as a joint commitment to the strategic "Fit for Standard" objective to implement lean and efficient processes understood by users and forming a solid ground for digital transformation had been solidified, the dedicated "glocal" teams started to break down the goals into sub-goals and operational goals.

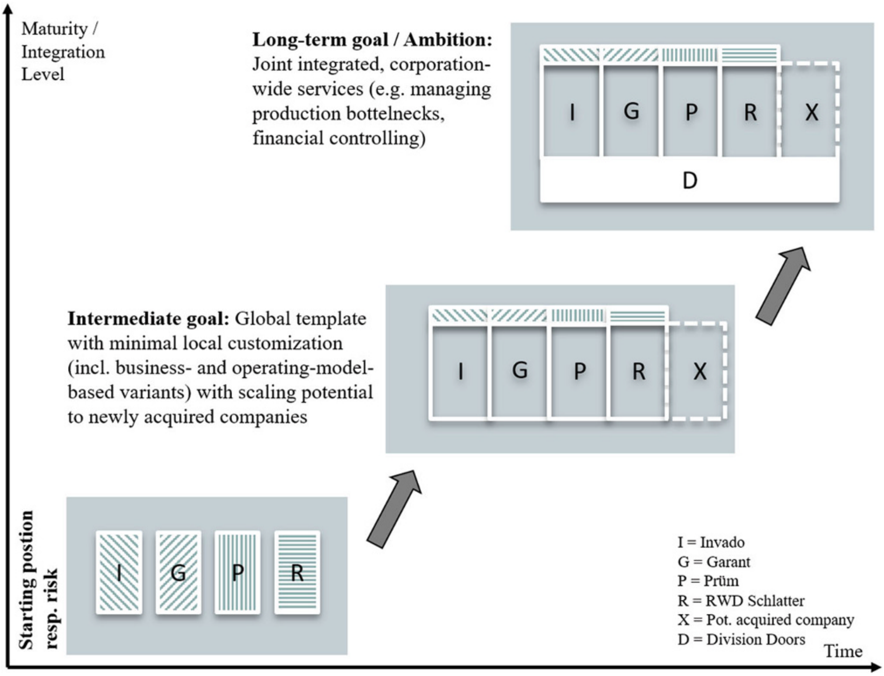


Fig. 6 Program ambition

During these activities, key topics such as variant configuration, production capacity planning, and governance of master data were also further developed through dedicated "glocal" teams.

In addition, to foster the joint commitment and a "glocal" image towards employees of the whole division, another measure was taken: Bedsides the division head, CIO and Group CEO members of senior management of each subsidiary were selected as program ambassadors.

Another governance measure was to set up program community meetings that would eventually be institutionalized. The program management office, therefore, organized informal (virtual) meetings where master key users, process owners, and core business process owners representing different processes and affiliations could come together and share their views, experiences, and ideas regarding, for example, the central themes within the global template.

Moreover, they also defined a global budget and local backfilling processes to ensure that there is no staff shortage, and "glocal" teams can be installed without local or global budget restraints.

The activation of both formal and informal governance mechanisms took place through a mix of authoritative and enabling styles of measure implementation. The setup of the program organization was at first clearly top-down enforced by the program manager and sponsors but later allowed for co-design with other program members. The subsidiaries were then asked to fill in the spots with the right people, for which the division supported the subsidiaries with the abovementioned backfilling process. Other measures, such as the joint development of a target vision map, were, from the beginning, taken in a rather enabling style, allowing interested program members to co-design not only the resulting vision but also the formal aspects and processes of realizing the measure.

4 Results Achieved

The combined set of governance measures contributed to positive results that led to improvements on the program level and a solid basis for future digital transformation. As the program sponsor pointed out: “With our ‘glocal’ governance approach, we set a solid basis to continuously collaboratively align global goals with local goals and find the perfect degree of harmonization needed to successfully tackle the digital transformation.”

The alignment impact (i.e., the effectiveness) of the governance measures was evaluated through 12 single interviews with program members from the division as well as from subsidiaries. The interviewees assume diverse roles ranging from program manager to local key user. Through the interviews, an ex ante evaluation of the impact for future digital transformation was also conducted. The interviews took place in June 2020. Table 3 summarizes the results of the alignment impact evaluation.

In the following, the results achieved in the strategy phase of the ERP program and the impacts on future digital transformation are outlined.

Observed alignment impact Overall, Arbonia Doors’ objective to find ways to align both sides of the identified tensions and enable local differentiation and global consistency could be achieved. In sum, especially structural measures and joint activities were observed of having a broad and—at least regarding some tensions—even a high impact on alignment.

The formal mechanism of setting up a “glocal” program organization with corresponding decision-making rights and responsibilities clearly defined by role profiles gave the program members the initial orientation they needed. Although not yet in action, program members of the division and subsidiaries could envision their integrational role and their corresponding responsibilities. After getting to know the idea of “glocal” structures with the close collaboration of division and subsidiary representatives according to the business processes, having a formal program organization in place helped the program members to understand the idea and the different teams and roles in relation to composition and responsibilities. As a representative of the division pointed out: “The formal program organization and the clear role profiles helped me to understand the ‘glocal’ approach and the information flows and the joint decision rights of division and subsidiaries that come with it. A well-organized cascading communication needs to be set up.”

Table 3 Observed alignment impact of governance measures

Observed impact:

- No alignment impact
- Low alignment impact
- Medium alignment impact
- High alignment impact

Governance Measures	Tensions: ERP implementation goals of subsidiary X vs. ERP implementation goals of subsidiary Y	Specific process design requirements of subsidiary X vs. specific process design requirements of subsidiary	Subsidiary-specific performance optimization vs. division-wide optimization of performance	Maximal subsidiary-specific ERP system adjustments vs. maximal division-wide standardization of ERP	Subsidiary-specific design of processes vs. division-wide harmonization of processes	Representation of subsidiary-specific interests vs. representation of division-wide interests	Being part of a local program team vs. being part of a global program team
Set up of "glocal" program organization with mixed teams	Low	Low	Low	Low	Low	High	High
Role profiles with shared responsibility and decision rights between the representatives of the subsidiaries and the Division	Low	Low	High	High	High	Low	Low
Composition of steering committee and change board with senior management members of each subsidiary and the Division	Medium	Low	High	Medium	Medium	Low	Low
Definition of a global budget and local backfilling processes	Low	Low	Low	Low	Low	Low	Low
Joint development of a vision map with overarching division-wide and subsidiary-specific goals	High	Low	Medium	Low	High	Medium	Medium
Joint goal specification within dedicated "glocal" process teams	Medium	High	High	Medium	High	Medium	Medium
Joint identification and further development of key topics within "glocal" teams	High	High	Medium	Medium	Medium	High	High
Program ambassadors from subsidiary- and division-level	No	No	No	No	No	Low	Low
Regular program community building meetings organized according to processes or roles	No	No	No	Low	No	Medium	Medium

Furthermore, the "glocal" structures helped to align the belonging tensions regarding interest representation and identification with the program. An appointed master key user of one subsidiary pointed out: "The formal program structure and role profiles are important to understand your role on activity level, and it also supports you in building your dual role as representative of your company and as contributor to the whole division-wide program."

The setup of mixed teams fostered close collaboration between division and subsidiary representatives and helped, in a first step, to identify competing demands regarding the ERP system. It also allowed mediating between the program members' divergent expectations. In a second step, it allowed to set, align, and prioritize local and global goals and define straightforward harmonization candidates (e.g., procurement, controlling, and accounting processes [except country-specific legal, fiscal regulations]), medium harmonization candidates (e.g., sales processes), and challenging harmonization candidates (e.g., production and logistics processes). As one program member put it:

> The initial rounds with the division's management and the local production companies to find the right ambition towards harmonization clearly revealed a lot of harmonization potential that we would not have seen on our own. The following joint activities within the mixed teams facilitated goal alignment tremendously—but clearly this did not come without compromises from both sides and tough discussions.

Topics encompassing such discussions were, for example, pricing (i.e., finding a consistent pricing or defining net or gross prices as calculation standard), streamlining product classification, calculating contribution margin, or credit limit checks.

The work in mixed teams also contributed to the framing of the contrasting interests between the subsidiaries and the division as valuable to finding the best solution and optimizing business. Furthermore, dependencies and synergy potentials regarding local and global ERP processes and information as well as regarding the program progress could be identified.

The intensive collaboration in the strategic phase helped to establish an open communication culture where division and subsidiary representatives found a constructive way to develop and discuss their agenda critically. It also prevented misunderstandings (e.g., mutual understanding of similarities and differences in process flows).

Jointly establishing a global picture of the vision, goals, and mission of the program through iterations in "glocal" teams helped the team members of the different levels and companies build up the cross-boundary perspective needed to find commonalities and understand differences. Seeing one's goals in relation to the others' goals and the joint vision and collaborating closely with the (at least initially) perceived counterpart also contributed to dispelling fears. This led to reduced overall program resistance and made meeting halfway easier.

Moreover, the many collaborating activities and community-building measures activated the valuable informal governance mechanisms of trust, common ground, and joint understanding. This especially helped to align the program members' dual perspectives on their roles and identities within the program. A senior management member of the division said: "I am indeed surprised about our success in overcoming the traditional decentralized characterized structure of Arbonia Doors, where the majority focused on their business—especially in such a short time and in an ERP program that no one was really waiting for."

These informal governance mechanisms helped build up a strong feeling of belonging to a "glocal" team where both subsidiary and division interests are represented by both management members and operative staff. This will allow for a rather lean, non-bureaucratic governance approach and move one step further from command and control to enablement and self-control within the teams in the next phase.

Besides all the positive results, there were also challenges in establishing "glocal" governance, of which some still persist. In the beginning, time pressure had been a big issue. There was insufficient time to thoroughly think through all governance measures. It had soon become clear that establishing solid governance enabling local differentiation and global consistency within the program would require more time. The program management and sponsors thus decided to take more time to allow for solid design, settling, and evaluation of the governance measures in an iterative manner. The majority of people, especially those representing a subsidiary, had never been involved in division-wide programs and were not used to collaborating with other subsidiaries or the division's office and thus to boundary-spanning global thinking. Because such culturally influenced capabilities cannot be changed overnight, it is still an ongoing process, even after the already passed 18 months of governance activities with a positive experience and continuous learning.

Another prominent challenge was the need for a distinct abstraction capability (i.e., abstracting from understanding and solving daily business problems towards a conceptual solution) in some roles. Without this capability, core business process owners, process owners, and master key users, in particular, are not able to find harmonization potential and define and prioritize global and local requirements. The program manager, therefore, started to systematically staff these roles with those from the subsidiaries and the division's office that bring along this capability. Furthermore, the settling and positioning of these integrating conceptual roles took more time than expected.

Another challenge has come up from the matrix program organization. For program management, this setup introduces more coordination effort and management complexity.

Impact on future digital transformation The current experience with "glocal" governance within the ERP program serves Arbonia Doors as a valuable organizational basis for future digital transformation. In the meantime, Arbonia Doors, in particular, the division's management, now feels more confident that alternative organizational designs like boundary-spanning teams and collaboration, representing a more network-style organization, will be possible in the future. This has also been claimed as a central antecedent of digital transformation (Majchrzak et al. 2016). As the program sponsor said: "I am convinced that the close collaboration between the Division and the subsidiaries within the program has given us all more confidence that we can tackle future digital transformation endeavors together. Although it is a way to go, it has taken our reservation to division-wide collaboration and strategy alignment." The ERP program and its "glocal" governance measures have triggered a change in awareness from separated local and global optimization to integrated "glocal" optimization. Managers as well as operational staff of the subsidiaries are now experiencing new roles that are not only focused on optimizing daily local business but also on changing the systems, processes, organization, and strategy in the best possible way from a mutually global and local perspective. This experience is considered valuable for Arbonia Doors' upcoming programs aimed at implementing a manufacturing execution system and e-commerce platforms and also expected to contribute to the cultural change needed for successful digital transformation.

Altogether, the conscious and deliberate design and implementation of "tension-aware" resp. "glocal" governance in the early phases of the ERP program has brought Arbonia Doors, on both a division and subsidiary level, in a position of control and integrated manageability of a large-scale, global transformation preventing ad hoc moves or uncoordinated—even segregated—goal definition and realization.

With regard to the realization iterations soon to start, the ambition is to continuously develop and proactively adapt the governance to changing or upcoming tensions—hence, treating the governance framework not as static but rather as dynamic.

5 Lessons Learned

The iterative design of a set of governance measures to address the local differentiation/global consistency tension and the corresponding program risks has been accompanied by continuous reflection by the involved program manager, subprogram managers, program sponsors, steering committee members, functional managers, and executives of the line organizations. This reflection resulted in seven lessons learned that promise to be interesting for managers of other companies. While not claiming general projectability for all digital transformation programs because of the specific internal and external conditions of the case company, the generated lessons learned can serve as a consultable record for other large decentralized organizations, such as corporations, that are planning to upgrade or implement global information systems. They may not be aware of the tensions and corresponding program risks and will eventually be seeking tension-aware governance measures and possible leverage to lay the foundation for successful ongoing digital transformation.

Lesson #1—Continuously frame an ERP endeavor as a major step in the digital transformation journey rather than as a large, complex IT program To stress the importance of a new approach towards governance, senior management of Arbonia Doors continuously and actively communicated the ERP endeavors' great potential to allow each subsidiary and the division as a whole to take a major step in the digital transformation. This vision, which goes beyond the replacement of outdated ERP systems and laying the digital backbone for, for example, process automation and rather towards business and organizational transformation helped to build up a joint, division-wide understanding. From the program sponsors to the master key users and other program members, the understanding that not only division-wide process harmonization is needed but also new governance structures and processes to achieve the right degree of harmonization has been sustainably established. In this way—although requiring more effort regarding coordination, control, and collaboration—the program members can better appreciate that the new governance will pay off. They can enjoy the benefits of the program and the digital transformation as a whole. This leads to greater acceptance and motivation to engage in the program and assume an integrative, "glocal" role.

Lesson #2—Actively strengthen the understanding and handling of tensions as a both-and rather than an either-or decision While initially dealing with the idea of a global ERP, Arbonia Doors' senior management had soon realized that the decentralized organizational structures will evoke tensions within the program, potentially leading to reinforcement of the subsidiaries' boundaries. To avoid resulting black-and-white thinking and either-or decisions when it comes to program goals and system requirements, the program sponsors and manager actively framed the identified tensions positively and communicated among all involved parties that they were indeed a significant opportunity to find synergies and implement the best ERP solution for all rather than a barrier to program progress and success when addressed with a more balanced approach and both-and decisions. At the program outset, for instance, the division head claimed: "Our mission is to leverage contrasting local and global intensions to find the best possible solution."

Lesson #3—Start early and allow developing governance measures by trial and error The tight timeframe of the program's strategy phase forced the program sponsors and manager to quickly introduce governance measures to set up functioning governance. This could only be realized in an agile approach that allowed iterations of design, implementation, and evaluation of measures. This helped to learn from real-life results and integrate the insights into the further development of governance measures. When first introducing the "glocal" governance organization, for instance, core business process owner teams were constituted of representatives of the division and the subsidiaries. However, it soon became clear that "lower"--level teams (i.e., business process owners and master key users) also needed a "glocal" mix as soon as possible. Without a flexible, agile approach allowing trial and error and the continuous improvements of design elements, the program would be at risk of ineffective governance in the next program phases where other or additional tensions will probably arise.

Lesson #4—Foster co-creation of governance Enabling diverse program members of different levels to take part in the design, evaluation, and further development of the governance measures proved to be valuable to building confidence in the "glocal" governance approach and measures. Pushing governance in an authoritative manner onto the program would suppress program members' confidence and engagement for effective lived governance. An important prerequisite for a functioning co-design of the governance measures was to build a strong commitment of the division's and the subsidiaries' management to this mission. They were needed in addition to the program manager and sponsors to spread the idea and request dedicated program members to engage in the co-design.

Lesson #5—Cover formal as well as informal governance mechanisms Arbonia Doors' ERP program clearly shows that activating formal governance mechanism, such as program structures, is not sufficient to ensure the intended behavior that allows local differentiation and global consistency. For instance, the formal organizational chart is not enough to ensure "glocal" behavior and collaboration. Because program members are used to the line organization structures, there is a risk of bypassing program structures and falling back into behavioral patterns used in the daily business context. At Arbonia Doors' ERP program, the formal structures could only become an integral part of everyday program activity through measures such as community meetings, joint vision mapping, and goal alignment that activate informal governance mechanisms such as trust, joint commitment, common ground, and participation.

Lesson #6—Develop a clear strategy on how to include external partners ERP programs typically involve a large number of external partners, such as SAP consultants or external quality and risk managers. Arbonia Doors proactively sought to develop a strategy to integrate external partners into the "glocal" governance structures and processes. Like internal staff, external partners were actively involved in the realization of all governance measures. The program management made sure that every external partner developed the same understanding of and approach towards the tensions between the division and the subsidiaries. This allows preventing thwarting behavior of external partners and ensures that all involved parties act in concert.

Lesson #7—Systematically demonstrate the effects of the governance measures To demonstrate the value of the "glocal" governance approach, the ERP program's management regularly reported on meetings where division and subsidiary representatives met. They sent newsletters (incl. pictures) to make boundary-spanning collaboration visible for not only other program members but also for regular staff of the line organizations. Thereby, they could demonstrate the progress of the joint program and joint process harmonization and, in particular, joint collaboration successes. As Arbonia Doors' ERP program is very large and involves other significant alignment efforts, for instance, between business and IT and between functional units, local-to-local and local-to-global alignment is not a continual top priority for every program member. Thus, the continuous demonstration of positive effects of the governance measures on other alignment areas helped to generate a more integrated picture of the results achieved and future value potential of the developed governance approach.

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Correction to: Enabling Digital Transformation Through Cognitive Robotic Process Automation at Deutsche Telekom Services Europe

Christian Czarnecki, Chin-Gi Hong, Manfred Schmitz, and Christian Dietze

Correction to:
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Owing to an oversight, an incorrect affiliation was captured for Christian Czarnecki when published initially. This has now been corrected to reflect as "FH Aachen, Aachen, Germany".

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