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REINVENTING THE IT FUNCTION: THE ROLE OF IT AGILITY AND IT AMBIDEXTERITY IN SUPPORTING DIGITAL BUSINESS TRANSFORMATION

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Recommended Citation
Leonhardt, Daniel; Haffke, Ingmar; Kranz, Johann; and Benlian, Alexander, (2017). "REINVENTING THE IT FUNCTION: THE ROLE OF IT AGILITY AND IT AMBIDEXTERITY IN SUPPORTING DIGITAL BUSINESS TRANSFORMATION". In Proceedings of the 25th European Conference on Information Systems (ECIS), Guimarães, Portugal, June 5-10, 2017 (pp. 968-984). ISBN 978-989-20-7655-3 Research Papers.
http://aisel.aisnet.org/ecis2017_rp/63

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REINVENTING THE IT FUNCTION: THE ROLE OF IT AGILITY AND IT AMBIDEXTERITY IN SUPPORTING DIGITAL BUSINESS TRANSFORMATION

Research paper

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Abstract

The immanent opportunities and threats from digital business transformation significantly affect the role of the IT function. Line functions increasingly expect that the internal IT function provides support for digital value creation in addition to traditional IT services. This dual focus bears the potential for tensions as competing in digital business environments means to act fast and to explore, while managing traditional enterprise IT requires stability, reliability, and exploitation of existing resources. Therefore, our study empirically examines the role of two key capabilities—IT agility and IT ambidexterity—on the IT function's digitization support. Based on a survey including 258 IT executives, we find that IT agility is a main driver of the IT function's ability to support digitization. Furthermore, our results show that an ambidextrous focus of IT functions is best suited to find a balance between opposing demands.

Keywords: IT Agility, IT Ambidexterity, Digitization, Digital Business Transformation.

1 Introduction

Driven by the rapid advancements in digital technologies—understood as an assortment of information, computing, communication, and connectivity technologies—the role of enterprise information technology (IT) is undergoing a fundamental shift (Bharadwaj et al., 2013). In the past, the IT function has often been viewed as a functional unit with the mere purpose of providing IT services to increase operational efficiency and making information readily available across the organization (Bharadwaj et al., 2013). Today, IT is responsible for a value at stake of up to 40 percent of revenue, 20 percent of operational expenses, and sometimes the very survival of the business (Andersson and Tuddenham, 2014). Business leaders across industries have begun to realize the increasing strategic importance of digital technologies and digital innovation for creating competitive advantage, as innovation cycles and processes gain speed (Fichman et al., 2014).

Correspondingly, digital strategy elements often make up an indispensable part of successful business strategies, a development that amplifies the growing influence of IT on the creation and capturing of business value for the firm (Bharadwaj et al., 2013; Kohli and Grover, 2008). For instance, digital business strategies encompass the digitization of a firm's offerings (i.e., its products and services), the utilization of digital channels to interact with customers, digital customer engagement, and the provision of

ancillary digital services to end-customers (Yoo et al., 2012). Eventually, digital technologies have the potential to transform traditional business models into digital business models (Hess et al., 2016; Matt et al., 2015). Numerous examples in the media industry, financial services, and the automotive sector show how digital technologies have not only changed products and services "*but also strategic dimensions such as the scope, scale, speed, and sources of value creation.*" (Sandberg, 2014). Digitization is not a short-lived phenomenon. Therefore, to remain competitive in the digital era and survive digital disruption, it is imperative for incumbent firms to develop IT-related capabilities that allow leveraging the potential from digital technologies (Bharadwaj et al., 2013; Rai et al., 2012; Ray et al., 2005; Sambamurthy et al., 2003). Companies that have begun to recognize the possibilities for strategic differentiation and value creation through digital technologies are now placing additional demands on their IT function (Andersson and Tuddenham, 2014). Beyond reliably managing enterprise IT systems, the IT function is now also expected to support digitization (i.e., building up digital business capabilities). Thus, digitization does not only transform the way value is captured along an industry's value chain (Pagani, 2013), but also reinvents the role of a company's IT function. We refer to the IT function as a separate organizational entity which is primarily responsible for the management of information technology (Guillemette and Paré, 2012). Thus, the boundaries of the IT function and other business functions can be clearly identified (Chan, 2002).

In this new role, the IT function's mandate expands to support transformative activities, aiming at digital value creation and innovation in addition to its traditional focus on automation and information (Dehning et al., 2003). This dual focus bears the potential for tensions, as competing in the digital business world means to act fast and explore, while managing traditional enterprise IT requires stability, reliability, and exploitation of existing resources (Gregory et al., 2015). In response to these tensions, some companies are even structurally separating their IT function into an agile (high-speed) and a legacy (slower-speed) IT unit (Andersson and Tuddenham, 2014; Gartner, 2014). Thus, corporate IT functions need to find a balance and amalgamation of opposing demands for speed and stability (e.g., by enabling rapid innovation releases while maintaining a reliable IT service architecture)—a capability referred to as IT ambidexterity in the IS literature (e.g., Gregory et al., 2015).

This study seeks to extend our knowledge on the relationship between an IT function's agility and ambidexterity in supporting digital business transformation, which contributes to the research streams on IT capabilities and IT business value. Our study aims to address several gaps in the extant literature.

First, we study the IT function's agility, introducing a second-order construct comprising the two dimensions of agility, sensing and responding. Hitherto, IS literature has predominantly focused on the IT function's responding capabilities (Tiwana and Konsynski, 2010) and on how a variety of IT characteristics, such as IT project management or IT solution integration, influence organizational agility or business process agility at the firm level (e.g., Chakravarty et al., 2013; Overby et al., 2006; Tallon, 2008; Tallon and Pinsonneault, 2011). The impact of the IT function's agility, comprising sensing and responding, on critical business outcomes has yet taken a back seat. We argue, however, that owing to the increasing importance of digitization, IT is not only an enabler of a firm's sensing and responding capabilities, but the IT function itself needs to sense emerging technological trends and opportunities as well as prepare for unforeseen contingencies to seize those opportunities "*with speed and dexterity*" (Nazir and Pinsonneault, 2012, p. 158).

Second, we aim to investigate the relationship between the IT function's agility and ambidexterity. Ambidexterity allows organizations to simultaneously integrate and reconcile exploratory and exploitative activities in trade-off situations (Raisch and Birkinshaw, 2008; O'Reilly and Tushman, 2008). Accordingly, an ambidextrous IT function is able to simultaneously exploit current IT capabilities and resources as well as explore new opportunities for the use of IT and manage the tensions arising from pursuing both (Lee et al., 2015). Therefore, in the context of digital business transformation, we view IT ambidexterity as a key characteristic of an IT function that may foster the effectiveness of IT agility in supporting digitization initiatives on the business side.

In light of the aforementioned research gaps, our study attempts to address the following research question:

How do IT agility and IT ambidexterity influence the IT function's digitization support?

Drawing on previous literature on IT agility and IT ambidexterity, we conducted a survey-based research study collecting valid data from 258 IT executives. Our findings indicate that an IT function's agility is a key driver of its ability to support digitization at the firm level. This positive effect is strengthened by an ambidextrous orientation of the IT function, compared to orientations with either an exploitation or an exploration focus.

2 Theoretical Background and Hypotheses

In this section, we present our research model (Figure 1) and the hypotheses examining the relationship between the two IT characteristics, agility and ambidexterity, and the IT function's digitization support. In addition to drawing on prior literature, our hypotheses include initial findings of pre-test interviews that we conducted with CIOs as described in the methodology section. Insights from the pre-test interviews are used to complement the development of the hypotheses with a practice-oriented perspective.

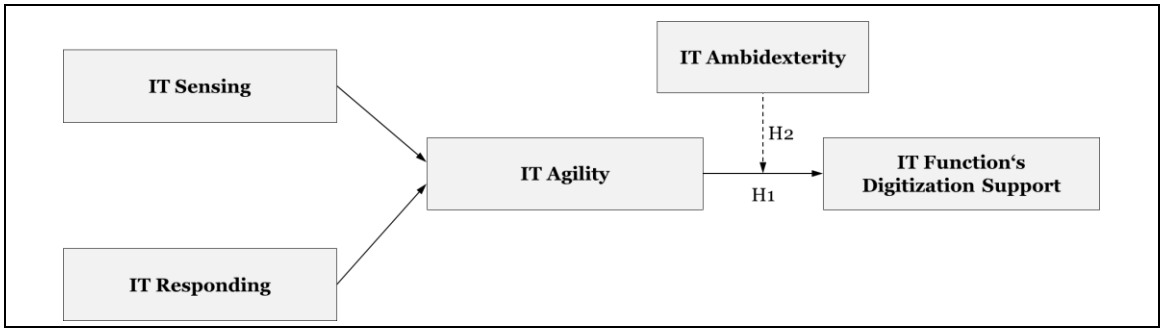

Figure 1. Research Model

2.1 The IT Function's Digitization Support

Much has been written about how IT creates value for the firm and how this value is to be captured most effectively (Kohli and Grover, 2008). In the specific context of our study, we focus on the effectiveness of the IT function's digitization support and the value derived by it, as digitization initiatives are prioritized increasingly high on many business leaders' strategic agendas (Bharadwaj et al., 2013; Loebbecke and Picot, 2015). We define the IT function's digitization support as the degree to which the IT function enables and facilitates digital innovation and is in the position to influence strategic business decisions (Chakravarty et al., 2013; Guillemette and Paré, 2012; Overby, 2006; Van Oosterhout et al., 2006). Digital innovation is defined broadly in our study "*as the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology"* Nambisan et al. (2017, p. 224). The enablement aspect of digitization support refers to the direct enhancement of entrepreneurial and adaptive organizational innovativeness by the IT function, whereas the facilitation aspect refers to the indirect activation of a firm's innovation capabilities (Chakravarty et al., 2013). The strategic guidance aspect is related to the IT function's involvement in business decision making, which greatly depends on the CIO's structural power, organizational support for IT, and the quality of partnerships the CIO has developed with top management team members (Guillemette and Paré, 2012; Preston et al., 2008). Largely, the latter factors correlate with the perceived business value of IT (Benlian and Haffke, 2016). The automotive manufacturer Audi provides an illustrative example of digitization support by the IT function, where "*the job of the IT is to proactively support the innovative transformation of the company as a whole*", referring to the powerful impact of digital technologies on optimizing the manufacturing process (Richter and Wee, 2016).

Digital technologies have the potential to transform established business models and evoke organizational change (Besson and Rowe, 2012; Loebbecke and Picot, 2015; Lucas et al., 2013). Thus, a central strength of an IT function that successfully supports digitization is the ability to leverage digital technologies to transform the organization at the strategic level (Bharadwaj et al., 2013). As information technology becomes an integral part of today's products and services, IT also becomes pivotal to business innovation (Yoo et al., 2010, 2012). The IT function can support strategic technological differentiation by adapting emerging technologies to relevant business areas of the company. Therefore, the IT function's digitization support includes the creation of IT-enabled innovation to improve the firm's competitive position and to react to or be at the forefront of digital technology induced changes.

Consequently, the IT function's digitization support is becoming an increasingly critical component of a firms' overall success, especially as many organizations launch transformation programs to harness the potential that digitization has for their business (Loebbecke and Picot, 2015). The role of the IT function and its competencies as enabling and facilitating factors for digitization have shifted into the focus of recent IS research (e.g., Chakravarty et al., 2013). Frequently, IT agility and IT ambidexterity are drawn on to conceptualize how different IT competencies act in sync to create value for the firm (e.g., Gregory et al., 2015; Tiwana and Konsynski, 2010).

2.2 IT Agility

Agility refers to a company's ability to sense opportunities for business innovation and its ability to rapidly take action and seize opportunities (Goldman et al., 1995). Many studies have provided evidence that organizational agility is a key factor for firms' success as it enables continuous improvements of how to create and capture value through product, service, process, and business model innovation (e.g., Chi et al., 2010; Lee et al., 2009). In the IS literature, the seminal paper of Sambamurthy et al. (2003, p. 238) introduced agility as a dynamic capability, stating that agility enables firms to uncover and seize business opportunities "*with speed and surprise*".

Much of the prior IS literature on agility perceives IT as an antecedent or platform for organizational agility that allows firms "*to generate more competitive actions and greater action repertoire complexity*" (Sambamurthy et al., 2003, p. 244). Correspondingly, IS research has focused on the IT function's role as an enabler of organizational agility (Overby et al., 2006; Sambamurthy et al., 2003; Tallon and Pinsonneault, 2011).

However, the role of IT for innovation and competitive actions has changed (Bharadwaj et al., 2013; Nambisan, 2013; Yoo, 2012). IT is no longer limited to enabling innovation and new ways of value creation through increasing a firm's sensing and responding capabilities. Especially with regard to digital business transformation, today, IT is a trigger of innovation. Accordingly, IT competences not only serve as a platform for developing organizational agility, but as a means for the IT function's agility itself. Tiwana and Konsynski (2010) define IT agility as the "*capacity of the IT function to rapidly adapt to changing line function demands and opportunities*" (p. 294). In their paper, IT agility is shown to have a positive influence on IT alignment for two major reasons: First, IT agility enables a swift modification and correction of misalignments between business needs and IT activities and applications. Second, IT agility facilitates that the IT function can respond rapidly when business functions have identified new market opportunities. We extend this perspective, arguing that the responsibilities of the IT function in its role as technology leader or business partner (Guillemette and Paré, 2012) are not limited to enabling rapid responses but also embrace the sensing of innovative opportunities that originate from emerging digital trends.

Hence, in this study, we propose an extended conceptualization of IT agility. Similar to organizational agility, we argue that the agility of the IT function is comprised of two dimensions—sensing and responding (Overby et al., 2006). The latter dimension refers to the ability of the IT function to be adaptive to emerging business needs. It includes, for example, the IT function's culture, the willingness to accept risk and act proactively and responsively, as well as the flexibility of IT in terms of scalability, reconfigurability, and integration abilities (Fichman, 2004; Lu and Ramamurthy, 2011; Weill et al., 2002).

The IT function's sensing capabilities—the second dimension of IT agility—refer to the ability to identify changes in customer needs and markets as well as emerging environmental opportunities (e.g., regulatory and legal changes, shifts in consumer preferences, technological advancements, or competitors' actions) that may affect the company's business. Sensing includes keeping current with and anticipating IT innovations and trends that may affect the core business or provide new business opportunities. Strong sensing capabilities require established processes and dedicated resources to continuously acquire external knowledge and disseminate it into the organization (Kranz et al., 2016). Accordingly, we define IT agility as consisting of IT sensing and IT responding. It needs to be noted that IT agility is not to be confused with agile software development or project management methods (e.g., Lee and Xia, 2010), although these can be ways for an IT function to acquire IT agility.

Organizational agility is widely considered imperative for business success (Brown and Eisenhardt, 1997; Christensen, 1997; D'Aveni, 1994; Goldman et al., 1995) and is generally associated with a greater level of flexibility and adaptiveness as well as proactiveness and radicalness (Lee et al., 2015; Miller and Friesen, 1983; Subramani and Youndt, 2005; Zahra and Covin, 1995). In a similar manner, we argue that IT agility is essential for successful digitization support from the IT function. Both an entrepreneurial culture (Krüp et al., 2014) and the adaptiveness and flexibility of the IT infrastructure (Tallon and Pinsonneault, 2011) are key factors determining the degree to which the IT function can contribute to digital business transformation. Moreover, IT sensing and responding capabilities influence if the IT function is in the position to impact strategic business decisions.

Supporting this argument, we observed several CIOs serving as pre-test interviewees who were struggling with their IT function experiencing immense pressure from the business side due to a lack of IT agility. "*The perception exists that our IT department is not agile enough*," stated the CIO of a large European enterprise in the wholesale industry, adding that "*our IT architecture is too rigid, […] our own processes slow us down, […] and our IT personnel is carrying a backpack of competencies that does not meet the needs for business-minded forward-looking digital thinking*."

The ability of the IT function to scan the environment for relevant digital developments is a critical component to being agile in an increasingly fast-pace technological surrounding. It allows the IT function to keep up with emerging trends and arising opportunities that are of highest relevance for the firm's digitization initiatives and might not always be known or sufficiently understood by the business. Being able to respond quickly and appropriately is the other equally critical dimension of IT agility. An IT function that maintains an IT landscape that is easily adaptable, has the appropriate resources to quickly launch change initiatives, and has a governance and process framework in place that allows for fast, yet risk-controlled responses to digital business needs, can provide significantly better digitization support than an IT function that lacks these capabilities (Lu and Ramamurthy, 2011; van Oosterhout et al., 2006).

Based on these arguments, our first hypothesis is:

Hypothesis H1: IT agility positively influences the IT function's digitization support.

2.3 IT Ambidexterity

The concept of ambidexterity describes the capability to pursue two disparate things at the same time (Tushman and O'Reilly, 1996) or the ability to combine capacities from two conflicting dimensions (Cao et al., 2009; Gibson and Birkinshaw, 2004). Organizational learning theory describes exploration (i.e., the development of new knowledge) and exploitation (i.e., the utilization of existing competencies) as a firm's competing goals (Levinthal and March, 1993; March, 1991). Exploitation refers to efficiently leveraging existing resources and capabilities through known processes, whereas exploration relates to discovering how to combine resources and capabilities in new ways to result in new capabilities and further opportunities (March, 1991).

In the context of IS research, IT ambidexterity is accordingly viewed as the ability of an IT function to simultaneously explore new IT resources and practices (IT exploration) as well as exploit current IT resources and practices (IT exploitation) (Gregory et al., 2015; Lee et al., 2015; Napier et al., 2011). IT

exploitation reflects the IT function's ability to manage existing IT assets well and improve the effectiveness and efficiency of the employed IT resources in order to ensure their best utilization. IT exploration, on the other hand, reflects the IT function's ability to devote resources to learn about emerging technologies, methodologies, and skills and experiment with them in order to select those that are of highest value for the firm. A high level of IT ambidexterity—that allows cost effective, yet flexible provision of IT services—is hence desirable, whereas an excessive focus on IT exploitation or IT exploration leads to subpar outcomes (He and Wong, 2004).

To date, our knowledge regarding the relationship between the IT function's agility and ambidexterity is limited. Merely the study by Lee et al. (2015) provides empirical evidence that IT ambidexterity has an indirect positive effect on organizational agility with operational ambidexterity mediating their relationship. Their research underscores the importance of a balance between IT exploration and IT exploitation and their nomological model clarifies the underlying mechanisms of the interplay between IT ambidexterity, operational ambidexterity, organizational agility, and environmental dynamism.

Agility facilitates seeking and taking advantage of opportunities for market arbitrage (Sambamurthy et al., 2003). However, beyond agile capabilities, managerial competences are required to implement these opportunities (e.g., Sirmon et al., 2007). Furthermore, the need for agility within the IT function may create tensions between IT exploration and IT exploitation activities (Gregory et al., 2015). Accordingly, we propose that IT ambidexterity moderates the relationship between IT agility and the IT function's digitization support. An IT function's ability "*to be aligned and efficient in its management of today's business demands while simultaneously being adaptive to changes in the environment*" (Raisch and Birkinshaw, 2008, p. 375) requires the IT function to be capable of exploring new alternatives and exploit existing competences simultaneously (March, 1991). Owing to the multiple trade-offs and opposing demands for an IT function that arise from engaging in exploring new innovative ventures and exploiting existing resources and assets, we argue that an ambidextrous IT function has a greater ability to manage these trade-offs. Since agility encompasses an exploration-focused entrepreneurial dimension and an exploitation-focused adaptive dimension (Lee et al., 2009; Overby et al., 2006), we expect that IT ambidexterity has a positive effect on the relationship between IT agility and the IT function's digitization support.

In contrast, an excessive focus on exploiting existing IT resources and capabilities tends to foster structural inertia (He and Wong, 2004). It weakens the effect of IT agility on the IT function's digitization support because it hinders IT sensing and IT responding capabilities to be effectively utilized by being fixated on IT exploitation. On the other hand, an excessive focus on discovering new possibilities for the innovative use of IT capabilities and resources may disrupt stable routines in existing domains (Mitchell and Singh, 1993) and slow down the improvement of existing competencies (March, 1991). This also weakens the effect IT agility has on the IT function's digitization support because even a highly agile IT function is not readily successful at supporting digitization initiatives without the continuous refinement of core IT infrastructure and operations as a foundation for the provision of digital services (Gregory et al., 2015).

In our pre-test interviews, we specifically asked our CIO interview partners about IT agility and wanted to know what fosters or hinders effective digitization support that results from IT agility. The responses led us to the same conclusions as theoretically derived above. The CIO of a multi-national retail company, for example, stated, *"we are building an agile IT architecture with interfaces between systems that allow quick adaptation […] but in the end, we still need to find a balance between operational excellence and IT innovation through experimentation.*" The CIO of an energy utility company reported how IT agility causes tensions between his IT division and various business functions because "*they [the business] now meet on a weekly basis and think they can change their mind on requirements every time they meet because we [the IT function] have become more agile.*" Yet, this CIO's IT strategy is binding him to focus on exploitation of current IT resources and capabilities in order to "*reduce IT cost year over year […] which causes less progress on key digitization initiatives*," hence ending up causing

ineffective digitization support despite reportedly high IT agility. These insights from our pre-test interviews indicate that the need for agility emerging from game-changing digital business innovation creates tensions both between the IT function and line functions as well as inside the IT function (Gregory et al., 2015; Svahn et al., 2017). These tensions place a premium on the organizational capability to balance IT exploration and IT exploitation tasks, i.e. IT ambidexterity (Gregory et al., 2015).

Accordingly, we expect that a balance between IT exploration and IT exploitation (i.e., a high level of IT ambidexterity) has a positive effect on an IT function's capability to leverage IT agility for digitization support. Therefore, we hypothesize that:

> *Hypothesis H2: The effect of IT agility on the IT function's digitization support is greater for ambidextrous IT functions compared to IT functions with an exploitative (a) or explorative (b) focus.*

3 Research Design and Method

This section describes the research design and methodology, including the conduction of qualitative pre-test interviews with CIOs, survey data collection and sampling, as well as the operationalization of construct measurements.

3.1 Pre-test Interviews with CIOs

We conducted pre-test interviews with ten CIOs of companies in various industries to receive feedback on survey items and structure and pose open questions regarding our principal research constructs (i.e., IT agility, IT ambidexterity, and the IT function's digitization support). All pre-test interviews were recorded and transcribed. We subsequently applied thematic coding to the transcribed interview data, using IT agility, IT ambidexterity, and the IT function's digitization support as seed categories. Finally, we used Miles and Huberman's (1994) method of data deduction for analysis purposes. The results of our pre-test interviews were used for making minor enhancements to the wording of survey items and supporting the derivation of relationships between constructs within our theoretical model, which we then empirically tested using our survey data.

3.2 Data Collection and Sample

We used an online survey to collect data from IT executives that were in the position to provide information on the relevant constructs. In gathering the data, we collaborated with a market research company hosting a panel of IT executives in the United Kingdom (U.K.) and United States of America (U.S.A.). Of the initial sample of 400 participants that took part in the study, 69% completed the survey (n = 276). After filtering out 18 data sets with implausibly low handling times, the final sample included valid responses from 258 firms.

3.3 Measurement of Constructs

We followed standard psychometric scale development procedures with Likert scales for measuring the IT function's digitization support and IT agility. For measuring IT ambidexterity, we followed the definition by Gregory et al. (2015), using a slide control ranging from an exploitation focus (Focus A) to an exploration focus (Focus B). The values for this scale ranged from 0 (entire focus on exploitation) to 100 (entire focus on exploration). We calculated the average value ($\overline{x}$) of all six items of IT ambidexterity for each respondent. An average value in the interval $0 \leq (\overline{x}) \leq 33.33$ corresponded with an exploitation focus, if $33.33 < (\overline{x}) < 66.66$ the IT function was considered as having an ambidextrous profile, and if $(\overline{x}) \geq 66.66$ the IT function was categorized as explorative.

Constructs (References)	**Items**		**Factor Loadings**
IT function's digitization support (Chakravarty et al., 2013; Guillemette and Paré, 2012; Overby et al., 2006; van Oosterhout et al., 2006)	The IT department of my firm…		
	…enhances my firm's ability to leverage digital technologies to transform our organization at the strategic level.		.914***
	…is essential to my firm's business strategy.		.789***
	…improves my firm's competitive position by tapping the potential of emerging technologies (e.g. reengineering business processes, facilitating change in firm's activities, ICT-enabled innovation).		.933***
IT Agility (Fichman, 2004; Lu and Ramamurthy, 2011; Weill et al., 2002)	The IT department of my firm…		
	IT Sensing		
	…constantly keeps current with new IT innovations and trends.		.934***
	…constantly seeks new ways to enhance the effectiveness of IT use in our firm.		.916***
	…anticipates changes and trends in IT that may affect our business.		.916***
	…commits resources for sensing new opportunities for the innovative use of IT in our business.		.890***
	IT Responding		
	…is capable of and continues to proactively experiment with new IT.		.910***
	…is able to rapidly scale up and down the IT infrastructure.		.892***
	…is able to quickly setting up the IT infrastructure needed to collaborate with partners in ecosystems.		.900***
	…enables us to swiftly respond to emerging opportunities in customer needs, markets and emerging environmental opportunities (e.g. regulatory/legal changes, economic shifts, technological advancements) using IT.		.877***
IT Ambidexterity (Gregory et al., 2015)	***Please indicate the strategic focus of the IT department's focus.***		
	IT portfolio decisions		
	Focus A (exploitative): IT efficiency, i.e., focus on reducing operational IT costs and expenditures	Focus B (explorative): IT innovation, i.e., focus on investing in IT innovations for enabling IT-based business opportunities	
	IT platform design		
	Focus A (exploitative): IT standardization, i.e., focus on harmonization and consistent use of IT	Focus B (explorative): IT differentiation, i.e., focus on customization and flexible adaptation of IT to business needs	
	IT architecture change		
	Focus A (exploitative): IT integration, i.e., focus on reusing and integrating existing IT components	Focus B (explorative): IT replacement, i.e., focus on fundamental IT renewal and leaving legacy systems behind	
	Please indicate the execution focus of the IT department's focus.		
	IT program planning		
	Focus A (exploitative): IT project stability, i.e., ensuring a stable foundation for IT project execution	Focus B (explorative): IT program agility, i.e., being responsive in the IT program to strategic and contextual changes.	
	IT program governance		
	Focus A (exploitative): IT program control, i.e., ensuring program-level alignment between IT project goals and solutions	Focus B (explorative): IT project autonomy, i.e., giving IT projects in the IT program sufficient leeway to address local requirements.	
	IT program delivery		
	Focus A (exploitative): IT program coordination, i.e., focus on synchronizing releases and ensuring continuous IT delivery	Focus B (explorative): IT project isolation, i.e., enabling delivery teams in IT projects to deliver components for releases.	

Note. * p < .05; ** p < .01; *** p < .001; Seven-point Likert scale from (1) "strongly disagree" to (7) "strongly agree" for IT agility and IT function's digitization support; slide control from Focus A [0] to Focus B [100] for IT ambidexterity.

Table 1. Operationalization of Constructs

In order to reflect the two dimensions of IT agility (IT sensing and IT responding), we modeled IT agility as a second order construct with the two components IT sensing and IT responding as reflective constructs. This measurement approach fits the nature of the agility construct, which is viewed as the combination of sensing and responding (Nazir and Pinsonneault, 2012; Overby et al., 2006). Furthermore, both IT sensing and IT responding require a multi-item measurement to capture the full domain of their meaning. Thus, an ordinary formative construct with two items relating to sensing and responding would be an inept over-simplification of our model. Focal constructs should be modeled as multidimensional "*[…] to permit a more thorough measurement and analysis*" (Petter et al., 2007, p. 627). We validated the instruments with a qualitative (n = 10) and quantitative (n = 15) pilot study including IT professionals and scholars, which revealed reliable scales suitable for further use.

4 Analysis and Results

For the analysis of our data, we applied partial least squares (PLS) regression, since it places low demands on the distribution of the underlying data and is particularly well suited for models that include formative constructs (Hair et al., 2012; Ringle et al., 2012). We utilized SmartPLS3 for an assessment of the measurements, the structural model, and the multi-group analysis (Ringle et al., 2015). A two-stage approach—as described in the following sub-sections—is suggested by Anderson and Gerbing (1988). Prior to the measurement assessment, we tested for non-response bias comparing early and late responses. The means of the first and last quartile of responses showed no statistically significant difference, thus indicating that a non-response bias was unlikely to have affected our sample (Armstrong and Overton, 1977).

4.1 Assessment of the Measurement Model

Our assessment of the measurement model mainly relies on the guidelines provided by Gefen and Straub (2005). It is important to differentiate between ordinary and multidimensional constructs because they require different evaluation methods (e.g., Petter et al., 2007; Ringle et al., 2012). Being a reflective-formative second-order construct, IT agility was modelled using the indicator reuse approach (Ringle et al., 2012). This is a suitable approach in order to conduct subsequent PLS analysis (Lohmöller, 1989). Moreover, Ringle et al. (2012) recommend using the same number of indicators for the lower order constructs; we followed their advice.

We assessed the validity of our instruments by conducting factor analysis. The factor loadings of the items of reflective constructs should be higher than .707 (Chin, 1998), which applies to the two reflective sub-constructs of IT agility—IT sensing and IT responding. The same has to be true for the IT function's digitization support. Table 2 exhibits the factor loadings for all items.

In order to assure internal consistency of the constructs, we assessed composite reliability scores and Cronbach's alpha for all reflective constructs. Composite reliability should exceed .80 and Cronbach's alpha should be higher than .70 (Bhattacherjee and Premkumar, 2004; Hair et al., 2010). Table 2 shows that both criteria are met for all four constructs. Furthermore, we assessed each construct's average variance extracted (AVE) and found the values to exceed the suggested threshold of .50 (Bhattacherjee and Premkumar, 2004). For evaluating discriminant validity, we used the Fornell-Larcker criterion (Fornell and Larcker, 1981). This criterion is met when each construct's square root of the average variance extracted (diagonal values in bold in Table 2) exceeds the values for inter-construct correlation between the respective construct and other constructs (Fornell and Larcker, 1981). Our constructs meet the Fornell-Larcker criterion with the exception of IT agility, which features high inter-construct correlation with both IT sensing and IT responding. This is due to the fact that IT agility is a formative second order construct consisting of IT sensing and IT responding; it thus does not constitute an issue from the perspective of discriminant validity.

Construct	Mean (SD)	CR	AVE	Cα	ITAG	ITDS	SENS	RESP
IT Agility	5.016 (1.498)	.964	.771	.957	**.878**			
IT Function's Digitization Support	5.407 (1.505)	.912	.776	.857	.766	**.881**		
IT Sensing	5.087 (1.506)	.953	.836	.934	.972	.757	**.895**	
IT Responding	4.944 (1.488)	.941	.801	.916	.969	.728	.884	**.914**

Note: ITAG: IT Agility; ITDS: IT Function's Digitization Support; SENS: IT Sensing; RESP: IT Responding; CR: Composite Reliability; AVE: Average Variance Extracted; Cα: Cronbach's α; Bold diagonal elements are the square root of the AVE.

Table 2. Construct Correlations

4.2 Structural Model

We utilized the PLS method to analyze our data and applied bootstrapping with 5,000 samples to determine the significance of the effects. The results of the estimated basic model, including IT agility as a formative second order construct of IT sensing and IT responding and the IT function's digitization support as a dependent construct—but without IT ambidexterity as a moderator—are depicted in Figure 2.

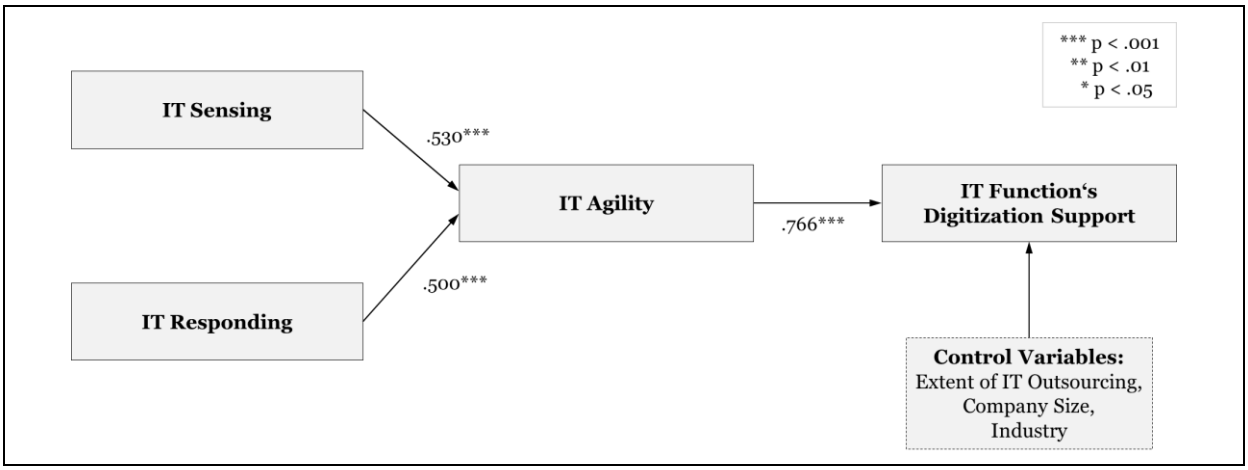

Figure 2. Research Results

Looking at the results, it is noticeable that the weights of IT sensing's and IT responding's contribution to IT agility are quite similar (.53 for IT sensing; .50 for IT responding). The effect from IT agility on the IT function's digitization support—as proposed in hypothesis H1—is significant (ß = .766; $p < .001$). The IT function's ability to sense market and business developments as well as its ability to respond to these changes explains a major portion of the variance of the IT function's digitization support (R^2 = .586). We did not find any significant effects of the control variables on the dependent construct of our study.

4.3 Multi-Group Analysis

Our second hypothesis (H2) relates to the impact of IT ambidexterity on the relationship between IT agility and the IT function's digitization support. Both sub-hypotheses (H2a and H2b) were tested using multi-group analysis to compare the path coefficients for different groups of firms in our sample, differentiated by their profiles with respect to IT ambidexterity. In order to do so, we used PLS multi-group analysis as proposed by Henseler (2007). The sub-samples were first tested with separate bootstrapping calculations and then tested for differences. The advantage of this approach is that it is not subject to restrictive distributional assumption and suitable software algorithms are already integrated in SmartPLS3 (Sarstedt et al., 2011).

IT ambidexterity was measured on a scale ranging from 0 (exploitation focus) to 100 (exploration focus) for each of the six items. To distinguish between varying levels of IT ambidexterity (exploitative, ambidextrous, explorative focus), we first calculated the mean value ($\overline{x_i}$) of the six IT ambidexterity item values for each firm *i*. For firms with ($\overline{x_i}$) ≤ 33.33, the IT function was categorized as focusing on exploitation, while for 33.33 < ($\overline{x_i}$) < 66.66 the IT function was categorized as "*ambidextrous*". All remaining firms (66.66 ≤ ($\overline{x_i}$)) were categorized as "*exploration focus*". Figure 3 shows the path coefficients of the relationship between IT agility and the IT function's digitization support for each of the three groups of firms with different IT ambidexterity levels.

To test our second hypothesis, we used PLS multi-group analysis to calculate whether the path coefficients between the three groups significantly differ. First, we compared the group of ambidextrous IT functions (ß = .778) with the sub-sample containing IT exploitation-focused firms (ß = .628). This comparison resulted in a p-value of .047 according to the PLS multi-group analysis, indicating a significantly stronger effect of IT agility on an IT function's digitization support for ambidextrous IT functions, thus supporting hypothesis H2a. Comparing the path coefficients of IT agility and the IT function's digitization support for ambidextrous vs. exploration-focused IT functions yielded a p-value of .099, indicating moderate support for hypothesis H2b.

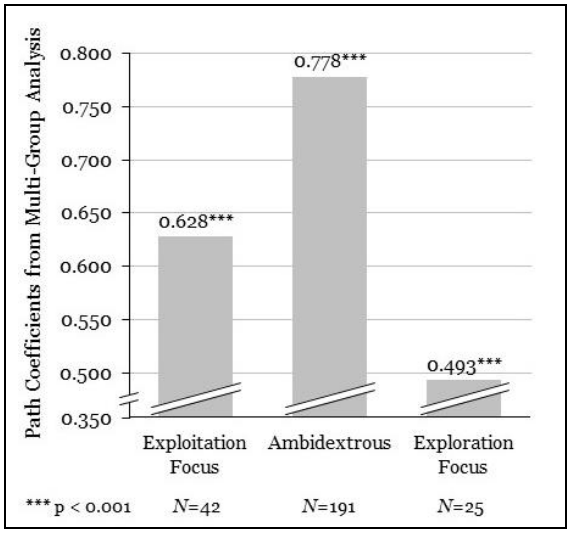

Figure 3. Results of Multi-Group Analysis

5 Discussion

The aim of our study was to examine how IT agility and IT ambidexterity influence the IT function's digitization support. Our findings show a strong positive direct impact of IT agility on the IT function's digitization support. This relationship is moderated by IT ambidexterity. More specifically, the effect of IT agility on the IT function's digitization support is significantly higher for an ambidextrous IT orientation in comparison to IT functions with an exploration or exploitation focus. These findings have several implications for theory and managerial practice. We discuss these implications as well as the limitations of our study and opportunities for further research in the following sub-sections.

5.1 Theoretical Implications

This study has several implications for IS research regarding organizational capabilities that determine the role of the IT function in supporting digitization. First, our results indicate that for the enabling role of IT agility and IT ambidexterity for the IT function's digitization support. IS research has dealt with the changing role of the IT function as IT strategy increasingly merges with business strategy (e.g., Bharadwaj et al., 2013; Guillemette and Paré, 2012), but there are no studies that have thus far assessed

which factors affect the IT function's contribution to digitization. Thus, this study—to the best of our knowledge—is the first of its kind that empirically tests factors influencing the IT function's digitization support. Digitization implies that products and services increasingly rely on digital technologies, hence shifting the role of the IT function in a strategic direction (Bharadwaj et al., 2013; Del Giudice and Straub, 2011; Yoo et al., 2010). However, the IT function requires certain organizational characteristics that enable effective digitization support. As digital transformation causes a turbulent environment, in which technological developments are shaping the business landscape, it is crucial to sense and respond to changes in a timely manner (Kranz et al., 2016). This argumentation is reflected in the positive influence of IT agility on the IT function's digitization support as suggested by our empirically validated model.

Second, while organizational agility is a well-established research concept and the enabling role of IT is widely acknowledged (e.g., Lu and Ramamurthy, 2011; Tallon, 2008), IT agility is a relatively new concept and the antecedents and outcomes of IT agility are less understood (Tiwana and Konsinsky, 2010). We depart from previous conceptualizations of IT agility by adapting the definition of IT agility according to the sensing and responding definition used by prior studies on organizational agility (e.g., Overby et al., 2006; Nazir and Pinsonneault, 2012). By proposing and testing a second-order construct that encompasses both the sensing and responding dimension of IT agility, we provide a starting point for further research.

Third, our study unveils implications for the role of IT ambidexterity in digital business transformation. For operationalizing IT ambidexterity, we developed a measurement approach following Gregory et al.'s (2015) qualitative study on IT ambidexterity. We contribute to this emerging research field by providing empirical support for the role of IT ambidexterity as a moderator of the relationship between IT agility and the IT function's digitization support. For ambidextrous IT functions that are able to simultaneously exploit current IT resources and practices while exploring new ones, the positive effect of IT agility on the IT function's digitization support increases—a pattern of interaction that has thus far not been addressed by previous research.

5.2 Practical Implications

Our empirical findings have several implications for IT management practice. Digitization in general—and digital innovation in specific—relies on the use of information technology. With IT historically being the competency of the IT function within an organization, a new mandate for the IT function may arise which puts additional demands on enterprise IT functions. Business innovations in times of digitization require support from the IT function. Our study shows that IT agility is an important characteristic due to its positive effect on the IT function's digitization support. Particularly, companies that face disruptive changes induced by digital innovations in their industry should foster both their sensing and responding capabilities. Since it is not sufficient to excel at either sensing or responding (Overby et al., 2006), managers may particularly focus on the lesser developed component of IT agility. The positive moderation effect of IT ambidexterity renders the simultaneous exploitation of existing resources particularly important for successful digital business transformations. IT managers should thus try to establish a balance between experimenting with new technologies and refining established technologies and processes.

There are different ways for companies to achieve IT agility and enable digital innovation. First, IT personnel can be encouraged to use agile methods and lean processes to react faster to needs for changes (Andersson and Tuddenham, 2014). Moreover, IT management can exempt employees from parts of their day-to-day activities to enable innovative experimenting and keeping abreast with technological developments and trends (Krüp et al., 2014). Google has shown that providing employees a certain degree of autonomy to follow their own ideas can foster innovation (Finkle, 2012). However, shifting the focus of the entire IT function to innovation and agility can cause conflicts with the requirements for stability and reliability of IT systems (Andersson and Tuddenham, 2014; Avedillo et al., 2015). Thus,

some companies are trying to adopt a bimodal approach for their IT function, which meets these contrary needs by building a two-speed IT organization.

The positive moderation effect of IT ambidexterity shows that a balance of IT exploration and IT exploitation activities helps to harness the positive effects from IT agility. Therefore, simply establishing a bimodal IT function with a second (more agile) mode might be insufficient; firms still need to coordinate, align, and combine the forces between traditional IT resources and capabilities and their explorative counterparts.

5.3 Limitations and Future Research

Our study is not without limitations, the most important of which we summarize as follows. First, cross-sectional research does not allow us to determine cause-and-effect relationships. Future research should consider longitudinal research designs to improve the validity of our findings. Second, our data is limited to the responses from representatives of the IT function of their companies. Thus, their assessment of the IT function's digitization support as well as its level of agility and ambidexterity may be biased. Future research should utilize matched-pair surveying methods based on business and IT responses, which would improve the objectivity of our results. Third, our data may be culturally biased since our sample is limited to companies from the United States of America and the United Kingdom. Additional studies in different cultural settings would improve the validity of our results

6 Conclusion

Digital technologies have the potential to not only exercise significant impact on business model innovation but to transform the core of products and services. Digitization changes how firms create and capture value and bring about innovation. Since IT is the foundation of digital innovation, a company's IT function plays a major role in supporting digitization initiatives. First, our study finds IT agility to positively influence the IT function's digitization support. Thus, IT functions that are able to sense relevant developments and to act accordingly are best suited to produce digital innovation. Furthermore, we found that IT ambidexterity has a moderating effect on this relationship, suggesting that IT functions need to be able to experiment with new technologies, while at the same time efficiently and effectively refining their current IT resources to best utilize their capabilities in the agility dimensions sensing and responding for digitization.

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