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The Impact of Digital Innovation on Path-Dependent Decision-Making: The Mediating Role of Risk Propensity and Opportunity-Threat Perception

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Completed Research Paper

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Abstract

While the information systems literature highlights the business opportunities that digital innovation provides, the management literature foregrounds the challenges of path-dependent decision-makers face to exploit such potential. To bring these views together, we examine the impact of digital innovation on path-dependent decision-making. For this purpose, we conducted an experiment with 148 practitioners. Our study indicates that digital innovation has a negative impact on path-dependent decision-making, thus leading path-dependent decision-makers to deviate from their decision path. Furthermore, our results suggest that risk propensity and opportunity-threat perception mediate this relationship. Our study complements the literature on digital innovation with insights into the challenges of incumbents, adds to the literature on path dependence by shedding light on the behavior of path-dependent decision-makers in the face of digital innovation, and demonstrates how scholars can examine phenomena on digital innovation and path dependence with experiments.

***Keywords**: Digital business model, risk, organizational strategies, digital innovation, decision making/makers, strategic path*

Introduction

Digital innovation has become an important topic in research and practice. In recent years, the renovation of innovation processes, as well as the development and delivery of new products or services based on digital technology (Nambisan et al. 2017; Yoo et al. 2010), has led to severe technological and social changes, thus leading firms to fundamentally rethink the way in which they develop, produce, and distribute their products and services (Bieber et al. 1997; Chen et al. 2009; Fadel et al. 2015;; Hoehle et al. 2015; Jiang et al. 2016; Karahanna et al. 2015; Koh et al. 2012; Li and Karahanna 2015; Lowry et al. 2008;; Nambisan et al. 2017; Oh et al. 2015; Stein et al. 2015; Tan and Teo 2000; Tan et al. 2015; Teo et al. 2008, 2011; Tilson et al. 2010; Twyman et al. 2014; Venkatesh et al. 2016; Verhagen et al. 2015; Wang et al. 2014; Yoo et al. 2010). Along with these developments, recent works have highlighted the business opportunities that digital innovation entails (Bharadwaj et al. 2013). Such opportunities relate to increased production efficiency (Rothmann et al. 2014), increased efficiency and effectiveness of product distribution (Oestreicher-Singer and Zalmanson 2013), and new value propositions for customers (Pagani 2013). Yet although this literature has gained a comprehensive overview of the potential value of digital innovation for firms, it has paid much less attention to the challenges that firms with established business models face (Arvidsson et al. 2014; Besson and Rowe 2012). Incumbent firms in particular struggle with digital innovation and do not straightforwardly exploit its potential (Lucas and Goh 2009; see also Polites and Karahanna 2012, 2013). Due to these challenges, the survival of many incumbents is threatened (Karimi and Walter 2015).

Extant research indicates an important challenge that incumbents face in light of digital innovation is the path dependence of their decision-makers (Singh et al. 2015; Wenzel et al. 2017). Path dependence refers to a process in which a decision-maker's range of available options is gradually reduced over time and eventually becomes locked in (e.g., Sydow et al. 2009; Vergne and Durand 2010; see also Garud and Karnøe 2001; Garud et al. 2010). The central idea of path dependence theory is that positive feedback on past decisions encourages similar decisions because past decisions yielded positive results (Schreyögg et al. 2011). This development creates a legacy of decisions that eventually leads to the formation of a decision path, that is, a rigid pattern of decisions. This is particularly the case for incumbents whose past decisions have been successful. In that respect, much of this literature has demonstrated how decision paths emerge (Dobusch and Schüßler 2013), and the central role of path dependence in struggles with digital innovation, such as in the music industry (Kunow et al. 2013), the newspaper industry (Rothmann and Koch 2014), the book industry (Schreyögg et al. 2011), and the software industry (Schmidt and Braun 2015). Although these studies provide valuable contributions to a better understanding of how decision paths emerge, the specific decision-making patterns of path-dependent decision-makers in the face of digital innovation remain poorly understood. This lacuna is surprising, given that path dependence is widely acknowledged as the key challenge for incumbents in the face of digital innovation that is causing the demise of many contemporary firms (Besson and Rowe 2012; Karimi and Walter 2015). Therefore, in this paper, we formulate the following research question: How does digital innovation impact path-dependent decision-making?

Whereas previous works on digital innovation and path dependence have relied on traditional methodological approaches, such as case studies and surveys (Karimi and Walter 2015; Rothmann and Koch 2014), we follow Dobusch and Kapeller's (2013) and Nambisan et al.'s (2017) suggestion to gain a better understanding of this phenomenon with an experimental study (Berkowitz and Donnerstein 1982). An experimental design is promising for the examination of our research question because it allows us to unveil the underlying causal relationships in which this phenomenon is embedded (Burgoon et al. 2014; Rauch et al. 2016). By controlling the setting, we can exclusively manipulate key variables and observe their causal impact (Bono and McNamara 2011). This important feature of experiments enables us to level out the shortcomings of field data, which help researchers retrospectively identify path-dependent dynamics but do not explain how these dynamics would have unfolded if key events, such as the emergence of new digital technologies, had not happened (Durand and Vaara 2009; Vergne and Durand 2010).

The results of our experiment suggest that path-dependent decision-makers deviate from their decision path in the face of digital innovation. Furthermore, our results highlight the mediating role of a decision-maker's willingness to take risks and the perception of digital innovation as an opportunity or threat. Specifically, our results indicate that digital innovation positively influences the willingness of path-dependent decision-makers to take risks. This, in turn, increases the likelihood that path-dependent

decision-makers perceive digital innovation as an opportunity. Eventually, this perception positively influences a path-dependent decision-maker's propensity to deviate from the established decision path.

Our examination of the impact of digital innovation on path-dependent decision-making brings together two different views on digital innovation that span different disciplines: information systems research with its focus on the business opportunities of digital innovation (Bharadwaj et al. 2013) and management research with its focus on the challenges of path dependence in the face of digital innovation (Rothmann and Koch 2014). Thus, our paper not only sheds light on the impact of digital innovation on path-dependent decision-making but also offers contributions to both lines of research. First, our study complements works on digital innovation that highlight its business opportunities (Bharadwaj et al. 2013) by offering insights into path-dependent dynamics as a key challenge to incumbents in the face of digital innovation (Singh et al. 2015; Wenzel et al. 2017). Specifically, our study shows that the exploitation of the potentials of digital innovation is not straightforward but is a complex issue that is mediated by the risk propensity of path-dependent decision-makers and their perception of digital innovation as an opportunity or threat. Second, our study adds to the literature on path dependence. Whereas previous works have largely focused on the emergence of decision paths (Dobusch and Schüßler 2013), our study provides insights into the specific behavior of path-dependent decision-makers in the face of digital innovation. Third, our paper offers a methodological contribution. In particular, our paper complements other works on digital innovation and path dependence that have relied on more traditional methodological approaches (Karimi and Walter 2015; Schmidt and Braun 2015). By conducting an experiment on the impact of digital innovation on path-dependent decision-making, our study not only highlights the fruitfulness of experiments to examine related phenomena but also responds to a recent call to unveil the underlying causal mechanisms (Dobusch and Kapeller 2013) and do justice to the complex and dynamic nature of today's digitized business environments (Nambisan et al. 2017) with this methodological approach.

Theoretical Background

Digital Innovation

"Digital innovation" refers to the emergence of digital technologies that allow firms to conduct strategic change by developing, producing, and/or distributing entirely new or newly reconfigured products or services in new or different ways (Bharadwaj et al. 2013; Nambisan et al. 2017; Yoo et al. 2010, 2012); that is, firms can digitize the technological foundation of their products and services, switch from analog to digital distribution channels, renovate their innovation processes, and so on. Thus, digital technology can operate as an operant (generating new or different products or services) and as an operand (resulting in reconfigured innovation processes). Although these two ends of digital technology can be theoretically distinguished, through the interconnectedness of these two aspects digital innovation has become pervasive in recent years: Although digital innovation is not an entirely new phenomenon (Bell 1973; Machlup 1962; Wiener 1948), it has only recently begun to fundamentally transform the ways in which firms produce and sell their products and services and how consumers purchase and use them (Tilson et al. 2010; Yoo 2010; Yoo et al. 2010, 2012). As Nambisan et al. (2017) argued, this transformation requires scholars to revise existing and develop new theories about the ways in which firms strategize and organize in today's digitized business environments.

Much of this burgeoning literature has highlighted the business opportunities that digital innovation entails (Bharadwaj et al. 2013). This literature advances the idea that firms can realize new benefits through digital innovation that they have not had available before (Zhu et al. 2006). For instance, Rothmann et al. (2014) argued that firms may rely on digital innovation to reduce their production costs. In turn, Oestreicher-Singer and Zalmanson (2013) highlighted that digital innovation can help firms distribute their products and services more efficiently. Furthermore, Pagani (2013) argued that digital innovation enables firms to offer new value propositions to their customers.

Although previous literature provided a valuable overview of the potential business opportunities that digital innovation entails, literature has focused much less on the challenges of exploiting these potentials (Arvidsson et al. 2014; Besson and Rowe 2012). Incumbent firms in particular seem to face severe struggles in light of digital innovation. Specifically, previous works have demonstrated that these firms are unable to transform their business processes to make use of digital innovation (Lucas and Goh 2009). As digital innovation not only comes with technological changes but also entails social changes in markets and

societies (Tilson et al. 2010), it has led to severe disruptions of the established business practices of incumbent firms (Karimi and Walter 2015; Lyytinen and Rose 2003). However, the specific challenges that incumbents face when new digital technologies emerge have remained poorly understood (Besson and Rowe 2012).

Path Dependence

Path dependence constitutes an important challenge for incumbents in the face of digital innovation (Singh et al. 2015; Wenzel et al. 2017). Path dependence is a process in which a decision-maker's scope of action, that is, the range of available options, is gradually reduced over time (Sydow et al. 2009; Vergne and Durand 2010; see also Figure 1). This process is driven by positive feedback on previous decisions (Schreyögg et al. 2011), such as realized cost advantages and increases in efficiency. Such positive feedback increases the attractiveness of re-selecting the same option and decreases the attractiveness of selecting alternatives (Dobusch and Schüßler 2013). Therefore, affected decision-makers increasingly commit their resources to re-selecting one option over time and may eventually become "locked in," that is, they may have only one remaining one option available (Sydow et al. 2009). As a result, these decision-makers are trapped in a decision path, that is, an established decision pattern in which the costs of deviating from the re-selected option (i.e., "switching costs") are too high for deviations from the decision pattern.

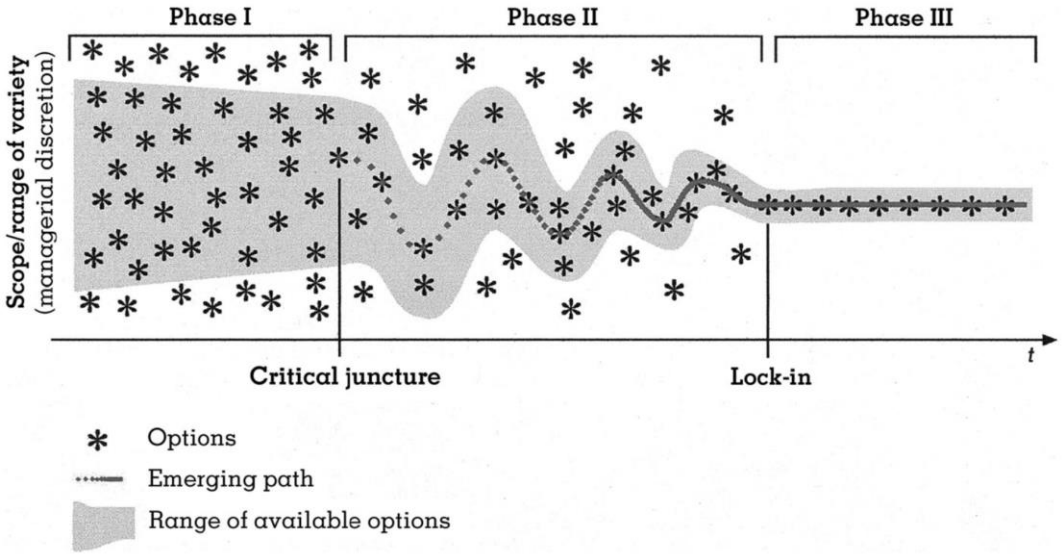

Figure 1. The Emergence of a Path (Sydow et al. 2009: 692)

Given the importance of positive feedback in the process of path dependence, much of the previous literature has examined the emergence of decision paths (Dobusch and Schüßler 2013). Accordingly, studies on path dependence have developed a better understanding of the struggles that incumbents face in light of digital innovation (Koch 2011; Rothmann and Koch 2014; Schmidt and Braun 2015; Schreyögg et al. 2011). For instance, Rothmann and Koch (2014) showed that the newspaper industry has received positive feedback on generating revenues in the advertising market. Consequently, news publishers were locked in: They focused exclusively on generating revenue through selling ads. Therefore, as Rothmann and Koch (2014) showed, these firms missed the opportunity to generate revenue in the readership market by offering paid digital news and were attacked by suppliers of free online news, thus leading these firms to change their business models only slowly in the face of digital innovation. Other prominent cases such as Kodak (Lucas and Goh 2009), Polaroid (Tripsas and Gavetti 2000), and the camera industry more generally (Benner and Tripsas 2012), but also less prominent cases such as the automotive sector (Wagner et al. 2011), the biopharmaceutical industry (Johnson 2007), consulting (Christensen et al. 2013), and the funeral industry (Wenzel 2015), showed similar dynamics. In the camera industry, entrenched beliefs in the success

of the "razor/blade" business model of selling the camera hardware at a lower price and selling complementary products such as the film at a higher price led to a specialization of the resource base that was based on exploiting this complementarity. When digital cameras emerged, the incumbent producers of analog cameras perceived little scope of action to deviate from their established decision path.

Much of the previous literature provides valuable contributions to a better understanding of the emergence of decision paths. However, although doing so is important in order to gain an understanding of the persistent reproduction of decision paths (Wenzel et al. 2017), previous works do not particularly focus and shed light on the specific decision-making patterns of path-dependent decision-makers when new digital technologies emerge. As an exception, Gilbert (2005) highlighted two important factors that can play a role in this process. First, deviating from the established decision path requires decision-makers to experiment. Therefore, the specific decisions of path-dependent decision-makers in the face of digital innovation depend on their willingness to take risks. Second, decision-makers can perceive emerging digital technologies as opportunities or threats (see also Jackson and Dutton 1988). Thus, the way decision-makers perceive such technologies has implications for the way they decide. However, the specific impact of such factors on the decision-making patterns of path-dependent decision-makers in the face of digital innovations remains poorly understood (Nambisan et al. 2017). Taken together, the literature on path dependence does not fully specify the decision patterns of decision-makers in the face of digital innovation.

Hypotheses Development

We derive our hypotheses by drawing on the stated streams of literature and derive our hypotheses by adopting a commonly used two-step approach (MacKinnon 2008). First, we hypothesize the direct effect of digital innovation on path-dependent decision-making. Second, we investigate the indirect effects and thus the explanatory mechanisms, which affect path-dependent decision-making.

Direct Effect of Digital Innovation on Path-Dependent Decision-Making

Building on the stated literature streams, path dependence theory suggests that the emergence of new options increases the scope of action of path-dependent decision-makers. Thus, although path-dependent decision-makers have a very limited range of options available, their available range of options increases when new options emerge, thus providing them with the opportunity to leave their established decision path (Rothmann and Koch 2014; Sydow et al. 2009). The same should apply to digital innovation: When new digital technologies emerge, path-dependent decision-makers have additional options available that have not been available before, thus allowing the decision-makers to deviate from the established decision path. Therefore, we hypothesize the following:

H1: Digital innovation negatively influences the continued reproduction of the decision path.

After hypothesizing the proposed direct effect of digital innovation on path-dependent decision-making, we explore the explanatory mechanisms through which the expected effect of digital innovation may operate.

The Mediation Process between Digital Innovation and Path-Dependent Decision-Making

Overall, we argue that digital innovation has an impact on path-dependent decision-making by first increasing risk propensity, which then translates into higher opportunity perception, rather than threat perception. This serial effect chain finally affects path-dependent decision-making. Accordingly, we argue that risk propensity and opportunity-threat perception act as mediators, which are conceptualized as the "mechanism[s] through which X influences Y" (Hayes 2013: 7). In the following paragraphs, we develop hypotheses for the serial effect chain and the mediation effect.

The observations of the challenges that path-dependent decision-makers face in light of digital innovation (Karimi and Walter 2015; Lucas and Goh 2009; Wenzel et al. 2017) indicate that the hypothesized relationship is more complex. One important factor that plays an important role in this relationship is risk propensity (Gilbert 2005), i.e., the willingness of decision-makers to take risks (Lim et al. 2011; Mishra and Agarwal 2010; Sitkin and Weingart 1995; see also Hanseth and Ciborra 2007). Whereas risk propensity is widely conceived as a static construct (Rainer et al. 1991), Lim et al. (2011) showed that risk propensity can change over time. More specifically, the general enthusiasm about digital innovation (Bharadwaj et al. 2013) reflects observations of incumbent firms that, despite their path-dependent position, experiment

with emerging digital technologies (Tripsas and Gavetti 2000). As such experimentation requires decision-makers to be willing to take risks (Gilbert 2005; Karimi and Walter 2016), we expect the advent of digital innovation to increase the risk propensity of path-dependent decision-makers. Thus, our hypothesis is as follows:

H2a: Digital innovation positively influences the risk propensity of path-dependent decision-makers.

Previous works suggest that risk propensity is related to the propensity of a path-dependent decision-maker to perceive changes in the environment as an opportunity or threat (Gilbert 2005; Kühberger 1998; Saebi et al. forthcoming). Gilbert's (2005) study suggested that risk-averse decision-makers have a lower likelihood of conceiving environmental changes as an opportunity; instead, they perceive environmental changes as a threat. Thus, in turn, when decision-makers have a higher willingness to take risks in the face of digital innovation, they may perceive digital innovation as an opportunity rather than as a threat. Therefore, we hypothesize the following:

H2b: An increased risk propensity positively influences the perception of digital innovation as an opportunity rather than a threat.

The way in which decision-makers perceive environmental changes (i.e., as an opportunity or threat) has implications for their decision-making behavior (Chattopadhyay et al. 2001; Gilbert 2005; Jackson and Dutton 1988; Staw et al. 1981; Thomas et al. 1993). Specifically, decision-makers tend to reproduce past decisions when they conceive of environmental changes as a threat; in contrast, they tend to select alternative options that deviate from previous decisions when they perceive environmental changes as an opportunity (Jackson and Dutton 1988). Therefore, as reflected in the following hypothesis, we expect path-dependent decision-makers to deviate from their decision path when new digital technologies emerge:

H2c: The tendency to perceive digital innovation as an opportunity negatively influences the continued reproduction of the decision path.

In summary, considering H2a through H2c together, we expect that digital innovation will affect path-dependent decision-making through a serial mediation process with risk propensity and opportunity-threat perception as the key explanatory constructs.

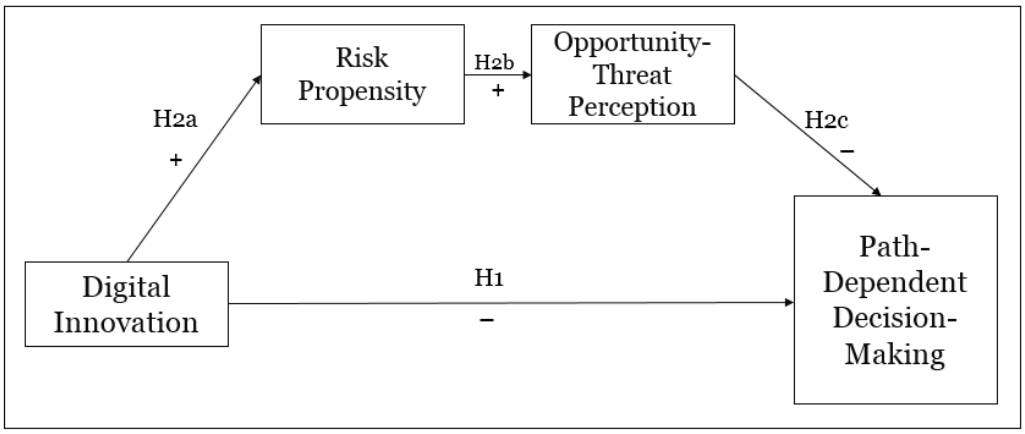

Figure 2. Research Model

Research Methodology

To test our hypotheses, we conducted an experiment based on a one-factorial between-subject design (Shadish et al. 2001) with one control group and one treatment group, manipulating digital innovation. The control group helped us experimentally verify the path-dependent influence of positive feedback on decision-making processes (Koch et al. 2009; Rauch et al. 2016), whereas the treatment group facilitated the investigation of the impact on path-dependent decision-making and the effects of risk propensity and

opportunity-threat perception. An experimental setting was especially suited to address our research question because a controlled setting enabled us to better investigate the impact of digital innovation on path-dependent decision-making by isolating the desired effects and controlling for possible interferences (Dobusch and Kapeller 2013; Koch et al. 2009). For this research endeavor, we used the software tool (WheelCorp) previously used in research in the context of digital disruption of strategic paths (Rauch et al. 2016). WheelCorp was particularly suitable for our research endeavor as it we could modify and adapt it to the needs of our experimental study, in contrast to many existing simulation games. WheelCorp is operated on Unipark, an online research platform that is useful for conducting studies based on experimental and survey designs.

This tool helped us verify and test the path-dependent influence of positive feedback on decision-making in a controlled setting (Rauch et al. 2016) and experimentally test the impact of digital innovation on path-dependent decision-making, as well as the mediating role of risk propensity and opportunity-threat perception (e.g., see Sitkin and Weingart 1995). The experiment followed the same structure and logic for the control group and the treatment group. The control group did not receive a manipulation. Therefore, we presented no information about digital innovation to the control group.

The scenario unfolded as follows: The participant is the innovation manager and, thus, is in charge of the innovation strategy for an international automotive firm that produces steering wheels for the automotive industry. Within the scope and responsibility as the innovation manager, the participant is in charge of selecting among four machines to produce the steering wheel. The firm will produce only one product, namely, the steering wheels. Therefore, the choice of machine is directly linked to the firm's overall strategy. The scenario at hand was appropriate for the chosen sample because the majority of the participants worked in the automotive industry and adjacent industries and, therefore, were familiar with the functionality and purpose of this product and the firm's strategy in the scenario. Furthermore, the scenario simulated the interconnectedness of digital technology as an operant and an operand at the same time (see Nambisan et al. 2017; Yoo et al. 2010), given that a change in choices in favor of a digital option in the face of the availability of new digital technology implies a shift in developing, producing, and delivering the product, as well as a change in the product itself. The illustrated situation also allowed us to simulate different settings that are common in real-life decision-making, such as decisions that are strategically consequential for the firm's strategic development, aspiring cost savings, and strategic thinking and acting.

Because commonly used student samples usually lack experience with and exposure to real-life decision-making in firms, we recruited 148 participants (48 female) by email, who were alumni and participants of part-time master's of business administration (MBA) executive programs at a German private university that are targeted at senior managers and executives. Focusing on this population allowed us to gather data based on a sample that is exposed to decision-making in firms on a daily basis. We sent out two reminder emails within a period of four weeks. The selection process for the participants was threefold. First, the study was limited to former or current participants of the executive programs and MBA alumni living in Germany. Second, we stated a substantial list of requirements for participation, based on which recipients had to self-evaluate whether they would be eligible to participate in our research project. Among other criteria, we required participants to have substantial decision-making experience in firms, managerial experience, more than 10 years of work experience, and work experience in senior or middle management. Third, in a post-hoc analysis, we controlled for several factors to ensure the quality of the responses (e.g., attention and manipulation checks, work history, and demographics). We used several manipulation checks to ensure that the participants understood the task at hand and that their professional and personal background (e.g., position, work experience, managerial experience, decision-making experience, leadership experience, size of responsible team/employees, position, company size, and industry) was suitable for the research setting. The participants' average age was 39.91 years (σ = 6.6), with an average of 18.4 years of work experience (σ = 6.8). We excluded six participants due to partial information on dependent variables and a lack of work experience, decision-making experience in firms, and managerial experience.

To minimize suspicion, we told participants they would be participating in a study on decision-making in an innovation context. The experiment proceeded in four major steps. First, after the participants opened the study request, they were randomly assigned to the treatment or control group. Second, the participants were first asked to fill out a pre-experimental questionnaire on socio-demographic data and their eligibility to take part in the study, such as their exposure to and experience concerning decision-making in firms.

Then, all participants were presented with and informed about the basic idea of the experiment and had the opportunity to get to know the rationale of the software tool with a set of four machine alternatives that produce steering wheels for the national and international markets. Next, the participants were instructed on how to use the software. For this purpose, the participants were presented with an identical start page that displayed all main components of the experiment. With the presentation of this start page, we allowed the participants to establish a common frame of reference in order to ensure that the context and background of their experimental experiences were homogeneous across treatments and that the disparities across different treatments were caused only by different treatment stimuli (Helson 1964). Fourth, after taking 25 consecutive decisions and answering the questions associated with the decision rounds (e.g., risk propensity and opportunity-threat perception), participants completed a post-experimental questionnaire. The participants were given the chance to win three different prizes for participating in the study, which included two tickets to a popular and long sold-out sporting event and a university sweatshirt or polo shirt. To ensure that the participants remained motivated to continue through the following decision rounds, participants were provided with detailed individual feedback on their decisions, chosen strategies, and performance, as well as a debriefing and explanations of the rationale of the study and their theoretical and practical implications. Finally, the participants were thanked for their participation.

The participants went through 25 rounds of consecutive decisions in total and needed 27 min 31 sec on average for this process (σ = 6.4). The fastest participant—a member of the control group—completed the experimental design in 17 min 33 sec. Before starting the decision-making process, we asked several questions in order to make sure that the participants were eligible and suitable to participate in the study. In line with previous work (Koch et al. 2009), the participants were advised to make several consecutive decisions among a set of four alternative machines. Participants were given a budget of 100 money units for each decision round. There was no time restriction for making a decision. However, after 7 min was spent in one decision round, the system displayed a friendly reminder to make a decision and provided the option to receive an additional explanation on the game and its features, if needed. However, no participant used this option. The participants received positive feedback once a decision was made (Sydow et al. 2009) in the form of a message about their savings in the respective round. After the feedback message about the respective decision, new information was presented for the next decision round in which the participants were required to make a decision. Then, the participants had to decide again. The following information was provided in each decision round:

- The cost structure of the four machines (Turbo, Heavy, Fast, and Efficient) in the present and following four decision rounds, including the basic fee, total production costs, total labor costs, and total energy costs
- The costs for placing a new contract with another machine ("switching costs") for the present and the following four decision rounds
- Information about savings in each round and total accumulated savings.

The information was presented on one page in various tables on the computer screen. Switching costs are costs that occur when changing from one machine to another machine (see Figure 3). The increase led to a lock-in for those who stayed with the machine Turbo until decision round 20 because the switching costs then exceeded the available budget of 100 monetary units. Figure 4 shows an example of the computer screen for decision round 6. By providing information on the present and following four decision rounds, we simulated a real-life setting in which the participants could come up with an optimal decision in each round with only limited foresight about the future development of the cost structures (see Levinthal and March 1993). Participants were encouraged to make notes and/or use a calculator if needed because participants had to make calculations in order to make decisions.

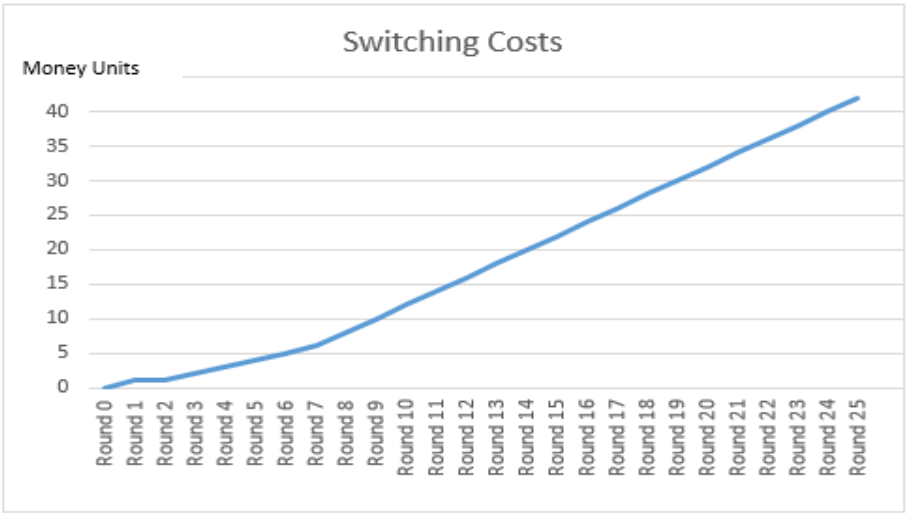

Figure 3. Switching Costs for the Decision Rounds

Decision 6/25:

Overview of Machines:

Costs for Round 6

	Turbo	Heavy	Fast	Efficient
Basic fee	43	46	55	53
Total production costs	16,5	21,5	10,5	7,5
Total labour costs	5,6	7	4	7
Total energy costs	4,2	2	5	5

Switching Costs

Round 6	Round 7	Round 8	Round 9	Round 10
5	6	8	10	12

Future Predictions:

Costs for future rounds/Machine Turbo

	Round 7	Round 8	Round 9	Round 10
Basic fee	43	43	43	43
Total production costs	16,2	15,9	15,6	15,3
Total labour costs	5,5	5,4	5,3	5,2
Total energy costs	4,2	4,2	4,2	4,2

Costs for future rounds/Machine Heavy

	Round 7	Round 8	Round 9	Round 10
Basic fee	46	46	46	46
Total production costs	20,8	19,9	19	18,1
Total labour costs	6,8	6,6	6,4	6,2
Total energy costs	2	2	2	2

Costs for future rounds/Machine Fast

	Round 7	Round 8	Round 9	Round 10
Basic fee	55	55	55	55
Total production costs	10,4	10,3	10,2	10,1
Total labour costs	4	4	4	4
Total energy costs	5	5	5	5

Costs for future rounds/Machine Efficient

	Round 7	Round 8	Round 9	Round 10
Basic fee	53	53	53	53
Total production costs	7,3	7,1	6,9	6,7
Total labour costs	7	7	7	7
Total energy costs	5	5	5	5

Question 16:
Which machine do you choose?

Machine Turbo ○ Machine Heavy ○ Machine Fast ○ Machine Efficient ○

Figure 4. Information Displayed in Decision Round 6

The manipulation for the treatment group was introduced in decision round 22 (see Figure 5). The control group did not receive a manipulation. The manipulation addressed a change in the market environment

(the demand for manual steering wheels), allowing each participant to produce steering wheels for the boat industry (Machine Water) and automatic steering wheels for autonomously driving cars (Machine Automatic). Both newly introduced options and the existing Machine Heavy had the same cost structure (see Figure 5). To make sure the information settings were equivalent in terms of attractiveness, we conducted a pretest, in which we asked 50 participants to evaluate the information settings on a 7-point Likert scale on the attractiveness and complexity of the information display (Amos and Spears 2010; Holbrook 1981). The participants evaluated the information settings as statistically significantly similar in terms of attractiveness ($t = 1.189$, $p < 0.032$) and in terms of complexity ($t = 1.97$; $p < 0.01$).

The experimental design and the information settings aimed to provide an optimal decision path and the possibility of a lock-in. In line with previous experimental research on path dependence (Koch et al. 2009), we identified path dependence when a decision that had been optimal for many decision rounds due to positive feedback became suboptimal and could no longer be changed due to budget restrictions—a situation that Sydow et al. (2009) called a "rationality shift." In line with previous research (Koch et al. 2009), we conceptualized path dependence in its resource-based form (Koch 2008, 2011; Rothmann et al. forthcoming; Sydow et al. 2009) based on production costs. An optimal decision was defined by referring to the cost structure; that is, an optimal decision was the one with the lowest overall costs. When all costs were considered, a specific alternative was superior in every decision round during the course of the experiment (see Figure 6). During the course of the experiment, the superior alternative changed in order to create a rationality shift. The optimal change from one alternative to another alternative was in the 17th decision round.

Decision 22/26: New Development and Notice from the Machine Supplier:

There has been a big decline in demand of steering wheels since a longer time. During a long meeting with the owners of the company, you are now tasked to make a decision concerning the future innovation strategy of the firm. The current market situation looks as follows: The international automotive market experiences a significant decrease in demand in (manual) steering wheel systems. However, a steady increase in demand in (automatic) steering wheel systems which is new invention where steering is taken over by the bordcomputer´s software. This shift can be explained by a steady growth in demand of autonomous cars on the international market.

Based on the current development on the automotive market, new opportunities have emerged for your company. The boat industry is interested in steering wheels. Based on the expertise in producing steering wheels over 80 years, your company would be able to shift from producing steering wheels for automotive to producing steering wheels for boats. Producing steering wheels for boats is relatively similar to producing steering wheels for the automotive industry. As described above, there is a big increase in demand in automatic steering wheel systems. Your machine supplier also offers you this option which means your companies would shift from producing manual steering wheels to produce automatic steering wheels.

Based on this development, your machine supplier offers you the known four machine alternatives as well as two new alternatives Machine Automatic to produce automatic steering wheel systems and Machine Water to produce steering wheels for the boat industry. For which option do you decide?

Overview of Machines:
Costs for Round 22

	Turbo	Heavy	Fast	Efficient	Automatic	Water
Basic fee	43	46	55	53	46	46
Total production costs	11,7	7,3	8,3	4,3	7,3	7,3
Total labour costs	4	3,8	4	7	3,8	3,8
Total energy costs	4,2	2	5	5	2	2

Switching Costs

Round 22	Round 23	Round 24	Round 25	Round 26
36	38	40	42	44

Future Predictions:

Costs for future rounds/Machine Turbo

	Round 23	Round 24	Round 25	Round 26
Basic fee	43	43	43	43
Total production costs	11,4	11,1	10,8	10,5
Total labour costs	3,9	3,8	3,7	3,6
Total energy costs	4,2	4,2	4,2	4,2

Costs for future rounds/Machine Heavy

	Round 23	Round 24	Round 25	Round 26
Basic fee	46	46	46	46
Total production costs	6,4	5,5	4,6	3,7
Total labour costs	3,6	3,4	3,2	3
Total energy costs	2	2	2	2

Costs for future rounds/Machine Fast

	Round 23	Round 24	Round 25	Round 26
Basic fee	55	55	55	55
Total production costs	8,8	8,7	8,6	8,5
Total labour costs	4	4	4	4
Total energy costs	5	5	5	5

Costs for future rounds/Machine Efficient

	Round 23	Round 24	Round 25	Round 26
Basic fee	53	53	53	53
Total production costs	4,1	3,9	3,7	3,5
Total labour costs	7	7	7	7
Total energy costs	5	5	5	5

Costs for future rounds/Machine Automatic

	Round 23	Round 24	Round 25	Round 26
Basic fee	46	46	46	46
Total production costs	6,4	5,5	4,6	3,7
Total labour costs	3,6	3,4	3,2	3
Total energy costs	2	2	2	2

Costs for future rounds/Machine Water

	Round 23	Round 24	Round 25	Round 26
Basic fee	46	46	46	46
Total production costs	6,4	5,5	4,6	3,7
Total labour costs	3,6	3,4	3,2	3
Total energy costs	2	2	2	2

Figure 5. Manipulation in Decision Round 22 for the Treatment Group

The dependent variable was path-dependent decision-making. We measured path-dependent decision-making with a dummy variable that distinguished between choosing the optimal alternative in the last round versus choosing a non-optimal alternative. Participants who ended up with a choice for a non-optimal alternative in the last round were regarded as being path-dependent because the switching costs were higher than the available budget; that is, they were locked in (Koch et al. 2009).

We measured risk propensity on a five-item scale (α = .86), which was adopted from established measurements in previous literature (Sitkin and Weingart 1995), including the following: "As the innovation manager of this firm, you face a decision that affects your organization's financial future. Given this circumstance, how would you rate your tendency to … (1) choose more or less risky alternatives based on the assessment of others on whom you must rely, (2) choose more or less risky alternatives which could have a major impact on the strategic direction of your organization, (4) initiate a strategic corporate action which has the potential to backfire, and (5) support a decision when you were aware that relevant analyses were done while missing several pieces of information." All items were measured on a 7-point Likert scale anchored at 1 = strongly disagree and 7 = strongly agree. We measured risk propensity after the first round, that is, after the first decision was made, as well as in decision round 22 (after the introduction of the manipulation). This allowed us to make direct comparisons and observe changes in perception within and between individuals. Regarding opportunity-threat perception, which was measured based on an established measurement from previous literature (Jackson and Dutton 1988), we included questions such as "Does this represent a threat for us?" and "Does this represent an opportunity for us?" The questions were included with the scale of risk propensity to add face validity to the task and to minimize participants' sensitivity to the research questions. For risk propensity, we measured opportunity-threat perception at two points in time, that is, after decision rounds 1 and 22, to recognize any changes in the perception of digital innovation. All factor loadings were greater than 0.70, Cronbach's alpha values were all greater than 0.75, and the values of average variance extracted were all greater than 0.623 (Fornell and Larcker 1981).

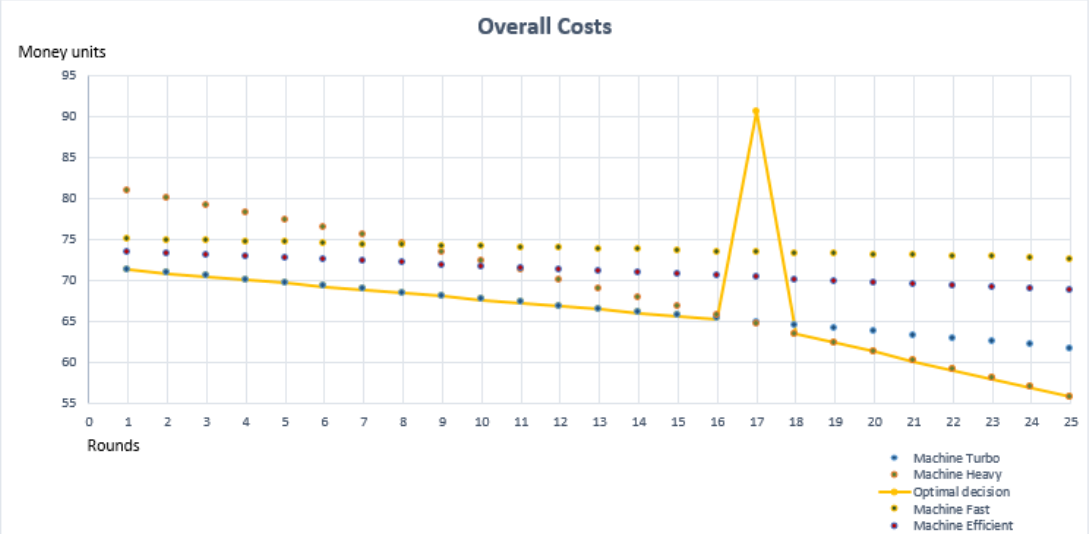

Figure 6. Overall Costs

Finally, we controlled for several other factors in the experiment, such as entrepreneurial intent, perceived attractiveness, risk aversion, and entrepreneurial intention (Burton et al. 1998; Dontu and Garcia 1999; Ajzen 1991). We included these variables and the participants' demographics to isolate the effects of the manipulated variables.

Data Analysis and Results

Control Variables and Manipulation Checks

To ensure the random assignment of subjects to the different experimental conditions and to rule out alternative explanations, we performed several one-way analyses of variance (ANOVAs). There were no significant differences in gender ($F = 1.11$, $p > 0.05$), marital status ($F = 2.02$, $p > 0.05$), work experience ($F = 0.56$, $p > 0.05$), managerial experience ($F = 1.13$, $p > 0.05$), leadership experience ($F = 1.08$, $p > 0.05$), team size ($F = 1.76$, $p > 0.05$), age ($F = 0.59$, $p > 0.05$), size of company ($F = 1.272$, $p > 0.05$), position ($F= 0.89$, $p > 0.05$), education ($F = 2.184$, $p > 0.05$), and time spent going through the study ($F = 1.677$, $p > 0.05$), indicating that these factors were not the cause of differences in responses.

The analysis of the descriptive statistics of the applied manipulation checks within the two groups revealed that the participants who were assigned to the treatment group clearly recognized the manipulation in decision round 22 (except one person), whereas participants in the control group clearly stated that no apparent change happened during the course of their decisions (except two persons). Additionally, the analysis of the descriptive statistics of the applied manipulation checks also revealed that the participants in both groups clearly recognized the positive feedback on savings in each decision round and total cumulative savings concerning their individual choices (except three persons). In addition, one-way ANOVAs confirmed these findings (all $p < 0.05$). These results provided strong evidence that the manipulations were successful.

Hypothesis Testing

Direct Effects of Digital Innovation on Path-Dependent Decision-Making

H1 argued that digital innovation has a negative impact on the reproduction of the decision path. A significant chi-square test revealed that the tendency to become path-dependent was consistent with our prediction that digital innovation is effective in decreasing the probability to reproduce the established decision path compared to the control group ($x^2 = 28.337$, $p < .001$); thus, H1 was supported. Figure 7 shows that 40 participants out of 75, more than half of the control group, did not recognize and thus missed the possibility to switch to the favorable alternative within 25 decision rounds, while only 35 participants (46.6 percent) succeeded in switching to the optimal decision and were not locked in. This result demonstrates a significant relationship between digital innovation as an external event that broadens the available scope of action and the probability of path-dependent decision-making and, thus, verifies the existence of path-dependent dynamics in our experimental design (Koch et al. 2009). Therefore, the main direct effect of digital innovation on path-dependent decision-making as formulated in H1 was supported.

Once the impact of digital innovation on the probability of path dependence was established, we explored the explanatory (i.e., mediation) mechanisms through which digital innovation affects path-dependent decision-making.

The Mediating Role of Risk Propensity and Opportunity-Threat Perception

Regarding our mediation hypotheses that focused on the explanatory mechanisms through which digital innovation impacts path-dependent decision-making, we argued that an increase in risk propensity and subsequently, in perceiving digital innovation as an opportunity are primary reasons for the negative impact of digital innovation on the continued reproduction of path-dependent decision-making.

To test our first mediator hypothesis (H2a), we conducted a one-way ANOVA ($F = 6.876$, $p < .01$) with planned contrasts; that is, we examined whether the risk propensity of the treatment group and the control group differed statistically significantly. Results from the contrast analysis revealed that the participants in the treatment group experiencing digital innovation were statistically significantly more willing to take risks than the participants in the control group ($t = 2.628$, $p < .01$); thus, H2a was supported.

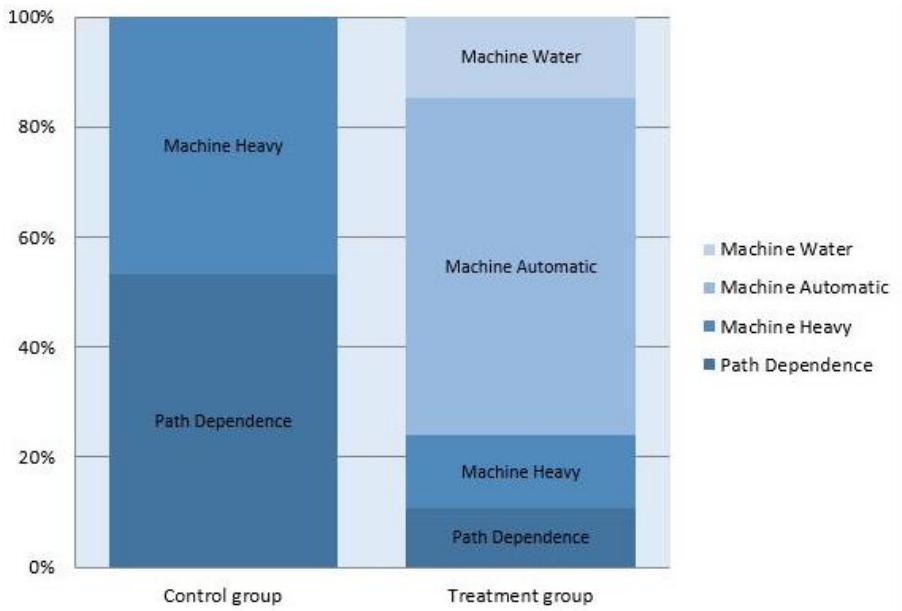

Figure 7. Graphical Overview of the Results across the Groups

To test H2b and H2c, we ran a linear ordinary least squares regression on a sub-sample. Specifically, we compared the treatment group and the control group to examine the impact of risk propensity on the degree to which the participants perceived digital innovation as an opportunity or threat. The results indicated that, in support of H2b, a higher willingness to take risks statistically significantly increased the subjects' perception of digital innovation as an opportunity ($\beta = 0.550$, $p < .01$), all else being equal. Furthermore, the results of a logistic regression ($\beta = 0.703$, $\exp(\beta) = 2.091$, $p < 0.001$) revealed that a high perception of digital innovation as an opportunity also statistically significantly increased the odds that decision-makers, when exposed to digital innovation, do not follow path-dependent decision-making; thus, H2c was supported.

Finally, following Hayes' (2013) recommended procedure, we ran a serial multiple mediator analysis between the control group and the treatment group (N = 142) with risk propensity and opportunity-threat perception as mediators, while controlling for all direct and indirect paths between the mediators and path-dependent decision-making. The results of the serial multiple mediator analysis are depicted in Tables 1 and 2. The results in Table 1 indicate significant effects of digital innovation on risk propensity, of risk propensity on opportunity-threat perception, and of opportunity-threat perception on path-dependent decision-making, further validating our results from our previous hypothesis testing. Furthermore, the direct effect of digital innovation on path-dependent decision-making became statistically insignificant after risk propensity and opportunity-threat perception were included, suggesting full mediation.

	M1 (Risk Propensity)			M2 (Opportunity-Threat Perception)			Y (Path-Dependent Decision-Making)		
Antecedent	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*
X (Digital Innovation)	.769	.176	.001	-.057	-.682	.497	-.756	.497	.120
M1 (Risk Propensity)	-	-	-	1.101	.037	.001	.454	.601	.479
M2 (Opportunity-Threat Perception)	-	-	-	-	-	-	1.072	.531	.044
Constant	2.235	.299	.001	.470	.154	.002	-2.928	1.794	.001
	$R^2 = .120$ $F(1, 140) = 19.052$, $p = .001$			$R^2 = 0.232$ $F(2, 139) = 35{,}661$ $p = .001$			Nagelkerke $R^2 = .387$ Model x^2 [3] = 43.551, p = .01		

Table 1. Results from Serial Multiple Mediation Analysis: Coefficients and Model Summary

Indirect Effect Paths	*Effect z*	*Boots SE*	*LLCI*	*ULCI*
(1) Digital Innovation -> Risk Propensity -> Path-Dependent Decision-Making	.327	.442	-.493	1.531
(2) Digital Innovation -> Opportunity-Threat Perception -> Path-Dependent Decision-Making	-.061	.104	-.327	.121
(3) Digital Innovation -> Risk Propensity -> Opportunity-Threat Perception -> Path-Dependent Decision-Making	.908	.541	.089	2.057
[a] Note: We conducted inferential tests for indirect effect paths based on 1,000 bootstrap samples generating 95 percent bias-corrected bootstrap confidence intervals (LLCI = Lower Limit / ULCI = Upper Limit of Confidence Interval)				

Table 2. Results from Serial Multiple Mediation Analysis (Bootstrapping Results[a] for Indirect Paths)

After completing the 25 consecutive decision rounds, all participants filled out a questionnaire that contained open and closed questions, for example, on the chosen strategy, the rationale for their decisions, demographics, manipulation checks, and an additional check of the participants' eligibility. The post-hoc analysis supports our findings, given that the responses about the chosen strategy and rationale of decision-making are in line with the presented results. For example, one participant stated, "Savings were the highest with the Machine Turbo [the path-dependent alternative]" and "When a trend was assumable and the opportunity of savings was higher than the switching costs, I stayed with the machine because changing was just too risky even after the market change." Furthermore, the statements support our research design and experimental setting such as the functionality of positive feedback. For instance, one participant stated, "[i]t was never worth switching as I was constantly saving the company," and another participant said, "First of all, the aim was to save as much money as possible and taking into account what will happen in the near future. Plus, I saved every round. So I didn't see a reason to change my business model and strategy."

Discussion and Conclusion

Conclusions and Contributions

In this paper, we set out to examine how digital innovation influences path-dependent decision-making. The findings of our experimental study suggest that digital innovation leads path-dependent decision-makers to select options that extend beyond those of past decisions. Thus, our results show that digital innovation helps path-dependent decision-makers leave their decision path. Furthermore, our study demonstrates that this relationship is fully mediated by the decision-makers' risk propensity and their perception of digital innovation as an opportunity or threat. In particular, our findings suggest that digital innovation increases the likelihood of taking risks. This, in turn, leads to perceiving digital innovation as an opportunity rather than a threat. This perception negatively influences the likelihood that path-dependent decision-makers continue to reproduce past decisions.

By examining the impact of digital innovation on path-dependent decision-making, our paper brings together different views across disciplinary boundaries: Whereas information systems research on digital innovation highlights the opportunities of emerging digital technologies (Bharadwaj et al. 2013), management research on path dependence focuses on the challenges that incumbents face in light of digital innovation (Rothmann and Koch 2014). Our study shows that these views are not incompatible; quite the contrary, it demonstrates how path-dependent decision-makers deviate from their decision path when new digital technologies emerge but highlights that it is a complex process that is mediated by risk propensity and opportunity-threat perception. By unbundling this process, our study provides several contributions to the literatures on digital innovation and path dependence.

First, whereas the previous literature has largely focused on the opportunities of digital innovation (Bharadwaj et al. 2013), our results provide insights into the dynamics of path dependence, a key challenge for incumbent firms in the face of digital innovation (Singh et al. 2015). Specifically, our study shows that decision-making by path-dependent decision-makers in light of digital innovation is a complex process that is fully mediated by risk propensity and opportunity-threat perception. In addition, our findings demonstrate that these constructs can vary over time. In particular, our results reinforce Lim et al.'s (2011) idea that risk propensity is not a static but a process-based construct; our findings extend beyond this previous work by demonstrating and highlighting the specific impact of digital innovation on the risk propensity of path-dependent decision-makers over time. Overall, our study highlights that exploiting the opportunities of digital innovation is not a straightforward process for path-dependent decision-makers. Especially the mediating constructs may cause tremendous frictions, or at least delays, when decision-makers are confronted with new digital technologies. Thus, this paper highlights the need for more sensitivity regarding the challenges that path-dependent decision-makers face in light of digital innovation.

Second, our study adds to the literature on path dependence. Whereas the previous literature has mainly focused on examining the emergence of decision paths (Dobusch and Schüßler 2013), our paper sheds light on the specific decision-making patterns of path-dependent decision-makers. In particular, our experimental study unfolds the path-dependent decision-making process. Thus, it highlights the crucial role of risk propensity and opportunity-threat perception in path-dependent decision-making. While previous works have emphasized the importance of these constructs (Gilbert 2005), our paper specifies their mediating role in the relationship between digital innovation and path-dependent decision-making. Therefore, our paper develops a better understanding of path-dependent decision-making in the face of digital innovation, an important but under-researched topic. Our study thus shows why path-dependent decision-makers may deviate from their decision path in the face of new digital technology despite the difficulties of this process that the extant literature (Rothmann and Koch 2014; Sydow et al. 2009) has highlighted and explored.

Third, our paper provides a methodological contribution. Whereas previous works mainly examined digital innovation and path dependence with traditional research methods, such as case studies and surveys (Karimi and Walter 2015; Rothmann and Koch 2014), our paper uses an experimental design to examine the process of path-dependent decision-making in light of digital innovation. This methodological approach allowed us to unveil the causal relationships that mediate the influence of digital innovation on path-dependent decision-making. Therefore, our paper not only responds to recent calls for such empirical examinations (Dobusch and Kapeller 2013; Nambisan et al. 2017) but also highlights the fruitfulness of experiments for examinations of digital innovation and path dependence.

Our paper also has practical implications. Specifically, for external interventions that aim at helping path-dependent incumbents exploit the potentials of digital innovation (see Schreyögg and Kliesch-Eberl 2007), the measures undertaken must clarify to the decision-makers in these firms that (1) this requires taking some risks and that (2) digital innovation might be an opportunity rather than a threat. To stimulate such thinking, firms should allow for some resource slack with which employees can freely experiment without hesitating to make losses. This resource lack includes the creation of protected open spaces where experimenting, failing, and learning from failures are explicitly welcomed. Such spaces are especially important for incumbent firms that develop efficient operating procedures that are, and in a way have to be, failure-intolerant as expressed by a zero-defect culture directed toward avoiding risks. Accordingly, protected open spaces allow and foster another kind of behavior that favors risk-taking and opportunity-seeking. The willingness to take this risk and the more profound engagement with digital innovation may then lead to recognition that digital innovation provides interesting opportunities beyond the established decision path instead of a threat. By recognizing such opportunities, path-dependent decision-makers may be inclined to deviate from the established decision path and exploit the potentials of digital innovation.

Limitations and Directions for Future Research

Our findings are subject to a number of limitations, which constitute fruitful starting points for future research. First, conducting experiments on a variety of real-life business processes would be avenues for future research to pursue. We believe that such efforts will further advance our understanding of the degree to which characteristics, mechanisms, and processes associated with digital innovation, which are central to this, are influenced by other real-life contingencies. However, despite the contributions of our study, our

findings are logically bound to the methodological design. This study was designed to analyze the impact of digital innovation on path-dependent decision-making in a typical business situation in which the business model is directly related to the choice of machine, for example, in the manufacturing context. However, the scenario is transferrable to the service sector only to a certain extent.

Second, in real-life situations, digital innovation is subject to additional factors. For instance, digital innovation shapes and is shaped by the environment in which the innovation is embedded (Majchrzak et al. 2016; Yoo et al. 2012). Therefore, different aspects of environmental dynamism, such as environmental velocity, uncertainty, frequency of change, and amplitude (Davis et al. 2009), as well as other factors, may further increase the complexity of such decisions. Thus, although our experimental design took into account environmental dynamism, such as market change, future work could expand on the influence of environmental dynamism and its interdependencies. Furthermore, this research design assumed that the decision-making power is subject to an intervention by a high-level executive (Barreto 2010). Future work might benefit from the inclusion of different individuals at higher and lower levels in the firm, as well as the aspect of team decision-making.

Third, in line with Koch et al.'s (2009) experiment, our study examined the path dependence of resource investments. Although this form of path dependence is ubiquitous (March 1991), there are other forms of path dependence that our study does not include. In particular, in addition to resource-based reasons, decision-making may become path-dependent due to strict normative guidelines and entrenched cognitive schemata (Koch 2008, 2011; Rothmann et al. 2014; Sydow et al. 2009), which have led to additional frictions for incumbents in the transition from analog to digital imaging (Lucas and Goh 2009; Tripsas and Gavetti 2000) and from paper-based to digital news (Rothmann and Koch 2014). Therefore, giving explicit consideration to these forms of path dependence can lead to different outcomes regarding the impact of digital innovation on path-dependent decision-making. For instance, imagining a plausible use case for emerging digital technologies requires decision-makers to extend beyond established cognitive schemata. The inability of path-dependent decision-makers to do so may lead them to reject digital innovation (Rothmann and Koch 2014; Benner and Tripsas 2012). Similarly, the willingness to take risks and the perception of digital innovation as an opportunity or threat might significantly vary based on an underlying set of established norms and values. Therefore, we consider a more detailed focus on other forms of path dependence (Rothmann et al. forthcoming) in the face of digital innovation as an insightful alley for future research.

References

Amos, C., and Spears, N. 2010. "Generating a Visceral Response," *Journal of Advertising* (38:3), pp. 25–38.

Arvidsson, V., Holmström, J., and Lyytinen, K. 2014. "Information Systems Use as Strategic Practice: A Multi-Dimensional View of Strategic Information System Implementation and Use," *Journal of Strategic Information Systems* (23:1), pp. 45–61.

Ajzen, I. 1991. "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* (50:2), pp. 179–211.

Barreto, I. 2010. "Dynamic Capabilities: A Review of Past Research and an Agenda for the Future," *Journal of Management* (36:1), pp. 256–280.

Bell, D. 1973. *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, New York: Basic Books.

Benner, M., and Tripsas, M. 2012. "The Influence of Prior Industry Affiliation on Framing in Nascent Industries: The Evolution of Digital Cameras," *Strategic Management Journal* (33:3), pp. 277–302.

Berkowitz, L., and Donnerstein, E. 1982. "External Validity Is More Than Skin Deep: Some Answers to Criticism of Laboratory Experiments," *American Psychologist* (37:3), pp. 245–257.

Besson, P., and Rowe, F. 2012. "Strategizing Information Systems-enabled Organizational Transformation: A Transdisciplinary Review and New Directions," *Journal of Strategic Information Systems* (21), pp. 103–124.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., and Venkatraman, N. 2013. "Digital Business Strategy: Toward a Next Generation of Insights," *MIS Quarterly* (37:2), pp. 471–482.

Bieber, M., Vitali, F., Ashman, H., Balasubramanian, V., and Oinas-Kukkonen, H. 1997. "Fourth Generation Hypermedia: Some Missing Links for the World Wide Web," *International Journal of Human-Computer Studies* (47:1), pp. 31–65.

Bono, J. E., and McNamara, G. 2011. "Publishing in AMJ—Part 2: Research Design," *Academy of Management Journal* (54:4), pp. 657–660.

Burgoon, J. K., Proudfoot, J. G., Schuetzler, R., and Wilson, D. 2014. "Patterns of Nonverbal Behavior Associated with Truth and Deception: Illustrations from Three Experiments," *Journal of Nonverbal Behavior* (38:3), pp. 325–354.

Burton, S., Lichtenstein, D. R., Netemeyer, R. G., and Garretson, J. A. 1998. "A Scale for Measuring Attitude towards Private Label Products and an Examination of its Psychological and Behavioral Correlates," *Academy of Marketing Science* (26:4), pp. 293–306.

Chattopadhyay, P., Glick, W. H., and Huber, G. P. 2001. "Organizational Actions in Response to Threats and Opportunities," *Academy of Management Journal* (44:5), pp. 937–955.

Chen, J. V., Yen, D. C., and Chen, K. 2009. "The Acceptance and Diffusion of the Innovative Smart Phone Use: A Case Study of a Delivery Service Company in Logistics," *Information and Management* (46:4), pp. 241–248.

Christensen, C. M., Wang, D., and van Bever, D. 2013. "Consulting on the Cusp of Innovation," *Harvard Business Review* (91:10), pp. 106–114.

Davis, J., Eisenhardt, K., and Bingham, C. 2009. "Optimal Structure, Market Dynamism, and the Strategy of Simple Rules," *Administrative Science Quarterly* (54:3), pp. 413–452.

Dobusch, L., and Kapeller, J. 2013. "Breaking New Paths: Theory and Method in Path Dependence Research," *Schmalenbach Business Review* (65:3), pp. 288–311.

Dobusch, L., and Schüßler, E. 2013. "Theorizing Path Dependence: A Review of Positive Feedback Mechanisms in Technology Markets, Regional Clusters, and Organizations," *Industrial and Corporate Change* (22:5), pp. 617–647.

Donthu, N., and Garcia, A. 1999. "The Internet Shopper," *Journal of Advertising Research* (39:3), pp. 52–58.

Durand, R., and Vaara, E. 2009. "Causation, Counterfactuals, and Competitive Advantage," *Strategic Management Journal* (30), pp. 1245–1264.

Fadel, K. J., Meservy, T. O., and Jensen, M. L. 2015. "Exploring Knowledge Filtering Processes in Electronic Networks of Practice," *Journal of Management Information Systems* (31:4), pp. 158–181.

Fornell, C., and Larcker, D. F. 1981. "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research* (18:1), pp. 39–50.

Garud, R., and Karnøe, P. 2001. "Path Creation as a Process of Mindful Deviation," in *Path Dependence and Creation*, R. Garud and P. Karnøe (eds.), Mahwah, NJ: Erlbaum, pp. 1–38.

Garud, R., Kumaraswamy, A., and Karnøe, P. 2010. "Path Dependence or Path Creation?" *Journal of Management Studies* (47:4), pp. 760–774.

Gilbert, C. G. 2005. "Unbundling the Structure of Inertia: Resource versus Routine Rigidity," *Academy of Management Journal* (48:5), pp. 741–763.

Hanseth, O., and Ciborra, C. (eds.). 2007. *Risk, Complexity and ICT*, Cheltenham, UK: Edward Elgar.

Hayes, A. F. 2013. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, New York: Guilford Press.

Helson, H. 1964. *Adaptation-Level Theory: An Experimental and Systematic Approach to Behavior*, New York: Harper & Row.

Hoehle, H., Zhang, X., and Venkatesh, V. 2015. "An Espoused Cultural Perspective to Understand Continued Intention to Use Mobile Applications: A Four-country Study of Mobile Social Media Application Usability," *European Journal of Information Systems* (24:3), pp. 337–359.

Holbrook, M. B. 1981. "Integrating Compositional and Decompositional Analyses to Represent the Intervening Role of Perceptions in Evaluative Judgments," *Journal of Marketing Research* (18), pp. 13-28.

Jackson, S. E., and Dutton, J. E. 1988. "Discerning Threats and Opportunities," *Administrative Science Quarterly* (33:3), pp. 370–387.

Jiang, Z., Wang, W., Tan, B. C. Y., and Yu, J. 2016. "The Determinants and Impacts of Aesthetics in Users' First Interaction with Websites," *Journal of Management Information Systems* (33:1), pp. 229–259.

Johnson, W. H. A. 2007. "Managing Uncertainty in Innovation: The Applicability of Both Real Options and Path Dependence Theory," *Creativity and Innovation Management* (16:3), pp. 274–281.

Karahanna, E., Xu, S. X., and Zhang, N. 2015. "Psychological Ownership Motivation and Use of Social Media," *Journal of Marketing Theory and Practice* (23:3), pp. 185–207.
Karimi, J., and Walter, Z. 2015. "The Role of Dynamic Capabilities in Responding to Digital Disruption: A Factor-based Study of the Newspaper Industry," *Journal of Management Information Systems* (32:1), pp. 39–81.
Karimi, J., and Walter, Z. 2016. "Corporate Entrepreneurship, Disruptive Business Model Innovation Adoption, and Its Performance: The Case of the Newspaper Industry," *Long Range Planning* (49:3), pp. 342–360.
Koch, J. 2008. "Strategic Paths and Media Management: A Path Dependency Analysis of the German Newspaper Branch of High Quality Journalism," *Schmalenbach Business Review* (60:1), pp. 51–74.
Koch, J. 2011. "Inscribed Strategies: Exploring the Organizational Nature of Strategic Lock-in," *Organization Studies* (32:3), pp. 337–363.
Koch, J., Eisend, M., and Petermann, A. 2009. "Path Dependence in Decision-making Processes: Exploring the Impact of Complexity under Increasing Returns," *Business Research* (2:1), pp. 67–84.
Koh, T. K., Fichman, M., and Kraut, R. E. 2012. "Trust Across Borders: Buyer-Supplier Trust in Global Business-to-Business E-Commerce," *Journal of the Association for Information Systems* (13:11), pp. 886–922.
Kühberger, A. 1998. "The Influence of Framing on Risky Decisions: A Meta-analysis," *Organizational Behavior and Human Decision Processes* (75:1), pp. 23–55.
Kunow, K., Gersch, M., and Koch, J. 2013. "Temporary Incompetence as a Path-breaking Strategy: Two Major Record Companies' Efforts to Escape Their Competence Lock-in," *Jahrbuch Strategisches Kompetenz Management* (6), pp. 9–33.
Levinthal, D. A., and March, J. G. 1993. "The Myopia of Learning," *Strategic Management Journal* (14), pp. 95–112.
Li, S., and Karahanna, E. 2015. "Online Recommendation Systems in a B2C E-Commerce Context: A Review and Future Directions," *Journal of the Association for Information Systems* (16:2), pp. 72–107.
Lim, W. K., Sia, S. K., and Yeow, A. 2011. "Managing Risks in a Failing IT Project: A Social Constructionist View," *Journal of the Association for Information Systems* (12:6), pp. 414–440.
Lowry, P. B., Vance, A., Moody, G., Beckman, B, and Read, A. 2008. "Explaining and Predicting the Impact of Branding Alliances and Web Site Quality on Initial Consumer Trust of E-Commerce Web Sites," *Journal of Management Information Systems* (24:4), pp. 199–224.
Lucas, H. C., and Goh, J. M. 2009. "Disruptive Technology: How Kodak Missed the Digital Photography Revolution," *Journal of Strategic Information Systems* (18:1), pp. 46–55.
Lyytinen, K., and Rose, G. M. 2003. "The Disruptive Nature of Information Technology Innovations: The Case of Internet Computing in Systems Development Organizations," *MIS Quarterly* (27:4), pp. 557–596.
Machlup, F. 1962. *The Production and Distribution of Knowledge in the United States*, Princeton: Princeton University Press.
MacKinnon, D. 2008. *Introduction to Statistical Mediation Analysis*, New York: Routledge Academic.
Majchrzak, A., Markus, M. L., and Wareham, J. 2016. "Designing for Digital Transformation: Lessons for Information Systems Research from the Study of ICT and Societal Challenges," *MIS Quarterly* (40:2), pp. 267–277.
March, J. G. 1991. "Exploration and Exploitation in Organizational Learning," *Organization Science* (2:1), pp. 71–87.
Mishra, A. N., and Agarwal, R. 2010. "Technological Frames, Organizational Capabilities, and IT Use: An Empirical Investigation of Electronic Procurement," *Information Systems Research* (21:2), pp. 249–270.
Nambisan, S., Lyytinen, K., Majchrzak, A., and Song, M. 2017. "Digital Innovation Management: Reinventing Innovation Management in the Digital World," *MIS Quarterly* (14:1), pp. 223–238.
Oh, C., Sasser, S., and Almahmoud, S. 2015. "Social Media Analytics Framework: The Case of Twitter and Superbowl Ads," *Journal of Information Technology Management* (26:1), pp. 1–18.
Oestreicher-Singer, G., and Zalmanson, L. 2013. "Content or Community? A Digital Business Strategy for Content Providers in the Social Age," *MIS Quarterly* (37:2), pp. 591–616.
Pagani, M. 2013. "Digital Business Strategy and Value Creation: Framing the Dynamic Cycle of Control Points," *MIS Quarterly* (37:2), pp. 617–632.

Polites, G. L., and Karahanna, E. 2012. "Shackled to the Status Quo: The Inhibiting Effects of Incumbent System Habit, Switching Costs, and Inertia on New System Acceptance," *MIS Quarterly* (36:1), pp. 21–42.

Polites, G. L., and Karahanna, E. 2013. "The Embeddedness of Information Systems Habits in Organizational and Individual Level Routines: Development and Disruption," *MIS Quarterly* (37:1), pp. 221–246.

Rainer, R. K., Snyder, C. A., and Carr, H. H. 1991. "Risk Analysis for Information Technology," *Journal of Management Information Systems* (8:1), pp. 129–147.

Rauch, M., Wenzel, M., and Wagner, H.-T. 2016. "The Digital Disruption of Strategic Paths: An Experimental Study," in *Proceedings of the 37th International Conference on Information Systems*, editors (eds.), Dublin, Ireland

Rothmann, W., and Koch, J. 2014. "Creativity in Strategic Lock-ins: The Newspaper Industry and the Digital Revolution," *Technological Forecasting and Social Change* (83:3), pp. 66–83.

Rothmann, W., Wenzel, M., and Wagner, H.-T. 2014. "Alternating Forms of Lock-in: Publishing Digital News in the Path of a Free Content Culture," in *Proceedings of the European Conference on Information Systems*, editor name (ed.), Location, pp. xxx–xxx.

Rothmann, W., Wenzel, M., and Wagner, H.-T. forthcoming. "Technological Opportunities and their Rejection: A Process Perspective on Organizational Lock-in," in *Technological Innovation Networks: Collaboration and Partnership*, B. Ran (ed.), Charlotte, NC: Information Age, pp. xxx–xxx.

Saebi, T., Lien, L, and Foss, N. J. forthcoming. "What Drives Business Model Adaptation? The Impact of Opportunities, Threats and Strategic Orientation," *Long Range Planning*.

Schmidt, T., and Braun, T. 2015. "When Cospecialization Leads to Rigidity: Path Dependence in Successful Strategic Networks," *Schmalenbach Business Review* (67), pp. 489–515.

Schreyögg, G., and Kliesch-Eberl, M. 2007. "How Dynamic can Organizational Capabilities be? Towards a Dual-Process Model of Capability Dynamization," *Strategic Management Journal* (28:9), pp. 913–933.

Schreyögg, G., Sydow, J., and Holtmann, P. 2011. "How History Matters in Organisations: The Case of Path Dependence," *Management and Organizational History* (6:1), pp. 81–100.

Shadish, W. R., Cook, T. D., and Campbell, D. T. 2001. *Experimental and Quasi-experimental Designs for Generalized Causal Inference*, Boston: Houghton Mifflin.

Singh, R., Mathiassen, L., and Mishra, A. 2015. "Organizational Path Constitution in Technological Innovation: Evidence from Rural Telehealth," *MIS Quarterly* (39:3), pp. 643–665.

Sitkin, S. B., and Weingart, L. R. 1995. "Determinants of Risky Decision-Making Behavior: A Test of the Mediating Role of Risk Perceptions and Propensity," *Academy of Management Journal* (38:6), pp. 1573–1592.

Staw, B. M., Sandelands, L. E., and Dutton, J. E. 1981. "Threat Rigidity Effects in Organizational Behavior: A Multilevel Analysis," *Administrative Science Quarterly* (26:4), pp. 501–524.

Stein, K.-M., Newell, S., Wagner, E. L., and Galliers, R. D. 2015. "Coping with Information Technology: Mixed Emotions, Vacillation, and Nonconforming Use Patterns," *MIS Quarterly* (39:2), pp. 367-392.

Sydow, J., Schreyögg, G., and Koch, J. 2009. "Organizational Path Dependence: Opening the Black Box," *Academy of Management Review* (34:4), pp. 689–709.

Tan, B., Pan, S. L., Lu, X., and Huang, L. 2015. "The Role of IS Capabilities in the Development of Multi-Sided Platforms: The Digital Ecosystem Strategy of Alibaba.com," *Journal of the Association for Information Systems* (16:4), pp. 248–280.

Tan, M., and Teo, T. S. H. 2000. "Factors Influencing the Adoption of Internet Banking," *Journal of the Association for Information Systems* (1:1), pp. 1–42.

Teo, T. S. H., Nishant, R., Goh, M., and Agarwal, S. 2011. "Leveraging Collaborative Technologies to Build a Knowledge Sharing Culture at HP Analytics," *MIS Quarterly Executive* (10:1), pp. 1–18.

Teo, T. S. H., Srivastava, S. C., and Jiang, L. 2008. "Trust and Electronic Government Success: An Empirical Study," *Journal of Management Information Systems* (25:3), pp. 99–132.

Thomas, J. B., Clark, S. M., and Gioia, D. A. 1993. "Strategic Sensemaking and Organizational Performance: Linkages among Scanning, Interpretation, Action, and Outcomes," *Academy of Management Journal* (36:2), pp. 239–270.

Tilson, D., Lyytinen, K., and Sørensen, C. 2010. "Digital Infrastructures: The Missing IS Research Agenda," *Information Systems Research* (21:4), pp. 748–759.

Tripsas, M., and Gavetti, G. 2000. "Capabilities, Cognition, and Inertia: Evidence from Digital Imaging," *Strategic Management Journal* (21:10/11), pp. 1147–1161.

Twyman, N. W., Elkins, A. C., Burgoon, J. K., and Nunamaker, J. F. 2014. "A Rigidity Detection System for Automated Credibility Assessment," *Journal of Management Information Systems* (31:1), pp. 173–202.

Venkatesh, V., Thong, J. Y. L., Chan, F. K. Y., and Hu, P. J. H. 2016. "Managing Citizens' Uncertainty in E-Government Services: The Mediating and Moderating Roles of Transparency and Trust," *Information Systems Research* (27:1), pp. 87–111.

Vergne, J.-P., and Durand, R. 2010. "The Missing Link Between the Theory and Empirics of Path Dependence: Conceptual Clarification, Testability Issue, and Methodological Implications," *Journal of Management Studies* (47:4), pp. 736–759.

Verhagen, T., Swen, E., Feldberg, F., and Merikivi, J. 2015. "Benefitting From Virtual Customer Environments: An Empirical Study of Customer Engagement," *Computers in Human Behavior* (48), pp. 340–357.

Wagner, H. T., Morton, S. C., Dainty, A. R. J., and Burns, N. D. 2011. "Path Dependent Constraints on Innovation Programmes in Production and Operations Management," *International Journal of Production Research* (49:11), pp. 3069–3085.

Wang, J.-L., Jackson, L. A., Gaskin, J., and Wang, H.-Z. 2014. "The Effects of Social Networking Site (SNS) Use on College Students' Friendship and Well-being," *Computers in Human Behavior* (37), pp. 229–236.

Wenzel, M. 2015. "Path Dependence and the Stabilization of Strategic Premises: How the Funeral Industry Buries Itself," *Business Research* (8:2), pp. 265–299.

Wenzel, M., Wagner, H.-T., and Koch, J. 2017. "The Funeral Industry and the Internet: On the Historical Emergence and Destabilization of Strategic Paths," *European Journal of Information Systems* (26:4), pp. 361–378.

Wiener, N. 1948. *Cybernetics: Or Control and Communication in the Animal and the Machine*, Cambridge: MIT Press.

Yoo, Y. 2010. "Computing in Everyday Life: A Call for Research on Experiential Computing," *MIS Quarterly* (34:2), pp. 213–231.

Yoo, Y., Boland, R. J. J., Lyytinen, K., and Majchrzak, A. 2012. "Organizing for Innovation in the Digitized World," *Organization Science* (23:5), pp. 1398–1408.

Yoo, Y., Henfridsson, O., and Lyytinen, K. 2010. "The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research," *Information Systems Research* (21:4), pp. 724–735.

Zhu, K., Song, S., Xu, S. X., and Kraemer, K. L. 2006. "Innovation Diffusion in Global Contexts: Determinants of Post-Adoption Digital Transformation of European Companies," *European Journal of Information Systems* (15:6), pp. 601–616.