Does One Size Fit All?
Theorizing Governance Configurations for Digital Innovation

Abstract
Organizations from nearly every industry face critical challenges of organizing for successful digital innovation. While the notion of digital innovation management has received increasing interest, prior IS research has offered limited insights into the effectiveness of specific organizing structures and mechanisms, such as the allocation of decision rights or the coordination between IS and business units. In this study, we combine an IT governance perspective with configurational theory to explore digital innovation governance configurations that achieve high performance. We employ fuzzy-set qualitative comparative analysis (fsQCA), a method that accommodates mutual causality, discontinuity and equifinality, to analyze survey data from a sample of U.S. IT managers. The analysis reveals six different configurations that produce high digital innovation performance. We use these results to derive theoretical insights as configurational propositions for further research, and discuss their practical implications.

Keywords: Digital Innovation Governance, Fuzzy Set Qualitative Comparative Analysis, Digital Innovation Control Rights, Interdepartmental Dynamics, Chief Digital Officer

Introduction
Digital innovations and transformations are increasingly a part of contemporary firms regardless of whether they follow a platform or pipeline strategy for competitive advantage. Due to significant
advancements in digital technologies, established organizations find themselves competing in increasingly fast-changing digital business environments (Hendridsson and Yoo 2014). Digital innovation, defined 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), poses an organizing challenge for many firms because of their unique characteristics, such as generativity and convergence (Yoo et al. 2012). Recent research describes tensions between digital innovations and existing organizing logics and capabilities (e.g., Svahn et al. 2017), and often focuses on the role of individual elements such as IT artifacts and seeding strategies across different settings (e.g., Huang et al. 2018; Ravichandran et al. 2017; Saldanha et al. 2017). However, existing research provides few guidelines on how to design effective governance structures and mechanisms to successfully develop and introduce new digital offerings, calling for future research to delve into new theorizing that accounts for the idiosyncratic nature of digital innovation (Nambisan et al. 2017).

From a governance perspective, digital innovation performance depends on formal decision rights (e.g., Sambamurthy and Zmud 1999) and horizontal mechanisms used to facilitate interdepartmental interaction and collaboration (e.g., Brown 1999), as well as their interaction with the environmental context (e.g., Xue et al. 2011). With regard to decision rights, it is unclear how and to what extent established IT departments, in the past often primarily concerned with IT use for supporting business processes (Gannon 2013), can effectively contribute to digital innovation. While current research stresses the role of specific organizational capabilities in influencing the contribution of the IT department to digital innovation (e.g., Leonhardt et al. 2017), we know little about the efficacy of different organizational configurations, and the degree to which the IT department assumes control rights of digital innovations. Concerning horizontal governance mechanisms, and the role of formal integrator in particular, recent studies point to the relevance of Chief Digital Officers (CDOs) in facilitating interdepartmental collaboration for developing digital innovations (e.g., Haffke et al. 2016; Tumbas et al. 2018). However, there is a lack of empirical studies that investigate if and how CDOs impact performance. Therefore, our study aims to address these gaps in the understanding by developing an integrated digital innovation governance framework that explains digital innovation performance. We employ a configurational theory perspective, following the call of El Sawy et al. (2010) for adopting configurational approaches in information systems (IS) strategy research.

Using configurational theories as a theoretical lens has a long tradition in IT governance research (e.g., Brown and Magill 1994). In contrast to variance and process theories, the configurational perspective is better suited to the investigation of complex phenomena by allowing conjunctural, equifinal, and asymmetric causation (El Sawy et al. 2010; Park and Mithas 2018). Because existing research regarding successful governance dimensions for digital innovations is scarce, a configurational research design allows for an exploratory and inductive approach (Thomann and Maggetti 2017). Prior research has not yet accumulated sufficient knowledge to apply a deductive research design to formulate specific hypotheses a priori. Therefore, our study proceeds as follows: First, we borrow from the IT governance domain to identify relevant elements in a digital innovation governance framework. After choosing relevant constructs and measures for the different components of the framework, we describe our data collection, which is based on a survey of U.S. IT managers. Finally, we apply a configurational analysis that results in six different configurations for high digital innovation performance, and derive theoretical configurational propositions for future research. In doing so, we shift from a theory-based perspective to a data-driven approach, resembling the retroductive theory-building research approach of Park et al. (2017), who use a configurational lens to investigate the relationship between IT and organizational agility.

Our results contribute directly to the theorizing on digital innovation as well as IT governance, integrating the roles of digital control rights, CDOs and informal coordination mechanisms that were often examined separately in prior literature. Moreover, we make theoretical contributions by developing new propositions for digital innovation governance, leveraging data in an “important developmental, illustrative or justificatory role” (Burton-Jones et al. 2018, p. 3). From a managerial perspective, our study suggests different governance design options to organizations under specific contextual conditions. Since firms vary in their idiosyncratic resources and governance mechanisms shaped by their unique histories, configurational theories enable managers to include context-dependent variables as well as path-dependent choices into their decision-making process to find an optimal configuration for their unique situation (El Sawy et al. 2010).
Conceptual Background

Configurational Theories

The idea of identifying a set of decisive characteristics to distinguish between different *types, gestalts* or *configurations* of firms has a long history in management research. In this study, we follow Meyer et al. (1993, p. 1175) and define an organizational configuration as “any multidimensional constellation of conceptually distinct characteristics that commonly occur together”. Accordingly, organizational configurations consider firms as sets of interconnected variables to explain performance outcomes. As a result, configurational inquiries overcome the assumption that a particular variable or set of variables contribute to certain outcomes across all firms or cases (i.e., variance theories) (Ketchen et al. 1997). The configurational perspective implies the notion of equifinality, meaning that different configurations (or combinations of elements) may produce the same outcome, e.g., high performance (Doty et al. 1993). While variance theories are based on correlational hypotheses and process theories describe temporal sequences of events, configurational theories adopt a systems perspective (Burton-Jones et al. 2015) to determine the causal combinations or recipes that produce a certain outcome. Moreover, results from configurational analyses can reveal the relative importance of elements, in addition to their mere presence or absence, allowing for suppression, substitution, and complementarity effects, as well as asymmetric causality (El Sawy et al. 2010; Fiss 2011). Because of these unique properties, a configurational perspective can effectively generate middle range theories that are embedded in a specific context (El Sawy et al. 2010). Due to the multifaceted nature of configurations, it is crucial to choose the relevant domains as well as key constructs based on careful review of prior literature related to the study’s research question (Dess et al. 1993). Contrary to using deductive correlational analysis that focuses on testing a theory, applying a configurational perspective together with a retroductive research approach allows for defining relevant theoretical dimensions beforehand without hypothesizing specific relationships. Building on the empirical patterns explaining how the combinations of theoretical constructs result in a certain outcome, researchers can then turn to theorizing (e.g., Misangyi and Acharya 2014; Park et al. 2017). This approach is particularly suited to our research context as existing research on IT governance as well as recent studies on new organizational phenomena, such as the role of CDOs, offer insight into key theoretical building blocks that can be used in a retroductive configurational analysis of successful digital innovation governance.

Recent research in IS follows El Sawy et al. (2010) to use a configurational perspective for building richer theories. For example, Leischnig et al. (2016) identified different market approaches and environmental characteristics that interact with digital business strategy to result in high market performance. Mikalef and Pateli (2017) focused on environmental variables and IT-enabled dynamic capabilities as elements of configurations that lead to high organizational agility. In contrast, Park et al. (2017) examined the interaction of information technology, environmental velocity, and organizational factors to identify successful configurations for producing different types of organizational agility. We extend these studies by using a configurational theory lens to examine digital innovation governance and associated performance outcomes.

Digital Innovation Governance Research Framework

Because literature on digital innovation management is still in its infancy, we borrow from IT governance research that has been well established in IS research. In the narrow sense of the term, IT governance refers to decision rights and accountabilities for the effective use of IT in an organization (Weill and Ross 2004). Early research in this domain mostly examined different governance modes (e.g., centralized, decentralized, federal/hybrid) for assigning the decision rights for IT activities as well as their respective contingency factors (Sambamurthy and Zmud 1999). More recently, researchers focused on examining the effectiveness and outcomes of IT governance (Huang et al. 2010; Wu et al. 2015). Researchers have alluded to different mechanisms that contribute to IT governance performance that include structures, processes, and relational mechanisms (Bradley et al. 2012; De Haes and Van Grembergen 2009). Applying the insights from prior studies to our context, digital innovation governance can be understood as structures, processes, and relational mechanisms for the effective development of digital innovations in an organization.

In this study, we adopt the perspective of Horlacher et al. (2016), who consider two different dimensions: IT governance architectures (i.e., structures) and horizontal coordination mechanisms (i.e., relational
mechanisms). IT governance architectures refer to the decision-making structures implemented to define the locus of authority for IT activities (Sambamurthy and Zmud 1999). Organizations face the choice of a centralized, decentralized, or hybrid decision-making structure for organizing their IT activities. While a central IT governance architecture grants all decision rights to the IT organization, a decentralized organizational design delegates decision-making authority to the business units (Brown and Magill 1994).

In between these two extremes, the hybrid or federal IT governance architecture splits the authority between IT and business, for instance by placing the locus of control for IT infrastructure decisions in the IT organization, and those related to IT applications in the business departments (Sambamurthy and Zmud 1999; Tiwana and Kim 2015). Whereas a centralized IT governance is generally associated with higher efficiency (due to economies of scale), a decentralized IT governance is associated with greater responsiveness to idiosyncratic needs of the different business units (Brown and Magill 1994). In our case, we adapted the definition of different IT governance architectures to the context of digital innovations. Thus, during the development of digital innovations, the decision rights can be characterized in the same way: While in some firms the IT organization (centralized) or the business units (decentralized) have complete control over the development process, in others the decision authority is split up somewhere in between the two extremes. In the same way that decision-making architectures are important antecedents for IT governance effectiveness (Brown and Magill 1994), we argue that the locus of digital innovation control rights plays a role for high-performing digital innovation governance configurations.

The second relevant IT governance dimension includes horizontal coordination mechanisms (Mintzberg 1979), that can be described as formal and informal organizational designs to facilitate the interaction of individuals and to coordinate activities across two units in an organization (Brown 1999). Horizontal mechanisms are not entirely independent to an organization’s hierarchical decision-making structure, but can be used separately in order to increase coordination and communication between different units (Brown 1999). On the one hand, informal mechanisms are non-structural in nature and aim at facilitating interaction and problem-solving across different departments (Brown 1999). For example, Galbraith (1994) describes six different network-building practices that enable relationship-building between individuals of different units, such as interdepartmental rotation and events, or physical colocation. On the other hand, formal horizontal mechanisms include structural roles and groups that are used to coordinate between different units in an organization. For instance, steering committees or cross-unit integrators can be utilized as organizational design schemes to facilitate cross-unit problem-solving (Brown 1999).

For the informal dimension of horizontal governance mechanism, we consider interdepartmental dynamics. Following Jaworski and Kohli (1993), the interdepartmental dynamics concept comprises subdimensions of conflict and connectedness. Interdepartmental conflict “refers to the tension arising from the incompatibility of actual or desired responses” (Jaworski and Kohli 1993, p. 55), and therefore inhibits communication between departments as well as coordinated responses to market demands. In contrast, interdepartmental connectedness describes the degree of direct contact among individuals of different units. Consequently, a high connectedness enables effective information exchange and collaboration across departments (Jaworski and Kohli 1993). Since digital innovation requires the combination of diverse knowledge across different departments (Yoo et al. 2010), interdepartmental dynamics may be at the core of successful digital innovation governance configurations. For the formal dimension of horizontal governance mechanisms, we focus on the role of the Chief Digital Officer as a design option for firms aiming to facilitate their digital innovation performance. The CDO can embody the formal integrator role according to Brown’s (1999) classification of horizontal governance mechanisms. Recent research results point to the need of coordinating digital initiatives as one of the main drivers behind creating a CDO position (Haffke et al. 2016; Horlacher and Hess 2016; Singh and Hess 2017). Consequently, main areas of responsibility for CDOs are the coordination of digital activities across departmental boundaries, especially with regard to digital innovation (Tumbas et al. 2017), as well as informing and educating the rest of the organization about digital opportunities and threats (Haffke et al. 2016). Thus, CDOs may constitute a crucial causal ingredient for successful digital innovation governance designs.

The final element in describing digital innovation governance configurations is an organizations’ external environment, as it plays an important role in its interaction with the implemented governance structures and mechanisms. We follow Jap (2001) who describes three sources of environmental turbulence that, in combination, constitute the multidimensional construct. The three components are: (1) market turbulence, which is related to changes in customer demands or preferences; (2) competitive intensity; and (3) technological change, describing the rate of technological innovations (Jap 2001; Rai and Tang 2010). Early
contingency-based studies used environmental turbulence as a predictor of certain governance choices. In this regard, a high environmental uncertainty was often related to decentralized governance architectures, because decentralization emphasizes local responsiveness (Brown 1997). In contrast, firms operating in stable and predictable environments could harness the economies of scale of centralized decision-rights architectures (Xue et al. 2011). However, new results challenge this assumption by finding a curvilinear relationship between environmental uncertainty and IT infrastructure governance centralization. This finding is attributed to agency arguments as well as the idea that business units may not be able to respond appropriately on their own in very turbulent environments, which encourages centralization (Xue et al. 2011).

Environmental turbulence should not only interact with the choice of governance architecture, but is also widely used as a contextual variable in models explaining organizational performance, since stable and predictable business environments may require substantially different capabilities and organizational structures than unstable and unpredictable settings (e.g., Pavlou and El Sawy 2006; Rai and Tang 2010). Thus, environmental turbulence, in its interaction with the different digital innovation governance dimensions, should constitute a major factor for the outcome of this study.

Figure 1 depicts the proposed research framework as a summary. It illustrates the configurational perspective by showing how different antecedents on the left hand side can potentially interact with one another to produce causal recipes for the digital innovation performance outcome. This contextual approach, including the organization’s environment, allows for the generation of a middle-range theory explaining conjunctural, equifinal, and asymmetric effects of different governance configurations on performance (Park et al. 2017, Park and Mithas 2018).

![Figure 1. Digital Innovation Governance Research Framework](image)

**Research Methodology**

**Data Collection and Sample**

To examine the interactions and relationships in our research framework, we collected survey data from a sample of U.S. IT managers in cooperation with a market research company by using panels from diverse industries. Because most of the relevant constructs specifically relate to the IT department, we focused on senior IT managers who were able to assess both the IT function and the overall organization. Survey respondents were offered a token amount of monetary compensation for their participation.

After a small-scale, qualitative pre-test (see Straub et al. 2004) with scholars commenting on the wording and comprehensiveness of the instrument, the market research company administered the online survey to
potential respondents. In total, the survey was sent to 404 individuals, who filled out some initial questions confirming the participants’ job roles as senior IT managers. After removing respondents who were screened out, we received 222 completed questionnaires (response rate = 55%). We further eliminated 41 observations that were either incomplete or featured implausibly short handling times, resulting in a final sample size of 181. Table 2 depicts basic demographical information about the respondents and the corresponding firms in our sample.

Table 1. Sample Demographics (n = 181)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
<th>Industry</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>77</td>
<td>42.54%</td>
<td>Agriculture/Forestry/</td>
<td>1</td>
<td>0.55%</td>
</tr>
<tr>
<td>Male</td>
<td>104</td>
<td>57.46%</td>
<td>Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>Mining</td>
<td>1</td>
<td>0.55%</td>
</tr>
<tr>
<td>20 - 30</td>
<td>27</td>
<td>14.92%</td>
<td>Construction</td>
<td>14</td>
<td>7.73%</td>
</tr>
<tr>
<td>31 - 40</td>
<td>72</td>
<td>39.78%</td>
<td>Manufacturing</td>
<td>28</td>
<td>15.47%</td>
</tr>
<tr>
<td>41 - 50</td>
<td>47</td>
<td>25.97%</td>
<td>Transportation,</td>
<td>16</td>
<td>8.84%</td>
</tr>
<tr>
<td>51 - 60</td>
<td>25</td>
<td>13.81%</td>
<td>Communication, Electric,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 60</td>
<td>10</td>
<td>5.52%</td>
<td>Gas and Sanitary Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm Size (number of employees)</td>
<td></td>
<td></td>
<td>Wholesale Trade</td>
<td>5</td>
<td>2.76%</td>
</tr>
<tr>
<td>&lt; 100</td>
<td>25</td>
<td>13.81%</td>
<td>Retail Trade</td>
<td>22</td>
<td>12.15%</td>
</tr>
<tr>
<td>100 - 499</td>
<td>27</td>
<td>14.92%</td>
<td>Finance, Insurance and</td>
<td>23</td>
<td>12.71%</td>
</tr>
<tr>
<td>500 - 2,499</td>
<td>65</td>
<td>35.91%</td>
<td>Real Estate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,500 - 9,999</td>
<td>36</td>
<td>19.89%</td>
<td>Services</td>
<td>33</td>
<td>18.23%</td>
</tr>
<tr>
<td>10,000 - 24,999</td>
<td>12</td>
<td>6.63%</td>
<td>Public Administration</td>
<td>4</td>
<td>2.21%</td>
</tr>
<tr>
<td>25,000 - 100,000</td>
<td>11</td>
<td>6.08%</td>
<td>Other</td>
<td>34</td>
<td>18.78%</td>
</tr>
<tr>
<td>&gt; 100,000</td>
<td>5</td>
<td>2.76%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position</td>
<td></td>
<td></td>
<td>IT Size (number of IT employees)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Executive Director</td>
<td>66</td>
<td>36.46%</td>
<td>&lt; 10</td>
<td>20</td>
<td>11.05%</td>
</tr>
<tr>
<td>Head of Division</td>
<td>41</td>
<td>22.65%</td>
<td>10 - 49</td>
<td>51</td>
<td>28.18%</td>
</tr>
<tr>
<td>Head of Department</td>
<td>61</td>
<td>33.70%</td>
<td>50 - 99</td>
<td>26</td>
<td>14.36%</td>
</tr>
<tr>
<td>Team Leader</td>
<td>9</td>
<td>4.97%</td>
<td>100 - 249</td>
<td>43</td>
<td>23.76%</td>
</tr>
<tr>
<td>Specialist</td>
<td>4</td>
<td>2.21%</td>
<td>250 - 999</td>
<td>28</td>
<td>15.47%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1,000 - 2,500</td>
<td>8</td>
<td>4.42%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; 2,500</td>
<td>5</td>
<td>2.76%</td>
</tr>
</tbody>
</table>

Measurement and Validation

For the measurement of the constructs, we relied on scales established in prior literature as much as possible and adapted them to the context of either an IT department or digital innovation when necessary. For the measurement scales, we mainly adopted 7-point Likert scales, but also used a 0 – 100 sliding scale for digital innovation control rights centralization to allow for greater granularity in measuring the construct. Table 2 shows the final operationalization after dropping single items due to poor loadings on their respective construct (e.g., Chin 1998), together with their sources and the scales. As the CDO is a relatively new construct, we used a new measure that straightforwardly asks whether the firm has appointed a CDO or not. Since we relied on responses from single respondents, we tested for common method bias in several ways. First, Harman’s single-factor test identified five components explaining 66.60 % of the total variance, with the first factor accounting for 26.65 % of the variance, thus indicating no major influence of common method bias (Podsakoff et al. 2003). Second, we also used a marker variable: the theoretically unrelated construct motivation to engage in sports (Semin et al. 2005). This marker variable showed low correlations with the rest of the constructs in our model, therefore alleviating common method bias concerns (Lindell and Whitney 2001).
### Construct (Reference) | Items | Scale
---|---|---
**Digital Innovation Performance** (Jansen et al. 2006; Oshri et al. 2015) | In comparison to our competitors:  
- We invent more new digital products and/or services.  
- We experiment with more new digital products and services in our existing market.  
- We commercialize more digital products and services that are completely new to our organization.  
- We frequently utilize more new digital opportunities in new markets.  
- Our organization frequently uses more new digital distribution channels. | 7-point Likert

**Environmental Turbulence** (Rai and Tang 2010) | Customer preferences change rapidly for this product market.  
There is intense competition for market share in this product market.  
Technological innovations have brought many new product ideas to this product market in the recent past. | 7-point Likert

**Interdepartmental Dynamics** (Jaworski and Köhli 1993) | Connectedness:  
- People around here in the IT department are quite accessible to those in other departments.  
- Junior managers in the IT department can easily schedule meetings with junior managers in other departments.  
Conflict:  
- When members of the IT department get together with other departments, tensions frequently run high.  
- People in the IT department generally dislike interacting with those from other departments.  
- Protecting one's departmental turf is considered the way of life for the IT department. | 7-point Likert

**Digital Innovation Control Rights Centralization** (Tiwana 2009) | Please assess the extent to which the IT/business departments were primarily responsible for decisions regarding the following for digital innovation projects:  
- Establishing project outcome rewards and penalties.  
- Monitoring project progress.  
- Approving intermediate prototypes. | Slide control from 0 (“primarily the business departments”) to 100 (“primarily the IT department”)

**Chief Digital Officer** (self-developed) | Our firm has appointed a Chief Digital Officer (CDO). | Binary (yes/no)

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We calculated the composite reliability (CR) and average variance extracted (AVE) scores for internal validity (e.g., Hair et al. 2010), and the Fornell-Larcker criterion (Fornell and Larcker 1981) and the heterotrait-monotrait (HTMT) ratio of correlations (Henseler et al. 2015) for discriminant validity. Table 3 and Table 4 present the results of these calculations. Values for composite reliability range from .786 to .892, exceeding the common threshold of .70 (Hair et al. 2011), and values for average variance extracted are at least .555, therefore exceeding the threshold of .50 (Hair et al. 2011). Regarding the Fornell-Larcker criterion, the diagonal values in Table 3 in bold show the square root of the AVE scores, which exceed all cross-correlations below (Fornell and Larcker 1981), thus confirming discriminant validity. Moreover, the HTMT ratios, which are more sensitive in detecting discriminant validity issues, are consistently lower than .85, the conservative threshold suggested by Henseler et al. (2015). To summarize, our measurement model is reliable and valid, meeting all standard criteria.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean</th>
<th>S.D.</th>
<th>CR</th>
<th>AVE</th>
<th>DIP</th>
<th>ET</th>
<th>CON</th>
<th>COF</th>
<th>DIC</th>
<th>CDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP</td>
<td>5.329</td>
<td>.994</td>
<td>.892</td>
<td>.623</td>
<td>.789</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**Fuzzy Set Qualitative Comparative Analysis (fsQCA)**

Qualitative comparative analysis (QCA) uses Boolean algebra to determine set memberships, and employs necessity-sufficiency tests (Fiss 2007). For example, if we observe that the set of high performing organizations contains all instances of organizations with a CDO, we can deduce that firms with a CDO form a subset of firms with high digital innovation performance. In other words, having a CDO is a sufficient condition for a high digital innovation performance (Fiss 2007). However, this may not imply necessity (i.e., the antecedent must be present for the outcome), if the set of high-performing firms also includes instances of firms with a high centralization of digital innovation control rights that do not feature a CDO. Thus, having a CDO is a sufficient, but not necessary, condition for a high digital innovation performance. Boolean algebra also allows for logical combinations of antecedents for a certain outcome (Ragin 2008), e.g., having high interdepartmental connectedness AND decentralized digital innovation control rights AND high environmental turbulence may form a causal recipe for high performance.

Fuzzy set qualitative comparative analysis (fsQCA) extends the general set theoretic, Boolean functioning by introducing fuzzy set-membership scores in contrast to the often simplifying presence/absence (i.e., crisp) categorization of data (e.g., Ragin and Fiss 2008). Fuzzy membership scores range from 0 to 1, but can take on any value in between to express the degree to which a case is member of a set (Ragin and Fiss 2008). As a result, fuzzy sets allow researchers to specify membership more precisely, which is particularly useful for organizational or environmental variables (e.g., environmental turbulence) that would suffer from loss of information if simplified to a crisp set membership (Fiss 2007).

Based on the research framework with digital innovation performance as an outcome, we conducted fsQCA in three steps following general recommendations (e.g., Fiss 2011) and recent examples in IS research (e.g., Leischning et al. 2016; Park et al. 2017). After calibrating the raw data to obtain fuzzy membership scores, we performed a necessary condition test, and finally identified sufficient conditions using a truth table analysis (Ragin 2008).

**Calibration**

After combining all multi-item constructs into composite scores, the calibration process requires the definition of three qualitative anchors: full membership, full non-membership and the crossover point in

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**Table 4. HTMT Ratios**

<table>
<thead>
<tr>
<th></th>
<th>DIP</th>
<th>ET</th>
<th>CON</th>
<th>COF</th>
<th>DIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET</td>
<td>.609</td>
<td>.492</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CON</td>
<td>.400</td>
<td>.581</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COF</td>
<td>.132</td>
<td>.163</td>
<td>.376</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIC</td>
<td>.460</td>
<td>.381</td>
<td>.280</td>
<td>.143</td>
<td></td>
</tr>
<tr>
<td>CDO</td>
<td>.342</td>
<td>.366</td>
<td>.097</td>
<td>.167</td>
<td>.206</td>
</tr>
</tbody>
</table>

Note: DIP = Digital Innovation Performance; ET = Environmental Turbulence; CON = Connectedness; COF = Conflicts; DIC = Digital Innovation Control Rights; CDO = Chief Digital Officer; S.D. = Standard Deviation; CR: Composite Reliability; AVE: Average Variance Extracted; bold diagonal elements are the square-root of the AVE.
between (Ragin 2008). Most of the constructs in our research model are measured on 7-point Likert scales that are usually calibrated using values larger than 6 for full membership, lower than 2 for full non-membership and 4 as the crossover point (e.g., Park et al. 2017). However, the calibration process is typically conducted by considering both theoretical and empirical knowledge of the specific research context (e.g., Ragin 2008). Specifically, we observed that our collected data, measured with Likert-scales, is slightly skewed. In this case, fsQCA suffers from problems of limited diversity and distortions in measurements of fit, and it is beneficial to adapt the anchor values according to the observed skewness (Thomann and Maggetti 2017). For the constructs digital innovation performance, interdepartmental dynamics, and environmental turbulence that are measured on 7-point Likert scales, we followed the approach of Mikalef and Pateli (2017) in setting the thresholds to 6.5 for full membership, 3 for full non-membership, and 4.5 as the crossover point to address the skewness of the underlying data. Since having a chief digital officer is a binary variable, we did not need further calibration for this variable. The construct of digital innovation control rights was measured on a scale from 0 to 100 and the data was not highly skewed. Therefore, it was calibrated using 95 for full membership, 5 for full non-membership, and 50 as the point of maximum ambiguity regarding membership. We used the fsQCA 3.0 software developed by Ragin and Davey (2016) for the calibration, as well as the further steps in the fsQCA process.

**Results**

**Necessary Conditions**

To determine whether any antecedents are necessary for high digital innovation performance, we conducted a necessary conditions test (e.g., Ragin 2008). Consistency scores above the typically used threshold of .90 indicate that an antecedent is almost always necessary for the outcome. Our results show that the consistency score of environmental turbulence (.906) exceeds this threshold and is therefore nearly always a necessary condition for high digital innovation performance. The relatively high coverage value of .862 indicates that a large proportion of the outcome is covered by this condition (Park et al. 2017).

<table>
<thead>
<tr>
<th>Antecedents</th>
<th>Consistency</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Innovation Control Rights</td>
<td>.799</td>
<td>.894</td>
</tr>
<tr>
<td>Chief Digital Officer</td>
<td>.652</td>
<td>.821</td>
</tr>
<tr>
<td>Interdepartmental Connectedness</td>
<td>.877</td>
<td>.852</td>
</tr>
<tr>
<td>Interdepartmental Conflicts</td>
<td>.440</td>
<td>.876</td>
</tr>
<tr>
<td>Environmental Turbulence</td>
<td>.906</td>
<td>.862</td>
</tr>
</tbody>
</table>

**Sufficient Conditions**

To identify the sufficient conditions for high digital innovation performance, we used truth table analysis (Ragin, 2008) that results in a parsimonious and intermediate solution. We used the frequency cutoff value of 2, such that only solutions with 2 or more empirical instances are included in the truth table analysis. Moreover, we set the raw consistency threshold to .898 (virtually .90, which is most commonly used (e.g., Park et al. 2017), since we observed a drop-off in consistency after this solution, and the choice of consistency levels should be research-specific (Schneider and Wagemann 2010). As an alternative measure, we used the proportional reduction in inconsistency (PRI) with a cutoff value of .80 (e.g. Leischnig et al. 2016). According to both consistency indicators, we coded solutions higher than the cutoff values as 1 (i.e., as resulting in high digital innovation performance), and otherwise as 0. In the following truth table algorithm, fsQCA uses the Quine-McCluskey algorithm as well as counterfactual analysis to determine the configurations to achieve high digital innovation performance (Ragin 2008). The resulting configurations are based on conjunctions, i.e., Boolean expressions, highlighting the conditions that have to be present or absent for producing the outcome variable (e.g., El Sawy et al. 2010; Leischnig et al. 2016).

Table 6 presents an overview of these results using the notation of Ragin and Fiss (2008). Black filled and crossed-out circles indicate the presence and absence of an antecedent, respectively. The size of the circle stands for the importance of an antecedent: large circles are causal core elements that are also part of the
parsimonious solution, while small circles are peripheral elements that complement the core conditions and are only part of the intermediate solution (Fiss 2011; Ragin and Fiss 2008). The six different configurations identified in the analysis show different core and peripheral elements that in combination produce high digital innovation performance. Moreover, multiple blank spaces represent the notion of neutral permutations, indicating that our configurational analysis exhibits both first-order and second-order equifinality (Fiss 2011). The high overall solution consistency of .908 indicates that the combination of configurations consistently results in high digital innovation performance. The examination of the coverage scores for the individual configurations allows for assessing the “[... ] empirical relevance and effectiveness of the solution for the outcome” (Park et al. 2017, p. 664). Configuration 3 exhibits the highest raw and unique coverage values, and is consequently the most relevant configuration for achieving high digital innovation performance.

From a descriptive perspective, configuration 1 features only one core element (the presence of a CDO) together with two peripheral elements (the presence of environmental turbulence, and the absence of interdepartmental conflicts). Configuration 2 similarly has CDO as the only core element, but includes digital innovation control rights in the IT department together with environmental turbulence as peripheral elements. Configuration 3, the most relevant configuration, features two core elements: digital innovation control rights in the IT department and environmental turbulence. These two causal elements are complemented with the presence of interdepartmental connectedness as a peripheral element. In contrast, configuration 4 is unique with the presence of interdepartmental conflicts as the only core condition for high digital innovation performance. This configuration also includes connectedness and turbulence as less important causal elements. Comparably to configuration 1 and 2, the fifth identified combination emphasizes the role of the CDO, while including digital innovation control rights in the IT department, interdepartmental connectedness, and the absence of interdepartmental conflicts. The last configuration is the only one featuring digital innovation control rights in the business departments and the absence of environmental turbulence (both as core elements). This solution is complemented with interdepartmental connectedness as well as the absence of a CDO and interdepartmental conflicts as peripheral elements.

<table>
<thead>
<tr>
<th>Antecedents</th>
<th>Configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Governance Dimensions</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Locus of Authority:</strong></td>
<td></td>
</tr>
<tr>
<td>Digital Innovation Control Rights*</td>
<td>●</td>
</tr>
<tr>
<td><strong>Formal:</strong></td>
<td></td>
</tr>
<tr>
<td>Chief Digital Officer</td>
<td>●</td>
</tr>
<tr>
<td><strong>Informal:</strong></td>
<td></td>
</tr>
<tr>
<td>Interdepartmental Connectedness</td>
<td>●</td>
</tr>
<tr>
<td>Interdepartmental Conflicts</td>
<td></td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Environmental Turbulence</td>
<td>●</td>
</tr>
</tbody>
</table>

| Consistency                      | .919 | .954 | .939 | .934 | .960 | .943 |
| Raw coverage                     | .378 | .507 | .699 | .392 | .294 | .091 |
| Unique coverage                  | .064 | .021 | .088 | .039 | .003 | .017 |
| Overall solution consistency     |      |      |      |      |      | .908 |
| Overall solution coverage        |      |      |      |      |      | .867 |
Theoretical Configurational Propositions

Following our exploratory, retroductive research design, we next discuss the configurations and derive theoretical propositions by integrating empirical observations with relevant literature.

**Environmental Turbulence as a Necessary Condition**

The necessary condition test indicated that environmental turbulence is almost always necessary for a high digital innovation performance. Prior IS research has mostly used environmental turbulence as a moderator, e.g., for the relationship of dynamic capabilities and competitive advantage (Pavlou and El Sawy 2010). In IT governance research, turbulence was often used as a contingency factor for specific governance choices (e.g., Brown 1997). However, none of the governance elements of our research framework could be identified as necessary conditions, indicating that environmental turbulence is, independent of governance choices, necessary for high digital innovation performance. While this result seems surprising at first glance, there are several possible arguments that may provide a plausible explanation. First, firms in turbulent business environments may be pressured to increase their engagement in digital innovations to keep up with the competition. Similar to Mithas et al.’s (2013) finding of convergence in IT investments within an industry, a turbulent business environment could imply higher digital innovation activity, which results in a mimetic reaction of firms in the industry. Organizations may even be forced to increase their digital innovation efforts when their products or services are becoming obsolete in a turbulent, digitally transformed business field (Mithas et al. 2013). On a different note, Nan and Tanriverdi’s (2017) multilevel perspective on IS strategy shows how individual IT innovations lead to collective-level hyperturbulence. Particularly, digital innovations with their specific characteristics (i.e., generativity and convergence) lead to a continually changing competitive environment with blurring industry boundaries (Yoo et al. 2012). Applying these arguments to our results leads to the first proposition:

**Proposition 1:** Environmental turbulence as a necessary condition for high digital innovation performance could be attributed to (1) external pressure caused by competition that either provokes a mimetic reaction or forces firms to invest in digital innovation in order to survive, and/or (2) firms generating environmental turbulence themselves by introducing digital innovations.

**The Interaction of Digital Innovation Control Rights and Environmental Turbulence**

Based on the sufficient conditions analysis, the results show an interesting relationship between digital innovation control rights and environmental turbulence. In configurations 3 and 6, the only solutions in which either of the two elements is a core ingredient for high digital innovation performance, the two factors occur together and in the same logical direction. In configuration 3, the presence of digital innovation control rights in the hands of the IT department and a high environmental turbulence constitute the only two core elements. On the contrary, in configuration 6, the absence of digital innovation control rights (i.e., authority in the hands of the business departments) as well as the absence of environmental turbulence are core elements. Furthermore, configuration 3 has the highest coverage scores, thus indicating that high environmental turbulence together with decision-making authority located in the IT department (and connectedness between the departments as a peripheral element), is the most common successful causal recipe for producing high digital innovation performance. This finding contrasts with earlier IT governance research that argues for a decentralized decision-making architecture for a higher responsiveness that is needed in a turbulent environment (e.g., Brown 1997). However, Xue et al. (2011) find a curvilinear relationship between environmental uncertainty and IT infrastructure governance decentralization. Their study confirms that firms tend to have a centralized IT infrastructure governance architecture in environments with either very low or very high uncertainty, while decentralized structures are used in moderately uncertain environments (Xue et al. 2011). Our configurational analysis comes to the same results, and since our study’s empirical data on environmental turbulence was skewed towards more turbulent environments, the absence of this element in a configuration could be related to a low-to-

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Note: * = presence indicates centralized digital innovation control rights (i.e., in the IT department); ○ = presence of an antecedent; ⊖ = negation of an antecedent; big circle = core element; small circle = peripheral element; blank space = subordinate antecedent
moderate rather than very low level of turbulence, thus confirming the results of Xue et al. (2011). Consequently, the second proposition is:

**Proposition 2:** For firms with high digital innovation performance, the decision-making architecture for digital innovations is contingent on the level of environmental turbulence in the following manner: In highly turbulent environments, a centralized digital innovation governance structure, in which the locus of authority is mainly located in the IT department, is an effective architecture choice. In contrast, in a low-to-medium environmental turbulence, a decentralized digital innovation governance structure, where decision authority is mainly located in the business departments, is effective in achieving high digital innovation performance.

**The Role of the CDO**

The presence of a CDO is the only core element in three of the six configurations presented in Table 6, therefore indicating that installing a dedicated position for managing and coordinating digital innovations can lead to high performance. This finding could directly be attributed to the tasks a CDO usually assumes, which are, among other things, initiating digital innovation projects and experimenting as well as generating revenue streams with digital technologies (Tumbas et al. 2018). Since the CDO role is often implemented to coordinate across departments in their digital innovation efforts (e.g., Haffke et al. 2016), it is not surprising that a CDO appears as a core element in different configurations for high digital innovation performance.

On the other hand, the equifinality introduced by a configurational analysis allows for a more fine-grained view. Having a CDO is not always necessary for achieving high performance, as, for instance, in configuration 3 where the IT department is responsible for the organization’s digital innovation efforts, and whether a firm features a CDO is irrelevant. This configuration could potentially be explained by CDOs that interpret their role as Digital Evangelists (Haffke et al. 2016), who are not that actively involved in the management of digital innovations. In configuration 6, the only configuration with the absence of a CDO as a causal element (although peripheral), business departments are in charge of digital innovation management, which could result in situations where a CDO is not needed and may even be hampering. In conclusion, the proposition around CDOs requires further research attention:

**Proposition 3:** Establishing a CDO as a formal horizontal governance role is a valid option in different environmental and decision-making structure settings to achieve high digital innovation performance. However, in cases where competent IT or business departments clearly have authority over digital innovations, a CDO may not be needed or could even be detrimental for digital innovation performance.

**The Impact of Interdepartmental Dynamics**

In general, interdepartmental connectedness as well as conflicts seem to play a relatively minor role for high digital innovation performance in comparison to the other antecedents in our framework. Based on prior literature, we expected that connectedness should be a positive influencing factor, since it facilitates the interaction of IT and business employees, and thus should lead to a more effective integration of business and IT knowledge (e.g., Bradley et al. 2012). This assumptions generally holds true, because interdepartmental connectedness is present (although as a peripheral element) in four of the six identified configurations. Moreover, the six configurations suggest a potential substitution effect between formal and informal horizontal governance mechanisms, in the sense that all successful configurations either include the CDO as a formal mechanisms, or (although only as peripheral elements) feature high interdepartmental connectedness. Similarly, we expected that interdepartmental conflicts would be harmful for successful interactions between business and IT employees (Jaworski and Kohli 1993), and thus hurt the integration of the diverse knowledge needed for digital innovations (Yoo et al. 2012). However, our analysis provides inconsistent results in that regard: While the absence of interdepartmental conflicts is a peripheral element in two different solutions, configuration 4 includes the presence of conflicts as the only core element. The presence of interdepartmental conflicts for high digital innovation performance does not interact with the control rights elements, thus indicating that the effect is independent from the allocation of decision-making authority. At this point, we can only speculate why and how the presence of interdepartmental conflicts may lead to a high digital innovation performance, e.g., by facilitating constructive task-related
Proposition 4: The role of interdepartmental dynamics for high digital innovation is rather ambiguous. On the one hand, interdepartmental connectedness is a complementary factor that can facilitate digital innovation performance. On the other hand, both the absence and the presence of interdepartmental conflicts could be a causal ingredient for high digital innovation performance, demonstrating the need for further research in this regard.

Discussion

Theoretical Contributions

This study makes three theoretical contributions. First, we extend IT governance research by shifting the attention from classic IT activities, such as IT infrastructure and IT application management, to the management of digital innovations (Nambisan et al. 2017). The predominant perspective on IT governance is focused on the effective internal use of IT within an organization (e.g., Weill and Ross 2004). In contrast, the governance of digital innovations, particularly in terms of new digital products and business models, emphasizes an external perspective. Therefore, while the classic understanding often limits the role of the IT department to an internal service provider, their contribution to the development and introduction of digital innovations heightens their role towards technological leaders and partners (Guillemette and Paré 2012). Moreover, we complement related governance research in the IS domain that studies the governance of platforms and platform ecosystems (e.g., Foerderer et al. 2018; Huber et al. 2017; Tiwana et al. 2010) by focusing on digital innovations as a new and relevant corporate task that requires effective governance structures and mechanisms. As such, the identified digital governance configurations and related propositions in our study could spark interest and provide starting points for future research.

Second, we add a governance perspective to the digital innovation research stream. Prior research has identified general organizing principles like distributed and combinatorial innovation (Yoo et al. 2012), but does not fully explore specific governance options firms face for developing and introducing digital innovations. A notable exception is the study by Svahn et al. (2017), who qualitatively investigate the tension of control versus flexibility in digital innovation governance. However, they restrict their analysis to only this central conflict. In comparison, our study is the first to delve into the different dimensions of digital innovation governance, as well as to link empirically observed governance configurations to performance. By doing so, our study also provides insights on how to achieve high digital innovation performance. We encourage future research to extend our initial findings regarding antecedents of digital innovation performance, for instance, by examining relevant organizational capabilities.

Third, our study demonstrates the usefulness of configurational theories in both IT governance and digital innovation research, and at a broader level, in IS strategy research. The use of this perspective allows for a fine-grained view on the interaction of causal elements and their importance for producing digital innovation performance. Consistent with the arguments of El Sawy et al. (2010), digital business environments include complex interactions between IT-related, organizational, and environmental variables. While variance- and process-based theories remain relevant as they can shed light on specific parts of these relationships, configurational theories produce additional insights that cannot be replicated by these other approaches.

Practical Implications

We derive several implications for managerial practice based on the identified configurations. First, since environmental turbulence has been identified as a necessary condition for digital innovation performance, managers should be aware that by increasing their engagement in digital innovations, they will potentially raise the uncertainty and speed of the business environment they operate in. Therefore, if firms are faced with the decision to increase their investment and efforts in digital innovations, they should foresee that they will enter a turbulent business environment that requires different, i.e., dynamic, capabilities (e.g., Drnevich and Kriauciunas 2011; El Sawy et al. 2010).
Second, the configurational analysis revealed a relationship between digital innovation control rights and environmental turbulence. Applying this finding to business practice would imply that managers should set up decision-making architectures based on the level of environmental turbulence in which they are operating. Firms in extremely turbulent business environment should use centralized digital innovation control rights with the IT department in charge, whereas companies in low-to-medium level turbulence should, vice versa, rely on a decentralized architecture for authority over digital innovations.

Finally, since the presence of a CDO is a core causal element in three of the six identified combinations, it seems that installing a CDO for coordinating digital activities is generally conducive for digital innovation performance. In contrast, only one configuration includes the absence of a CDO as a peripheral element in a situation with low environmental turbulence and decentralized control rights. Thus, managers could use additional research implications for deciding in which situations a CDO is needed (Singh and Hess 2017; Tumbas et al. 2017), and which functions and tasks a CDO can assume (e.g., Haffke et al. 2016; Horlacher and Hess 2016).

These implications arising from use of a configurational approach are appealing to managers, because they allow for an option-based thought process, in which managers can include the specific circumstances (e.g., unique resources, prior investments, and the business environment) of their organization (El Sawy et al. 2010). Therefore, managers may consider the six identified configurations as options for digital innovation governance design.

Limitations and Future Research

Our study also has limitations that should be addressed by further research. First, there may be some concerns about the use of a survey-based research method. However, by sampling senior-level IT managers, we tried to minimize potential biases, and future research could use multiple respondents per firm or rely on objective measurements (e.g., for the performance dimension) to increase validity. In addition, self-reported measures reflect the respondents' perception, thus they may have underestimated or exaggerated some constructs, potentially introducing bias into the results. Moreover, since we only collected data from U.S. firms, we cannot generalize our results to countries with different cultural and business environment settings. Thus, we encourage future research to replicate our study on a global scale to assess the generalizability of the results. Finally, there may be additional governance options for digital innovations that were not represented in our research model. For instance, while our framework included the locus of digital innovation control rights, Svahn et al. (2017) suggest that it is also relevant to decide between control and flexibility in governing digital innovations. As another example, we only included the CDO as a formal horizontal governance mechanism to facilitate cross-departmental collaboration and coordination. One could imagine that organizations also use other integrator roles to enable effective cooperation across departments for digital innovations. Accordingly, this dimension could particularly benefit from further research attention. Prior IT governance research has also emphasized that the locus of decision rights should be colocated with the knowledge needed to make those decisions (e.g., Tiwana and Kim 2015).

Therefore, we encourage future research to validate this assumption in the context of digital innovation.

Conclusion

Our study sets out to identify governance configurations that may result in high digital innovation performance. With regard to the dimensions included in our digital innovation governance framework, the identified configurations reveal some interesting patterns of interaction. First, environmental turbulence is almost always a necessary condition for high digital innovation performance. Second, environmental turbulence and the distribution of decision rights appear to be interdependent such that decision rights in turbulent environments are better allocated to the IT department, whereas stable environments favor decision rights residing within the business departments. Third, having a CDO is a core element in three of the six identified high-performing configurations, highlighting its importance for digital innovation performance. Finally, interdepartmental dynamics as informal horizontal coordination mechanisms show somewhat ambiguous relationships with digital innovation performance. While interdepartmental connectedness is primarily a peripheral element of successful governance configurations, interdepartmental conflicts is the only core causal element in one of the identified configurations, calling for further research into its role.
References


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