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How Digitalization Drives the IT/IS Strategy Agenda

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How Digitalization Drives the
IT/IS Strategy Agenda

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Abstract
Throughout the last decade, digitalization has fundamentally transformed the business world and put into question traditional strategy wisdom. As (digital) information technologies (IT) are the drivers of this transformation, we can expect it to have an even more profound influence on IT/IS strategy thinking. While several scholars have acknowledged the fundamental changes induced by digitalization on the conceptual level, research on emerging IT/IS strategy contents is still missing. This paper intends to fill this gap by revealing both practically relevant and theoretically valid concerns worth considering when developing IT/IS strategies for/in the digital age. Based on a working definition of digitalization, we present a set of hypotheses on how IT/IS strategies might respond to trends in digitalization. We also put these hypotheses to discussion in ten interviews with IT/IS managers in practice. Our research adds to a better understanding of the complex phenomenon of digitalization and its implications for IT/IS strategy development. Our research responds to calls for a stronger focus on strategy contents and more practice-oriented IT/IS strategy research.

Keywords: Digitalization, digital transformation, IT/IS strategy, information infrastructure strategy, information function strategy, IT/IS strategy contents

1 Introduction

The proliferation of digital technologies we have been witnessing throughout the last decade has fundamentally transformed economic and social structures (Legner et al. 2017; Matt et al. 2015). These (socio-)technical changes, typically referred to as "digitalization", affect not only business processes, services or products but also challenge traditional business models and management principles (Hess et al. 2016). Against this backdrop, both practitioners and scholars have postulated the need for novel management approaches in the digital age (Hinings et al. 2018; Nambisan et al. 2017).

Given the demand for new management paradigms in general, we can expect an even higher demand in the domains of information management and IT/IS strategy in the digital age since technological matters are at their core. In fact, recent studies indicate that coping with the challenges induced by digitalization is right at the top of IT/IS strategy agendas in practice and that IT executives actively seek advice on managing digitalization strategically (Kappelman et al. 2018). The academic community has responded to this urgent practical demand mostly on a conceptual level. Emerging notions like "digital business strategy" (Bharadwaj et al. 2013), "digital strategy" (Ross et al. 2016), or "digital transformation strategy" (Hess et al. 2016) acknowledge that digital technologies have become an integral part of the products, services and customer interactions of many contemporary firms and thus shape their businesses. However, as helpful as these concepts might be for advancing academic theories, the value for practitioners resulting from abstract conceptual discussions is questionable. Earlier work exhibited a significant gap between IT/IS strategy research and practice, manifesting in significant differences in both espoused theories and theories in use (Brown 2010; Teubner et al. 2012). These studies also display a clear focus on and a critical demand for IT/IS strategy contents in practice. Still, when it comes to actual contents of contemporary IT/IS strategies, research is scarce. Since IT/IS strategy research has always been favouring process discussion over concrete strategy contents (Teubner 2013), it is not surprising that we know little about strategy contents in the digital age so far. However, as long as actual topics, issues and concerns of strategic IT/IS planning are missing, planning methodologies and concepts necessarily remain vague and practical implications remain limited. Thus, the paper at hand aims at shedding light on practically relevant planning concerns in the digital age and poses the following research question:

> *What specific concerns call for specific consideration in strategic IT/IS planning in the face of challenges upcoming with the phenomenon of digitalization?*

The structure of the remainder of this paper is as follows. In the next sections, we clarify our understanding of digitalization and exhibit the fundamental phenomena associated with it, before we briefly outline the research design underlying this paper. Grounded in our understanding of digitalization and based on digitalization trends we identified in the academic literature, we subsequently derive propositions on how digitalization might alter IT/IS strategy contents and contrast these propositions with practitioners' opinions. In this regard, we are interested in revealing, whether practitioners concur with the strategic challenges we anticipated, and, if so, how they engage with these. Finally, we summarize key findings and list managerial implications before discussing limitations in the concluding section of this paper.

Despite the practical contribution mentioned above, our research also contributes to the academic debate in two ways. First, we follow the call for more research on actual contents of IT/IS strategy (Teubner 2013). Second, we are reacting to the demand for more practice-oriented IS research in general (Fitzgerald 2003), as well as more practice-oriented IT/IS strategy research in particular (Hackney et al. 2000; Ward 2012).

2   Digitalization and related phenomena

Digitalization is a similarly multi-faceted and complex phenomenon (Legner et al. 2017). In their effort to reduce complexity, it is comprehensible that some researchers try to tackle the phenomenon from a pure technical point of view. In this regard, scholars have established the acronym "SMAC" to epitomize the most prominent digital technologies, namely social, mobile, analytics and cloud (Peppard and Ward 2016; Sebastian et al. 2017). Social computing encompasses all internet-based applications that facilitate the interaction, i.e. communication, between their users and the creation and exchange of media content (Parameswaran and Whinston 2007). Social applications, such as blogs, peer-to-peer networks, or video sharing communities, build on the core ideas of Web 2.0 and user-generated content (Kaplan and Haenlein 2010). Mobile computing describes the location-independent access to information infrastructures (IISs) by means of mobile communication devices, such as smartphones, laptops or tablet computers (Fischer and Smolnik 2013). With more than 2.3 billion smartphone users worldwide (Statista 2018), mobile devices have become the key means of connecting people to the internet. Analytics can be defined as fact-based deliberations which result in insights or as the process of careful examination of data that is supported by logically aided sciences (Banerjee et al. 2013; Davenport 2006). Chen et al. (2012) emphasize the role of technology by referring to business analytics as the set of technologies, applications and practices that helps a company to understand its business market and enhance its decision-making process. The trend of cloud computing is rooted in ever-growing provider markets of managed IT services and increasing network capabilities. It can be understood as "a model for enabling […] on-demand network access to a shared pool of configurable computing resources […] that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance 2011, p. 2).

As sketched above, individual SMAC technologies and their occurrences have triggered new respective debates. These debates go beyond the effects of single technologies, but also acknowledge synergies between the different SMAC technologies, which result from the homogenization of the representation across different types of information including data, music, videos, books, or telephone calls. This homogenization has removed the tight coupling between information representation and the devices required for processing, storing, and transmitting them. Specific telephone networks, videocassette recorders, or Polaroid cameras are no longer required, an effect which referred to as "digital convergence" (Yoo et al. 2010). The effects of convergence are further accelerated by increased connectivity enabled by substantial improvements in network capacity and broad mobile network coverage. The availability of small and cheap but powerful digital devices has allowed for substituting material goods such as books with digital ones. Moreover, such devices have been used to enrich physical products, to enable them to collect information and to exchange information via powerful wireless networks as is the case for the "Internet of Things (IoT)" (Wortmann and Flüchter 2015). The IoT is much more than a technology as it combines very different technologies such as sensors and actuators, analytics, mobility data and cloud services. Hence, the most fundamental changes originating from digital technologies lie in the phenomenon of "infrastructuring". In other words, besides their individual mode of action, digital technologies intertwine and integrate with existing technical infrastructures such as the internet, converge with them, and create novel, digital infrastructures.

Infrastructures, per definition, are embedded in social practices and shape and are shaped by conventions of practice (Hanseth 2010). Therefore, we follow Tilson et al. (2010, p. 749) who define digitalization as a "socio-technical process of applying digitizing techniques to broader social and institutional contexts that render digital technologies infrastructural". Given this understanding, comprehending digitalization holistically requires looking beyond mere technology trends and incorporating changes in the social and institutional contexts equally. Figure 1 illustrates the driving forces that have an impact on organizations in the digital age. These include not only the direct impact of digital technologies and related changes in the IT service market (see left bold arrow) but also indirect effects that digital technologies trigger in the larger business context of organizations. The latter include both changes to the economic and social environment (see right bold arrow and the smaller arrows in the upper part of the figure).
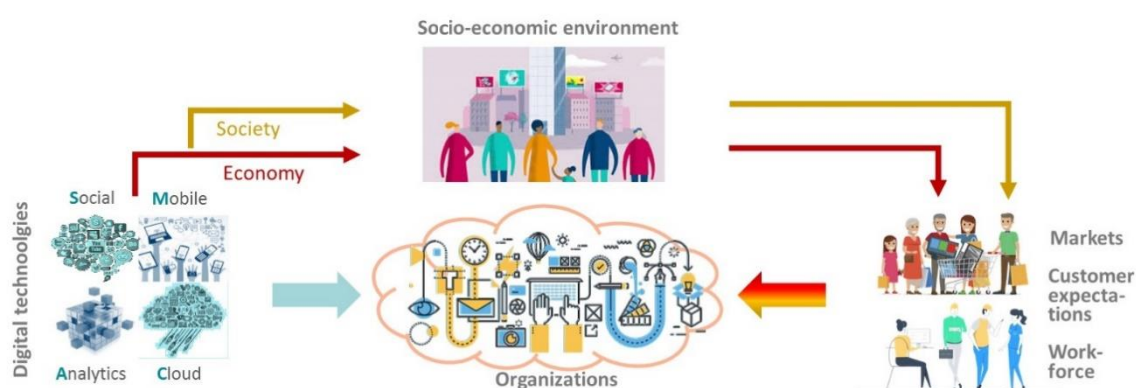

Figure 1:   Direct and indirect effects of digital technologies on organizations

Figure 1 indicates an ongoing progress and dissemination of digital technologies, which represent a new quality of information technologies to organizations. These technologies drive digitalization in the sense of empowering organizations and triggering innovations. Independent of their potential for individual organizations and the challenges their adoption impose on them, digital technologies have reshaped the overall economic structures of value creation and social life in general. Hence, even if some organizations ignore the availability of digital technologies and refuse to adopt them, these technologies will shape the conditions under which these organizations operate.

On the overall economic level, digitalization triggers innovations that lead to turbulent and volatile business environments for many contemporary firms (Newkirk et al. 2008; Venkatraman 2017). In this context, El Sawy et al. (2010) draw on the term "digital ecodynamics" and refer to the phenomenon as being messy, complex and chaotic. Conventional approaches for coping with this business situation include developing dynamic capabilities that help to increase organizational agility (Barreto 2010; Lo and Leidner 2018) and allying with external partners, for example in strategic alliances or innovation networks (Laudon and Laudon 2018; Malhotra et al. 2007).

On the overall societal level, digital technologies have, for example, shaped the behaviours of young people, often called "digital natives", which use technology and think and process information fundamentally different from their predecessors (Vodanovich et al. 2010). Nowadays, organizations compete for attracting this tech-savvy and digitally literate workforce. They also

have to accommodate the trending needs of such a digital native workforce (IT consumerization), e.g. by offering the organizational integration of personal devices, such as smartphones and laptops (Astani et al. 2013). In a similar vein, digitalization has affected customer demand and behaviour to which organizations have to respond pro-actively. This includes competing on digital marketplaces and market spaces as well as offering digital customer experiences (Lemon and Verhoef 2016).

3   Research approach

Grounded in our understanding of digitalization as outlined above, we studied the professional (Stockhinger 2018; Stockhinger and Teubner 2018; Teubner and Ehnes 2018) and academic literature dealing with general digitalization trends (see Figure 1). Given the ambiguity surrounding the understanding of digitalization, respective literature was only eligible in case it related to our understanding of digitalization outlined above. Based on this literature, we abducted propositions on concerns that need to be considered when developing IT/IS strategies in the digital age. We understand these propositions as "informed guesses" on IT/IS strategy concerns (Rogers 2011) that might become critical in the digital age.

When referring to IT/IS strategy, we did not narrow down our interest to a specific strategy concept proposed in the academic literature such as that of a departmental plan or a shared managerial attitude towards the role of IT in an organization (Chen et al. 2010). Rather than assuming a particular concept, we defined IT/IS strategy in a broad sense as a set of fundamental decisions on the deployment and use of IT/IS in an organization. Given our interest in the contents of IT/IS strategy, we drew upon a strategy model introduced by Teubner and Mocker (2009) as a fundamental structure. This model distinguishes strategic IT/IS decisions in two domains, the information infrastructure (IIS) and the information function (IF). The IIS comprises the technical facilities such as servers and network equipment, the application systems, and information resources an organization deploys in support of conducting its business. The IIS is the original concern of IT/IS strategy and as such in the focus of our study. However, this is not to ignore the information function as a derivate IT/IS strategy concern. Organizations that plan for updating, changing or extending their IIS also have to make sure that they possess the skills and resources necessary to operate, maintain, and further develop their (future) infrastructure (Teubner and Mocker 2009). Unlike the IIS strategy, the IF strategy does not refer to IT/IS assets, but to a specific set of tasks and skills required for planning, building, operating, and maintaining an organization's IIS. The IF has traditionally been organized in a dedicated IT/IS department, but IF tasks may also be taken over by different IT/IS units, by business units, or even be outsourced to external service providers. Given the strong interrelation between IIS and IF strategy, we can even expect that new demands imposed on the IIS by digitization to go along with new skill requirements and new forms of organizing the IF effectively.

To test our proposition and their practical relevance, we conducted ten semi-structured interviews with IT managers. By drawing on semi-structured interviews, we have opted for an exploratory study character, since our focus is not on verifying or falsifying propositions in a "yes or no" manner but on complementing those by rich insights from practice. In particular, we have intended to reveal reasons why practitioners consider an issue relevant to their organization or not. Semi-structured interviews are well-suited for this purpose (Bogner et al. 2009). Table 1 presents an overview of all the interviewees and their respective organization in form of pseudonyms. The sample focuses on German-based organizations, yet includes both medium-sized, local and large organizations, operating worldwide. Likewise, we aimed for a heterogeneous set of industries to cover a broader range of potentially relevant concerns. This sample allowed for conducting detailed and rich face-to-face meetings with the practitioners. To qualify as an interviewee, the candidate needed to be involved in an organization's strategic IT/IS planning efforts. Based on the deduced propositions and under consideration of the directives proposed by Myers and Newman (2007), a semi-structured interview guideline was created and fine-tuned during an initial

pilot run. All interviews were recorded, transcribed and analysed using thematic analysis (Guest et al. 2012). To this end, we coded specific statements in accordance with the thematic background of our propositions. We conducted the interviews in July and August 2018. The interviews lasted 158 minutes on average, and at least two interviewers have been present in each interview. We have recorded twenty-six hours of material in total during ten interview sessions (Hoffmeister 2018; Werner 2018).

Organization	Industry	Brief description	Revenue mil. € p.a.	IT staff	Position of the interviewee(s)
Chemico	Manufacturing	Globally operating manufacturer of chemicals and plastic	50,000-100,000	1,000-5,000	Program manager for the organization's digitalization initiative
Equus Insurance	Insurance	German general-purpose insurance company	1,000-5,000	500-1,000	(1) Head of IT infrastructure (2) Head of IT organization (3) Member of staff IT infrastructure
Eurobank	Finance	Internationally operating bank	NA	500-1,000	Deputy head of the shared IT service department
Farm News	Information and Communication	German, domain-specific publisher releasing magazines and journals	50-100	1-50	Head of the IT department
Food and Crops	Wholesale Trade	Wholesaler for food and agricultural products	500-1,000	1-50	Member of the management board, focusing on IT-related topics, i.e. Head of the IT department
Insure One	Insurance	German general-purpose insurance company	1,000-5,000	100-500	Line manager for the coordination of the IT development
Omni Goods	Retail Trade	German-based e-commerce company for diverse goods	1,000-5,000	1,000-5,000	Head of platform management for the category of electronic and digital goods
Phone Tech	Information and Communication	IT service provider for a multinational telecommunications operator based in Germany	500-1,000	100-500	Member of the executive IT strategy department
Picture Publishing	Information and Communication	Internationally operating publisher	1,000-5,000	100-500	Former head of corporate IT and deputy CIO
Public Tech	Information and Communication	Agency providing IT services to public authorities of a federal German state	100-500	500-1,000	(1) Head of database dept., (2) Head of IT strategy and e-Government

Table 1:   Overview of interviewees and organizations

4 Findings

Table 2 summarizes the full set of propositions we developed and put to discussion. These propositions and a presentation of the literature that led us to their development together with the findings from the interviews can be found in Hoffmeister (2018) and Werner (2018).

IIS strategy	IF strategy
Information Resources	
Information generation from big data	Data integration capabilities (lakes, marts)
Information variety and quality	Data quality and integrity management
Information analysis and insight generation	Data analytics competencies
Information privacy and intellectual property	Data protection and governance structures
Application Systems	
Growing amount of business owned systems	Growing amount of shadow IT
Integrity and protection of cloud applications	Agile application development
Two-speed systems development	Customer centric systems development
Legacy systems and path dependencies	AS development and SaaS outsourcing
	Integration of development and operations (DevOps)
Technical Infrastructure	
Bring your own device (BYOD)	Technology sensing capabilities
IIS Integrity and protection with BYOD	External innovation partners
Increased capacity requirements	Physical IIS protection
Scalability and flexibility	Multi-provider outsourcing (IaaS)
Commoditization through IaaS/cloud	
Overarching	
Corporate policies for consumerization (BYOD) and governance	Ambidextrous IT/IS organization allowing for synchronous exploitation and exploration
	Managing multi-provider outsourcing

Table 2: Overview of the IT/IS strategy concerns raised by digitalization

In the following two subsections, we report on findings concerning propositions that the interviewed practitioners deemed most significant for their organization. For each of the the selected propositions, we start with presenting the literature and line of reasoning that led us to formulate the proposition. We then state each concrete proposition (in italics) in the way we put it to discussion in the semi-structured interviews we conducted, followed by a presentation of the interview results. We have structured our presentation of findings in the two domains of IT/IS strategy introduced above, i.e. IIS strategy (section 4.1) and its implications for IF strategy (section 4.2).

4.1 Propositions for information infrastructure planning

4.1.1 Open infrastructure

Organizations operating in the digital age are increasingly interconnected and engaged in interdependent relationships with customers, suppliers, competitors and partners. Researchers

have acknowledged the competitive impact stemming from these changes, e.g. by extending the traditional value chain model to more comprehensive frameworks like value networks and value webs (Laudon and Laudon 2018; Peppard and Ward 2016). To this end, a recent trend in IT/IS strategy research is to draw on complexity science for better understanding contemporary business landscapes (El Sawy et al. 2010; Merali et al. 2012; Tanriverdi et al. 2010). Proponents of this view refer to organizational environments as "complex adaptive business systems" and argue that strategic decision-making is a highly dynamic process in the digital age. This is because IT, by enabling interconnections and interdependencies, has induced a complexity to industries that renders isolated strategic decision making impossible. Instead, strategy needs to co-evolve with all relevant parties in an organization's ecosystem (Tanriverdi, 2010). In a similar vein, the concept of "open strategy" has gained attention lately, which acknowledges the possibility to integrate large numbers of customers, employees and partners in strategy development processes (Tavakoli et al. 2017).

Given these circumstances, conducting business in the digital age demands organizations to arrange for additional interfaces for automated data exchange, IT-based collaboration and acting out innovation across a multitude of ecosystem stakeholders. This leads to an intentional opening of the organizational IIS (technical infrastructure, applications and data), as well as the need to integrate external IIS components from partners and customers (Teubner and Ehnes 2018). Therefore, our first, general proposition sets the playing field for the remaining propositions and reads as follows:

> **Proposition 1:** *Conducting business in the digital age is characterized by an increasing IT-based interconnection and interdependence between customers, suppliers and partners across their ecosystems. Hence, the organizational IIS needs to be open for external access and ready to integrate IIS components of external parties.*

All interviewees surveyed stated that a deliberate opening of the IIS has happened throughout the last decade and still is an ongoing concern in their organizations. In this regard, several pundits stressed the growing role of programming interfaces, allowing for a convenient online collaboration and data exchange within business partnerships. However, while the IIS has always been geared towards business-to-business interactions and thus does not undergo a qualitative change in this regard, integrating customers and their needs represents a new challenge for seven out of ten organizations in our sample. Notably, in four cases the integration is still at the very beginning, meaning that either it is in the planning stage or occasional attempts have been made. As illustrated by the managers of Equus Insurance and Farm News, the reasons for integrating external customers lie in the customer interactions demanding a high level of usability and mix of communication channels to ensure that customer demands are understood as early as possible. This implies challenges for the organizational IIS, since new applications and data, e.g., from social media, need to be integrated.

Within this view, the respondents also highlighted the need for a flexible infrastructure in general. According to Chemico's program manager, the fundamental challenge does not just lie in integrating customer demands per se, but in reacting to highly dynamic customer demands rapidly. Omni Goods is in line with this perception and directly experiences the need for flexibility, whenever high seasons such as Christmas or Black Friday require the IIS to provide significantly more resources to the business than usually needed.

4.1.2   Open infrastructure

In times of an increasing number of digitized business models, products and services, the relevance of data as a business resource has increased tremendously. Practitioner-oriented journals regard data as the most valuable resource nowadays (The Economist 2017). On the one hand, the amount of data accessible for organizations has increased, since firms are increasingly interwoven in value networks with a multitude of partners (see proposition 1). On the other hand, the advent of technology trends such as big data analytics, social computing and cloud computing has boosted the sheer quantity of data available. Moreover, new data sources emerge by the technological advances provided by the IoT. By equipping physical objects such as production machinery with sensors that are able to measure and monitor its state, new, business-relevant information sources will be disclosed (Jardine et al. 2006; Shin and Jun 2015). Still, the IoT trend is not limited to manufacturing companies. Service providers, such as insurance companies, have to consider that business relevant data, made accessible by technologic advances in the field of IoT, can be acquired in external markets or in form of publicly available open data (Baecke and Bocca 2017).

However, a major challenge for organizations to generate purposeful insights from these vast amounts of data lies in their heterogeneity (Hashem et al. 2015; Sivarajah et al. 2017). Former information sources were limited to capturing and providing highly structured, homogenous data at certain interval-based points of time. Today's data stem from a variety of sources and may include continuous streams of unstructured data, such as voice recordings, pictures and videos. Thus, the integration and harmonization of unstructured data and new formats require novel ways to plan and structure the IIS.

> **Proposition 2a:** *In order to leverage the ever-growing variety of raw data for generating purposeful insights, organizations need to ensure appropriate data integration mechanisms.*

Lately, the concept of a capacious repository for raw data called "data lake" is frequently mentioned to help with the integration, independent from the data's form of being structured or unstructured (Terrizzano et al. 2015). Nevertheless, the mere presence of information will not automatically result in better decision making (Evgeniou et al. 2013). Only if information is maintained and stored in ways that fulfill a certain level of quality, insightful and correct decisions can be made. This level of quality should cover various dimensions including, among others, the completeness of information, its consistency, as well as accuracy and integrity (Fox et al. 1994; Wand and Wang 1996). Before leveraging information resources to create business insights, it will thus become a core challenge to institutionalize and maintain existing and new information resources. Accordingly, we propose:

> **Proposition 2b:** *Appropriate decision-making strongly depends on a high level of data quality, which is crucial in the digital age.*

The discussion revealed that data and information as a business resource is indeed a topic of high strategic relevance in practice. Eurobank, for instance, has already exploited opportunities to generate business-relevant information resources regarding new abilities to track the circulation of money by means of more sophisticated automatic teller machines, enabling the bank to track the life cycle of single bills. Retailers, such as Food and Crops and Omni Goods leverage

the abilities to track the location of their goods via services offered by third-party logistics providers. Others, while having realized new business opportunities as well as a pressing demand for their implementation, are still at an initial stage. In that sense, an example mentioned by Insure One is the use of telematic data, which allow the tracking of customers' driving behaviours in order to adapt car insurance tariffs. Farm News and Picture Publishing mentioned that further customer-related information resources need to be exploited, e.g., data describing the usage and navigation of customers interacting with websites and social media platforms.

While all pundits noticed that digitalization has led to a growing amount of data volume, the statements on data integration as a major challenge for the IIS have been heterogeneous. For many companies, an increase in the variety of data, e.g. integrating unstructured data types, has not posed a major concern so far, since there is no interest in such data at present or the technical prerequisites are not given. For the case of Eurobank, the responsible IT manager explained that the types of data that have to be stored and maintained are prescribed and regulated by legislation. On the contrary, respondents from Chemico and Farm News reported that unstructured data, e.g. originating from social media platforms have or might become interesting for analytic purposes, e.g. within the marketing and sales department, especially when combined with existing, structured customer data. Adequate information architectures mentioned in this regard by the IT manager of Farm News are data lakes and data catalogs.

Ensuring high data quality, has been regarded a present concern by all interviewees in their respective organization. Data quality was often discussed as a topic that has gained complexity, especially in the digital age. As long as data remains within the functional boundaries, employees, based on their experience, may be capable of understanding data even if it is of poor quality. However, as mentioned by the representative of Phone Tech, digitalization requires breaking down the silo mentality, since data is used across various functions for comprehensive analysis. Against this backdrop, an interesting debate arose on the question of data quality responsibility. The pundits agreed that data quality ensurance is supposed to be conducted by the corresponding business function that generates this data for only they can evaluate respective data quality. Since IT personnel typically lacks these business skills and the business function's context, their role is limited to the provision of technical means that enhance data quality. Discussed examples of these include the application of sophisticated machine learning techniques, which are able to generate product information only on the basis of related product images (Omni Goods) or simpler means such as duplets detection as part of more extensive data cleansing tools (Equus Insurance).

4.1.3 Information security

As outlined in the justifications for our first proposition and as confirmed by the practitioners, organizations increasingly expose parts of their IIS to the public. One aftermath of this deliberate IIS opening lies in the realm of security concerns. Obviously, the more public interfaces an organization exhibits, the greater the surface for cyber attacks. Still, there are additional reasons why security issues might become increasingly dangerous in the digital age. First, the informatization of products and services by means of embedding IoT technologies extends the reach of an organization's IIS, which enlarges its surface for potential attacks (Ahmad et al. 2013; Funmilola and Oluwafemi 2015). As IoT devices are generally deployed in large numbers, cheap, small and energy efficient (Sehgal et al. 2012), Hossain et al. (Hossain et al. 2015) point towards

their general resource constraints and deduce security issues related to hardware, software and networks. Second, due to the trend of mobile computing, remote accesses to the organizational IIS are on the rise, which also increases the susceptibility to cybercrime (Mavridis and Pangalos 1997). Third, IT consumerization may induce a twofold concern: On the one hand, companies run the risk of accidentally integrating compromised, privately owned devices that can affect the overall IIS. On the other hand, once employees copy confidential and business-critical information to private devices, the organization loses control of its dissemination (Köffer et al. 2015). Since employees make frequent use of online cloud sharing (e.g., Dropbox or Google Drive) (Koch et al. 2014) this behaviour could also induce data privacy issues.

> **Proposition 3:** *The deliberate public opening of the IIS, the integration of IoT devices and the trend of IT consumerization raise security concerns on all layers of the IIS.*

Even though security topics have always been a central strategic concern for the companies examined, all pundits strongly agreed that security issues had achieved a whole new quality in the digital age. The interviewees found the openness of the organizational IIS and the integration of emerging technologies to be primary drivers for this. IT consumerization was regarded as a particularly relevant factor in this regard, which explains why all ten firms in our sample prohibit practices like "bring your own device". Furthermore, Farm News found the pressure created by shorter development cycles and reduced time-to-markets to be a catalyst for security threats, since potential concerns might be taken too light-heartedly or omitted due to economic reasons. Picture Publishing supports such economically-driven concerns, reporting on missing top-level commitment, i.e., budget for addressing security concerns appropriately. *"Often, only successful attacks can change managers' mind-sets"*, was mentioned by the representative of Picture Publishing. Moreover, the interviewees perceived an increased risk and an actual number of attacks, which they root in the emergence of professional cybercrime organizations. The pundits, highlighting botnets or distributed-denial-of-service attacks, refer to this market as being a key facilitator for increasing cyber-security risks because it has become more professional and more mature than ever before. The dimensions in the form of type and number of attacks, which large companies like Chemico face, have been reported to be "unbelievable" and "terrifying".

Resulting from the ever-growing threats in the digital age, the managers have reported on a plethora of technical means to protect their IISs. Farm News, for instance, employs and integrates only encrypted devices and builds on a sophisticated mobile device management, which allows wiping data stored on mobile devices remotely. Concerning network infrastructures, redundant physical firewalls, as well as perimeter networks, that shield the local area network from the wide area network, i.e., the WWW, were declared as core measures taken to reduce cyber-security risks by Phone Tech. Instead of IoT-induced risks, cloud computing (as one component of the IoT) was identified as a major trend of the digitalization and was often discussed in terms of an information security or information privacy concern. Omni Goods and Picture Publishing, however, follow a divergent perspective. Instead of imposing further risks and decreasing levels of control, the interviewees appreciated the unmatched security standards that can be offered by professional cloud service providers and considered cloud solutions as a security-enhancing step in most of the cases. Finally, some companies, such as Eurobank and Public Tech, even require their IIS to be certified by organizations such as the Federal Office of Information Security (BSI) and conduct penetration tests to assess the security of their IIS on a regular basis.

4.1.4   Cloud sourcing

In the previous paragraph, cloud computing has already been mentioned in passing. The combination of increasing network capabilities and a growing provider market of managed IT services allows for a provision of services, formerly exclusively offered by internal, on-premise IIS components (Bhardwaj et al. 2010). These offerings are not limited to mere infrastructural services but extend to platforms and complete software applications (Subashini and Kavitha 2011). Given the advantages that come along with cloud-sourced services, we expect future IISs to be built upon an ever-larger stack of those services. With cloud services, companies have access to application, programming and technical resources absent of tedious installation and implementation routines. The resulting IT architecture increases the speed, elasticity, flexibility and scalability of service delivery. Complementary to faster access, a greater scalability of infrastructural services allows organizations to react more rapidly to changing situations in their environments. With the increasing market of cloud computing solutions and the ongoing pressure for reducing costs, strategic decision makers in the digital age have to ask what infrastructural parts need to be transferred into the cloud. However, we consider cloud computing to be a trend that starts permeating the organizational IIS from its bottom, i.e. increasingly extending from the technical to the application layer. Hence, we propose:

> ***Proposition 4:*** *In volatile business environments, the use of cloud services is expected to increase, due to benefits regarding scalability, speed and costs. Thus, the integration of cloud services into the existing IIS becomes one vital strategic concern.*

In general, the pundits praised cloud computing services, providing the ability to swiftly and easily access resources on demand, which can complement the existing IIS whenever needed. The representatives of Phone Tech and Chemico even referred to dedicated cloud strategies as part of their overall IT/IS strategy. Similarly, Eurobank's IT manager, when asked to depict Eurobank's major strategic IT/IS concerns of the previous decade, declared moving large parts of the IIS into private cloud environments and the additive use of public cloud services as key concerns. The prime reason to rely on cloud services lies in the flexibility they offer, which is desperately needed in times of rapidly changing business and customer demands (Chemico). For the case of the online retailer Omni Goods, infrastructural resources can be conveniently and dynamically sourced from cloud services providers whenever demand is peaking (for instance during the holiday season). Besides the ability to dynamically add infrastructural capacities by means of cloud computing, Food and Crops's main motivation to rely on such services is the lack of specific skills within the cooperation and the speed at which these skills can be obtained. Reasons of cost reduction, by contrast, have been mentioned rather infrequently, or at least not as a core motivation. The head of Farm News' IT department even stressed that the overhead generated by required integrative work, i.e. ensuring that systems existing already on premise harmonize with cloud-sourced services, might exceed the promised cost benefits entirely.

Integrating cloud services into the IIS proved to be a challenging task for several organizations across our sample. For Public Tech and the two insurance companies, strict regulations and compliance policies demanded by the BSI hinder an efficient integration of most cloud service providers for the time being. Further difficulties persist in terms of missing competencies; Chemico, for instance, refers to their need to build competencies in the IIS elements that are outsourced to a cloud service provider in order to remain capable of controlling as well as

evaluating this service. However, others displayed a rather sanguine mindset. Accompanying and facilitating the integration of cloud computing services, container technologies such as the open source project "Docker" allow for further enhancement of the IIS flexibility, as these render software deployments and operations independent from the underlying technical infrastructure (Eurobank). Omni Goods' representative argues that these virtual containers encapsulate the software application and all the required components so that they can easily be moved, e.g. to another Infrastructure-as-a-Service provider, increasing portability and flexibility.

4.1.5 Bimodal infrastructures

Above we explained that the main reason to rely on cloud services lies within the technology's ability to grant flexibility in times of constantly changing business and customer demands. As it has been argued before (see proposition 1), incorporating customers and their expectations into strategic decision-making is vital in the digital age. To address changing requests in general, organizations do not only have to develop agile development capabilities but also care for an IIS that supports this agility by means of technological innovation and experimentation (Ross et al. 2016). However, this puts the organizational IIS in a difficult spot: The contemporary IIS is obliged to provide efficient and reliable services that guarantee continuous business operations, as well as explorative and experimental services that support and enable innovation at the same time (Du and Chen 2018). Referring to the terms "ambidexterity" or "bimodal IT," several scholars have reported on the organizational challenges that come along with integrating these two technical backbones (Haffke et al. 2017; Jöhnk et al. 2017). Given the fundamentally different set of characteristics and aims (Ross et al. 2016), we think planning and setting-up these two backbones within the same IIS becomes a strategic concern in the digital age. Based on this dilemma, we derive the following proposition.

> ***Proposition 5:*** *In times of ever-changing customer and business demands, organizations require an IIS that is capable of handling the exploitation of existing business opportunities and resources and the exploration of new, undisclosed potentials equally.*

In this regard, the IT manager of Food and Crops expressed the most radical position and contradicted our proposition decisively. Vindicating his point of view, he argued that IT itself is simply "profane technology" and that the IT department is not in charge of driving innovation. Accordingly, there is neither a team nor distinct IIS components that thrive for innovation explicitly. Most interviewees, however, opposed his assertions. Eurobank and Chemico called for a paradigm shift in the self-perception of the IT department, in the sense that they consider themselves as innovation drivers instead of sole service providers. Still, the approaches to achieve the required level of innovativeness differ. Whereas Chemico relies on a single IIS that caters all teams, Eurobank and most of the other organizations have established separate IISs that allow for exploration of new IT-enabled business opportunities. In the case of Eurobank, Insure One and Farm News, the separation was even organized in encapsulated innovation labs. Two arguments back this decision. First, integrating experimental, trial-and-error projects within its core IIS would bear security risks. Second, the existing IIS would not be able to satisfy the experimental projects' resource needs timely, as integration processes are too slow. Instead, technologies that have not been tested can be probed in a secure, decoupled environment that leverages external providers' resources and omits stiff and slow traditional processes found within

the IT department. A major drawback of that model mentioned by the IT manager of Farm News lies in the requirement of building additional interfaces and middleware-systems to harmonize the different IISs.

Overall, the pundits advocated a rather conservative stance by emphasizing the important role of a rigid, solid core that fulfills daily business duties. Core characteristics are given by high levels of security, stability, durability and availability. Respecting its value, integration of experimental structures within the IIS and its architecture calls for decisive care in order to avoid putting any operational activities at risk.

4.1.6 Legacy systems

The previous proposition emphasized the demand for responsive and evolvable systems in the digital age. Legacy systems, by contrast, can be considered as the complete opposite of agile systems and may thus depict burdens requiring particular emphasis. Legacy systems describe software that is based on outdated technologies but is critical to everyday business (Bennett 1995). Reviewing the academic literature on legacy systems reveals that they have always been a concern when planning the technological pathways of application landscapes (Reddy and Reddy 2002; Wu et al. 1997). However, we deem the digitalization and its major trends to exacerbate the problems linked to legacy systems due to three reasons. First, technologies or programming languages like COBOL that were popular decades ago have gone extinct within most academic curricula (Rubens 2016; Thibodeau 2013). This implies that the future workforce, although being tech-savvy, does not bring along appropriate capabilities to maintain and update these legacy systems. Moreover, skillful developers who remain in the company are bound to retire in the near future, eventually increasing the scarcity of capable developers (Musthaler 2017). In other words, the longer organizations delay approaching and substituting legacy systems, the worse the situation is supposed to get. This problem is intensified if legacy systems are poorly documented so that unknown interdependencies with other systems impose further risks and enhance complexity in case of outages. Second, within volatile business environments, legacy systems' static and monolithic designs impede swift reactions to change. The agility requested in the digital age cannot be provided by an application landscape that is permeated by legacy applications (Reddy and Reddy 2002). Third, having discussed the severe risks that emerge from increasing numbers of cyber attacks, legacy systems have to be portrayed as a facilitator of such threats (Miller 2018; Weber 2006). Application systems that have ceased to receive developers' support or cannot be protected by internal developers present a decisive risk of being vulnerable to attacks (Korolov 2014). Therefore, we propose:

> **Proposition 6:** Legacy systems impede the necessary agility needed in volatile business environments, constitute a security risk and will be increasingly difficult to update and maintain.

The prevalence of and the challenges induced by legacy systems seem to be heavily dependent on the industry. Phone Tech, Farm News and Chemico declared that legacy systems are no or just a minor concern since they considered their industries being "rather young" and the IIS in place "fairly new". On the contrary, the insurance and banking industry managers revealed that legacy systems pose a great challenge that might have been given not enough attention in recent times. Equus Insurance reported that they have just reviewed their stack of legacy systems and

start to plan their migration and substitution, which will be fully realized in about ten years. Public Tech acknowledges that, depending on specific definitions, up to 90% of all systems within the IIS could be regarded as dated, legacy systems. Being asked whether legacy systems have become a more significant concern in the digital age, some respondents referred to shorter development and planning cycles which exacerbate the challenge. While in former times, systems were planned for ten years, the market environment for Public Tech does no longer allow for such timeframes. Furthermore, outdated legacy systems were reported to slow down organizational extensions in the case of Omni Goods's warehouse management systems. Food and Crops regarded legacy systems as impediments of outsourcing initiatives, as old, proprietary systems require specific know-how, that is not to be found in external provider markets.

As we assumed, a significant challenge that hinders the dismantling of legacy systems lies within a lack of skilled personnel. Since the original staff, which has initially taken care of a legacy system, might have retired in the meantime, today's organizations have to search for a set of knowledge that is – according to the insurance experts – all but abundant within the labour market. Food and Crops's way of dealing with this scarcity is to train their own personnel within the organization, tailored to the specific needs of its systems. Yet, the interviewees have questioned whether it is worthwhile to build up internal knowledge that might become obsolete within a few years until a legacy system is eventually substituted. Security risks, on the other hand, have been considered solely by Public Tech. Other organizations, like Equus Insurance, are not worried at all as their legacy systems consist of isolated components that are not open to external parties' attacks.

4.2   Implications for planning the corporate information function

As concerns the professional tasks and IT/IS competencies gaining importance in the digital age, our interviewees found two competencies to be particularly crucial. First, whereas the IIS is obliged to ensure proper mechanism of data integration and quality, profound competencies in making sense of these data, i.e. data analytics, are desperately sought-after for seven out of the ten companies surveyed. To this end, Public Tech's head of IT strategy argued that "*accessing data is becoming easier in the digital age. However, it becomes essentially more challenging to generate actual insights*". Reasons for gaps in data analytic capabilities were mainly attested to skill shortages in the labor market. Farm News, for instance, endorsed the idea of implementing several "data scientists" but was not able to realize this endeavor yet due to an unsatisfactory quantity of applicants. Second, resonating with hypothesis 4, the deployment of agile application development methods and the development of requisite skills was highlighted as a strategic issue by 90% of the interviewees. The key driver for drawing on such methods can be seen in dynamic business environments in terms of rapidly changing customer needs and the associated demand for flexibility and speed. An example given by Omni Goods's expert referred to the switch from the "catalog world" to the "online world". Back then, projects of two to three years were feasible since the production of the catalog (designing, printing, and sending the catalog) used to take quite some time. In today's online shop, customers expect fast shipments and new payment models such as PayPal. Hence, software development must be capable of swiftly adapting to these changes and become more agile. Methods of choice encompass SCRUM primarily but also Kanban, as it was said to be more suitable for prioritizing different tasks and projects. Notwithstanding the strong approval for agile development methods, several interviewees recommended a combination with traditional waterfall development models, which is also

supported by academic research (Cooper and Sommer 2018; Rahmanian 2014). Another topic that we assumed to gain relevance in the digital age is multi-provider management. We anticipated that the increasing usage of cloud computing services would lead to the extension of an organization's provider portfolio and thus pose the challenge of coping with the complexity of multi-provider management. However, this assumption was largely rejected by the practitioners. For them, multi-provider management has always been a concern and is not a phenomenon that spawned or increased in complexity in the digital age. According to some respondents, there is no difference between multi-provider management without or with the use of public cloud services. Picture Publishing's CIO underlined that companies could take advantage of public cloud providers such as Salesforce and Amazon that offer supplementary functionalities in the form of web shops. In doing so, the cloud computing customer does not face a growing portfolio of providers at all as the main public cloud provider handles them.

On the organizational level, the pundits considered building bimodal functional structures as well as structures allowing a closer collaboration between development and operations as most relevant. The former takes the discussion on bimodal IISs (see hypothesis 4) to an organizational level and aims at establishing structures that can simultaneously exploit current resources and explore new resources. Although particular implementation approaches differ, except for Food and Crops, all organizations surveyed are currently establishing such structures. Almost half of the companies make use of one IT/IS department in which both takes place – the delivery of traditional IT services on the one hand and the realization of agility as well as innovativeness by means of cross-functional project teams on the other hand. The other half have spun off digital units or innovation labs in the form of limited companies which operate independently from the classical IT/IS department. As has been argued by its proponents, one major benefit of a clear separation lies within its potential to circumvent a clash of cultures. With regard to fostering collaboration between development and operations, all firms are concerned with breaking down the functional wall between both parties. The principal reason is the experience of a faster business environment that obligates companies to speed up the software development process to decrease the time-to-market of products as well as services. Chemco's expert argues that closer collaboration improves the quality of software as the fusion of development and operations avoids problems stemming from functional interfaces. A concept frequently mentioned to bring software development and operations together is that of DevOps. With an eye on this concept, Eurobank restructured the whole IT/IS organization in accordance with tasks or service provision such as mainframe or workplace in which developers and employees responsible for the deployment work in one unit.

When it comes to governance and leadership questions, we expected to discover new C-level roles. Especially the idea of introducing a "chief digital officer (CDO)" to promote the digital transformation is gaining more and more recognition in the academic debate recently (Singh and Hess 2017; Tumbas et al. 2017). To this end, only three firms have already a CDO in place and Eurobank plans to introduce the role in the near future. Whereas advocates of the role argue that leading digital transformation requires capabilities that go beyond traditional IT service delivery and refer to already overburdened CIOs, the opponents prevail. One opinion echoed by several respondents attests the occurrence of CDOs to be based on the inability of current CIOs to comprehend the digital domain and business, which is not the case for their organizations.

We closed each interview with asking for further remarks on strategic issues that may have been forgotten during the design of our interview guideline. Four respondents remarked that a new style of leadership needs to be established in the digital age. From their perspective, leaders still preserve a top-down culture when it comes to strategic planning, which is against the interviewees feel that especially in these times employees want to assume more responsibilities and participate in decision-making processes. In this regard, leaders are expected to become moderators and provide space in which employees can fulfill themselves. Additionally, the interviewees see the need that leaders need to become more acquainted with change management methods to support employees in times of constant change.

5   Summary: Key IT/IS strategy challenges in the digital age

With this report, we have embarked on the quest of revealing both practically relevant and theoretically valid concerns to be considered when planning IT/IS strategies in the digital age. Based on an analysis of major technological and social trends induced by digitalization, we presented seven propositions on how digitalization might affect strategic IT/IS planning concerns. We investigated the validity of these propositions in the context of ten practitioner interviews. While we could not present all our findings in detail within the limitations of this paper, we arrived at a set of concerns that yielded theoretically interesting results and, according to the managers, exhibit highly relevant issues. Table 3 revisits the major concerns we identified and depicts driving forces as well as managerial implications resulting from given concerns.

Concern	Driving Forces	Managerial implication
Open infra-structure	• partnerships and alliances with external partners including suppliers and customers • ever-growing complexity of organizational and technological environment	• opening up the IIS to external partners • integration of customers by means of IIS interfaces
Information as a business resource	• ever-increasing number of heterogeneous information resources • new means to analyse data in unprecedented ways generating novel insights resulting in better decision making	• integration and analysis of new information resources • emphasizing the need for maintaining high data quality • eliminating departmental silo thinking to foster information resource integration
Information security	• opening and widening IIS integrating new technologies • growing threat of becoming subject to professionalizing cybercrime activities • increasing value of information as a critical business resource	• increasing IT security effort regarding both hard- and software • incorporating external service providers asserting sufficient security levels
Cloud sourcing	• increasing network capabilities • growing provider markets of managed IT services	• integration of cloud sourced services in the IIS to enhance flexibility, scalability and security • keeping internal capabilities that manage the required integration efforts
Bimodal IT	• volatile markets expecting flexible and simultaneously stable IISs, allowing for exploration and exploitation of business opportunities	• focusing on a reliable IIS allowing for continuous service delivery • establishing a capsuled IIS allowing for explorative projects
Legacy systems	• growing shortage of employees skilled in developing and maintaining legacy systems • growing security risks emerging from the usage of outdated applications • insufficient capabilities of legacy system to cope with changing business environments	• continuously assessing the applications lifecycle • setting up migration projects for existing legacy systems

Table 3:   IT/IS strategy concerns, driving forces, and managerial implications

Regarding the topic of open infrastructures, all organizations in our sample perceived the need to make parts of the organizational IIS accessible to partners in their ecosystems. A special emphasis was on customer integration, but only four firms took specific actions in this regard. A

possible explanation for this gap between perceived relevance and actions undertaken is the fact that most IT/IS departments are unfamiliar with external customer interactions and are still in requisite conversion periods. The academic IT/IS strategy community increasingly acknowledges the relevance of integrating customers in strategic decision-making, for instance, as expressed in the discussion on open strategy (Morton et al. 2016; Tavakoli et al. 2017).

In a similar vein, the IT managers surveyed stressed the relevance of data and information as a critical business resource, whereas only a few companies indicated profound endeavors in analyzing such. As has been mentioned, our interviewees ascribed this gap to the lack of personnel in this domain. The strategic value of data is vividly discussed in academia and the concept of a dedicated "data strategy" has even found its way into textbooks (McKeen and Smith 2019).

One of the essential concerns mentioned and approached by the practitioners lies in the domain of IIS security. During the interviews, it has become evident that protecting the IIS from external attacks has become a complex challenge in the digital age. Interestingly, the current IT/IS strategy literature, apart from a few exceptions (e.g., Kayworth and Whitten 2010; Seeholzer 2012), rather neglects security topics, which is especially alarming against the backdrop of our study's results.

The managers in our sample praised the flexibility enabled by cloud services. However, this flexibility comes at the price of increased infrastructural complexity induced by the integration of numerous systems. The substantial academic contributions in this regard (Berman et al. 2012; Iyer and Henderson 2010) might help practitioners to overcome given issues.

The discussions on bimodal IISs were rather conducted on the organizational level of the IT/IS department and dealt with cultural and political challenges primarily. To this end, academics have already proposed organizational prototypes and measures to bridge the gap between keeping the lights on and striving for innovation and agility (Haffke et al. 2017; Jöhnk et al. 2017).

Unlike our expectations, legacy systems were not seen as a general strategic issue per se, but only in consideration with an organization's industry. Particularly interviewees from the banking, insurance and public sector confirmed the existence of legacy systems and regarded it as a critical challenge in today's world. Yet, respondents from other industries did not report on the existence of legacy systems at all or considered it only as a marginal issue.

Although the interviewees confirmed that the selected propositions presented in this paper are major strategic concerns, there are others (see Hoffmeister 2018; Werner 2018). However, our exploratory study was primarily focused on providing initial but rich empirical insights into relevant strategy contents and did not aim at comprehensiveness. Our sample is limited in size and representativeness and thus is not statistically generalizable. Future research can build upon the propositions we put forward in terms of quantitative analyses. Other fruitful approaches that might fuel the discussion on IT/IS strategy encompass industry-or country-specific studies. We look upon such studies as being vitally important not only for further insights on IT/IS strategy contents but also for IT/IS strategy research in general. Without contents, concepts and development methodologies of IT/IS strategy necessarily remain vague and implications for practitioners remain limited.

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