



JITTA

JOURNAL OF INFORMATION TECHNOLOGY THEORY AND APPLICATION

ISSN: 1532-3416

Structuring Digital Transformation: A Framework of Action Fields and its Application at ZEISS

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Abstract:

Digital products and services are an integral part of everyday life for both individuals and organizations. Further, given that digitalization greatly impacts our society and in particular how customer and organizations interact, organizations need to react to changing business rules and to leverage opportunities associated with digital technologies. Accordingly, the chief information officer (CIO) role is frequently a flexible one in the sense that it encompasses a much broader perspective on organizations than before. Most of the CIOs or newly appointed chief digital officers (CDOs) whom we interviewed in the course of our study recognized the need for change catalyzed by emerging digital technologies, but they typically lacked comprehensive knowledge on how to scope digital transformation initiatives. Against this background, we develop and validate a holistic framework of action fields for digital transformation. Our framework builds on extant literature and a series of exploratory interviews with over 50 organizations, and we have validated it in numerous contexts. In this paper, we present our framework and demonstrate its application at ZEISS, one of the organizations that participated in our study.

Keywords: Digital Transformation, Digital Strategy, Digitalization, Digital Economy, Framework.

Markus Rothenberger acted as the Senior Editor for this paper.

¹ Ulrich Faisst served as Digital Transformation Officer at Carl Zeiss AG during the creation of this paper.

1 Introduction

Digitalization disrupts established business rules. First and foremost, organizations should scrutinize existing business models because they are being attacked by digital challengers and prone to become obsolete in the digital economy. One can find various companies with successful digital business models, such as Skype and WeChat (the largest of the world's phone providers that do not own any major telecommunication infrastructure), Netflix (the world's largest movie house that owns no cinemas), and Apple and Google (the world's largest software vendors that develop only a very small fraction of the apps available on their operating systems). Other well-known examples include Uber, Airbnb, Alibaba, and Facebook (Goodwin, 2015). The success of these companies' business models arguably lies in the fact that they build on platforms, do not attack incumbents with better products or services, and leverage new ways of customer access. Thus, digitalization erodes traditional industry structures. It promotes winner-takes-it-all effects while simultaneously offering huge potential for niche players and micro-businesses to prosper in the ecosystem of digital platforms. Competitive pressure arises particularly from digital leaders (e.g., Google or Apple) and start-ups that push forward in multiple sectors, which reduces the distance between the physical and the digital world. Digitalization also empowers customers via unprecedented connectedness. 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). More critical than ever before, wowing one's customers in the digital economy is independent from an organization's position in the value network. Likewise, employee behavior and thought patterns continue to evolve towards a new future of work, which calls for innovative work models and ways of collaboration (Gimpel, 2015; Brynjolfsson & McAfee, 2014).

In response to the changes that digitalization has catalyzed, many established organizations have already started to engage in digital transformation and to set up a digital agenda. Yet, so far, many executives still struggle to understand how to implement their digital agenda (Römer et al., 2017). Compounding the problem, recent academic work has focused on specific facets of digital transformation rather than providing overall guidance (Hess, Matt, Benlian, & Wiesböck, 2016). For instance, Lee, Sambamurthy, Lim, and Wei (2015) shed light on transforming businesses from an IT ambidexterity perspective and show the importance of organizational agility for successful transformation. Similarly, Bharadwaj, El Sawy, Pavlou, and Venkatraman (2013) point out the importance of reconsidering the role of IT as a fundamental driver of value creation and propose to establish synergetic digital business strategies. Keen and Williams (2013) and Neumeier, Wolf, and Oesterle (2017) suggest that merely adapting the business model and digital business strategy does not suffice and that organizations should also improve their capability to flexibly adapt in turbulent environments. On the other hand, Hansen and Sia (2015) examine digital transformation from an omni-channel perspective by highlighting the challenges that may arise when striving for a seamless customer experience. Matt, Hess, and Benlian (2015) discuss the first steps toward overcoming such partial analyses of digital transformation and propose a conceptual framework that comprises the dimensions "use of technologies", "value creation", "structural change", and "financial aspects". However, Hess et al. (2016) emphasize that these building blocks are too vague to provide clear guidance on how to structure digital transformation initiatives. Digitalization shifts the focus of IT functions from software development and IT operations to agile business innovations that leverage digital technologies: in both cases, we do not clearly understand how digital strategy relates to business and IT strategy (Hess et al., 2016).

Contribution:

Building on extant literature and an exploratory interview study with over 50 organizations, this paper proposes a framework of six action fields (i.e., customer, value proposition, operations, data, organization, and transformation management) that assist established organizations in structuring their digital transformation initiatives. Each action field includes four action items to offer concrete guidance. Structured around our framework, the paper also provides first-hand insights into the changes and challenges that digital transformation brings about for ZEISS, a global innovation leader in optics and optoelectronics.

In sum, existing academic work focuses on single facets of digital transformation or case-based evidence. We lack a holistic understanding of the action fields that CIOs and CDOs should keep in mind when structuring digital transformation initiatives. Although the first steps have been made toward a holistic approach, we need more research to incorporate cross-industry findings and provide clear and specific guidance. Against this backdrop, our paper proposes a framework that holistically compiles action fields of digital transformation. We validated the framework in different settings (e.g., industry workshops, presentation at industry conferences, and CIO roundtables), which builds on both existing literature and qualitative exploratory interviews with practitioners from over 50 established organizations engaged in digital transformation.

The paper proceeds as follows: in Section 2, we provide background on digitalization. In Section 3, we outline our multi-phase research process. In Section 4, we present our framework before we apply it to the digital transformation of ZEISS in Section 5. In Section 6, we summarize the paper and discuss its theoretical and managerial implications.

2 Digitalization Connects Individuals, Organizations, and Objects

Digitalization reflects the increasing presence of digital technologies in business and society and the associated changes in the connectivity of individuals, organizations, and objects (Gartner, 2016). While digitization refers to the technical process of converting analog signals into a digital form, digitalization refers to the manifold sociotechnical phenomena and processes of adopting and using digital technologies in broader individual, organizational, and societal contexts (Legner et al., 2017). Digital transformation refers to organizations' managed adaptation as they capitalize on digital technologies to change business models, improve existing work routines, explore new revenue streams, and ensure sustainable value creation. Technologies typically associated with digital transformation include the four groups commonly abbreviated as SMAC: social, mobile, analytics, and cloud. While these technologies are already in widespread use, new technological trends include the Internet of things, artificial intelligence, blockchain, 3D/4D printing, wearables, gamification, and augmented and virtual reality.

Moore's and Metcalfe's laws govern the broadening availability and commoditization of digital technologies: that computing hardware is becoming ever more powerful, embedded, and ubiquitous, while network effects yield super-linear increases in value by connecting individuals, organizations, and objects. Today, users adopt technologies more quickly than ever before and, in particular, more quickly than organizations do. While it took 38 years for the radio to reach 50 million people, the iPod reached the same number in four years. Instagram took less than six months to reach 50 million users (Chui et al., 2012). Some sources have predicted the number of connected devices to rise up to 50 billion by 2020 (Evans, 2011). This development offers enormous economic potential. Some have even predicted that the Internet of things (i.e., the equipment of physical objects with sensors and actors and the connection of these smart things with the Internet) alone will reach an economic potential of US\$8 billion over the next decade (Macaulay, Buckalew, & Chung, 2015).

Digitalization, however, is not a new phenomenon. Data has been processed and exchanged digitally for more than half a century. Early examples include electronic data interchange, which began in the 1960s. The Internet has been used for civil purposes since the 1990s, and e-commerce was first promoted around the year 2000. With the introduction of smart devices and mobile applications, digitalization experienced a significant boost. While in former times digitalization only concerned data managers working in corporate IT, it now affects all business departments; it has moved from support to core processes and has become an essential part of many organizations' value propositions and strategies. In our opinion, the most significant aspect of digitalization does not concern the usage of data or technology but the unprecedented speed of change and level of connectedness that together facilitate customers' dominant role in technology adoption and the inextricable entanglement and convergence of the physical and digital world (e.g., products, data, algorithms, machines, and services) (Yoo, Boland, Lyytinen, & Majchrzak, 2012). 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)—in short, a VUCA world (Bennett & Lemoine, 2014).

3 Research Process

To develop and validate a framework of action fields for organizations to consider when engaging in digital transformation, we conducted an exploratory interview study and followed a multi-phase research process (Figure 1). We provide details on each phase below.

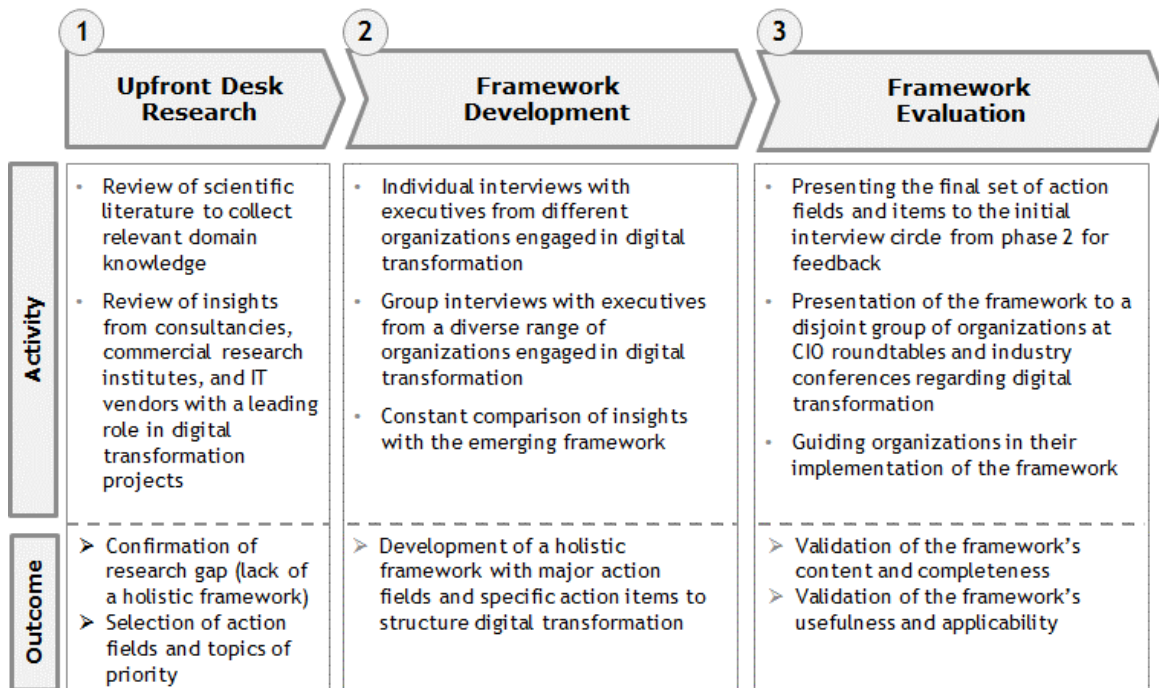


Figure 1. Research Process: Description of the Activities and Outcome

In phase one, we conducted a literature review to collect relevant domain knowledge by identifying relevant publications on digital transformation. Academia and industry-related publications underline that ever-changing business environments continue to reshape entire industries and business models (Downes & Nunes, 2013). As the extant research and references that we show in Section 1 exemplify, recent academic work focuses primarily on specific facets relevant to the digital transformation. To the best of our knowledge, we lack a holistic framework that supports decision makers in structuring digital transformation initiatives in terms of concrete fields of action. We follow the call of Hess, Matt, Benlian, and Wiesböck (2016) to remedy such partial analyses. Against this backdrop, we decided to complement theoretical insights with practical insights. As such, we considered selected non-academic literature by reviewing various studies and webpages from consultancies (e.g., McKinsey & Company, Accenture), commercial research institutes (e.g., Gartner, GfK), and IT vendors (e.g., IBM, Fujitsu). This research was reasonable and necessary to check to what extent prior academic results could be complemented. However, we found the results to be too abstract and vendor specific. The information did not help reveal digital transformation in terms of specific fields of action or organizational objectives.

In sum, by focusing on specific facets of digital transformation, prior research has so far led to mature but isolated pockets of understanding digital transformation. Despite the availability of scientific and industry literature, digital transformation still remains ambiguous for researchers and practitioners. Our own research focuses on remedying this problem by integrating existing pockets of understanding to provide a holistic and yet concrete framework for understanding and managing digital transformation.

In phase two, we conducted individual and group interviews with a variety of organizations. By doing so, we could challenge and refine the results of phase one for their real-world fidelity and, further, examine insights that extant literature has not yet sufficiently explored. First, we conducted semi-structured qualitative interviews with executives from 21 different organizations. In each organization, we interviewed the person in charge of digital transformation. Our interviewees included CIOs, CDOs, digital transformation officers, chief technology officers, chief innovation officers, digitalization program leads, managing partners, and professionals in strategy and business development. These interviews were

insightful, yet, on several occasions, we realized that a single perspective on an entire organization—even if the person in charge of digital transformation provided it—may not necessarily fully reflect the complexity and cross-functional approach to digital transformation. Thus, we proceeded with seven cross-functional group interviews that involved experts from more than 30 different organizations and different organizational functions such as the digital office, innovation management, IT, marketing and sales, and manufacturing. These group interviews provided—among many advantages—opportunities for interaction and the development of ideas or opinions that built on other respondents' comments, which individual interviews usually do not afford. We used group interviews in the exploratory stages of phase one during which we further refined our framework and in the confirmatory stages of phase three during which we evaluated our framework (Tremblay, Hevner, & Berndt, 2010).

For individual and the group interviews, we approached established organizations with non-digital value propositions (i.e., neither start-ups nor digital leaders such as Google or Apple) in order to cover the diversity of those organizations that typically engage in digital transformation. We adopted the approach of theoretical sampling from the grounded theory methodology (Glaser & Strauss, 1967). For the individual interviews, our sample included 21 different organizations. By design, the sample covered many industries from the manufacturing and service sectors (e.g., automotive, engineering, chemicals, transportation, logistics, healthcare, telecommunication, and financial services). The sample also covered organizations that operated B2C and B2B markets and in local and global markets (see Figure 2). The revenue of the sample organizations ranged from €10 million to €92 billion, while the number of employees spanned from less than 100 to over 340,000. Our sample deliberately included small and medium-sized enterprises because some of these organizations are hidden champions (Hermann, 2009). We illustrate the diversity of the organizations in our sample with the following examples: in one case, we interviewed a mid-sized, fifth-generation, family-owned German manufacturer highly specialized in textile filters and plastic profiles for industrial applications and that employed around 1,500 workers at 12 national and international production sites. In another case, we interviewed a leading producer of semiconductors, computer chips, and security products with €5 billion sales in 2015. More than 35,000 employees worked for this company, which mainly focused on B2B markets. In the service sector, we interviewed a local hospital operator with 25 clinics and other medical centers and among others, an international bank that served retail and corporate clients and that operated in over 70 countries with more than 100,000 employees. Digital transformation had a different meaning for each of these organizations, and the topics discussed in the interviews varied in priority. However, all organizations included in our sample already engaged in digital transformation, and we could, therefore, discuss relevant changes, chances, and challenges with them.

| | | | | | |
|-----------------------|---------------------------------|-----------------------------|---------------------------------------|--------------------------------|-------------------|
| Revenue | Min. 10 mn EUR | ← 25% Quantil 340 mn EUR | Median 3,500 bn EUR | → 75% Quantil 15,500 bn EUR | Max. 92 bn EUR |
| Employees | Min. 100 | ← 25% Quantil 1,500 | Median 10,000 | → 75% Quantil 25,000 | Max. 340,000 |
| Regional Focus | Regional 4 (19%) | ← National 3 (14%) | International 4 (19%) | → Global 10 (48%) | |
| Customer Focus | Primarily B2C 9 (42%) | ← Hybrid 5 (25%) | → Primarily B2B 7 (33%) | | |
| Sector | Primarily Service 8 (38%) | ← Hybrid 3 (14%) | → Primarily Production 10 (48%) | | |

Figure 2. Characteristics of the Organizations Participating in our Study

For our group interviews, we used meetings that external partners scheduled: either cross-functional workshops on digital transformation in a single organization or cross-functional meetings across organizations. The individual organizations and industry associations that invited us to join their regular cross-functional workshops allowed us to shape the agenda and to use their workshop formats for our group interviews. The benefits of this approach as compared to inviting participants for dedicated group interviews include feasibility, broad attendance by many participants, and (from the participants'

perspective) a familiar environment and group for discussing digital transformation. The downsides were that we could not determine the group size or select the individual group participants. Yet, experts from more than 30 organizations participated in our group interviews, and the cross-functional and cross-industry nature of the group interviews supports the holistic perspective of our framework. In sum, phase two of our research absorbed the perspectives of more than 50 organizations.

We conducted the individual interviews and the group interviews in a semi-structured form (Briggs & Schwabe, 2011), and they took between 1.5 to two hours each. The individual interviews were either recorded for later in-depth analysis, attended by at least two researchers, or (in most cases) both. At least two researchers also attended the group interviews, and they took notes. We used both the recordings and the notes as a basis for the analysis. Figure 3 shows how we captured, analyzed, and structured quotes (Q) taken during the interviews (I) into content-related groups that contributed to our developing the action items and action fields of our framework. Each interview comprised three parts: The first part addressed the perceived trends regarding digital transformation for the respective industry; in the second, the interviewee(s) evaluated the current progress of their organization; finally, in the third, the discussion focused on the impact of opportunities and challenges associated with the transformation.

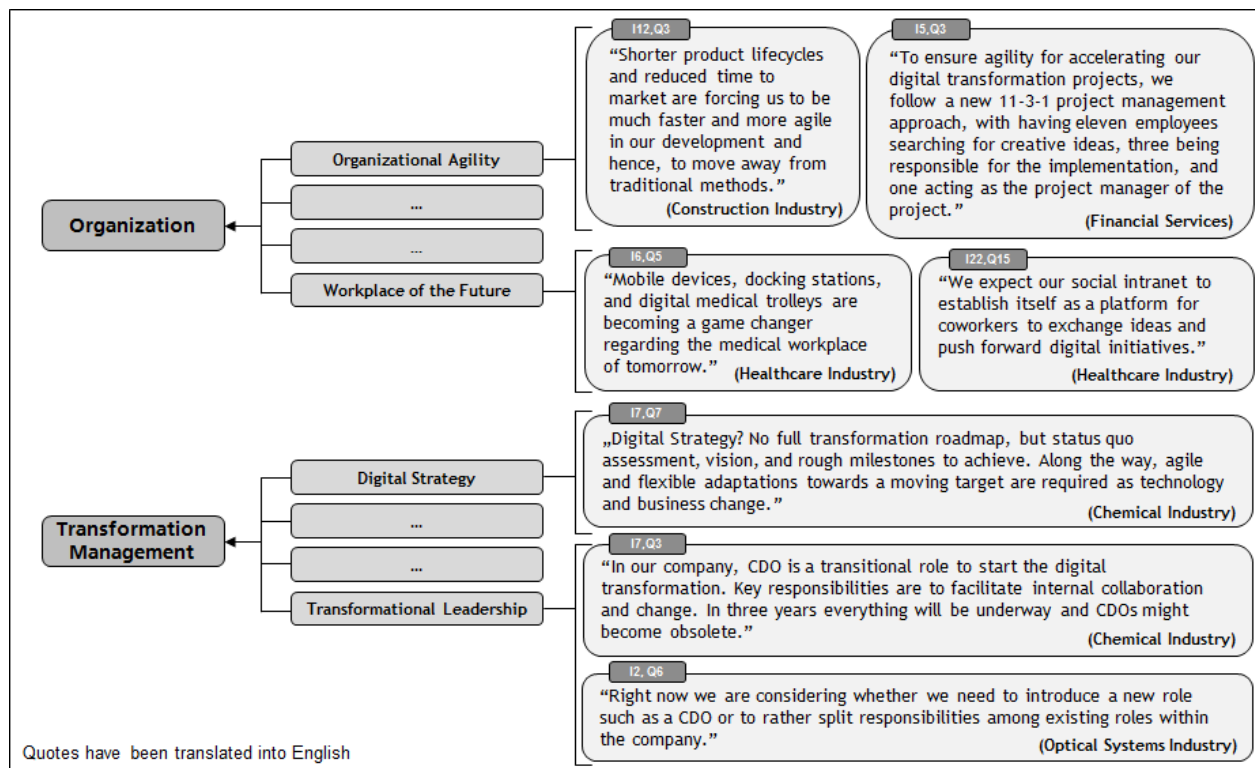


Figure 3. Development of Action Items and Fields Based on Interview Analysis

When developing our framework, we used two approaches known from grounded theory methodology: constant comparison and theoretical saturation (Glaser & Strauss, 1967). Throughout the interview process, we compared new insights from the interviews against the perspectives we developed in phases one and two and revised the framework where necessary. As such, the final framework is one that emerged during the interview process. Unsurprisingly, changes made in response to the earlier interviews were the most substantial; subsequent alterations became smaller as the framework matured and the interviewees' input reiterated insights from earlier interviews. Once we achieved theoretical saturation—that is, once we considered the action fields and items sufficiently dense and the interviews did no longer generate new leads for further improvement (Glaser & Strauss, 1967)—we stopped sampling new interviewees, and, thus, phase two of our research concluded.

To structure the interviews, we initially used the Business Model Canvas, a framework that compiles nine essential business model components (Osterwalder & Pigneur, 2010). We chose to use the Business Model Canvas because it is widely accepted and used in business environments as a template for developing new business models. The canvas divides organizations into the following building blocks: key

partners, key activities, key resources, value propositions, customer relationships, channels, customer segments, cost structure, revenue streams. We classified relevant topics of digital transformation identified during phase one of our study as belonging to one or more of these blocks: for example, one can regard data as both a component of an organization's key resources and the basis for smart products and smart services in terms of an organization's value proposition. Yet, in the first few interviews, it became apparent that the Business Model Canvas is not an ideal framework to structure digital transformation because, while all aspects of the business model that the canvas covers relate to digital transformation, discussions with interviewees raised two points of concern: 1) that the canvas does not adequately balance the nine elements according to importance and 2) that an important part of digital transformation is the ability to relate the different parts of a business model to one another rather than treating them separately. In response to these findings, we gradually moved away from the Business Model Canvas towards an original framework that we developed ourselves: one that focused on action fields and action items geared to digital transformation. We did so by constantly comparing insights from the interviews with intermediate results and extant knowledge from literature. The new framework comprises action fields, each of which comprises action items that organizational roles responsible for digital transformation should consider. By the end of the individual interviews, our framework already comprised the same six action fields that constitute the final framework. The group interviews did not suggest changes on this level, yet they were instrumental in our developing and sharpening the action items associated with each of the action fields.

The new framework includes action fields from Osterwalder and Pigneur's (2010) Business Model Canvas (e.g., value proposition) and operationalizes them against the background of digital transformation via concrete action items. At the same time, the framework highlights particular action fields to account for their importance in digital transformation. For instance, the Business Model Canvas treats data as a component of an organization's resources. All interview partners and extant literature emphasized the substantial value attributed to data in the digital economy. In line with this finding, our framework includes data as a separate action field. Another example for an action field that the Business Model Canvas does not recognize is transformation management, an important building block of transformation projects. The cross-functional workshops in particular revealed the importance of topics such as transformation management as different stakeholders of organizational functions shared their observations on the opportunities and challenges that arise in the course of transformation.

In phase three, we validated our framework. First, we discussed the framework and its contribution with the individual interviewees from the set of initial interviews to ensure that the action fields and action items comprehensively cover all relevant aspects regarding chances and changes of the digital transformation. This process assured that we did not forget or lose any important aspect when developing the framework. Second, we conducted further group interviews, this time with a different set of organizations than those that we interviewed in phase two. This involved presenting the framework at four CIO roundtables, each with between 15 and 30 participating organizations, and at two industry conferences dedicated to digital transformation, each attended by representatives from up to 50 participating organizations. The diversity of organizations and their representatives that took part in this validation phase helped us achieve a cross-functional, cross-company, and cross-industry perspective. We found the framework to be a useful tool to approach digital transformation in a structured manner. Despite the variety in the organizations' industry, size, customer, regional focus, business model, and culture, our discussions confirmed the relevance, comprehensiveness, and broad applicability of each action field and the associated action items included in our framework. Additionally, we used the framework to guide organizations in analyzing digital transformation projects. In Section 5, we show in more detail how the final framework enables and supports a structured approach towards an organization's digital transformation. As an example, we refer to one evaluation of the framework that ZEISS, a high-tech company and innovation leader in optics and optoelectronics, applied. The application provides further evidence for the framework's relevance and completeness.

4 Digitalization Requires Mastering Six Fields of Action

Our framework includes six actions fields: customer, value proposition, operations, data, organization, and transformation management (Figure 4). Each action field includes four action items. The action fields "customer" and "value proposition" take an external perspective, whereas "operations" and "organization" take an internal perspective. The action field "data" links both perspectives, whereas "transformation management" addresses how to get from an as-is to a digitally enhanced to-be state. By considering

these action fields, organizations will ensure they develop a holistic yet concrete perspective on digital transformation, which will reduce the risk that they will experience silo thinking with individual departments' striving for partial solutions.

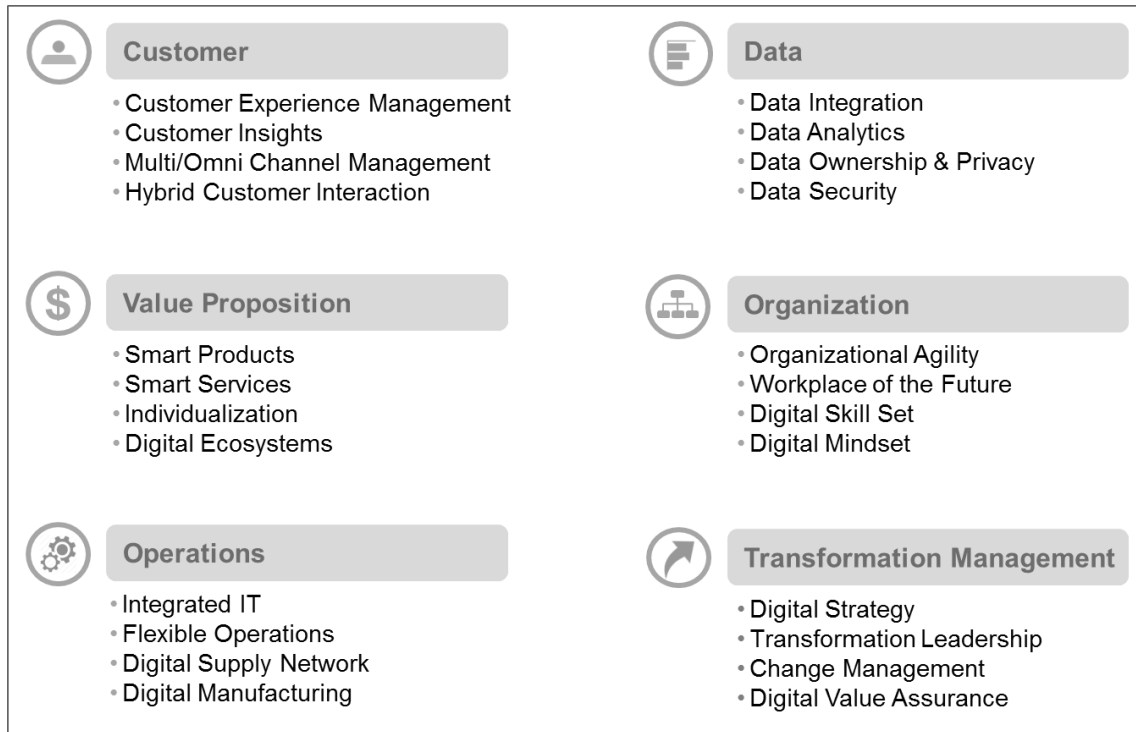


Figure 4. Digitalization Requires Mastering Six Action Fields

In Sections 4.1 to 4.6, we present the final version of our action fields and items, which reflects the results of our research process. We describe each action item in turn and provide insights from interviews and workshops to highlights each item's importance. We also include selected justificatory references where appropriate.

4.1 Customer

Digitalization changes how customers are informed, evaluate value propositions, and make purchase decisions. In the digital economy, customers tend to be well informed, self-confident, connected, and convenience addicted (Nguyen & Mutum, 2012; Hosseini, Oberländer, Röglinger, & Wolf, 2015). Yet, while digital leaders and start-ups follow a strict customer-first strategy, our interviews highlighted that many established organizations do not. Our interviews also confirmed that digitalization heavily affects customer access and that keeping in touch with customers has become very difficult.

In the digital economy, customer experience management is important for any organization that seeks to gain and sustain customer relationships. Customer experience management marks a counterpoint with respect to sales process automation and centers on subjective experiences instead of efficiency and straight-through processing. Customer experience refers to customers' subjective experiences through direct and indirect interactions with organizations. This experience is individual and volatile, which implies that customers engage with organizations on different levels (i.e., rational, emotional, sensory, physical, or spiritual) (Gentile, Spiller, & Noci, 2007). Organizations that engage in digital transformation stand to benefit from a greater understanding of how digital technologies, which can seamlessly immerse into customers' lives, affect customer experience at every single touch point. Each touch point and interaction contributes to a consistent end-to-end customer experience (Payne & Frow, 2004).

Digital technologies also offer organizations new ways of gaining customer insights by collecting customer data along customer journeys, across digital touch points, or when customers use smart products and services (Brynjolfsson, Hu, & Rahman, 2013; Porter & Heppelmann, 2015). The volume and variety of customer data provides organizations with insights into their customers' mindsets, moods, motivations, desires, and aspirations. These insights serve as foundation for individually tailored products and

services, for precise forecasts of customer behavior, and for enhanced customer experience, satisfaction, and loyalty. Our interview partners pointed out that the main challenge related to customer insights does not involve collecting customer data but integrating it from various sources (e.g., social media, mobile apps, mobility profiles, smart products, and customer records that enterprise systems or third party providers provide).

In the digital economy, customers interact with organizations via digital and traditional channels in such an interconnected way that many organizations refrain from segmenting their customers according to channel usage behavior (Melero, Sese, & Verhoef, 2016). As our interviewees mentioned, customers use digital channels not only for sales and customer service but for all interactions with organizations. This phenomenon forces organizations to engage in multi- and omni-channel management to interact with customers in a more target-oriented manner and to meet their individual desires (Hosseini, Oberländer, Röglinger, & Wolf, 2015; Verhoef, Kannan, & Inman, 2015). Many established organizations struggle to manage the increasing number of channels and touch points. In particular, our interviews highlighted the challenge of ensuring consistent customer experience across all channels and touch points while avoiding cannibalization effects and leveraging synergy effects among digital and traditional channels.

Finally, digitalization promotes hybrid customer interaction, which means that customers interact with organizations via several channels simultaneously and may deviate from organization-defined interaction patterns (Ehrnrooth & Gronroos, 2013; Nüesch, Alt, & Puschmann, 2015). Thus, hybrid customer interaction leads to non-sequential customer journeys. Nüesch et al. (2015) recommend that organizations consider hybrid customer interactions that can take place on a strategic level (i.e., convergence of digital and traditional channels), process level (i.e., customers as part of organizational processes and organizations as part of customer processes), and systems level (e.g., involvement of digital technologies). For instance, hybrid customer interaction enables organizations to integrate customers into organizational processes via platforms and self-services, which enriches innovation processes and decreases transaction costs.

4.2 Value Proposition

In the digital economy, customers require innovative value propositions that leverage digital technologies (Römer et al., 2017). We found that, on the one hand, customers demand integrated, convenient, and individual solutions. On the other, we found that, as new competitors access markets, traditional competitive advantages erode due to low entry barriers and push the disintermediation of organizations that do not add value from a customer perspective. Some interviewees admitted to investing in digital value propositions not to explore new revenue streams but to prevent customer churn. The majority of our interviewees stated that, in the digital economy, the most challenging competitors are not from the same industry but are digital leaders. From this perspective, organizations need to gain momentum to keep up with the digital leaders' and start-ups' technological mastery and capability of continuous innovation. Such companies might aim to create innovative digital value propositions by turning their legacy products and processes from liabilities into assets as well as by engaging in digital ecosystems (Porter & Heppelmann, 2014).

Our interviewees saw huge potential associated with smart products—physical products enhanced with sensors, actuators, computing power, and connectivity (Porter & Heppelmann, 2014; Püschel, Röglinger, & Schlott, 2016). Likewise, organizations might enrich their value proposition via smart services either in combination with smart products or by themselves. While thing-centric services are strongly tied to physical products, complementary services use physical products as carriers of value, and ecosystem services help integrate physical products into wider product and service systems (Püschel, Röglinger, & Schlott, 2016). In the digital economy, the basis of competition shifts from single products over smart products and services to product and service systems and to systems of systems (Porter & Heppelmann, 2014). Although this shift attracts competitors from other industries, it grants established organizations access to novel revenue pools. Our study corroborated the claim that smart products offer promising ways of keeping in touch with customers. Where customer journeys formerly ended at the point of sale, smart products enable ongoing interactions, which can revolutionize the after-sale strategies of established organizations and whole industries (Porter & Heppelmann, 2015).

In addition, the trend toward individualization enables new value propositions. Many interviewees highlighted that ever more customers expect individually tailored or even self-designed products and services (Piccoli & Watson, 2008). An important driver of individualization is software-based innovation, which equips physical products with intelligent IT components. To tap the revenue pools associated with

individualization, organizations might invest in product and service modules, integrate customers in innovation and design processes, and align individualization possibilities with customer insights gained from analyzing data from smart connected products and related usage patterns (Hosseini, Kees, Manderscheid, Röglinger, & Rosemann, 2017).

Established organizations also can engage in digital ecosystems by connecting and collaborating with partners and customers to leverage additional benefits (Weill & Woerner, 2015). Digital ecosystems integrate large volumes of digital content, devices, software, and services under a single umbrella such that customers can be better understood and no longer have to leave the platform (Weill & Woerner, 2015). Companies such as Google, Apple, Facebook, eBay, and Amazon showcase how to lock in customers and suppliers horizontally and vertically. Such digital ecosystems typically adopt a “walled-garden” strategy in which they attempt to use exclusive distribution models to retain control, generate lock-in effects, and enable monetarization (Dapp, 2015). Our interviews suggest that many established organizations consider how they might enhance their traditional value propositions by integrating the offerings of other organizations. For instance, organizations can collaborate in their innovation processes by exchanging usage data or product specifications via platforms. Digital ecosystems, however, are not only a place for collaborating with other established organizations but also for teaming up with start-ups (e.g., joining the infra-structure and market access of established organizations with the ideas and smart services of digital leaders and start-ups). Digital ecosystems help organizations quickly offer new products and services to a global customer base. Prerequisites for the success of digital ecosystems are well-defined governance, standardized interfaces, (e.g., APIs) and shared dataspace including data privacy and security regulations (Weill & Woerner, 2015).

4.3 Operations

Digitalization heavily affects the operations of established organizations (particularly manufacturing organizations). As the digital and physical worlds continue to merge, we encourage organizations to rethink their operating models, business processes, and supply networks. In the manufacturing area, smart factories can tailor production processes and products on short notice and at low cost to meet individual customer needs (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). This objective requires an integrated yet flexible IT infrastructure and digital operations, supply networks, and manufacturing capabilities.

Our interviews highlighted that a central challenge involves establishing integrated IT, which means that components, systems, networks, and software should work in unity. Although this challenge is not specific to digital transformation, interviewees consistently named it as an indispensable prerequisite for succeeding in digital transformation (Jöhnk, Röglinger, Thimmel, & Urbach 2017). Many interviewees suggested that employing digital technologies in the organization and at the customer interface only adds value if solid IT foundations exist. Offering smart products and services and a consistent customer experience depends on seamless data processing and systems integration. Thus, many leading organizations make tremendous efforts to consolidate their IT infrastructure before and while starting digitalization projects geared to value creation. While consolidating their IT infrastructure, organizations also stand to benefit from investing in the adaptability of their IT infrastructure and in its compatibility with fast-changing digital technologies to better transform their businesses (Lee et al., 2015).

Given that a short time to market and high product variety are critical factors for delivering successful value propositions in the digital economy, organizations should develop flexible operations capabilities and design their processes and production facilities appropriately (Lasi et al., 2014). Flexible operations include volume flexibility (i.e., the ability to adjust to short-term demand fluctuations) and functional flexibility (i.e., the ability to serve unprecedented customer needs) (Goyal & Netessine, 2011). Flexible operations enable ever-smaller batch sizes, which organizations need to individualize products or services to meet dynamically changing customer demands.

As part of organizations' digital ecosystems, flexible operations are complemented by digital supply networks, which help exchange resources, products, services, and data end to end among participating organizations (Khaitan & McCalley, 2015). To tap the potential of digital transformation, organizations can engage in globally connected digital supply networks with decentralized management and self-organizing capabilities (e.g., by drawing on their integrated IT infrastructure and on technologies such as the Internet of things, cyber-physical systems, and blockchain). Compared to flexible operations, digital supply networks nurture flexibility on a higher level and help mitigate systemic risks (e.g., by dynamically handling spill-over demand in case a network participant breaks down).

One can consider digital manufacturing as both an evolution of traditional manufacturing and a new manufacturing paradigm (Chen et al., 2015). Digital manufacturing enables organizations to enhance manufacturing quality and efficiency via digital end-to-end processes that range, ranging from design and engineering, production and shipping, to use and refurbishment. Digital manufacturing relies on, among other things, additive fabrication technology (e.g., 3D/4D printing), smart production systems, cyber-physical systems, and machine-to-machine communication. According to our interviews, a critical challenge of digital manufacturing is IT-OT-integration, which requires a close integration of business-related information systems (e.g., enterprise resource planning, warehouse management, production planning), operations-related information systems (e.g., manufacturing execution systems, machine steering on PLC layer), and the production infrastructure (Petthey & van der Meulen 2011).

4.4 Data

New data sources such as digital transactions, social media usage, embedded sensors, and mobile devices drive data explosion. About 90 percent of the data available today has been produced in the last two years (SINTEF, 2013). However, the data analytics and decision making capabilities of organizations have not developed at the same pace. Most of our interviewees believed that data is the foundation of success in the digital economy because it affects many actions fields related to digital transformation (e.g., customer insights, smart products and services, or digital manufacturing). As such, organizations stand to benefit from learning how to absorb, analyze, and turn data into a valuable asset.

One key challenge involves data integration. Data integration refers to the process in which one retrieves and combines heterogeneous data and makes it accessible as an incorporated form and structure in a physical or virtual database (Goodhue, Wybo, & Kirsch, 1992). In the digital economy, where organizations consider data to be the “new oil”, this traditional process is still important to harness the value of data that becomes available in unprecedented volume, variety, and velocity. Many data-driven applications such as recommender systems or predictive analytics not only require data to be integrated but also require the data to be of a high quality. The trash-in, trash-out principle still holds in the digital economy. Some interviewees highlighted the challenge of integrating structured and unstructured data, which requires new data integration architectures, such as data lakes (Pääkkönen & Pakkala, 2015; Porter & Heppelmann, 2015).

Once an organization masters data integration, it can choose suitable approaches to data analysis. Although our interviewees acknowledged that data is the new oil in the digital economy and “analytics is the combustion engine” (the quote is typically credited to Peter Sondergaard from Gartner Research, 2011), many confessed to lacking the required data analytics capabilities. Frequently, organizations fail in their attempts to turn data into meaningful insights and stumble into typical big data pitfalls such as analyses of low-quality irrelevant data, the curse of dimensionality, spurious correlations, and big data IT investments or topics that lack business value. By exploiting data via advanced analytics, organizations can identify their customers’ behavioral patterns, improve the availability of production facilities, enable evidence-based corporate decision making, and reduce innovation latency. Against this background, approaches such as visual, predictive, and prescriptive analytics, deep learning, and artificial intelligence become ever more important (Porter & Heppelmann, 2015; Shmueli & Koppius, 2011).

With the increasing amount of available data and data-driven business models, the question frequently arises of who owns which data. It is by no means clear that the organization that collects or hosts specific data necessarily enjoys rights of usage or ownership. Data ownership and privacy (i.e., the rights and control over data) are highly relevant factors in determining competitive positioning and elements of an organization’s data strategy (Dallemler & Davenport, 2017; Kleindienst, Nüske, Rau, & Schmied, 2017). Tracking and analyzing digital footprints; how they align to specific customers, employees, and partners; and the footprints’ context not only allows companies to determine real-time needs but also enable them to improve their customers’, employees’, and partners’ experience to detect and leverage efficiency potentials and manage risks. Organizations would subsequently be wise to defend their customer touch points to gain relevant data and to carefully analyze their entire business model in order to determine where data might be a source of competitive advantage. To this end, they should consider currently available digital data (whether they or others own them), currently available analog data, and potentially available data in the future when using additional sensors (e.g., in the Internet of things, smart factories, or smart supply chains). Local regulations and customers’ and employees’ awareness of data privacy increase the complexity of the task. Some of our interviewees had already begun working on transforming data privacy from a cumbersome regulation to a competitive advantage by taking a pro-active approach,

which is to say they respected the voice of the customer with regard to privacy and traded off customer demands with value-creation potential from capturing and analyzing data.

Accordingly, our interviewees ranked data security among the major challenges of digital transformation. Strict regulations and unpredictable consequences in case of data loss or leakage require organizations to deliver superior data security as a brand promise and to minimize downside risks (Dallemule & Davenport, 2017). Scandals and cybercrime result in diverse consequences that range from upsetting customers, losing trust among business partners, and losing money due to downtime to jeopardizing highly critical trade secrets and intellectual property. Transparent and secure mechanisms not only help to stop data malpractice but also boost reputation and trust by supporting an organization's role as a reliable partner in the digital economy.

4.5 Organization

Meeting fast-changing customer demands and delivering innovative value propositions challenge established organizations as the digital economy propagates individuality and agility as core values and discards work practices that rely on predictability, uniformity, and consistency (Notter, 2015). According to our interviewees, organizations often make adjustments to existing organizational setups as quick fixes without a long-term strategy to nurture continuous innovation capabilities. Often, they lack skills in fundamentally redesigning their organizational setups in accordance with changes in employees' and managers' skills and mindsets (Kerpedzhiev, König, Röglinger, & Rosemann, 2017).

Our findings suggest that established organizations should foster agility: that is, an organization's capability to leverage digital business opportunities more quickly than its rivals (Sambamurthy, Bharadwaj, & Grover, 2003). Organizational agility involves drawing from approaches such as agile project management, process flexibility, lean start-up, design thinking, continuous deployment, and integrated development and operations. One should not reduce agility to bimodal IT, which advocates the parallel use of traditional and agile software development (Aron, Waller, & Weldon, 2015). Rather, agility should cover all facets of organizational setups such as processes, governance, people, culture, and IT. As our interviewees stated, bimodal approaches tend to fall short of coping with the complexity of historically grown organizational setups. Nevertheless, organizations should strive for an equilibrium between exploitative and explorative capabilities (Raisch & Birkinshaw, 2008) by combining a solid core that brings efficiency through standardization, modularization, and automation with flexible boundaries that enable fast and continuous innovation (Sarkees & Hulland, 2009). Our interviewees also revealed that the speed of corporate decision making is crucial to stay competitive (Bharadwaj et al., 2013).

The increasing prevalence of technology affects the way that organizations and people approach work (Colbert, Yee, & George, 2016). Changes in employee behavior and thought patterns will make it increasingly important for the workplace of the future to support communication- and knowledge-intense work. Work in the digital economy requires dynamically assembling people into project teams that compete in real-time for high-value tasks all over the world. Thus, the workplace of the future should foster collaboration models that emancipate work from factors such as time and location (Brynjolfsson & McAfee, 2014). For digital transformation, an organization relies on smart, creative employees with a digital, boundary spanning skillset, including skills such as striving for the latest technical development or mastering data analytics (Schmidt & Rosenberg, 2014). Partnering fresh digital talent with experience and with stimulation from outside the organization can boost the organization's creativity and innovation.

Established organizations are also likely to benefit from establishing a digital mindset as a core value of their corporate culture. As our interviewees mentioned, success in digital transformation does not hinge on an organization's age but on its mindset—or, to be precise, the mindset of its employees and managers (Kane, Palmer, Phillips, Kiron, & Buckley, 2015). As we observed in our interviews, most organizations still lack a digital mindset. Yet, those organizations that seek to compete with or even outperform digital leaders require a digital mindset because, as the adage goes, "culture will eat strategy for breakfast". Thus, it is in their own interest that organizations foster creativity and high ambitions, complement exploitation with exploration, keep up start-up mentality wherever appropriate, and actively engage in smart products and services. Our interviewees emphasized the challenge of impressing one's customers when the workforce is unenthusiastic about smart value propositions, business models, and visionary goals.

4.6 Transformation Management

In the end, all organizations from our sample faced a crucial challenge: how to transform the as is into a digitally enhanced target state. We suggest that they first need to define an appropriate digital strategy that incorporates their vision, goals, opportunities, and activities to maximize the benefits of digital technologies and digital transformation initiatives (Hess et al., 2016). The digital strategy of established organizations could account for their legacy product portfolio, processes, and IT. Organizations may benefit from acknowledging that they might never attain a perfectly clear target state for their digital transformation initiative due to the fast-moving nature of digital technologies, customer needs, and competition in the digital economy. Our interview partners stated that, although challenging, one needs to continuously scrutinize one's digital strategy, which points the way ahead and allows for a controlled process toward a moving digital target that needs to proceed in an agile and iterative manner.

Further challenges arise with the need to determine who might be responsible for compiling an organization's digital strategy, nurturing a digital mindset, and guiding the organization through digital transformation. The question is how transformation leadership will become manifest. Is it the chief executive, information, or innovation officer's job (Weill & Woerner, 2013)? Does digitalization call for a CDO (Tumbas, Berente, & vom Brocke, 2017)? Our interviews revealed no single best solution. The most effective strategies for assigning responsibility for digital transformation depend on an organization's corporate history, business model, organizational setup, and—last, not least—the individuals who hold key positions in it. Less paradoxical than it may seem, all CDOs we interviewed shared the objective of making themselves redundant as soon as digitalization is established as the norm, which would lead to redefined CIO job profiles (Rickards, Smaje, & Sohoni, 2015).

In the digital economy with its VUCA characteristics, change itself has changed. That is, change has become more volatile and harder to predict (Bennett & Lemoine, 2014). Thus, change management is arguably crucial for the transformation towards a moving digital target. Digital transformation is an endeavor that requires organizations to manage their evolution, engage with employees, and change the way employees work and think. It requires sensitizing employees to digitalization and the changes ahead and improving their skills and mindset (Kane et al., 2015)—processes that rely on constant experimentation and test-and-learn approaches. Providing role models, success stories, and reward structures can reinforce the desired change and adaption towards digital transformation (Hansen, Kraemmergaard, & Mathiassen, 2011).

Finally, digital value assurance focuses on ensuring that organizations realize benefits from digital transformation. It seeks to confirm that an organization's digital strategy is divided into a portfolio of manageable, interdependent projects. In particular, it confirms that an organization can track the scope, progress, dependencies, and benefits of all its digitalization projects. Digital value assurance also encourages organizations to continuously scrutinize and redefine their digital strategy. Organizations need to be able to determine the value of digital technologies to themselves (Kane et al., 2015). Many interviewees reported that their organizations' digital transformation started with some unaligned lighthouse projects to experiment with relevant digital technologies, to motivate employees, and to demonstrate that delivering on digital opportunities is not rocket science. After this initiation phase, organizations started to align individual projects to balance capability and infrastructure development projects with value proposition and legacy projects. In doing so, some organizations introduced flexible budgeting processes to scale up promising digital projects and to reduce innovation latency. Further, they established reporting lines, management reports, and performance measurement systems dedicated to digital transformation.

5 Application of the Framework at ZEISS

5.1 Background Information

The following example at ZEISS demonstrates how our framework enables reasoning about digital transformation in a structured manner. It not only provides insights into the digital transformation at ZEISS but also highlights some general implications for CIOs and CDOs. ZEISS showcases how a long-standing and well-established manufacturing company may leverage the opportunities associated with digital technologies to exploit extant capabilities and explore new business models to stay competitive. All information below is based on extensive discussions with ZEISS's digital transformation officer (DTO) at that time, who is part of the author team and directly reported to the CIO.

ZEISS is a high-tech portfolio company and leading global innovator in optics and optoelectronics. The company's headquarters resides in Germany. As a leading manufacturer, ZEISS's product portfolio ranges from lithography optics, measuring technology, microscopes, medical technology to eyeglass lenses, camera and cine lenses, binoculars, and planetarium technology. In the 2015/16 fiscal year, ZEISS employed around 25,000 people located in over 40 countries who operated on over 30 production sites, on over 50 sales and service locations, and on about 25 research and development (R&D) facilities. Facing the manifold opportunities associated with digital technologies, ZEISS is now about to transform itself from a traditional leading-edge hardware company with small software business into a hybrid hardware/software company with digital value propositions to boost its customer experience.

ZEISS did not develop its initial digital strategy based on our framework. Nevertheless, ZEISS currently uses our framework in different projects (e.g., to train employees). Further, all projects associated with ZEISS's digital transformation initiative can be mapped to our framework. Regarding its B2B focus in most segments and its role as a manufacturer of highly specialized products, not all action items of our framework are equally important for ZEISS. Figure 5 compiles the most important findings.



Figure 5. Key Actions Taken by ZEISS in its Digital Transformation

5.2 Customer

Regarding **customer experience management**, ZEISS's consumer optics segment launched a virtual reality experience product, "VR One", enabled by leading-edge optical design and precision lenses. ZEISS also offers fully connected dispensing tools that support eye-care professionals in providing consistent consumer experience. Like most companies, ZEISS interacts with its customers via multiple channels. ZEISS uses state-of-the-art customer relationship management (CRM) software and collaborates with major vendors to tailor the CRM software to the needs of business groups. A **digital multi-channel** architecture enables new sales, strengthens ZEISS's brand, and fosters the interaction with both B2B and B2B2C customers. Based on **customer insights**, ZEISS has defined its priorities to improve digital customer experience in its Internet presence. To do so, ZEISS worked on search engine optimization, content marketing, pushed personalization, and launched digital customer touch points such as social media. As ZEISS mostly operates in B2B markets, consumer-oriented topics such as hybrid customer interaction are of low relative importance.

5.3 Value Proposition

The changing needs of eyeglass wearers strongly affect the company's vision care segment. For example, many people check their smartphones around 150 times a day (Brody, 2017). Thus, vision care launched "digital lenses" to help customers avoid digital eyestrain. ZEISS's value proposition traditionally combines hardware and software offerings. In the course of its digital transformation initiatives, ZEISS geared its product development processed toward **smart products and services** by leveraging agile methods wherever applicable. ZEISS also embedded sensors into the equipment of its business groups and connected the resulting smart products to the Internet to enable smart services. One example is the "FORUM" service that ZEISS's medical technology segment owns. This service connects all medical devices in clinical workflows to enable clinicians to analyze image data. Other examples include the "PiWeb" service, which connects industrial metrology devices and offers 3D analytics to allow one to assess the precision of production pieces, and vision care's "i.com", a smart service that enables eye-care professionals to operate their dispensing tools and instruments using tablet PCs. **Individualization** based on customer needs has traditionally been important for ZEISS. With the uptake of software-based innovation, individualization has become much easier to implement.

5.4 Operations

At ZEISS, it is the head of IT's responsibility to operate an **integrated and robust IT setup**. In the digital age, this responsibility remains important to manage an ever-growing portfolio of IT tools and smart devices. As for **flexible operations**, precision is a skill for which ZEISS is known worldwide. To leverage this asset, ZEISS has developed the next generation of measuring techniques. For example, physicists and engineers have developed measuring devices that take measurements not only with extreme precision but also remarkable speed and so provide a significant competitive edge. The results obtained by such measuring devices can be directly sent to fabric managers in the supply network, which allows them to flexibly adjust production processes based on reliable data. This technique enables smart manufacturing at both ZEISS itself and at its customers across digital supply networks, which allows other companies to react faster to problems, to minimize callbacks, and to improve their products. Another area where ZEISS drives **digital manufacturing** is its big data initiative through which it aims to optimize its global supply chain. One success story has been the use of big data analytics to identify production obstacles (i.e., differing climate conditions) that had previously made it difficult for ZEISS to produce the same product with equal quality on all production sites. At some sites, ZEISS has also started to leverage digital assembly technologies and assistance functions (e.g., the display of complex tasks through step-by-step instructions on displays).

5.5 Data

Data ownership is essential for ZEISS because the company deals with sensitive customers and handles critical intellectual property. ZEISS has a heterogeneous range of customers, which makes it difficult for the company to apply a one-size-fits-all data ownership rule. For instance, many customers from the semiconductor industry are extremely sensitive when it comes to data ownership, whereas retail customers are often willing to share data for some services (e.g., benchmarking). As for **data privacy**, ZEISS's "better safe than sorry" policy no doubt helps its excellent reputation. ZEISS's customers, especially in the medical segment, have high data security demands and standards that must be met (e.g., the FDA regulations (Title II of the Health Insurance Portability and Accountability Act) that are mandatory in the US). Given the diverse business groups, their specific demands on data ownership and privacy, and the legacy IT and data infrastructure, company-wide **data integration** is neither required nor reasonable. Rather, business groups integrate separate data pools (e.g., for different smart connected products). Thus, **data security** is another key element for ZEISS when it comes to protecting its customer relationships. Data security also is of major importance internally because ZEISS must protect its R&D investments. Given that the company has an innovation budget of about 10 percent of yearly revenues, that 11 percent of its workforce works in R&D, and that it has over 400 patent applications handed in per year, ZEISS has a vested interest in data security. Yet, while the company sees cyberattacks as a serious threat and so continuously monitors for them, the need to maintain a high level of security and challenge new threats often conflicts with the equally pressing need to ensure that security measures do not inhibit innovation and operations.

5.6 Organization

Achieving **organizational agility** was one of the major challenges ZEISS faced at the outset of its digital transformation initiative. The company implemented many related approaches including agile project management and methods such as scrum and lean startup. Regarding its organizational setup, ZEISS implemented cross-functional alignment boards to speed up and increase flexibility for digital initiatives. Further, ZEISS introduced boundary-spanning roles such as that of the DTO. It also founded a cross-functional digital innovation unit named “**digital innovation partners**”, a core team of experienced, digitally perceptive employees to support business groups in ideation, rapid prototyping, and the testing of new ideas through validated learning. Operating globally and competing in the digital economy, ZEISS continuously makes advances in the workplace to ensure that its employees have access to the equipment and tools they need. As ZEISS dynamically assembles people from different locations and business groups into project teams, cloud solutions and social collaboration platforms (e.g., Yammer) boost collaboration. ZEISS hosts hackathons in which highly motivated entrepreneurs and software developers collaborate intensively on a software project in a given timeframe. These events both enhance the company’s employees’ digital skillset and provide experienced engineering-focused employees with new perspectives by allowing them to communicate and work together with digital natives and smart creatives. ZEISS does not only benefit from recruiting highly skilled graduates but also from creative and sometimes disruptive input. A second way for ZEISS to attract digital talent is through exchange programs with universities. Such university alliances help ZEISS stay in touch with researchers and young graduates, a promising human resource platform. Third, ZEISS has strengthened its engagement in social media communities (e.g., WhatsApp) to better connect with young people. Yet, ZEISS does not simply rely on “importing” digital natives to push digital transformation. It also focuses on developing a digital mindset among its employees. Therefore, ZEISS hosts innovation days that provide employees the opportunity to pitch, develop, and create digital products with corporate support. It promotes interest groups to provide employees with a platform to exchange and collaborate on new ideas. ZEISS has also institutionalized specific targets, clearly defined roles, and capabilities for continuous change. Agility in innovation processes and design thinking approaches in projects exemplify two such capabilities. The “**ZEISS eCademy**” is an example of how one can anchor and institutionalize such capabilities. In this academy, ZEISS employees have opportunities to master new skills (e.g., scrum methods). Managers also attend digital transformation seminars on various topics, which includes the framework that we present in this paper.

5.7 Transformation Management

At ZEISS, the responsibility for defining the **digital strategy** and **leading the digital transformation initiative** is rooted in the following rationale: ZEISS follows a “digital@scale” approach in which it leverages its strengths in its customer and installed product base. Thus, governed by the ZEISS executive board, the top management in each business group drives digital transformation. In the ZEISS executive board, the CIO in particular is responsible for ensuring that the business groups identify the most critical action fields for transforming the value proposition around products and services and customer experience. The CIO and his team also define principles for digital transformation to ensure that all employees understand the challenges and opportunities of digitalization. The CIO has three direct reports: the senior vice president of corporate IT, who is responsible for operating an integrated and robust IT setup serving standard demands; the senior vice president of the newly founded digital innovation partners, who addresses and develops digital capabilities; and the DTO, who serves as architect of ZEISS’s digital business and technology strategy. This structure has allowed the company to develop both a multi-modal organizational setup and an integrated view on the digital business and technology portfolio. In his enabling role, the DTO supports all business groups in defining their own digital strategy. At the same time, he ensures the alignment with the overall corporate goals. In particular, the DTO supports each business group in defining the top three to five business and technological disruptions that they predict will have a significant impact on the business in the coming years. Leveraging scenario simulation and other methods, the business groups develop and compile the top three to five solutions and strategies into a roadmap. Using the input of all business groups, ZEISS defines the vision, goals, and capabilities for the entire company. As architect and manager of the digital project portfolio, the DTO also evaluates which projects the business groups or the central units shall implement, which leads to one of the DTO’s most important tasks: **change management** (i.e., the daily challenge of convincing people of the need for change and showing them the benefits of digitalization). For the DTO, it is about changing people’s mindset from “being in front of the wave instead of behind it”. To ensure that the company generates

business value from its digital transformation, the DTO continuously monitors the initiatives derived from the digital strategy in close collaboration with the corporate IT and digitalization leadership team and with the business group executives. In terms of **digital value assurance**, ZEISS is considering introducing flexible budgeting, which the company anticipates will complement the current ideals of clearly defining targets for individual initiatives and team-level accountability among those working towards these targets.

6 Conclusion and Implications

Digital technologies are becoming an integral part of individuals' everyday lives and organizations' work routines, and digitalization continues to tremendously impact the economy and society. Digitalization not only forces organizations to react to disruptions in business rules but also enables them to pursue the opportunities associated with digital technologies. As a prerequisite for successful digital transformation, managers require guidance on how to structure related transformation initiatives. Because existing frameworks focus only on individual facets of digital transformation or build on case-based evidence, we develop a holistic yet concrete framework with six action fields for managers to consider when engaging in digital transformation. Each action field also encompasses four action items. Our framework has solid grounding in the extant literature and incorporates empirical insights gained from individual and group interviews with employees from over 50 established organizations engaged in digital transformation. We have also validated the framework via presentations at numerous industry workshops, conferences, and CIO roundtables and via its application in industry projects. Finally, the ZEISS case study corroborates the usefulness and applicability of the framework.

Based on these results, we identify theoretical implications and limitations that highlight directions for future research. Our key contribution is a well-founded and broadly applicable framework of action fields for structuring digital transformation initiatives. As such, our framework contributes to knowledge of digital transformation. To further increase the guidance that our framework offers, future research might assess how important the action fields and items are for distinct organizational contexts (i.e., service vs. manufacturing or small vs. large firms). Another worthwhile endeavor would be to design a maturity model to complement our framework in which each action item represents a capability that organizations can develop along predefined levels. Combined with insights into the importance of action fields and items in different organizational contexts, such a maturity model may help organizations select and schedule digital transformation projects. Finally, although most organizations involved in our study had an international or global focus, all had their headquarters in Germany. Thus, it would be interesting to challenge our framework by incorporating the perspective of organizations based in other countries. Of course, our framework is also beset with limitations. When building the framework, we focused on offsetting subjective bias as rigorously as possible (e.g., by involving a large sample of diverse established organizations in terms of size, sector, regional focus, and customer focus). In addition, multiple researchers constantly compared intermediate results against extant literature and data from previous interviews. Nevertheless, the framework primarily builds on explorative semi-structured interviews and, as such, inherently suffers from a certain level of subjectivity. In line with the exploratory nature of our study, we have no evidence so far that following the action fields included in our framework lead to superior corporate performance or success. Such evidence should be gained in terms of quantitative survey research in the course of future research.

In designing and evaluating our framework, we also developed insights that we encourage managers to consider when engaging in digital transformation. First, managers should recognize that there is no one-size-fits-all approach to digital transformation. The action fields from our framework vary in importance depending on industry- and organization-specific characteristics and an organization's progress through digital transformation. As the ZEISS case shows, a focus on B2B markets asks for less hybrid interaction management but reveals the same importance of customer experience and omni-channel management. Thus, organizations should carefully prioritize and operationalize the action fields included in our framework and continuously reassess the priority of each action field during their digital transformation initiative. Nevertheless, we strongly advise organizations to always keep an eye on all action fields and on their interplay no matter how important the action fields currently seem to be. As the ZEISS case illustrates, the company simultaneously focused on both internally and externally oriented action fields to ensure that it could actually deliver newly designed value propositions to the customer. Second, we advise organizations to continuously question their current role in the value network how digital technologies and new competitors that use these technologies might disrupt their own business model. Our study revealed that, regardless of their role in the value network, organizations should consider how their value

proposition contributes to delighting the end customer. At the same time, organizations should continuously monitor their customer touch points for attacks by start-ups or competitors from other industries. One of the biggest risks in the digital economy is to get cut off from one's customers and to be condemned to the role of an exchangeable back-end provider. Thus, we advise organizations to ground digitalization initiatives on customer-centric use and business cases and leverage legacy products, processes, data, and existing customer relations. When "smartifying" products and services, organizations must remember that great customer experience requires digital value propositions to be complemented by excellent delivery, which, in turn, relies on integrated IT, digital manufacturing, and organizational agility. Simply launching a few mobile apps is unlikely to suffice. As for ZEISS, the organization has not only introduced new (digital) products, such as smart lenses, but also started to transform its existing product portfolio into smart products (e.g., smart dispensing tools). ZEISS has also further developed its organizational setup to further increase time to market and to facilitate the transformation of hardware-based products into hardware- and software-based products and services. These strategies not only provide customers with new value propositions but also help the company to maintain its position as a leading innovator in the industry. Last not least, organizations require strong leadership and governance to master digital transformation. The question of whether the CIO or a newly appointed CDO should guide the organization through digital transformation is unlikely to be of central importance. Yet, because digital transformation requires convergence against a moving target, we advise organizations with distinct roles and responsibilities to continuously reassess their digital strategy, organizational set-up, and challenge existing organizational roles and responsibilities. In this regard, we suggest that organizations should assign this responsibility for continuous reassessment to a highly ambitious person who is closely connected with the top management and capable of propagating a digital mindset. This person must be able to arouse people's enthusiasm, leverage their creativity, and orchestrate the strategies of different divisions and stakeholder groups. Organizations require an agile transformation management and evidence-based performance measurement and decision making policies. Digital transformation cannot be mastered in waterfall mode nor in blind flight. ZEISS demonstrates this point by ensuring corporate support for digital transformation in the role of the CIO on the top management board who works in close collaboration with a DTO who motivates, orchestrates, and aligns digital initiatives.

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JITTA is a Publication of the Association for Information Systems
ISSN: 1532-3416

