Organized Complexity of Digital Business Strategy: A Configurational Perspective

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ORGANIZED COMPLEXITY OF DIGITAL BUSINESS STRATEGY: A CONFIGURATIONAL PERSPECTIVE[1]

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How should firms configure organizational capabilities to achieve competitive advantage in complex digital environments? To answer this question, we investigate parsimonious configurations for high firm performance in digital environments characterized by organized complexity. We adopt a configurational perspective accompanied by a fuzzy-set qualitative comparative analysis (fsQCA) to explicate complex nonlinear relationships among key digital and non-digital capabilities in the form of conjunction, equifinality, and asymmetry in producing the outcome. With this approach, we shift attention from individual capabilities to configurations of capabilities to develop a better understanding of the complex role of IT in the digital world. Our analyses, using a rare and unique dataset of 376 observations for organizations in healthcare, education, manufacturing, and service sectors in the United States, reveal three key findings. First, IT-enabled information analytics capability alone is neither necessary nor sufficient in any configuration for high performance; however, it is an important component of the configurations in which it plays multifaceted roles varying from an enabling role in some contexts, to no role or a counterproductive role in other contexts. Second, we document a few parsimonious configurations emergent from complex nonlinear interactions among six organizational capabilities. Interestingly, these configurations often have an isomorphic structure that produces both high financial performance and high customer performance simultaneously. Third, the structures of configurations for high performance differ from those of not-high performance, suggesting an asymmetric view of causality that underpins organizational performance. Together, the findings provide implications for further research on complexity theory in digital business strategy, and for managers to view and redesign digital business strategy as configurations of IT and organizational capabilities.

Keywords: Complexity theory, organized complexity, complex system, digital business strategy, parsimonious configurations, organizational capabilities, information analytics capabilities, configurational approach, fuzzy-set qualitative comparative analysis, fsQCA, complex causality

Introduction

Digital technologies are increasingly penetrating organizations, becoming fused and entangled with processes, structures, people, and things (El Sawy et al. 2010; Lyytinen and Yoo 2002; Yoo et al. 2012). In addition, digital assets and capabilities that are malleable, modular, and generative (Henfridsson and Bygstad 2013) enable a plethora of strategic options previously considered infeasible, and are driving significant changes in how firms compete, and develop and deliver new products and services (Yoo et al. 2012; Yoo et al. 2010). Some of these trends give rise to the need for new

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digital business strategy across organizations (Bharadwaj et al. 2013) to effectively compete and survive in complex adaptive digital ecosystems (Tanriverdi et al. 2010).

Formulating successful strategies in such digital environments requires a shift in thinking from individual causal elements to interactions among them as argued in the literature on complexity (Anderson 1999; Andriani and McKelvey 2009). Therefore, building on recent research in the digital strategy domain and relating to ideas from complex systems, we argue that information analytics capabilities and other key organizational capabilities as parts of a system form the digital business strategy of an organization to produce competitive firm performance. In other words, digital business strategy cannot be fully understood by focusing on any single capability in isolation, and there is a need to focus on configurations of capabilities, an emergent system derived from complex interactions among capabilities (Meyer et al. 1993; Simon 1996). Although extant research in information systems using the complexity perspective uses synthetic data or rich narratives and provides important descriptive language and tools to understand and theorize the complexity of digital environments, there is a need to develop a deeper understanding of how multiple capabilities give rise to systematic patterns of high performance across different economic sectors using real-world data and provide actionable prescriptions for managers. However, predicting systemic patterns emergent from nonlinear interactions among multiple capabilities is challenging unless a research approach and an analytical toolkit accommodate these complex nonlinear interdependencies, something that is harder to accomplish in conventional methods of enquiry. In turn, the limitations of such traditional approaches are reflected in the poor performance of some of the popular theories, such as the resource-based view and transaction cost economics, because they fail to deal with the complexities inherent in strategy formulation.[2]

We argue that one possible explanation for a poor record of existing theories is because they fail to adequately address the problems of organized complexity and causality in complex systems (Simon 1996; Weaver 1948). We rely on the idea that causality in complex systems is often better explained by conjunctural, equifinal, and asymmetric relations from the configurational perspective (Abbott 1988; El Sawy et al. 2010; Fiss 2007; Meyer et al. 1993; Misangyi et al. 2017). For example, the interdependencies of capabilities imply that attention shifts from individual capabilities as independent variables to the configurations of capabilities in assessing their impact on performance. Furthermore, it is necessary to recognize that multiple configurations may lead to the same outcome. Additionally, capabilities causally related in one configuration may be unrelated or inversely related in other configurations: the presence of a type of capability for high performance does not necessarily mean that its absence will lead to low performance. This viewpoint, relying on organized complexity and the configurational perspective, contrasts sharply from many existing conceptualizations of causality in the IS and strategic management literatures based on the linear net-effect of independent individual variables, symmetrical relations, and temporal "before and after" changes, as in experimental studies or phase transitions in the complexity literature.[3]

This study makes important contributions by developing a prescriptive theory to build parsimonious configurations for a digital business strategy and also contributing to the complexity literature (McKelvey et al. 2016). We focus on investigating the configurations of organizational capabilities, which include information analytics capability and other key capabilities, such as leadership, strategic planning, a customer focus, a human resources focus, and process management capabilities. All of these capabilities are considered as salient in the management literature and are used by the Baldrige National Quality Program to assess a firm's holistic capabilities and performance (see Flynn and Saladin 2001; NIST 2002; Schaefer 2011). With the findings, we explain how order emerges from the complex nonlinear interactions of multiple capabilities to provide new insights into the black box of complex digital business strategy.

[2]For example, as Newbert (2007) notes,

> The resource-based view (RBV) has received only modest support overall. … [and] only 53 percent of the tests … were empirically supported … David and Han (2004) find support for only 47 percent of tests of TCE [transaction cost economics]. … other reviews of strategic management … yield similarly non-compelling levels of support (pp. 121, 136).

Likewise, King and Baatartogtokh (2015) find support for all four elements of the so-called "theory of disruptive innovation" only in 9% of cases.

[3]Despite impressive strides made in conventional methods (e.g., cluster analysis, nonlinear effects through quadratic or cubic terms), the dominant focus is oftentimes centered on explaining the treatment or causal effect of a single focal intervention or interactions of (at best) two or three focal variables. While useful, these "fixes" are still unable to cope fully with the complexity of conjunctural, equifinality, and asymmetric causation. Having said that, we are aware of many different notions of causality in economics (Heckman 2005), statistics (Holland 1986), and sociology (Goldthorpe 2001), and ongoing debates about advantages and limitations of QCA to illuminate causal relationships (Seawright 2005).

Theoretical Background and Framework

The Problem of Organized Complexity in Digital Business Strategy

Despite significant advances in our understanding of complexity, how complexity theories apply to organizational phenomena in general and digital business strategy in particular is still in a nascent stage. Weaver (1948) coined the phrase "organized complexity" to characterize challenges in modeling interdependencies among a moderate number of variables.[4]

The problem of organized complexity can be contrasted with (1) the problem of simplicity in dealing with situations that assess the effect of two or three variables on an outcome of interest, and (2) the problem of disorganized complexity involving hundreds of variables (e.g., to explain the average patterns in Brownian motion of billions of gas molecules in a container) that has been well addressed through techniques of probability theory and statistical mechanics.

The problem of organized complexity still remains unsolved in organizational settings. We argue that situations involving organized complexity are often witnessed in phenomena involving digital strategies and interventions with which information systems scholars frequently grapple. Based on the complexity theory literature, we define organized complexity as *nonlinear relations and emergent effects among a few key organizational capabilities* that are part of a firm's digital business strategy. Specifically, organized complexity provides us with an important lens to understand research problems when a moderate number of variables interact with one another, often in unpredictable ways, to influence a set of outcome variables that are of interest in a particular study. Applying this definition and lens of organized complexity, one can view digital business strategy as a complex system, consisting of several organizational digital and non-digital capabilities that produce competitive firm performance. Thus, digital business strategy reflects the configurations emergent from nonlinear interactions among key organizational capabilities and prescribes recipes for organizing them into parsimonious configurations to achieve high firm performance.

There are at least two reasons that have made the problem of organized complexity in complex systems relatively intractable. First, just a few variables can easily create a large number of options, which makes it difficult or impossible for managers to find optimal combinations to achieve their outcome of interest, and for researchers to gather a sufficient number of observations for analysis.[5] A second reason for the intractability of organized complexity is that predicting systemic patterns emergent from complex interactions among multiple elements is difficult, and often impossible, given that the elements are interdependent and tend to change together, often in unpredictable ways. Furthermore, assessing and interpreting multiple interaction effects is challenging in conventional research approaches (Fiss 2007; Meyer et al. 2005) to deal with complexity characterized by conjunction, equifinality, and asymmetry in realistic business environments, as we explain next.

Configurational Approach to Studying Complex Digital Business Strategy

To understand the nonlinear interdependencies of organized complexity in digital business strategy, we propose and leverage the configuration theory approach and *fuzzy-set qualitative comparative analysis* (fsQCA) to derive rigorous but data-driven configurations of organizational capabilities that result in high performance. Our review of prior work suggests that although both the configuration and the complexity literatures deal with complex systems, they have rarely been connected as explicitly as we do in this study. Meyer et al. (1993, p. 1178) explain how the configurational perspective embodies the key ideas that are also shared in the complexity literature by noting:

> Configurational inquiry represents a holistic stance, an assertion that the parts of a social entity take their meaning from the whole and cannot be understood in isolation. Rather than trying to explain how order is designed into the parts of an organization, configurational theorists try to explain how order emerges from the interaction of those parts as a whole. Social systems are seen as tightly coupled amalgams entangled in bidirectional causal loops.

[4]Simon (1996, p. 183) views organized complexity as part of a *complex system* by focusing on the challenges of nonlinear, emergent relations, and indicates that "the parts of a complex system have mutual relations that do not exist for the parts in isolation" (p. 170).

[5]For example, if each organizational variable were to have just 3 levels of values, an analysis involving 10 variables could create approximately 59,000 options (i.e., 3 to the power of 10 equals 59,040), making it difficult or impossible for managers to find an optimal combination to achieve their outcome of interest. Even for a researcher, it will require a minimum of 295,000 observations if she needs five observations per cell to study the differences across cells, and millions or billions more observations if she intends to study any interactions among the variables. Note that the total number of potential combinations increases exponentially if we use more values for a variable, (e.g., 4, 5, 6). Because we do not know whether a high or low value of each variable is better or worse for the outcome, ordinal-type measures do not reduce the number of possible combinations.

> Nonlinearity is acknowledged, so variables found to be causally related in one configuration may be unrelated or even inversely related in another.

We extend the idea of organized complexity to the digital business strategy context, in which IT strategy is not subordinate to business strategy, and firms need to consider how IT capabilities interact with other organizational capabilities to achieve competitive advantage (Bharadwaj et al. 2013, p. 473). In pervasive digital environments, the mutual dependencies between digital and non-digital capabilities can create unexpected emergent behaviors and outcomes, and an exclusive focus on independent effects of just one or two capabilities may not be sufficient for achieving competitive advantage. Further, the difficulties in predicting systematic patterns emergent from the complex nonlinear interactions of key organizational capabilities make traditional top-down planned research approaches and methods less effective. Therefore, we adopt a configurational theory approach and fsQCA, which enables us to shift our attention from independent variables to holistic configuration, and to explain and analyze nonlinear, bottom-up emergent relations as configurations of key organizational capabilities to achieve competitive firm performance.[6]

Note that the notion of parsimonious configurations in this study is different from, and goes beyond the notion of, "gestalts," in that configurations with fsQCA also illuminate the differing roles of underlying variables as core, peripheral, present, and absent (Fiss 2011). In addition, the configuration perspective articulated and applied here differs from the idea of complementarities implicit in the resource-based view. The complementarity perspective assumes that the complements are individually manipulable, that is, easier to comprehend when one is dealing with two or three complements (Venkatraman 1989). However, this perspective becomes limiting when we have sparse data and when the focus is on configurations or conjunctions of multiple variables that simultaneously influence performance rather than individual variables separately (Misangyi and Acharya 2014; Misangyi et al. 2017; Park et al. 2017).

We explicate the link between causal complexity in the configurational perspective and the nonlinear and emergent relations in complexity theory in terms of conjunctural, equifinal, and asymmetric relations (see Table 1). Our use of a systemic configurational approach sheds new light on how complexity theory can illuminate discourse in the digital business strategy and IS literatures to explore alternative models to further theory building in complex digital phenomena often characterized by interdependency and nonlinearity (Bharadwaj et al. 2013; Fiss 2007; McKelvey et al. 2016).[7]

Toward Parsimonious Configurations of Organizational Capabilities

Figure 1 depicts our research model, and explains how key organizational capabilities work together to produce competitive firm performance through parsimonious configurations. We next provide a brief review of the six organizational capabilities that comprise the parts of a firm's digital business strategy.

First, *information analytics capability* focuses on (1) the quality of IT management practices (e.g., integrating IT into key operational and managerial processes); (2) the ability to develop appropriate information management processes to sense, gather, organize, and disseminate information; and (3) the ability to instill desired information behaviors and values (e.g., proactiveness, sharing, integrity) (Mithas et al. 2011).[8] Second, *leadership capability* indicates the ability to orchestrate organizational capabilities and to leverage the necessary IT and business resources needed to build organizational capabilities. Third, *strategic planning capability* pertains to the strategy-formulation process, including an

[6]Figure D1 (Appendix D) depicts how the configurational approach, with a focus on the synergistic effect of the sets of variables, differs from a correlation-based approach, with a focus on the additive linear net-effects of individual variables.

[7]Nonlinear interdependencies are often asymmetric in that some capabilities causally related in one configuration may be unrelated or inversely related in other configurations. Moreover, the presence of one capability for high performance does not necessarily mean that its absence will necessarily lead to low performance. Furthermore, their interactions can be complementary, substituting, or suppressing in nature. In these contexts, the configuration approach becomes more valuable in handling problems of organized complexity.

[8]Our use of the term *information analytics* is consistent with the usage of similar terms in recent academic studies (Brynjolfsson and McElheran 2016), although prior studies used different phrases such as *information management capability* or *information orientation* to refer to underlying ideas (see Mithas et al. 2011). For example, Brynjolfsson and McElheran characterize what they call "data-driven decision-making" for the plants in their sample from 2005 to 2010 by operationalizing it with three indicators relating to (1) the availability and use of data; (2) ten or more KPIs; and (3) the use of both short-term and long-term targets. Note that, unlike the self-reported survey-based perceptual operationalization in other studies, we rely here on more objective data from examiners external to a company. In a way, the Baldrige Criteria anticipated some of the ideas underlying the trend toward data-driven decision making through analytics because the criteria were designed in consultation with some of the leading companies of the world. Indeed, just how radical or incremental the idea of analytics is remains a matter of debate (Gillon et al. 2014; Gillon et al. 2012). We acknowledge that the word *analytics* has a far broader meaning, now informed by newer IT capabilities.

Table 1. Linking Causal Complexity to Nonlinear, Emergent Complexity

Complexity Concepts	*Complexity Theory*	*Configurational Perspective*
Nonlinearity	A change in one element creates larger or lesser changes in other elements, which can sometimes result in a significant change in the outcomes. Note that nonlinearity does not always amplify changes.*	Nonlinear interdependencies are presented in an asymmetrical, conjunctural way. Elements are related in one configuration, while they are unrelated or inversely related in other configurations as complementary, suppressing, or substituting, while playing different roles as present/absent/no-matter and core/peripheral.
Emergence	The parts of a complex system have mutual relations that do not exist for the parts in isolation (holistic view). A configuration of features evolves and fits with environments to survive (evolution view). A new revolutionary structure can emerge from mutation (disequilibrium view).	Configurations as a system are emergent from interactions among the elements, showing new emergent orders to build parsimonious configurations. Configurations with outcomes have evolved to fit the environment, and those without outcomes do not yet fit, possibly capturing different evolutionary states; they may require discontinuous/revolutionary transformation.
Example studies	Benbya and McKelvey 2006; McKelvey 1999; Nan and Tanriverdi 2017; Simon 1996; Tanriverdi and Lim 2017; Weaver 1948	El Sawy et al. 2010; Fiss 2007, 2011; Meyer et al. 1993; Misangyi and Acharya 2014; Park et al. 2017; Rivard and Lapointe 2012

*We thank an anonymous reviewer for suggesting this clarification that nonlinearity does not always amplify changes.

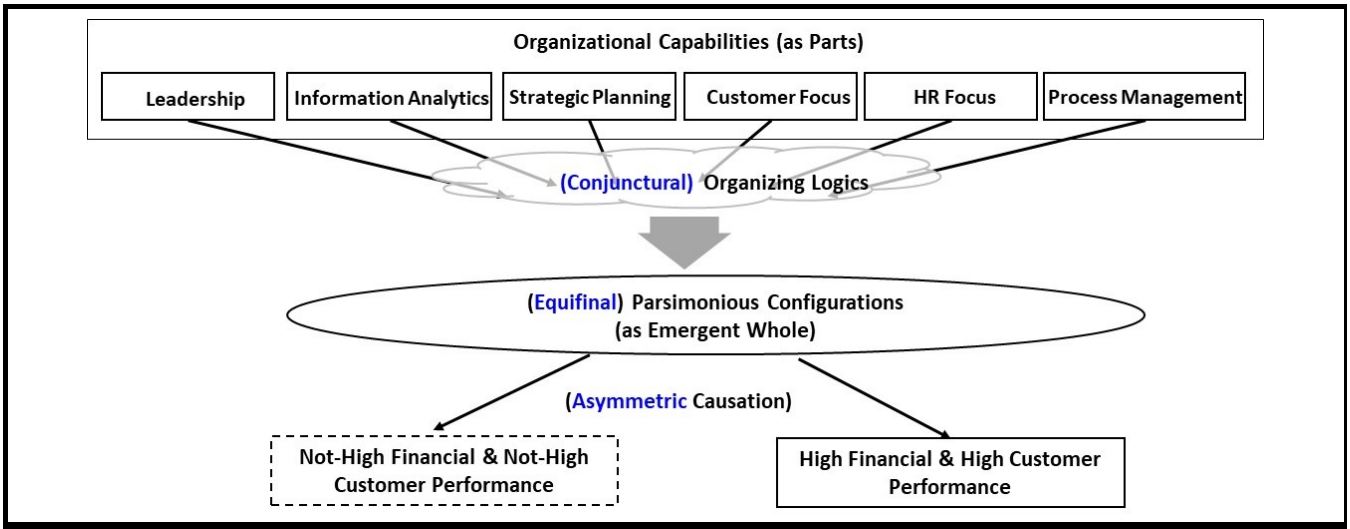


Figure 1. Research Model for Parsimonious Configurations in Complex Digital Environments

Notes: This figure shows how key organizational capabilities work together to produce parsimonious configurations, while accommodating the key features of conjunctural, equifinal, and asymmetric causation, as argued in the complexity literature. The model is consistent with modern complexity theory, which suggest that systems with many interactions among highly differentiated parts can sometimes "produce surprisingly simple, predictable behavior, while others generate behavior that is impossible to forecast, though they feature simple laws" (Anderson 1999, p. 217).

analysis of customer needs, competition, technology, strengths and weaknesses, and risks. Fourth, *customer focus capability* relates to the ability of an organization to determine the requirements, expectations, and preferences of its customers and markets (Hult et al. 2017). Fifth, *human resource* (HR) *focus capability* pertains to the ability of an organization to create a conducive workforce environment, accomplish an organization's work, and provide a supportive and secure work climate. Finally, *process management capability* pertains to the ability to attain flexibility, speed, and cost effectiveness by designing and managing three processes: (1) product design and delivery processes, including new product development and manufacturing; (2) non-product and non-service business growth processes, including innovation, research and development, supply chain management, supplier partnering, outsourcing, mergers and acquisitions, global expansion, and project management; and (3) support processes, such as finance and accounting, and facilities management. For organizational performance, we focus on financial and customer performance.

Why do we focus on the six capabilities shown in Figure 1? The first reason is that these six capabilities represent the major and core activities of firms, and many businesses are organized along very similar lines to focus on these core activities or capabilities. In related work (Mithas 2015), one of the CEO argued that the criteria provide a "crash course" on what is taught in business schools (such as a mini-MBA) to bring everyone onto the same page by providing a common framework and vocabulary for thinking about improvement. Indeed, the Baldrige constructs of leadership, strategy, customer and market focus, information and analysis, HR focus, process focus, and results map neatly onto a typical MBA program structure. Likewise, the concepts from finance and accounting relate directly to Category 7 in the Baldrige criteria, which focuses on measuring results in a comprehensive way. In fact, many business schools organize their academic departments into six or seven units that focus on these very dimensions. The CEO went on to argue that training on the Baldrige criteria is similar to a management development program because it provides opportunities to expose managers to other companies as assessors and mentors. Second, our selection of these capabilities was also pragmatic, given the availability of rich archival data on these capabilities and firm performance through the Baldrige National Quality Program, which assesses a firm's capabilities and performance excellence from a holistic systemic perspective (see Flynn and Saladin 2001; NIST 2002; Schaefer 2011).

Our core argument is that it is not a particular capability, nor a two-way or three-way interaction of capabilities, that explains performance; instead, organizational performance is best explained by examining the simultaneous interactions among the six capabilities above, and by considering their salience across different industry environments. As such, the focus of this study is on the configurations of the six capabilities rather than the influence of each capability to explore how orders emerge from interactions involving the parts. As mentioned above, it is often difficult or infeasible to predict or forecast an optimal configuration to effectively produce the outcome, which is consistent with arguments in the complexity literature (Tanriverdi and Lim 2017). Thus, this study aims to build a theory by adopting an abductive theory-building approach (Misangyi and Acharya 2014; Van Maanen et al. 2007). Following this approach, we first suggest a conceptual framework as shown in Figure 1, and later theorize the interdependencies and configurations of the six capabilities based on our empirical results.

Research Design and Methodology

Research Context and Data

We obtained the dataset of 376 organizational level cases in multiple economic sectors during the period 1999–2006. The data were collected by the Baldrige National Quality Program to measure a firm's capabilities and performance excellence (see Flynn and Saladin 2001; NIST 2002; Schaefer 2011). Here we examine healthcare, education, manufacturing, and service industry sectors, leveraging such classifications in the Baldrige data.[9]

As part of the Baldrige criteria evaluation process, organizations develop organizational profiles and provide responses on the process and results dimensions within the Baldrige framework by submitting an application of approximately 75 pages. The next step involves an independent review and scoring of an organization's application, similar to the academic peer review process solely based on the organization's detailed responses, by multiple external examiners trained in the Baldrige criteria and selected by the Baldrige program. After completion of the initial scoring, examiners hold a consensus meeting to arrive at a common score after clarifying their understanding through discussions with fellow examiners. Finally, in many cases, examiners make visits to an organization's selected locations to verify their consensus scores, and if necessary, amend their consensus scores based on their site visit findings.

[9]These industry sectors differ in their degree of digitization and turbulence. Although it is possible to combine the healthcare, education, and service sectors, we use disaggregated industry sectors to examine the nuances of configurations across such industry partitions (see Appendices A and B for further details on the Baldrige criteria and the measures used in this study).

Construct Operationalization

We measure organizational performance using financial performance and customer performance. *Financial performance* measures the trends in return on investment, profitability, liquidity, market share, and business growth. *Customer performance* measures the levels and trends in customer satisfaction, customer retention, positive referral, and product and service performance parameters that are important to customers.

Among the capability variables, we measure *information analytics capability* as an indicator of the quality, accuracy, reliability, and timeliness of the information. This construct also assesses the appropriateness of the data availability mechanisms and the IT infrastructure to changing business needs and directions. *Leadership capability* is measured as the effectiveness with which senior leaders guide a business unit through values, directions, and performance expectations and their review of organizational performance. *Strategic planning capability* refers to the strategic planning process in a business unit, including strategy development and deployment. A higher score on this variable indicates that the organization has a well-designed process in place to consider various short- and long-term risks and opportunities, and that the organization has translated its strategic objectives into action plans and performance projections. We measure *customer focus capability* as the ability to determine customer needs and requirements and to foster relationships with customers for effective acquisition, retention, and satisfaction. *HR focus capability* measures human resource management capability, which includes the workforce environment (how an organization manages workforce capability and the capacity to accomplish an organization's work and a supportive and secure work climate) and workforce engagement to achieve organizational and personal success. *Process management capability* measures the ability to design and manage product and service processes, growth processes, and support processes.

We use annual cross-sectional data across multiple economic sectors, pooled over time, for the period 1999–2006. We used some discretion for coding of the variables across years to account for any minor changes in criteria across 1999–2006. In this study, we focus on medium- to large-sized firms because such firms are more likely to adopt and rely on information technologies for their operations, thus enabling us to investigate the role of IT-enabled organizational information analytics capability more effectively. As noted earlier, the Baldrige process documents a well-specified coding scheme to generate numerical scores for items, which range from 0 to 100 for each item. It also specifies the weights of these items in a particular category. For example, a category such as process management capability may have two items, and these items may have different weights. We use either item- or category-level scores in this study for each construct. Two constructs, information analytics capability and leadership, are measured at the item level. Other constructs are at the category level, and for category-level scores, we use Baldrige weights to aggregate items as in prior work (Pannirselvam et al. 1998).

Data Analysis with Fuzzy-Set Qualitative Comparative Analysis

We use a fuzzy-set qualitative comparative analysis and next discuss the key steps of fsQCA that pertain to our study. The first step in fsQCA involves the calibration process, which allocates the set-memberships of each case in causal conditions (i.e., organizational capability) and the outcome (i.e., firm performance) by transforming the value of each variable for a case into a membership score in a set of say high financial performance firms. For performance, we set 50%, 40%, and 20% scores as the anchors for full membership, crossover, and full non-membership, correspondingly, for the set of high-performing firms. For organizational capabilities, we set 60%, 50%, and 20% scores as the anchors for full membership, crossover, and full non-membership, correspondingly, for the set of high-performing firms (Appendix B provides a detailed explanation of the level of firm capability for the three score anchors). QCA guidelines also permit the data distribution statistics for calibration (Ragin 2008), for example, the 75th, 50th, and 25th percentiles for full membership, crossover, and full non-membership, respectively.[10] Table 2 provides a summary of the calibration process.

The second step involves using a truth-table algorithm, which identifies the configurations of causal conditions (i.e., the six types of organizational capabilities) that *sufficiently* produce the outcome of interest. Appendix C shows truth tables for the healthcare sector, and for other industries. With the results of the calibration, each case is allocated into one of several possible combinations that correspond to one row in the truth table. Because we have six elements, there are 64 theoretically possible ideal combinations (i.e., 2 to the power of 6 = 64). In the table, the "Number" column shows the number of cases allocated to each row (i.e., combination).

[10]From our descriptive statistics, we found that the 75th, 50th, and 25th percentiles of performance measures are very close to the 50%, 40%, and 20% scores, respectively. For organizational capabilities, the 75th and 50th percentiles are close to the 60% and 50% scores, and the 25% score is slightly different, around the 20th to 40th percentiles, thus supporting our primary criteria for calibration. We also conducted a sensitivity analysis with these new calibration anchors and found no significant differences in the final fsQCA configurations.

Table 2. Summary Statistics and Calibration (N = 376)

Elements and Outcomes	Mean	SD	Min	Max	Anchors		
					Full Membership	Crossover	Full Non-membership
Financial performance	42.00	15.13	2.86	78.67	50	40	20
Customer performance	39.05	14.60	5.00	85.33	50	40	20
Leadership capability	49.65	11.68	7.27	75.00	60	50	20
Information analytics capability	48.91	12.90	5.00	77.77	60	50	20
Strategic planning capability	44.07	12.92	10.59	75.29	60	50	20
Customer focus capability	48.13	11.73	17.65	75.29	60	50	20
HR focus capability	47.62	10.54	10.00	72.94	60	50	20
Process management capability	48.82	12.45	14.12	77.65	60	50	20

Notes: Table 2 shows the numerical scores for items, which range from 0 to 100, following the Baldrige criteria. We used our substantive knowledge of the Baldrige criteria to select calibration anchors in Table 2; one of the authors was trained in evaluating organizations using Baldrige-like criteria and served as a senior examiner to lead the assessment of a large business unit. For performance, we set 50, 40, and 20 scores as the anchors for full membership, crossover, and full non-membership, respectively, for the set of high-performing firms. For a firm with a 50 score, (1) improvement trends and/or good performance levels are reported for most areas of importance to an organization's key business requirements; (2) no pattern of adverse trends and no poor performance levels are evident in areas of importance to an organization's key business requirements; (3) some trends and/or current performance levels—evaluated against relevant comparisons and/or benchmarks—show areas of strength and/or good to very good relative performance levels; and (4) business results address most key customer, market, and process requirements. For a firm with a 20 score, (1) there are some improvements and/or early good performance levels in a few areas; and (2) the results are not reported for many to most areas of importance to an organization's key business requirements. In the same way, for organizational capabilities, we set 60, 50, and 20 scores as the anchors for full membership, crossover, and full non-membership, respectively, for the set of high-performing firms.

For example, in the healthcare sector with 161 cases, we set the minimum acceptable number of cases to three, thus considering only combinations with at least three cases for subsequent analysis in the truth-table algorithm. The truth-table algorithm then calculates a consistency score that explains how reliably a combination results in the outcome, a measure that is similar to the significance level in regression analysis (Appendix C further explains how we set consistency cutoffs in truth-table analysis).

The third step in fsQCA involves set operations and a counterfactual analysis to minimize the number of elements in the truth table for the configurations and to find more succinct configurations that produce the outcome of interest. Then, the truth-table algorithm in fsQCA undertakes a counterfactual analysis to handle the rows without empirical cases, and to further minimize the number of causal conditions in a configuration (Fiss 2011).[11]

In our fsQCA analyses, we identified configurations of the causal conditions that were *sufficient* for the outcome by examining whether firms sharing the same set of capabilities consistently displayed high performance. We focus on financial and customer performance because prior work suggests potential tradeoffs among these performance outcomes (Fornell et al. 2006). For example, prior work in information systems reports a null or negative effect of IT investments on profitability in the period before 1997 (Rai et al. 1997), but a positive effect in the period afterward (Mithas and Rust 2016; Mithas et al. 2012). Researchers argued that lower profitability may have been because firms "competed away" all of the IT-enabled gains, and consumers realized most of these gains through overall customer satisfaction (Rai et al. 1997). Recent research supports this conjecture and finds that IT investments had a more positive influence on customer satisfaction for the 1994–1996 period than for the 1999–2006 period; conversely, IT investments had a positive effect on profits in the 1999–2006 period, but a negative effect in the 1994–1996 period (Mithas et al. 2016). Therefore, to the extent that organizational capabilities may have differential

[11]In this study, we did not make any assumptions about directional relationships or "easy counterfactuals," hence we do not obtain an intermediate solution. Therefore, we leverage complex solutions (i.e., configurations without any counterfactuals) and parsimonious solutions (i.e., configurations with both "easy" and "difficult" counterfactuals) to designate causal conditions that appear in both parsimonious and complex solutions as "core," and the ones that appear only in complex solutions as "peripheral," following such a convention used by Fiss (2011).

effects on financial and customer performance, we focus on these two specific measures of firm performance because any observed similarities in the results for them will provide stronger evidence if we observe any isomorphic patterns for these measures.

We make two sets of configurations for each economic sector (i.e., configurations of high and not-high financial performance, and configurations of high and not-high customer performance).

Results

Configurations in the Healthcare Sector

Figure 2 depicts the fsQCA results for the healthcare sector (see Table D1 in Appendix D for an alternative presentation of results using Boolean expressions) and shows four configurations that produce both high financial and high customer performance simultaneously. We make four key observations. First, the structures of the four configurations for high financial performance are the same as those for high customer performance (i.e., isomorphic structure).

Second, among all configurations, strong leadership is essential for achieving competitive performance, and other capabilities are peripheral, having a relatively lower causal relationship with the outcomes. Moreover, they may complement leadership and act together as a system to achieve the outcomes. Among the four configurations, H1d has the largest raw coverage, meaning that it is empirically most relevant for high performance. Further, its unique coverage is 0.28 for financial performance and 0.33 for customer performance, while other configurations (H1a, H1b, H1c) have a unique coverage of 0.01, meaning that these configurations mostly overlap with one another, and with H1d. Thus, H1d is empirically the most relevant and important configuration, and other configurations can be considered as modified, adjusted from H1d when strategic planning capability is absent, and either customer focus (H1a), HR focus (H1b), or process management (H1c) capability is irrelevant, implying *substitution* effects among the three capabilities. This finding implies that organizations can achieve high performance via different pathways, but individual paths are different in terms of empirical importance and effectiveness.

Third, we conducted a necessary condition test for information analytics capability because it is present in all configurations of competitive performance. The results showed that its consistency measures for being a necessary condition for high financial performance and high customer performance, are less than 0.9, indicating that it may not be a highly consistent necessary condition for performance (Ragin 2008). The results of the set-membership plot between the information analytics element and outcomes also show a similar conclusion.

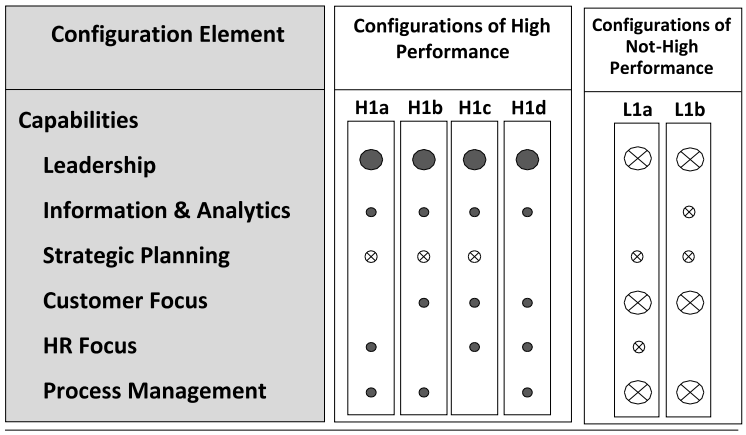
A necessary condition test for a combination of information analytics and leadership together shows that the consistency measures increase to 0.88 (financial performance) and 0.93 (customer performance) (Appendix E reports the detailed results of the necessary condition tests for the four economic sectors). Based on our tests, we conclude that IT-enabled information analytics work together tightly with leadership to achieve high performance, although it alone is neither a necessary nor a sufficient condition. The results of the necessary condition tests for other capabilities (i.e., strategic planning, customer focus, HR focus, and process management capabilities) show that no single capability has a consistency greater than 0.9, meaning that none of these four capabilities alone is a necessary condition for high performance.

Finally, our fsQCA results show no configuration that consistently produces low financial performance in the healthcare sector, which is presented with a dash (–). However, we find two configurations that consistently deliver not-high customer performance, suggesting that the absence of leadership, customer focus, and process management capabilities can lead to not-high performance. In L1a, information analytics capability does not matter for not-high performance, and the absence of strategic management is also needed for both L1a and L1b to produce not-high performance.

Configurations in the Education Sector

Turning now to the education sector, which shows two configurations for high financial performance and high customer performance, we note two key findings (see Figure 3). First, in contrast to the healthcare sector, the education sector demonstrates different solutions for competitive performance: strategic planning serves as a core element to create two alternative configurations of high performance. For both H1a and H1b in the education sector, strategic planning is a core element. While H1a includes leadership, information analytics, customer focus, and process management as its peripheral elements, H1b includes leadership, customer focus, process management, and no HR focus capability as its peripheral elements. H1a has larger raw/unique coverage than H1b, meaning that the solution supported by information analytics is empirically more relevant and effective for high performance in the education sector.

Second, we find two configurations (L1a, L1b) in the education sector that consistently deliver not-high financial perfor-



High Financial Performance							
	Consistency	0.91	0.91	0.91	0.93	-	-
	Raw Coverage	0.33	0.33	0.33	0.60	-	-
	Unique Coverage	0.01	0.01	0.01	0.28	-	-
	Overall Solution Consistency		0.92				
	Overall Solution Coverage		0.64				
High Customer Performance							
	Consistency	0.82	0.80	0.82	0.85	0.89	0.89
	Raw Coverage	0.36	0.36	0.36	0.68	0.51	0.43
	Unique Coverage	0.01	0.01	0.02	0.33	0.10	0.02
	Overall Solution Consistency		0.84			0.89	
	Overall Solution Coverage		0.73			0.53	

Figure 2. Sufficient Configurations for High Versus Not-High Performance in the Healthcare Sector

Notes: Black circles indicate the presence of a condition; circles with "X" indicate absence of a condition. Large circles indicate core conditions; small ones indicate peripheral conditions (see Footnote 11). Blank spaces indicate "don't care." The presence of capability relates to a high level of capability, whereas its absence indicates that a high level of capability should not exist. The dash (–) presents no configuration that consistently produces the outcome. In this figure, there is no consistent solution for achieving not-high financial performance in the healthcare industry. The fsQCA approach uses two measures to validate the solutions. First, the consistency measure indicates the degree to which a configuration consistently results in the outcome (Fiss 2007), which is roughly comparable to the concept of the significance level in a regression analysis. The overall solution consistency indicates the degree to which all configurations together consistently result in high performance. Second, raw coverage roughly indicates the extent to which a configuration covers the cases of the outcome (Ragin 2008). Unique coverage indicates how uniquely (and without an overlap with other configurations) a particular configuration captures cases having the outcome (Ragin 2008). Thus, coverage is a validation measure, similar to the coefficient of determination (R^2) in a regression analysis; it shows the empirical relativity of each configuration to the outcome, such that larger coverage implies empirically more relevant or important configurations (Ragin 2008). Overall, solution coverage is the total coverage by all configurations together.

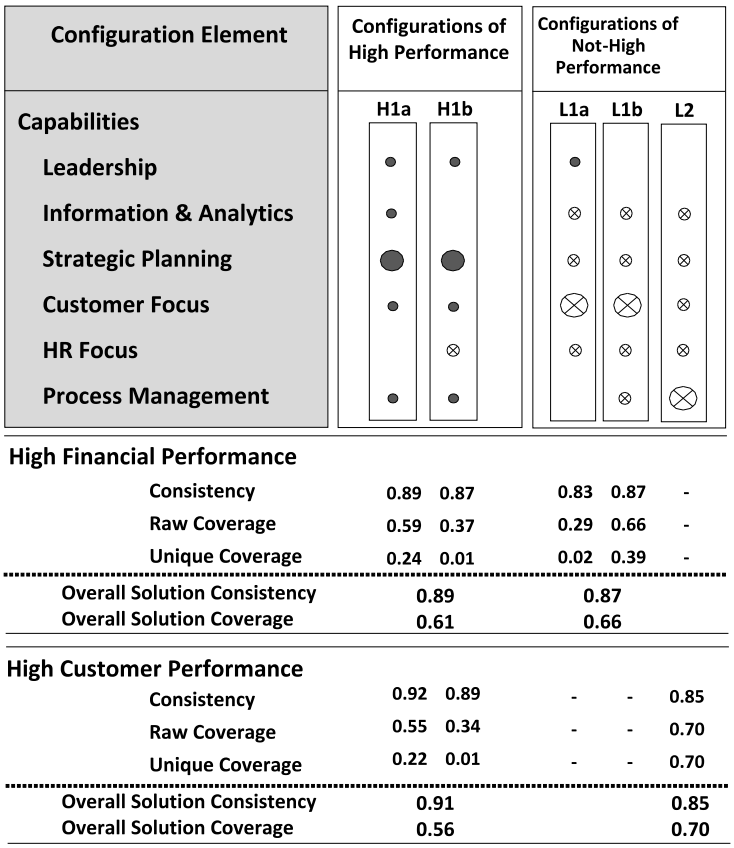


Figure 3. Sufficient Configurations for High Versus Not-High Performance in the Education Sector

Notes: Same notation as in Figure 2. In this Figure, L1a and L1b are configurations producing not-high financial performance, and L2 is a configuration for not-high customer performance. Here, L1b and L2 have the same structure, but the roles of customer focus and process management are different, changing between core and peripheral over L1b and L2, as depicted.

mance, and one configuration (L2) that delivers not-high customer performance. The absence of customer focus or process management capability is at the center of low-performing configurations.

Configurations in the Manufacturing Sector

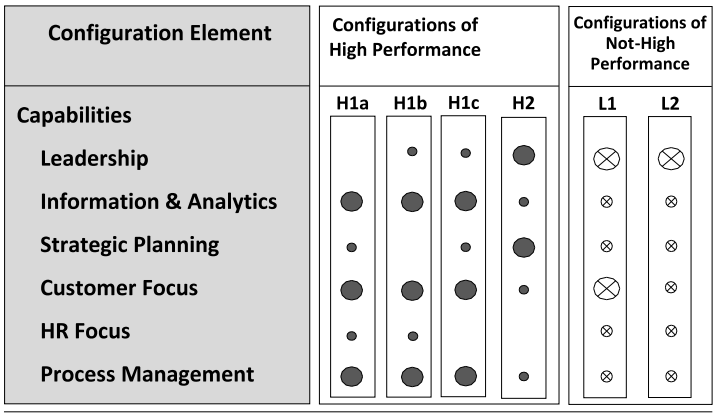
We have three key findings in the manufacturing sector (see Figure 4). First, we observe three configurations for high financial performance (H1a, H1b and H1c) and one for high customer performance (H2). Although we treat H1c and H2 as different configurations, they have the same structure in terms of the presence and absence of elements. However, the roles of the elements are different, changing between core and peripheral over H1c and H2. In other words, organizations with the same set of capabilities can achieve financial and customer performance, but may need to put a different emphasis on the types of capabilities in the configurations, depending on whether the main focus is either financial or customer performance.

Second, while information analytics, customer focus, and process management are core elements for high financial performance, leadership and strategic planning are core elements for high customer performance.

Finally, as with high performance, L1 and L2 can be considered as similar, since they have the same structure, except for the role of one element (i.e., customer focus capability), and we find that configurations of high and low performance are also different in this sector.

Configurations in the Service Sector

For the service sector (see Figure 5), we observe two configurations for high financial performance (H1a, and H1b) and



	H1a	H1b	H1c	H2	L1	L2
High Financial Performance						
Consistency	0.93	0.89	0.92	-	0.85	-
Raw Coverage	0.58	0.63	0.61	-	0.41	-
Unique Coverage	0.01	0.06	0.04	-	0.41	-
Overall Solution Consistency		0.89			0.85	
Overall Solution Coverage		0.68			0.41	
High Customer Performance						
Consistency	-	-	-	0.87	-	0.95
Raw Coverage	-	-	-	0.71	-	0.35
Unique Coverage	-	-	-	0.71	-	0.35
Overall Solution Consistency				0.87		0.95
Overall Solution Coverage				0.71		0.35

Figure 4. Sufficient Configurations for High Versus Not-High Performance in the Manufacturing Sector

Notes: Same notation as in Figure 2. In this Figure, H2 is a single configuration for high customer performance, and L2 is a single configuration for not-high customer performance. Here, H1c and H2 have the same structure, but the roles of the elements are different, changing between core and peripheral over H1c and H2, as depicted. In the same way, L1 and L2 have the same structure, with a different role of customer focus.

one for high customer performance (H2). While leadership and customer focus are the core elements for high financial performance, information analytics and strategic planning are the core elements for high customer performance. H1b has larger raw/ unique coverage for high financial performance than H1a, meaning that the solution supported by information analytics (H1b) is empirically more relevant for achieving high performance. Furthermore, in H1a, the HR focus is present and both information analytics and strategic planning are absent, while in H1b, the HR focus does not matter and both information analytics and strategic planning are present. Therefore, H1a and H1b show *substituting* or *competing* effects of the elements. In addition, H1b and H2 have the same structure in terms of the presence and absence of the elements, allowing a firm to achieve both high financial performance and high customer performance.

Finally, the service sector shows only one configuration for not-high financial performance and non-high customer performance, and the configurations for high and not-high performance also differ from each other.[12]

Discussion

Theoretical Propositions for Digital Business Strategy

Multifaceted Role of Information Analytics Capability in Configurations of Digital Business Strategy

Our findings point to a context-specific middle-range theory, suggesting boundary conditions for the role of IT-enabled information analytics capability across economic sectors and

[12]Appendix D reports additional robustness checks that provide confidence in our main findings, as well as additional analyses for small organizations.

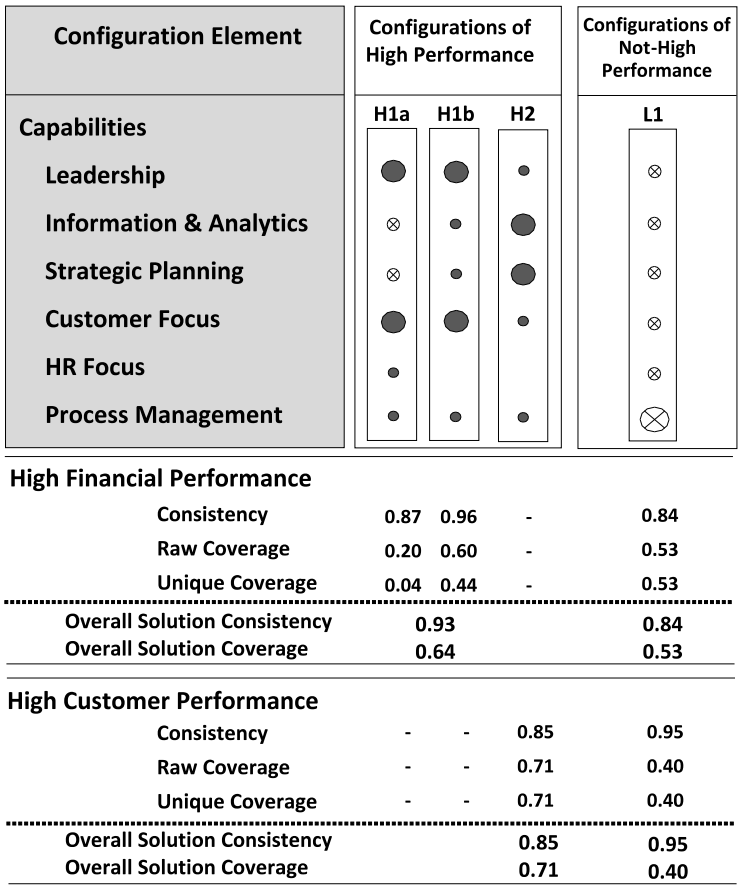


Figure 5. Sufficient Configurations for High Versus Not-High Performance in the Services Sector

Notes: Same notation as in Figure 2. In this Figure, H1b and H2 have the same structure, but the roles of the elements are different, changing between core and peripheral over H1b and H2, as depicted.

its interdependence with other capabilities to enable high performance. One of our key contributions here is to shift attention from individual capabilities to configurations of capabilities to develop a better understanding of the role of IT in complex digital business strategy. Note that in the configurations for high performance, depicted in Figures 2–5, information analytics capability needs to be combined with other capabilities having different roles in multiple pathways to high performance. Information analytics capability is present in all configurations, except for two configurations across all sectors, implying that information analytics capability needs to be tied with other capabilities in order to create a successful digital business strategy.

Furthermore, although a high level of information analytics capability must often be present in all configurations representing a successful digital business strategy, its role changes across economic sectors, and even in configurations within the same sector. For example, information analytics capability is a core capability, along with either customer focus and process management in three out of four configurations for high performance in the manufacturing sector, but it is supportive and complementary for leadership, which plays a dominant and essential role in the healthcare sector. In the education sector, it complements other core capabilities in one configuration and may not even matter in the other configuration. In the service sector, although it should be present to achieve both high financial performance and customer performance in some configurations, a high level of this capability may even become counterproductive for high financial performance in one configuration. This may seem counterintuitive at first, but once we recognize the opportunity cost of investing in high levels of information analytics capability, it appears plausible that more may not always be better.

The result that the effect of information analytics capability on firm performance is always contingent on the status of other capabilities and economic sectors exemplifies the notion of the conjunctural causality, one of the key aspects of organized complexity. This view of conjunctural causality is a sharp departure from the focus on the "net effect" of particular capabilities in extant research (e.g., Mithas et al. 2011). Our findings also exemplify the notion of equifinal causality which is evident in multiple configurations that explain the asymmetrical structures for high and not-high performance. Our findings can jumpstart further research involving more complex interactions that have so far been rarely considered in the RBV literature, the complementarity literature, and the contingency and configuration literatures.[13]

One common finding across all economic sectors is that information analytics capability alone is neither a necessary nor a sufficient condition in any configuration for achieving high performance, but is often an important part of the configurations of capabilities that sufficiently produce both high financial performance and high customer performance. When following a complex system perspective of digital business strategy, the key to success lies not in individual capabilities, but rather in how IT-enabled capabilities are configured with other organizational capabilities (DeSarbo et al. 2005; El Sawy et al. 2010; Park et al. Fiss 2017; Pavlou and El Sawy 2011).

Our findings regarding the role of IT-enabled information analytics capability extend arguments based on the resource-based view, which have been used in prior work to explain the effect of IT capabilities or IT investments on firm performance (Wade and Hulland 2004). Frequently, empirical studies have operationalized the tenets of RBV to justify the effect of their focal IT variables on firm performance (Hitt and Brynjolfsson 1996), sometimes using other capabilities as mediators (Mithas et al. 2011), and at other times, using other capabilities or environmental factors (e.g., the industry environment or hyperturbulence) as moderators (Saldanha et al. 2017). The configurational approach enabled us to reduce the dimensionality of the problem by shifting attention from "variables" to "configurations" that we believe can provide a more promising reinterpretation of RBV by thinking of resources as configurations of capabilities rather than the limiting view of such capabilities as additive or multiplicative terms within a regression framework.

The conjunctural causality idea suggests that it is not so much one individual capability or resource, but rather a configuration of several capabilities or resources that explains firm performance, which is only implicit in prior research. As Flynn et al. (1995, p. 666) note, the "simultaneous pursuit" of several competitive advantages can lead to stronger performance, given that competing on "several fronts simultaneously" makes it more difficult for competitors to replicate such configurations. However, what has been missing is a practical way to study such detailed dynamics in configurations, which is where we believe that the complexity view, enabled by the configurational approach adopted in this study, opens a new frontier for enquiry.

Based on the foregoing discussion, we suggest the proposition:

> ***Proposition 1***. *The Multifaceted Role of Information Analytics Capability: The role of digital technology for competitive performance is multifaceted, depending on the context. IT-enabled information analytics capability alone is neither necessary nor sufficient in any configuration for achieving high performance, but is often an important part of the configurations of capabilities, for both high financial performance and high customer performance. Thus, harmonizing it with other organizational capabilities and environmental contexts is key for a successful digital business strategy.*

Parsimony and Isomorphism in the Configurations of Digital Business Strategy

Our findings, summarized in Table 3, suggest that a few configurations are sufficient to explain high or low performance. For example, the configurations in our study show that only a few systematic pathways, often fewer than five, explain high performance across industries that differ in their levels of digitization.

In addition, we find that configurations are often isomorphic and applicable to different types of firm performance as alluded to in complexity theory (Anderson 1999; Andriani and McKelvey 2009; Davis et al. 2009). For example, in the healthcare and education sectors, all configurations have the same structures to achieve both high financial performance and high customer performance. In the manufacturing and service sectors, there is one configuration that can achieve both high financial performance and high customer perfor-

[13]As we noted before, much of the prior theorizing has stopped at two- or three-way interactions or clusters, and has almost never explained the detailed dynamics within configurations in terms of the multifaceted roles of individual elements and their interdependent relationships, such as the dominant, supportive, or even counterproductive roles of information analytics capability and the complementary or suppressive roles of other capabilities, which we illuminate in this study.

Table 3. Summary of Results: Parsimonious Configuration Solutions for High Performance

	Healthcare (Financial & Customer Performance)				*Education (Financial & Customer)*		*Manufacturing*				*Service*		
							Financial			*Customer*	*Financial*		*Customer*
	H1a	*H1b*	*H1c*	*H1d*	*H1a*	*H1b*	*H1a*	*H1b*	*H1c*	*H2*	*H1a*	*H1b*	*H2*
Leadership capability	**L**	**L**	**L**	**L**	l	l		l	l	**L**	**L**	**L**	l
Information analytics capability	i	i	i	i	i		**I**	**I**	**I**	i	~i	i	**I**
Strategic planning capability	~s	~s	~s		**S**	**S**	s		s	**S**	~s	s	**S**
Customer focus capability		c	c	c	c	c	**C**	**C**	**C**	c	**C**	**C**	c
HR focus capability	h		h	h		~h	h	h			h		
Process management capability	p	p		p	p	p	**P**	**P**	**P**	p	p	p	p

Notation: Upper Case = Core (**I**), Lower case = Peripheral (i), ~ = Negation (~i), Blank = Don't care.

The presence of capability relates to a high level of capability; its absence indicates that a high level of capability should not exist.

Each column corresponds to one configuration, representing a set of variables that builds a single system to achieve high financial performance and high customer performance. Shaded columns indicate an isomorphic solution, in that the same configurational structure in terms of the presence/absence of individual capabilities achieves both high financial performance and high customer performance. If configurations have the same core elements with different peripheral elements, then their names are under the same number, for example, H1a and H1b. However, two configurations with different core elements have names with different numbers, for example, H1 and H2. This notation intends to show more general patterns, each of which has possibly multiple minor variations in its structure with the same core elements and different peripheral elements, also known as first-order, across-type equifinality (i.e., more general patterns), and second-order, within-type equifinality (i.e., neutral permutations within an across-type) (Fiss 2011).

mance, but other configurations with different structures also achieve high financial performance. This comparison with an intersection analysis explicitly shows that there are isomorphic configurations that enable firms to achieve different types of performance simultaneously.[14]

How does one explain the findings relating to the emergence of parsimonious configurations, which are often isomorphic? We offer several reasons for the parsimony or limited diversity in configurations. Although mathematically there can be many possible configurations when we assume that all elements are independent, as in general linear models, the elements are, in fact, interdependent and tend to change together, resulting in limited diversity (Meyer et al. 1993). Theoretically, there are many forces that can drive the attributes of cases and can be combined systematically, resulting in a small number of configurations covering a large portion of the empirical cases, leading to parsimonious configurations (Simon 2001). Examples include exogenous forces, such as environmental selection in population ecology (Hannan and Freeman 1989), institutional pressures (DiMaggio and Powell 1983), and functional, mutually reinforcing relationships among organizational components that create alignment and synergy (Miller 1987). As such, a systemic configurational approach explains how interdependent, diverse organizational capabilities are systemically combined in the form of parsimonious configurations to produce high customer performance and high financial performance. Thus,

> ***Proposition 2. Parsimonious Configurations for Digital Business Strategy:*** *Only a few configurations of organizational capabilities are sufficient for explaining high or not-high competitive performance due to tight interdependencies between IT-enabled information analytics capability and other key organizational capabilities. The logics formulating the configurations of digital business strategy are often isomorphic, so that the organization can apply them to achieve different performance measures, such as financial or customer performance, simultaneously.*

[14]Figure D2 in Appendix D depicts such isomorphic configurational structures for all sectors.

Configurations of Capabilities for Competitive Performance in Multiple Economic Sectors

Our results across healthcare, education, manufacturing, and service sectors show nuances of capability configurations that are worth noting (see Table 3). The results suggest an overarching proposition that applies across all economic sectors, drawing attention to conjunctural causation and nonlinear interdependencies among the six capabilities (rather than an overemphasis on one capability in isolation), and asymmetric causation in that the structures of configurations for high performance differ from those for not-high performance. Furthermore, the capabilities causally related in one configuration are unrelated or inversely related in other configurations, and the presence of one type of capability for high performance does not necessarily lead to low performance. In other words, a small change in one capability can trigger a "revolutionary change" with discontinuous, nonlinear transformations in the whole configuration (Tushman and Anderson 1986), and subsequent performance. These discontinuous and nonlinear transformations arise due to causal asymmetry (i.e., different structures between configurations for high performance and those for lower performance) and conjunctural causation, where an increase or decrease in the value of the elements in isolation does not go from a low-performing configuration to a high-performing one. Instead, a structural transformation is required to shift to a high-performing configuration (i.e., discontinuous change). Due to the interconnected relationships among elements in a configuration, a small change in one element can trigger a significant change in the entire system (i.e., nonlinear change). More formally, we propose:

> ***Proposition 3a****: For all economic sectors, to achieve competitive performance, an organization with a low-performing configuration should effect a revolutionary change by reconfiguring all capabilities simultaneously rather than changing individual capabilities separately.*

Next, we develop the following propositions that suggest *configurational recipes* for high financial performance and high customer performance simultaneously in each economic sector.

First, in the healthcare sector, information analytics appears as a peripheral and enabling condition in all configurations for high performance, along with strong leadership as a core element. However, even these two capabilities by themselves are not enough for high performance; organizations need the presence of at least two out of three remaining capabilities of customer focus, HR focus, and process management as peripheral conditions for achieving high performance. In other words, information analytics supports leadership capability to nurture and orchestrate other organizational capabilities (Earl and Feeny 2000; Srivastava et al. 2006) for achieving high performance.

Why is leadership so important in healthcare, compared to other sectors? One plausible reason may be that the healthcare sector relies on "expertise" power, compared to the power of authority because it employs physicians who are "experts," and who are more driven by altruistic, status, and legalistic values than economic values (Kohli and Kettinger 2004). Physicians are more likely to be inspired by strong leadership that they believe is congruent with the values that physicians share. Therefore, we suggest:

> ***Proposition 3b****. Healthcare: To achieve high financial performance and high customer performance simultaneously, strong leadership supported by information analytics should be central in configurations and should be complemented by at least two out of the three capabilities of customer focus, HR focus, and process management, while a high level of strategic planning capability should be suppressed.*

Second, the education sector shows evidence for a substituting or suppressing relationship between information analytics and HR capability in that the presence of information analytics can obviate the need for high HR capability, and vice-versa. This insight is new to the literature and shows that organizational capabilities can be substitutable, yet valuable at the same time, depending on the type of configuration that an organization chooses in order to achieve high performance. This finding allows us to go beyond simplistic acronyms, such as VRIN (valuable, rare, inimitable, and non-substitutable) for characterizing a particular resource or capability for all organizations or situations. The education sector findings also suggest that strategic planning is an important and core capability for high performance; however, it needs to be complemented with leadership, customer focus, and process management as peripheral conditions, while making a thoughtful choice between the presence of information analytics and the absence of HR capability.

Remarkably, the role of strategic planning capability is very different in the education sector, compared to the healthcare sector, even though both healthcare and education belong to "stagnant" services (Baumol 2012). In the education sector, brand and reputation are important success measures but it takes a long time to enhance one's brand and reputation (DiMaggio and Powell 1983). That is where strategic planning capability can help, by blending and synchronizing the necessary IT and organizational resources to achieve a

high brand name and reputation, which can in turn, result in high customer outcomes and high financial outcomes (Porter and Rivkin 2000; Segars and Grover 1999). Thus,

> ***Proposition 3c****. Education: To achieve high financial performance and high customer performance simultaneously, strategic planning capability plays an essential role in configurations, complemented by leadership, customer focus, and process management capabilities. The configuration can be more effective in achieving high performance when either information analytics capability is present, or a high level of HR focus is suppressed.*

Third, the manufacturing sector shows that high financial performance requires the presence of information analytics capability as a core element, along with customer focus and process management as additional core conditions, and the presence of at least two out of the three remaining capabilities of leadership, strategic planning, and HR focus as peripheral conditions. However, high customer performance in the manufacturing sector requires leadership and strategic planning as core elements, and information analytics, customer focus, and process management as peripheral elements. At the same time, in the manufacturing sector it is possible to achieve both high financial performance and high customer performance with the same set of capabilities, although by putting different emphases across the capabilities.

Interestingly, information analytics capability plays a more dominant role in the manufacturing sector in the United States for achieving high financial performance than any other sectors. One plausible reason may be that the manufacturing sector has experienced a much greater adoption and diffusion of IT for a long time to automate and improve processes. Additionally, it takes a while for organizational complements to emerge to realize payoff from information analytics capability.

> ***Proposition 3d****. Manufacturing: To achieve high financial performance and high customer performance simultaneously, leadership, information analytics, strategic planning, customer focus, and process management should be configured with different emphases. For high financial performance, information analytics, customer focus, and process management should be central in the configuration, while for high customer performance, leadership and strategic planning should be central.*

Fourth, in the service sector (other than healthcare and education), we find one isomorphic configuration that can achieve both high financial performance and high customer performance. This configuration requires (1) the presence of information analytics and strategic planning as core elements, and the presence of leadership, customer focus, and process management as peripheral elements for high customer performance and (2) the presence of leadership and customer focus as core elements, and the presence of information analytics, strategic planning, and process management as peripheral elements for high financial performance. In other words, in the isomorphic configuration, the HR focus is a "do not care" element for high performance, and a firm needs to put different emphases across capabilities between the financial and customer performance measures. We also find evidence for substitution between HR focus and the combination of information analytics and strategic planning for the two configurations of high financial performance. It may be that these services are more "progressive" (Baumol 2012) compared to education and healthcare, and better performance on information analytics can obviate the need for the HR focus.

> ***Proposition 3e****. Service: To achieve high financial performance and high customer performance simultaneously, leadership, information analytics, strategic planning, customer focus, and process management should be configured with different emphases. For high financial performance, leadership and customer focus should be central in the configuration, while for high customer performance, information analytics and strategic planning should be central.*

Contributions, Limitations, and Research Implications

We now discuss several implications of our research. First, this study makes a significant contribution to complexity theory by conceptualizing the notion of organized complexity in complex systems, in particular, nonlinear interdependencies among key organizational capabilities and their emergent effects in developing digital business strategy. The use of a configurational approach here enabled us to link the complexity theory to causal complexity in the organizational literature by conceptually and empirically explicating nonlinear, emergent relations in terms of conjunctural, equifinal, and asymmetric causation. Furthermore, a configurational approach with fsQCA sheds light on hitherto neglected aspects of complex causality by explicitly considering the necessary and sufficient conditions for the outcomes by using

set theory and Boolean algebra.[15] In turn, the configurational approach helps generate new theoretical propositions with prescriptive configurational recipes, which sharply differ from the conventional hypothesis-testing paradigm that often focuses on the effect of one or two variables in traditional correlation-based methods commonly used by economists.

The notion of complex causality in the configuration view that we employed is also distinct from the one used by statisticians and in medical field, which uses propensity score-based approaches that focus on the causal effect of a particular treatment on an outcome, using a potential outcomes approach (e.g., Mithas and Krishnan 2009; Rubin 1974). Economists, on the other hand, make simplifying assumptions about unobserved error terms to study causal impacts in observational studies. Often, practitioners find that the insights from such "causal impact" studies are limiting because they either do not trust or understand the underlying assumptions, or they find the assumption of "holding all else constant" to be somewhat incredulous. Even in business settings, holding all else constant in a study that looks at the effect of, say, advertising expenditures on performance does not clarify how a CEO will be able to effect a unit change in advertising expenditures without tinkering with other discretionary expenditures, such as those involving R&D or IT, given that the total amount of discretionary dollars is not unlimited.

The configuration view used here is also a useful addition to complexity ideas because the configuration view formalizes and helps individuals engage with real-world settings and data to develop causal prescriptions based on complexity ideas that are managerially relevant. While conventional complexity ideas and toolkits, such as the use of simulations, can help individuals understand and describe complex adaptive systems, these tools do not generate prescriptive causal recipes or configurations that fully accommodate the conjunctural, equifinal, and asymmetric causation that pervade many natural and business phenomena. That is where we believe that the notion of organized complexity operationalized via the configurational perspective can be a useful complement to the list of 20 or more complexity notions that are already embraced within an open and inclusive understanding of complex phenomena.

Second, this study makes contributions to complex digital business strategy by using a problem-solution argument.[16] We develop prescriptive causal recipes for building parsimonious configurations for dealing with organized complexity within a complex digital environment. The notion of parsimonious configurations in this study differs from "simple rules" (Sull and Eisenhardt 2012), in that the configurations here involve organizational capabilities that have conjunctural, equifinal, and asymmetric effects on high versus low financial performance and high versus low customer performance, based on set-theory, Boolean algebra, and counterfactual analysis. In contrast, simple rules tend to focus on observed "rules of thumb" or tentative insights from a few case studies (typically fewer than a dozen, and sometimes based on just one industry sector or experience of companies in one geographical area or cluster, such as Silicon Valley).

Third, this study also makes a contribution by bridging and extending the business value of the IT literature, with its focus on RBV and complementarities, which permit quantitative analyses of the effects of organizational capabilities (Dedrick et al. 2003; Pavlou and El Sawy 2011), overcoming some of their limitations on the one hand, and the sociomateriality perspective, which discusses the pervasive entanglement nature of digitization and the resulting complex notions of causality in a descriptive manner on the other hand (Henfridsson and Bygstad 2013; Svahn et al. 2009). The use of the configurational approach operationalizes and tests descriptive and prescriptive elements of the sociomateriality perspective through rigorous quantitative analyses. For example, fsQCA allows us to model the notion of IT pervasiveness through conjunctural notions inherent in the configurations of information analytics capability, operating in concert with leadership, human resources, and strategic planning etc.[17]

Despite its strengths and contributions, our study also has limitations that provide opportunities for further work. First, there is a need to test the generalizability of the configurations

[15]Arguably, fsQCA is not as well equipped to handle before and after temporal causality, which may be better handled in econometric approaches. However, these approaches have their own limitations in terms of the assumptions they make. Note also that many studies examining the business value of the IT literature also largely study contemporaneous effects, and are unable to deal with lagged effects because of limitations in the theory, data, or the unavailability of a long enough time series.

[16]From a problem-solution perspective, interdependencies of the causal elements in a system are the sources of problems involving organized complexity, consistent with the modern view of complexity theory (Anderson 1999; Andriani and McKelvey 2009; Brown and Eisenhardt 1997; Davis et al. 2009). As a solution, we develop causal prescriptions with a few parsimonious configurations in which IT-enabled capabilities combine with other organizational capabilities and engage organizations to achieve superior performance.

[17]As another example, Westerman et al. (2006) argue and demonstrate the notion of equifinality in their four case studies of CVS, Walgreens, Schwab, and Merrill, as these firms were trying to transform themselves for e-commerce. Although their focus was on the adoption mode, and their qualitative analyses considered a variety of contingency factors, the use of fsQCA can enable a more systematic handling of such cases to derive equifinal configurations than relying completely on researchers' judgments.

that we documented for the first time in four different industry sectors in other contexts and countries. Although the richness of the Baldrige data in terms of the capabilities and firm performance measures is a strength, these data are only available until 2006. Hence, it will be useful to replicate our findings when Baldrige releases data after 2006. Such data will permit an evaluation of the influence of technological innovations, such as mobile, cloud computing, social media, and AI/machine learning, which became more widespread after 2006.[18]

Second, future work could examine the capability configurations for other dimensions of firm performance, such as the amount, speed and inimitability of digital innovations (Leonhardt et al. 2018), and whether they differ from those that predict financial success.

Furthermore, researchers should be aware of ongoing conversations and concerns about QCA such as the ability to handle large sample and coarse-grained data (Miller 2018a), discovery of causal processes (Collier 2014; Lucas and Szatrowski 2014; Ragin 2014), sensitivity of results due to calibration, and the ability to support theoretical exploration and testing of causal relationships. Such conversations and concerns are part of the evolution of the scientific process, and already there have been responses to such concerns (Greckhamer et al. 2018; Miller 2018b; Ragin 2014) that explain how a configurational approach can handle such issues. For example, Greckhamer et al. (2018) suggest some best practices for QCA along with extant exemplar studies, and we followed such best practices in this study including sensitivity analysis to show robustness of our results, and transparent description of the QCA steps to enable future studies for generalizability.

Regarding ability of QCA to study complexity, we illustrated how a configurational approach with fsQCA can handle two key concepts of complexity, that is, nonlinear and emergent relations among multiple capabilities in terms of conjunctural, equifinal, and asymmetric causation. We also showed the existence of isomorphism, an interesting aspect of complexity, in that we empirically found isomorphic structures of configurations that produce two types of outcomes simultaneously. We believe that QCA can also help to test "fractal structure," another concept of complexity, if one has access to multi-level data. Just as no one method can explore many different facets of complexity, this applies to QCA as well. Our goal here was to point to unrecognized role and usefulness of QCA as another tool to understand the organized complexity of digital environments, and we encourage researchers to choose appropriate methods including QCA to explore specific concepts of complexity based on the focus of their study.

Finally, a few comments are in order about the durability of the discovered configurations and causal relationships over time. We view configurations to emerge from interactions among the elements, and our propositions prescribe configurational recipes that reflect such emergent orders. When the contexts do not change, the durability of configurations and causal relationship to produce the outcomes holds over time. Ultimately, durability of the discovered knowledge on the organizing logics for configurations needs continual examination in social contexts that are forever changing, unlike the possibility of relatively durable relationships in natural sciences such as physics or chemistry where gravitational constant or molecular structures are relatively immutable.

Although we could not study the evolution of organizing logics of configurations over time due to data limitations and lack of information on identity of organizations, it is an interesting topic for future studies. Arguably, configurations producing high performance reflect systemic structures of firms that have successfully evolved to fit environments, while configurations for not-high performance exhibit structures that may not fit environments. The configurational approach with fsQCA allows researchers to investigate how firms change from one configuration to other configuration to fit changing environments and organizational contexts. For example, equifinality suggests multiple pathways to the outcomes, implying firms can choose one of the multiple alternative configurations that best fits to their contexts. For instance, although we find that information analytics is an enabling but not a core condition in the healthcare sector using our data before 2007 (Khuntia et al. 2017), the role of information analytics may become more prominent over time at least in some configurations as newer technologies like artificial intelligence and gene sequencing are deployed more widely. We call for further studies that shed light on longitudinal changes in configurations and underlying reasons for those.

Managerial Implications

This study has at least two key managerial implications. First, the findings indicate that it is possible to achieve both high financial performance and high customer performance by

[18] In addition, researchers could use other archival data from Europe, which uses a variant of Baldrige called the European Foundation for Quality Management (EFQM) and has very similar capability constructs to assess the extent to which the patterns noted here apply to other contexts and cultures. We thank an anonymous reviewer for this discussion and limitation regarding the generalizability of the findings, based on the Baldrige data used in this study.

focusing on configurations, instead of focusing on just one or two capabilities and ignoring their interactions with other capabilities. In other words, firms should first assess their current capability profile, and then reconfigure the capabilities to approximate a capability configuration that leads to high performance. Thus, successful organizational transformation depends both on initial conditions and the capability configuration that organization wants to achieve, and some configurations may be more promising than others within a particular industry sector.

The most distinctive aspect of our findings is prescriptive causal recipes for managers to better understand their options in a more realistic way. This is a sharp contrast from the types of insights that one can gather by relying only on insights from the conventional econometric approaches that focus on the effect of just one or two causal variables, and how a unit change in them may affect a certain performance outcome. Our data-driven prescriptive configurational recipes are also a useful complement to the insights that one might gather from complexity approaches that rely on simulations or other approaches to understand or describe a phenomenon, but may not necessarily provide causal recipes of the type that the configurational approach delivers.

Second, the study provides implications for governance bodies, such as NIST, which administers the Baldrige model to revise the Baldrige criteria by drawing sharper attention to configurations of capabilities, rather than individual capabilities across economic sectors. Based on our findings, for example, in the healthcare sector, leadership and information analytics appear to be key capabilities that need to be combined with some other, but not all capabilities. The suggested causal recipes for building parsimonious configurations of successful digital business strategy could be useful guidelines to update the Baldrige criteria in a way that is appropriate and unique, depending on the economic sector and organization size.

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References

Abbott, A. 1988. "Transcending General Linear Reality," *Sociological Theory* (6), pp. 169-186.

Anderson, P. 1999. "Perspective: Complexity Theory and Organization Science," *Organization Science* (10:3), pp. 216-232.

Andriani, P., and McKelvey, B. 2009. "Perspective—From Gaussian to Paretian Thinking: Causes and Implications of Power Laws in Organizations," *Organization Science* (20:6), pp. 1053-1071.

Baumol, W. J. 2012. *The Cost Disease: Why Computers Get Cheaper and Health Care Doesn't*, New Haven, CT: Yale University Press.

Benbya, H., and McKelvey, B. 2006. "Using Coevolutionary and Complex Theories to Improve IS Alignment: A Multi-Level Approach," *Journal of Information Technology* (21), pp. 284-298.

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

Brown, S. L., and Eisenhardt, K. M. 1997. "The Art of Continuous Change: Linking Complexity Theory and Time-Paced Evolution in Relentlessly Shifting Organizations," *Administrative Science Quarterly* (42:1), pp. 1-34.

Brynjolfsson, E., and McElheran, K. 2016. "The Rapid Adoption of Data-Driven Decisionmaking," *American Economic Review* (106:5), pp. 133-139.

Collier, D. 2014. "Comment: QCA Should Set Aside the Algorithms," *Sociological Methodology* (44:1), pp. 122-126.

David, R. J., and Han, S.-K. 2004. "A Systematic Assessment of the Empirical Support for Transaction Cost Economics," *Strategic Management Journal* (25:1), pp. 39-58.

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

Dedrick, J., Gurbaxani, V., and Kraemer, K. L. 2003. "Information Technology and Economic Performance: A Critical Review of Empirical Evidence," *ACM Computing Surveys* (35:1), pp. 1-28.

DeSarbo, W. S., Di Benedetto, C. A., Song, M., and Sinha, I. 2005. "Revisiting the Miles and Snow Strategic Framework: Uncovering Interrelationships between Strategic Types, Capabilities, Environmental Uncertainty, and Firm Performance," *Strategic Management Journal* (26:1), pp. 47-74.

DiMaggio, P. J., and Powell, W. W. 1983. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields," *American Sociological Review* (48:2), pp. 147-160.

Earl, M., and Feeny, D. 2000. "How to be a CEO for the Information Age," *Sloan Management Review* (41:2), pp. 11-23.

El Sawy, O. A., Malhotra, A., Park, Y., and Pavlou, P. A. 2010. "Seeking the Configurations of Digital Ecodynamics: It Takes Three to Tango," *Information Systems Research* (21:4), pp. 835-848.

Fiss, P. C. 2007. "A Set-Theoretic Approach to Organizational Configurations," *Academy of Management Review* (32:4), pp. 1180-1198.

Fiss, P. C. 2011. "Building Better Causal Theories: A Fuzzy Set Approach to Typologies in Organization Research," *Academy of Management Journal* (54:2), pp. 393-420.

Flynn, B. B., and Saladin, B. 2001. "Further Evidence on the Validity of the Theoretical Models Underlying the Baldrige Criteria," *Journal of Operations Management* (19), pp. 617-652.

Flynn, B. B., Schroeder, R. G., and Sakakibara, S. 1995. "The Impact of Quality Management Practices on Performance and Competitive Advantage," *Decision Sciences* (26:5), pp. 659-691.

Fornell, C., Mithas, S., Morgeson, F. V., and Krishnan, M. S. 2006. "Customer Satisfaction and Stock Prices: High Returns, Low Risk," *Journal of Marketing* (70:1), pp. 3-14.

Gillon, K., Aral, S., Lin, C.-Y., Mithas, S., and Zozulia, M. 2014. "Business Analytics: Radical Shift or Incremental Change?," *Communications of the AIS* (34:1:Article 13), pp. 287-296.

Gillon, K., Brynjolfsson, E., Griffin, J., Gupta, M., and Mithas, S. 2012. "Panel: Business Analytics: Radical Shift or Incremental Change?," in *Proceedings of the 32nd International Conference on Information Systems*, Orlando, FL.

Goldthorpe, J. H. 2001. "Causation, Statistics and Sociology," *European Sociological Review* (17:1), pp. 1-20.

Greckhamer, T., Fiss, P., Furnari, S., and Aguilera, R. V. 2018. "Studying Configurations with Qualitative Comparative Analysis: Best Practices in Strategy and Organization Research," *Strategic Organization* (16:4), pp. 482-495.

Hannan, M. T., and Freeman, J. 1989. *Organizational Ecology*, Cambridge, MA: Harvard University Press.

Heckman, J. J. 2005. "The Scientific Model of Causality (with Discussion)," *Sociological Methodology* (31:1), pp. 1-150.

Henfridsson, O., and Bygstad, B. 2013. "The Generative Mechanisms of Digital Infrastructure Evolution," *MIS Quarterly* (37:3), pp. 907-931.

Hitt, L. M., and Brynjolfsson, E. 1996. "Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value," *MIS Quarterly* (20:2), pp. 121-142.

Holland, P. 1986. "Statistics and Causal Inference (with Discussion)," *Journal of American Statistical Association* (81:396), pp. 945-970.

Hult, G. T. M., Morgeson, F. V., Morgan, N., Mithas, S., and Fornell, C. 2017. "Do Managers Know What Their Customers Think and Why?," *Journal of the Academy of Marketing Science* (45:1), pp. 37-54.

Khuntia, J., Mithas, S., and Agarwal, R. 2017. "How Service Offerings and Operational Maturity Influence the Viability of Health Information Exchanges," *Production and Operations Management* (26:11), pp. 1989-2005.

King, A. A., and Baatartogtokh, B. 2015. "How Useful Is the Theory of Disruptive Innovation?," *MIT Sloan Management Review* (Fall), pp. 77-90.

Kohli, R., and Kettinger, W. J. 2004. "Informating the Clan: Controlling Physicians' Costs and Outcomes," *MIS Quarterly* (28:3), pp. 363-394.

Leonhardt, D., Hanelt, A., Huang, P., and Mithas, S. 2018. "Does One Size Fit All? Theorizing Governance Configurations for Digital Innovation " in *Proceedings of the 39th International Conference on Information Systems*, San Francisco.

Lucas, S. R., and Szatrowski, A. 2014. "Qualitative Comparative Analysis in Critical Perspective," *Sociological Methodology* (44:1), pp. 1-79.

Lyytinen, K., and Yoo, Y. 2002. "The next Wave of Nomadic Computing," *Information Systems Research* (13:4), pp. 377-388.

McKelvey, B. 1999. "Complexity Theory in Organization Science: Seizing the Promise or Becoming a Fad?," *Emergence* (1:1), pp. 5-22.

McKelvey, B., Tanriverdi, H., and Yoo, Y. 2016. "Complexity and Information Systems Research in the Emerging Digital World" (Call for Papers), *MIS Quarterly*.

Meyer, A. D., Tsui, A. S., and Hinings, C. R. 1993. "Configurational Approaches to Organizational Analysis," *Academy of Management Journal* (36:6), pp. 1175-1195.

Meyer, M. D., Gaba, V., and Colwell, K. A. 2005. "Organizing Far from Equilibrium: Nonlinear Change in Organizational Field," *Organization Science* (16:5), pp. 456-473.

Miller, D. 1987. "The Structural and Environmental Correlates of Business Strategy," *Strategic Management Journal* (8:1), pp. 55-78.

Miller, D. 2018a. "Challenging Trends in Configuration Research: Where Are the Configurations?," *Strategic Organization* (16:4), pp. 453-469.

Miller, D. 2018b. "Response to Greckhamer et al. (2018): Studying Configurations with Qualitative Comparative Analysis," *Strategic Organization* (16:4), pp. 496-498.

Misangyi, V. F., and Acharya, A. G. 2014. "Substitutes or Complements? A Configurational Examination of Corporate Governance Mechanisms," *Academy of Management Journal* (57:6), pp. 1681-1705.

Misangyi, V. F., Greckhamer, T., Furnari, S., Fiss, P. C., Crilly, D., and Aguilera, R. 2017. "Embracing Causal Complexity: The Emergence of a Neo-Configurational Perspective," *Journal of Management* (43:1), pp. 255-282.

Mithas, S. 2015. *Making the Elephant Dance: The Tata Way to Innovate, Transform and Globalize*, New Delhi: Penguin Portfolio.

Mithas, S., and Krishnan, M. S. 2009. "From Association to Causation Via a Potential Outcomes Approach," *Information Systems Research* (20:2), pp. 295-313.

Mithas, S., Krishnan, M. S., and Fornell, C. 2016. "Information Technology, Customer Satisfaction, and Profit: Theory and Evidence," *Information Systems Research* (27:1), pp. 166-181.

Mithas, S., Ramasubbu, N., and Sambamurthy, V. 2011. "How Information Management Capability Influences Firm Performance," *MIS Quarterly* (35:1), pp. 237-256.

Mithas, S., and Rust, R. T. 2016. "How Information Technology Strategy and Investments Influence Firm Performance: Conjecture and Empirical Evidence," *MIS Quarterly* (40:1), pp. 223-245.

Mithas, S., Tafti, A. R., Bardhan, I. R., and Goh, J. M. 2012. "Information Technology and Firm Profitability: Mechanisms and Empirical Evidence," *MIS Quarterly* (36:1), pp. 205-224.

Nan, N., and Tanriverdi, H. 2017. "Unifying the Role of IT in Hyperturbulence and Competitive Advantage Via a Multilevel Perspective of IS Strategy," *MIS Quarterly* (41:3), pp. 937-958.

Newbert, S. L. 2007. "Empirical Research on the Resource-Based View of the Firm: An Assessment and Suggestions for Future Research," *Strategic Management Journal* (28), pp. 121-146.

NIST. 2002. "Criteria for Performance Excellence, Baldrige National Quality Program 2002," National Institute of Standards and Technology, U. S. Department of Commerce, Gaithersburg, MD.

Pannirselvam, G. P., Siferd, S. P., and Ruch, W. A. 1998. "Validation of the Arizona Governer's Quality Award Criteria: A Test of the Baldrige Criteria," *Journal of Operations Management* (16), pp. 529-550.

Park, Y., El Sawy, O. A., and Fiss, P. C. 2017. "The Role of Business Intelligence and Communication Technologies in Organizational Agility: A Configurational Approach," *Journal of the Association for Information Systems* (18:9), pp. 648-686.

Pavlou, P. A., and El Sawy, O. 2011. "Understanding the Elusive Black Box of Dynamic Capabilities," *Decision Sciences* (42:1), pp. 239-273.

Porter, M. E., and Rivkin, J. W. 2000. "Industry Transformation," Case Study, Harvard Business School, Boston, MA.

Ragin, C. C. 2008. *Redesigning Social Enquiry: Fuzzy Sets and Beyond*, Chicago: University of Chicago Press.

Ragin, C. C. 2014. "Comment: Lucas and Szatrowski in Critical Perspective," *Sociological Methodology* (44:1), pp. 80-158.

Rai, A., Patnayakuni, R., and Patnayakuni, N. 1997. "Technology Investment and Business Performance," *Communications of the ACM* (40:7), pp. 89-97.

Rivard, S., and Lapointe, L. 2012. "Information Technology Implementers' Responses to User Resistance: Nature and Effects," *MIS Quarterly* (36:3), pp. 897-920.

Rubin, D. B. 1974. "Estimating Causal Effects of Treatments in Randomized and Nonrandomized Studies," *Journal of Educational Psychology* (66:5), pp. 688-701.

Saldanha, T., Mithas, S., and Krishnan, M. S. 2017. "Leveraging Customer Involvement for Fueling Innovation: The Role of Relational and Analytical Information Processing Capabilities," *MIS Quarterly* (41:1), pp. 267-286.

Schaefer, C. (ed.). 2011. "Baldrige20|20: An Executive's Guide to the Criteria for Performance Excellence," NIST, Gaithersburg, MD (http://baldrige.nist.gov/).

Seawright, J. 2005. "Qualitative Comparative Analysis vis-a-vis Regression," *Studies in Comparative International Development* (40:1), pp. 3-26.

Segars, A., and Grover, V. 1999. "Profiles of Strategic Information Systems Planning," *Information Systems Research* (10:3), pp. 199-232.

Simon, H. A. 1996. *The Sciences of the Artificial* (3rd ed.), London: MIT Press.

Simon, H. A. 2001. "Science Seeks Parsimony, Not Simplicity: Searching for Pattern in Phenomena," in *Simplicity, Inference and Modelling: Keeping it Sophisticatedly Simple*, Cambridge, UK: Cambridge University Press, pp. 32-72.

Srivastava, A., Bartol, K. M., and Locke, E. A. 2006. "Empowering Leadership in Management Teams: Effects on Knowledge Sharing, Efficacy, and Performance," *Academy of Management Journal* (49:6), pp. 1239-1251.

Sull, D., and Eisenhardt, K. M. 2012. "Simple Rules for a Complex World," *Harvard Business Review*, pp. 69-74.

Svahn, F., Henfridsson, O., and Yoo, Y. 2009. " A Threesome Dance of Agency: Mangling the Sociomateriality of Technological Regimes in Digital Innovation," in *Proceedings of the 30th International Conference on Information Systems*, Phoenix, AZ.

Tanriverdi, H., and Lim, S. Y. 2017. "How to Survive and Thrive in Complex Hypercompetitive and Disruptive Ecosystems? The Roles of IS-Enabled Capabilities," in *Proceedings of the 36th International Conference on Information Systems*. Seoul, South Korea.

Tanriverdi, H., Rai, A., and Venkatraman, V. 2010. "Reframing the Dominant Quests of Information Systems Strategy Research for Complex Adaptive Business Systems," *Information Systems Research* (21:4), pp. 822-834.

Tushman, M., and Anderson, P. 1986. "Technological Discontinuities and Organizational Environments," *Administrative Science Quarterly* (32), pp. 439-465.

Van Maanen, J., Sorensen, J. B., and Mitchell, T. R. 2007. "The Interplay between Theory and Method," *Academy of Management Review* (32:4), pp. 1145-1154.

Venkatraman, N. 1989. "The Concept of Fit in Strategy Research: Toward Verbal and Statistical Correspondence," *Academy of Management Review* (14:3), pp. 423-444.

Wade, M., and Hulland, J. 2004. "*Review*: The Resource-Based View and Information Systems Research: Review, Extension, and Suggestions for Future Research," *MIS Quarterly* (28:1), pp. 107-142.

Weaver, W. 1948. "Science and Complexity," *American Scientist* (36:4), pp. 536-544.

Westerman, G., McFarlan, F. W., and Iansiti, M. 2006. "Organization Design and Effectiveness over the Innovation Life Cycle," *Organization Science* (17:2), pp. 230-238.

Yoo, Y., Boland, 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.

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Appendix A

Additional Details on the Baldrige Criteria and Description of Measures

The Baldrige Program began as a public-private partnership to improve the national competitiveness of the United States in the 1980s when Japanese companies such as Sony, Honda, and Toyota were considered as exemplars of producing quality products and services. President Ronald Reagan signed the Malcolm Baldrige National Quality Improvement Act of 1987 into law (NIST 2012; Schaefer 2011) and charged the Baldrige Program to create the Criteria for Performance Excellence; these criteria became an application for the Malcolm Baldrige National Quality Award (Garvin 1991).

During its early days, the Baldrige Program received support from premier organizations, such as IBM, HP, Xerox, Ford, Johnson & Johnson, Corning, and the Juran Institute. The Baldrige program incorporated many of the total quality management principles that were receiving significant attention in those days among practitioners and researchers (Angell 2001; Flynn et al. 1995; Hendricks and Singhal 1996, 1997; Kathuria and Davis 2001; Kaynak 2003; Robinson et al. 1992; Singhal and Hayes 1992). Over the years, many countries and organizations have adapted the Baldrige criteria for their own versions of excellence and award programs, including IBM, Johnson & Johnson, McDonald's, Cargill, Eaton, Tata Group, and Ritz-Carlton, in diverse sectors such as manufacturing, service, healthcare, education, and small business for driving improvement (Mithas 2014, 2015a, 2015b; Schaefer 2012).

As noted earlier, the criteria for evaluation are based on a systems perspective. The core concepts are represented in seven main categories on which organizations are evaluated: (1) leadership; (2) strategic planning; (3) customer focus; (4) measurement, analysis, and knowledge management; (5) workforce focus; (6) operations focus; and (7) results.

The first six categories are evaluated as process dimensions, where "process" refers to the methods that an organization uses and improves to address the item requirements in Categories 1–6. The evaluation of these process dimensions focuses on approach, deployment, learning, and integration (ADLI). The seventh category, results, focuses on factors such as levels, trends, comparisons, and integration (LeTCI). The criteria use separate scoring schemes for capabilities and results items to avoid high or low performance to influence the process scores.

The Baldrige criteria are dynamic and undergo minor changes every year in the spirit of continuous improvement. Most of the minor changes relate to shifts in the points assigned to items or additional clarifications. For example, the criteria may provide more clarifications for items or change the weight of an item (the weight of item 1.1 changed from 80 to 85 from 1999 to 2000). Sometimes, items are reorganized or renumbered for clarity. The major changes in the Baldrige framework are relatively infrequent, at least since the late 1990s (Garvin 1991). Major changes over the years include greater emphasis on the results than on the process (the weight of points for the results category changed from approximately 25% in the early 1990s to approximately 45% in the late 1990s); more emphasis was placed on responding to changing business needs (rather than merely running the business) in 2000; adding processes for corporate governance in 2002 in the wake of certain scandals (e.g., Enron); more emphasis on sustainability in 2006; and adding workforce capability building in 2007 while shifting from employee satisfaction to employee engagement.

The rigor of the above-mentioned data-generation process has several strengths. The scores for capabilities and results are based on multiple sources of inputs such as self-reports by an organization, and independent scoring and evaluation by multiple reviewers external to an organization, followed by consensus development and site verification (instead of relying solely on executives' self-reports). Collectively, it takes hundreds of hours of effort by these examiners to evaluate an organization, resulting in very high-quality data. In addition, because of the care

and training involved in preparing examiners for such an evaluation, there is less risk of bias in scoring and greater confidence in the final scores. Among prior studies, the work of Flynn and Saladin (2001), among other similar studies, has investigated linkages among Baldrige categories by using the survey-based operationalization of key constructs from the 1992 and 1997 Baldrige criteria. More recently, Mithas et al. (2011) use the actual scores based on a framework modeled after the 1999–2002 Baldrige criteria from a business group from India. The study by Mithas et al. provides confidence in the validity of using scores from the Baldrige criteria for the current study, which aims to investigate parsimonious configurations from the complex interdependencies among organizational capability that lead to superior performance.

Note that we use annual cross-sectional data pooled over time across sectors for medium and large organizations because the main objective of this study is to investigate parsimonious configurations from complex interactions among the diverse capabilities that are amenable to the fsQCA method. We are aware of panel models and dynamic panel models, but such traditional econometric analyses of panel data can only make use of within-firm variation and cannot appropriately illuminate the conjunctural, equifinal, and asymmetric causation, which is the focus of our study. Furthermore, the potential lagged effects among elements are not the main concern in our approach, since the focus of this study does not lie in understanding the net effects of variables, but rather the simultaneous interdependencies among elements in producing the outcome. We nonetheless conducted robustness tests using only one observation per firm for each unique configuration of the capabilities over time, as explained in detail in the "Results" section of the paper. We conducted a separate analysis for small organizations (see Appendix D). Although small organizations can now leverage diverse types of information technologies (e.g., via cloud computing without huge initial investment), our data cover the period from 1999 to 2006, in which such computing options were not as frequently available. This may explain the rather simple pattern in the configurations for small organizations.

Table A1. Illustrative Description of Variables Following the Baldrige Criteria 2002[a]

Variable	*Description*
Financial Performance	**Item 7.2 Financial and Market Results: Summarize your organization's key financial and marketplace performance results by market segments, as appropriate. Include appropriate comparative data.** Provide data and information to answer the following questions: • Financial and Market Results (1) What are your current levels and trends in key measures/indicators of financial performance, including aggregate measures of financial return and/or economic value, as appropriate? (2) What are your current levels and trends in key measures/indicators of marketplace performance, including market share/position, business growth, and new markets entered, as appropriate?
Customer Performance	**Item 7.1 Customer-Focused Results: Summarize your organization's key customer-focused results, including customer satisfaction and product and service performance results. Segment your results by customer groups and market segments, as appropriate. Include appropriate comparative data.** Provide data and information to answer the following questions: • Customer Results (1) What are your current levels and trends in key measures/indicators of customer satisfaction and dissatisfaction, including comparisons with competitors' levels of customer satisfaction? (2) What are your current levels and trends in key measures/indicators of customer-perceived value, customer retention, positive referral, and/or other aspects of building relationships with customers, as appropriate? • Product and Service Results (1) What are your current levels and trends in key measures/indicators of product and service performance that are important to your customers?
IT-enabled information analytics capability	**Item 4.2 Information Management: Describe how your organization ensures the quality and availability of needed data and information for employees, suppliers/partners, and customers.** Within your response, include answers to the following questions: • Data Availability (1) How do you make needed data and information available? How do you make them accessible to employees, suppliers/partners, and customers, as appropriate? (2) How do you ensure data and information integrity, reliability, accuracy, timeliness, security, and confidentiality? (3) How do you keep your data and information availability mechanisms current with business needs and directions? • Hardware and Software Quality (1) How do you ensure that hardware and software are reliable and user friendly? (2) How do you keep your software and hardware systems current with business needs and directions?

Leadership capability	**Item 1.1 Organizational Leadership: Describe how senior leaders guide your organization, including how they review organizational performance.** Within your response, include answers to the following questions: • Senior Leadership Direction (1) How do senior leaders set and deploy organizational values, short- and longer-term directions, and performance expectations, including a focus on creating and balancing value for customers and other stakeholders? Include how senior leaders communicate values, directions, and expectations through your leadership system and to all employees. (2) How do senior leaders create an environment for empowerment, innovation, organizational agility, and organizational and employee learning? • Organizational Performance Review (1) How do senior leaders review organizational performance and capabilities to assess organizational success, competitive performance, progress relative to short- and longer-term goals, and the ability to address changing organizational needs? Include the key performance measures regularly reviewed by your senior leaders. Also, include your key recent performance review findings. (2) How are organizational performance review findings translated into priorities for improvement and opportunities for innovation? How are they deployed throughout your organization and, as appropriate, to your suppliers/ partners to ensure organizational alignment? (3) How do senior leaders use organizational performance review findings to improve both their own leadership effectiveness and your leadership system?
Strategic planning capability	**Item 2.1 Strategy Development: Describe how your organization establishes its strategic objectives, including enhancing its competitive position and overall performance.** Within your response, include answers to the following questions: • Strategy Development Process (1) What is your overall strategic planning process? Include key steps, key participants, and your short- and longer-term planning time horizons. (2) How do you ensure that planning addresses the following key factors? Briefly outline how relevant data and information are gathered and analyzed to address these factors: • customer and market needs/expectations/opportunities • your competitive environment and your capabilities relative to competitors • technological and other key changes that might affect your products/services and/or how you operate • your strengths and weaknesses, including human and other resources • your supplier/partner strengths and weaknesses • financial, societal, and other potential risks • Strategic Objectives (1) What are your key strategic objectives and your timetable for accomplishing them? Include key goals/targets, as appropriate. (2) How do your strategic objectives address the challenges identified in response to P.2 in your Organizational Profile? How do you ensure that your strategic objectives balance the needs of all key stakeholders? **Item 2.2 Strategy Deployment: Describe how your organization converts its strategic objectives into action plans. Summarize your organization's action plans and related key performance measures/indicators. Project your organization's future performance on these key performance measures/indicators.** Within your response, include answers to the following questions: • Action Plan Development and Deployment (1) How do you develop and deploy action plans to achieve your key strategic objectives? Include how you allocate resources to ensure accomplishment of your action plans. (2) What are your key short- and longer-term action plans? Include key changes, if any, in your products/services, your customers/markets, and how you operate. (3) What are your key human resource plans that derive from your short- and longer-term strategic objectives and action plans? (4) What are your key performance measures/indicators for tracking progress relative to your action plans? How do you ensure that your overall action plan measurement system achieves organizational alignment and covers all key deployment areas and stakeholders? • Performance Projection (1) What are your performance projections for your key measures/indicators for both your short- and longer term planning time horizons? How does your projected performance compare with competitors' performance, key benchmarks, goals, and past performance, as appropriate?

Customer focus capability	**Item 3.1 Customer and Market Knowledge: Describe how your organization determines requirements, expectations, and preferences of customers and markets to ensure the continuing relevance of your products/services and to develop new opportunities.** Within your response, include answers to the following questions: • Customer and Market Knowledge (1) How do you determine or target customers, customer groups, and/or market segments? How do you include customers of competitors and other potential customers and/or markets in this determination? (2) How do you listen and learn to determine key customer requirements (including product/service features) and their relative importance/value to customers' purchasing decisions for purposes of product/ service planning, marketing, improvements, and other business development? In this determination, how do you use relevant information from current and former customers, including marketing/sales information, customer retention data, won/lost analysis, and complaints? If determination methods vary for different customers and/or customer groups, describe the key differences in your determination methods. (3) How do you keep your listening and learning methods current with business needs and directions? **Item 3.2 Customer Relationships and Satisfaction: Describe how your organization builds relationships to acquire, satisfy, and retain customers and to develop new opportunities. Describe also how your organization determines customer satisfaction.** Within your response, include answers to the following questions: • Customer Relationships (1) How do you build relationships to acquire and satisfy customers and to increase repeat business and positive referrals? (2) How do you determine key customer contact requirements and how they vary for differing modes of access? How do you ensure that these contact requirements are deployed to all people involved in the response chain? Include a summary of your key access mechanisms for customers to seek information, conduct business, and make complaints. (3) What is your complaint management process? Include how you ensure that complaints are resolved effectively and promptly and that all complaints are aggregated and analyzed for use in improvement throughout your organization and by your partners, as appropriate. (4) How do you keep your approaches to building relationships and providing customer access current with business needs and directions? • Customer Satisfaction Determination (1) How do you determine customer satisfaction and dissatisfaction and use this information for improvement? Include how you ensure that your measurements capture actionable information that predicts customers' future business with you and/or potential for positive referral. Describe significant differences in determination methods for different customer groups. (2) How do you follow up with customers on products/services and transactions to receive prompt and actionable feedback? (3) How do you obtain and use information on your customers' satisfaction relative to customers' satisfaction with competitors and/or benchmarks, as appropriate? (4) How do you keep your approaches to determining satisfaction current with business needs and directions?
HR focus capability	**Item 5.1 Work Systems: Describe how your organization's work and jobs, compensation, career progression, and related workforce practices motivate and enable employees and the organization to achieve high performance.** Within your response, include answers to the following questions: • Work Systems (1) How do you organize and manage work and jobs to promote cooperation, initiative/innovation, your organizational culture, and the flexibility to keep current with business needs? How do you achieve effective communication and knowledge/skill sharing across work units, jobs, and locations, as appropriate? (2) How do you motivate employees to develop and utilize their full potential? Include formal and/or informal mechanisms you use to help employees attain job- and career-related development/learning objectives and the role of managers and supervisors in helping employees attain these objectives. (3) How does your employee performance management system, including feedback to employees, support high performance and a customer and business focus? How do your compensation, recognition, and related reward/incentive practices reinforce these objectives? (4) How do you accomplish effective succession planning for senior leadership and throughout the organization? (5) How do you identify characteristics and skills needed by potential employees? How do you recruit, hire, and retain new employees? How do your work systems capitalize on the diverse ideas, cultures, and thinking of the communities with which you interact (your employee hiring and customer communities)?

	Item 5.2 Employee Education, Training, and Development: Describe how your organization's education and training support the achievement of your overall objectives, including building employee knowledge, skills, and capabilities and contributing to high performance. Within your response, include answers to the following questions: • Employee Education, Training, and Development (1) How do education and training contribute to the achievement of your action plans? How does your education and training approach balance short- and longer-term organizational objectives and employee needs, including development, learning, and career progression? (2) How do you seek and use input from employees and their supervisors/managers on education and training needs and delivery options? (3) How do you address in your employee education, training, and development your key organizational needs associated with technological change, management/leadership development, new employee orientation, safety, performance measurement/improvement, and diversity? (4) How do you deliver education and training? Include formal and informal delivery, including mentoring and other approaches, as appropriate. How do you evaluate the effectiveness of education and training, taking into account individual and organizational performance? (5) How do you reinforce the use of knowledge and skills on the job? **Item 5.3 Employee Well-Being and Satisfaction: Describe how your organization maintains a work environment and an employee support climate that contribute to the well-being, satisfaction, and motivation of all employees.** Within your response, include answers to the following questions: • Work Environment (1) How do you improve workplace health, safety, and ergonomics? How do employees take part in improving them? Include performance measures and/or targets for each key environmental factor. Also include significant differences, if any, based on varying work environments for employee groups and/or work units. • Employee Support and Satisfaction (1) How do you determine the key factors that affect employee well-being, satisfaction, and motivation? How are these factors segmented for a diverse workforce and for varying categories and types of employees, as appropriate? (2) How do you support your employees via services, benefits, and policies? How are these tailored to the needs of a diverse workforce and different categories and types of employees, as appropriate? (3) What formal and/or informal assessment methods and measures do you use to determine employee well-being, satisfaction, and motivation? How do you tailor these methods and measures to a diverse workforce and to different categories and types of employees, as appropriate? How do you use other indicators, such as employee retention, absenteeism, grievances, safety, and productivity, to assess and improve employee well-being, satisfaction, and motivation? (4) How do you relate assessment findings to key business results to identify priorities for improving the work environment and employee support climate?
Process management capability	**Item 6.1 Product and Service Processes: Describe how your organization manages key processes for product and service design and delivery.** Within your response, include answers to the following questions: • Design Processes (1) What are your design processes for products/services and their related production/delivery systems and processes? (2) How do you incorporate changing customer/market requirements into product/service designs and production/delivery systems and processes? (3) How do you incorporate new technology, including e-technology, into products/services and into production/delivery systems and processes, as appropriate? (4) How do your design processes address design quality and cycle time, transfer of learning from past projects and other parts of the organization, cost control, new design technology, productivity, and other efficiency/effectiveness factors? (5) How do you design your production/delivery systems and processes to meet all key operational performance requirements? (6) How do you coordinate and test your design and production/delivery systems and processes? Include how you prevent defects/rework and facilitate trouble-free and timely introduction of products/services.

	• Production/Delivery Processes (1) What are your key production/delivery processes and their key performance requirements? (2) How does your day-to-day operation of key production/delivery processes ensure meeting key performance requirements? (3) What are your key performance measures/indicators used for the control and improvement of these processes? Include how in-process measures and real-time customer and supplier/partner input are used in managing your product and service processes, as appropriate. (4) How do you perform inspections, tests, and process/performance audits to minimize warranty and/or rework costs, as appropriate? Include your prevention-based processes for controlling inspection and test costs, as appropriate. (5) How do you improve your production/delivery systems and processes to achieve better process performance and improvements to products/services, as appropriate? How are improvements shared with other organizational units and processes and your suppliers/partners, as appropriate? **Item 6.2 Business Processes: Describe how your organization manages its key processes that lead to business growth and success.** Within your response, include answers to the following questions: • Business Processes (1) What are your key business processes for business growth and success? (2) How do you determine key business process requirements, incorporating input from customers and suppliers/partners, as appropriate? What are the key requirements for these processes? (3) How do you design and perform these processes to meet all the key requirements? (4) What are your key performance measures/indicators used for the control and improvement of these processes? Include how in-process measures and customer and supplier feedback are used in managing your business processes, as appropriate. (5) How do you minimize overall costs associated with inspections, tests, and process/performance audits, as appropriate? (6) How do you improve your business processes to achieve better performance and to keep them current with business needs and directions? How are improvements shared with other organizational units and processes, as appropriate? **Item 6.3 Support Processes: Describe how your organization manages its key processes that support your daily operations and your employees in delivering products and services.** Within your response, include answers to the following questions: • Support Processes (1) What are your key processes for supporting your daily operations and your employees in delivering products and services? (2) How do you determine key support process requirements, incorporating input from internal customers, as appropriate? What are the key operational requirements (such as productivity and cycle time) for these processes? (3) How do you design these processes to meet all the key requirements? (4) How does your day-to-day operation of key support processes ensure meeting key performance requirements? (5) What are your key performance measures/indicators used for the control and improvement of these processes? Include how in-process measures and internal customer feedback are used in managing your support processes, as appropriate. (6) How do you minimize overall costs associated with inspections, tests, and process/performance audits? (7) How do you improve your support processes to achieve better performance and to keep them current with business needs and directions? How are improvements shared with other organizational units and processes, as appropriate?

[a]For a complete description of all items and categories (including related notes and the assessment guidelines) that map to the variables used in this study, see the Baldrige criteria 2002 document available at the NIST website http://baldrige.nist.gov/Business_Criteria.2002.htm.

Notes: Prior literature provides support for the importance of the key capabilities measured by the Baldrige criteria. Information analytics capability measures the ability to provide accurate, timely, and reliable data and information to relevant entities and stakeholders, and thus can enable firms to effectively configure and tailor other organizational capabilities that might influence firm performance. Leadership capability is often considered among the most important of all the capabilities, particularly because of its role in identifying and nurturing the development of other organizational capabilities (Earl and Feeny 2000; Srivastava et al. 2006). Strategic planning capability helps blend and synchronize organizational resources to support and develop organizational capabilities (Porter and Rivkin 2000; Segars and Grover 1999). Customer focus capability can enable firms

to leverage their customer knowledge to gain market intelligence and detect opportunities to introduce new products, attract new customers, retain existing customers, and target new markets by tapping different customer roles (Fornell et al. 2006; Nambisan 2002; Saldanha et al. 2017; Yadav and Pavlou 2014). HR focus capability can contribute to a firm's competitive advantage, as argued by RBV (Barney 1991; Barney and Wright 1998; Wade and Hulland 2004), and can drive technological and managerial innovations that produce entrepreneurial rents (Chadwick and Dabu 2009). Process management capability is a key fundamental capability for competing in contemporary business environments (Kettinger and Grover 1995) due to the need to manage and reconfigure the organizational portfolio of processes, and to design and use appropriate metrics and controls (Davenport 1993, 2000; Kalakota and Robinson 2003) to minimize process variability (e.g., Frei et al. 1999).

Appendix B

Scale of Measures

Table B1. Levels of Organizational Capabilities

Scores	*Approach-Development (Measurement Criteria)*
0%	• No systematic approach is evident; information is anecdotal.
10% to 20%	• The beginning of a systematic approach to the basic requirements of the item is evident. • Major gaps exist in deployment that would inhibit progress in achieving the basic requirements of the item. • Early stages of a transition from reacting to problems to a general improvement orientation are evident.
30% to 40%	• An effective, systematic approach, responsive to the basic requirements of the item, is evident. • The approach is deployed, although some areas or work units are in early stages of deployment. • The beginning of a systematic approach to evaluation and improvement of basic item processes is evident.
50% to 60%	• An effective, systematic approach, responsive to the overall requirements of the item and your key business requirements, is evident. • The approach is well deployed, although deployment may vary in some areas or work units. • A fact-based, systematic evaluation and improvement process is in place for improving the efficiency and effectiveness of key processes. • The approach is aligned with your basic organizational needs identified in the other criteria categories.
70% to 80%	• An effective, systematic approach, responsive to the multiple requirements of the item and your current and changing business needs, is evident. • The approach is well deployed, with no significant gaps. • A fact-based, systematic evaluation and improvement process and organizational learning/sharing are key management tools; there is clear evidence of refinement and improved integration as a result of organizational-level analysis and sharing. • The approach is well integrated with your organizational needs identified in the other criteria categories.
90% to 100%	• An effective, systematic approach, fully responsive to all the requirements of the item and all your current and changing business needs, is evident. • The approach is fully deployed without significant weaknesses or gaps in any areas or work units. • A very strong, fact-based, systematic evaluation and improvement process and extensive organizational learning/sharing are key management tools; strong refinement and integration, backed by excellent organizational-level analysis and sharing, are evident. • The approach is fully integrated with your organizational needs identified in the other criteria categories.

Table B2. Levels of Firm Performance

Scores	*Results (Measurement Criteria)*
0%	• There are no results or poor results in areas reported.
10% to 20%	• There are some improvements and/or early good performance levels in a few areas. • Results are not reported for many to most areas of importance to your organization's key business requirements.
30% to 40%	• Improvements and/or good performance levels are reported in many areas of importance to your organization's key business requirements. • Early stages of developing trends and obtaining comparative information are evident. • Results are reported for many to most areas of importance to your organization's key business requirements.
50% to 60%	• Improvement trends and/or good performance levels are reported for most areas of importance to your organization's key business requirements. • No pattern of adverse trends and no poor performance levels are evident in areas of importance to your organization's key business requirements. • Some trends and/or current performance levels—evaluated against relevant comparisons and/or benchmarks—show areas of strength and/or good to very good relative performance levels. • Business results address most key customer, market, and process requirements.
70% to 80%	• Current performance is good to excellent in areas of importance to your organization's key business requirements. • Most improvement trends and/or current performance levels are sustained. • Many to most trends and/or current performance levels—evaluated against relevant comparisons and/or benchmarks—show areas of leadership and very good relative performance levels. • Business results address most key customer, market, process, and action plan requirements.
90% to 100%	• Current performance is excellent in most areas of importance to your organization's key business requirements. • Excellent improvement trends and/or sustained excellent performance levels are reported in most areas. • Evidence of industry and benchmark leadership is demonstrated in many areas. • Business results fully address key customer, market, process, and action plan requirements.

Appendix C

Truth Table for High Financial and Customer Performance

Table C1. Truth Table for High Financial and Customer Performance in the Healthcare Sector

Leadership	Information Analytics	Strategic Planning	Customer Focus	HR Focus	Process Mgmt	Number	Financial Performance	Raw Consistency	PRI Consistency
1	1	1	1	1	1	38	1	0.95	0.92
1	1	0	1	1	0	3	1	0.93	0.85
1	1	0	1	1	1	12	1	0.92	0.85
1	1	0	1	0	1	5	1	0.91	0.82
1	1	0	0	1	1	4	1	0.91	0.83
0	0	0	0	1	0	3	0	0.82	0.62
0	1	0	0	0	0	10	0	0.79	0.61
0	0	0	0	0	0	35	0	0.64	0.43
Leadership	**Information Analytics**	**Strategic Planning**	**Customer Focus**	**HR Focus**	**Process Mgmt**	**Number**	**Customer Performance**	**Raw Consistency**	**PRI Consistency**
1	1	1	1	1	1	38	1	0.88	0.81
1	1	0	0	1	1	4	1	0.86	0.58
1	1	0	1	1	1	12	1	0.82	0.61
1	1	0	1	1	0	3	1	0.82	0.53
1	1	0	1	0	1	5	1	0.82	0.55
0	0	0	0	1	0	3	0	0.74	0.28
0	1	0	0	0	0	10	0	0.71	0.23
0	0	0	0	0	0	35	0	0.53	0.15

Note: Each row in the truth table represents a combination of cases that have similar membership scores for all conditions. For example, the first row in Table C1 shows that 38 firms have membership in this combination. The truth-table algorithm excludes cases in the crossover cases because they may be included on the either side, and that is the default option in the software, which we followed. As an aside, if the exclusion of such cases on the boundary results in too few cases, then the software allows a researcher to decide (based on the knowledge of these cases) whether to add an insignificant value (e.g., 0.001) to each variable so that such cases are not excluded in the analysis, as suggested by Ragin (2008) and Fiss (2011, p. 407). Such an insignificant value does not change the resultant values of the consistency and coverage of each row in the truth table. Given that we followed the default procedure because we have a large dataset, and only a few cases were dropped due to their values on the crossover boundaries, as shown in our truth tables, the resultant configurations have clearer boundaries. In the healthcare industry, to which a total of 161 cases belong, we set the minimum acceptable number of cases at three, thus considering only combinations with at least three cases for subsequent analysis in the truth-table algorithm, as shown in Table C1. Handling the cases in fsQCA depends on the data size, number of variables, and research context. For example, if the data size is large enough (e.g., 200 cases for a firm-level study that includes 10 variables), one can use the frequency cutoff of 3 or greater. On the other hand, if a study involves states or countries with five variables, one may use a smaller cutoff value, such as 1 (Greckhamer et al. 2013). The frequency cutoff in the paper are three for the healthcare sector, which has 161 cases, and two for other sectors, for which the data size is smaller.

The column in the truth table for the outcome (i.e., Financial/Customer Performance) shows the extent to which each row consistently produces the outcome (i.e., high financial/customer performance). In fsQCA, there are two consistency measures: (1) raw consistency, which gives credit for "near misses" and penalties for large inconsistencies and (2) PRI (proportional reduction in inconsistency) consistency, which additionally eliminates the influence of cases that have simultaneous membership in both the outcome and its complement (i.e., y and ~y). The raw consistency and PRI consistency are calculated with the set membership scores (Xi and Yi) of the cases, consistent with the QCA literature (e.g., Ragin 2008, pp. 44-48; Rihoux and Ragin 2009).[19] In our study, we applied two rules, suggested by the QCA literature, to

[19] Consistency = $\sum\min(Xi,Yi) / \sum(Xi)$, PRI Consistency = $[\sum\min(Xi,Yi) - \sum\min(Xi,Yi,\sim Yi)] / [\sum(Xi) - \sum\min(Xi,Yi,\sim Yi)]$, Coverage = $\sum\min(Xi,Yi) / \sum(Yi)$, where Xi is a set membership score of a case for an element, and Yi is a set membership score of a case for the outcome. That is, Xi is a calibrated set membership score of case i regarding the X variable (e.g., leadership), which can be any value between 0 and 1, e.g., 0.13, or 0.78 or 0.92 (see Ragin 2008, pp. 44-48). Note that values of 1, 0.5, and 0.0 for full, cross-over, and full non-membership, respectively, are different from how Xi is calculated.

decide the cutoff for consistency (Ragin 2008). First, for a combination/row to reliably produce high performance, its consistency should be above 0.8. Second, if there is a break point in which the consistency significantly drops between two rows from a row with a high level of consistency to a row with the next level consistency, then the break point can be a cutoff for the high performance group. For example, in the healthcare industry, for financial performance, there is a significant drop in the consistency between the fifth row with a consistency of 0.91 to the sixth row with the next level of consistency, 0.82. Also, we use PRI consistency as a complementary measure for raw consistency. For the case with a raw consistency value of 0.82 in Table C1 for financial performance, its PRI consistency is far lower, compared to cases with a raw consistency of above 0.9. Thus, we can decide on a raw consistency of 0.90 as a cutoff for the high financial performance group, and can set a value of 1 in the "Financial Performance" column for rows with a consistency higher than the cutoff, otherwise, it is set to 0. For customer performance, there is a break point between the row with 0.82 to the next row with 0.74; thus, we may decide on 0.8 as the consistency cutoff. As such, the cutoff choice for consistency to determine the values for the outcome column in the truth table is ultimately context dependent, and a researcher decides the cutoff value, based on her/his knowledge of the cases and contexts, considering some guidelines for deciding the cutoff values.

Next, fsQCA apply the QM algorithm and counterfactual analysis (Ragin 2008) to reduce many combinations into a few configurations. First, using Boolean algebra, it does logical reduction of all possible combinations. Then, using counterfactual analysis, fsQCA overcomes the limitations of a lack of empirical instances (Ragin, 2008, p. 162). Specifically, counterfactual analysis distinguishes between "easy" and "difficult" counterfactuals, with which it results in three kinds of sufficient solutions: a complex solution without no counterfactuals, an intermediate one with only "easy" counterfactuals, and a parsimonious one with both "easy" and "difficult" counterfactuals. See more details in other sources (Fiss 2007, 2011; Park et al. Fiss 2017; Ragin 2008).

Table C2. Truth Table for High Financial and Customer Performance in the Education Sector

Leadership	*Information Analytics*	*Strategic Planning*	*Customer Focus*	*HR Focus*	*Process Mgmt*	*Number*	*Financial Performance*	*Raw Consistency*	*PRI Consistency*
1	1	1	1	1	1	16	1	0.91	0.85
1	1	1	1	0	1	3	1	0.87	0.71
1	0	1	1	0	1	2	1	0.87	0.69
1	0	0	1	0	1	2	0	0.78	0.50
1	0	0	0	0	1	3	0	0.73	0.40
1	0	0	0	0	0	2	0	0.67	0.34
0	0	0	0	0	0	50	0	0.35	0.15
Leadership	*Information Analytics*	*Strategic Planning*	*Customer Focus*	*HR Focus*	*Process Mgmt*	*Number*	*Customer Performance*	*Raw Consistency*	*PRI Consistency*
0	0	0	0	0	0	50	1	0.39	0.15
1	1	1	1	1	1	16	1	0.92	0.87
1	1	1	1	0	1	3	1	0.90	0.80
1	0	0	0	0	1	3	0	0.78	0.51
1	0	1	1	0	1	2	0	0.92	0.80
1	0	0	1	0	1	2	0	0.84	0.62
1	0	0	0	0	0	2	0	0.74	0.44

Table C3. Truth Table for High Financial and Customer Performance in the Manufacturing Sector

Leadership	Information Analytics	Strategic Planning	Customer Focus	HR Focus	Process Mgmt	Number	Financial Performance	Raw Consistency	PRI Consistency
0	1	1	1	1	1	2	1	0.96	0.91
1	1	1	1	1	1	13	1	0.93	0.90
1	1	1	1	0	1	3	1	0.91	0.82
1	1	0	1	1	1	2	1	0.86	0.71
0	0	0	0	0	0	10	0	0.57	0.24
Leadership	**Information Analytics**	**Strategic Planning**	**Customer Focus**	**HR Focus**	**Process Mgmt**	**Number**	**Customer Performance**	**Raw Consistency**	**PRI Consistency**
1	1	1	1	1	1	13	1	0.88	0.82
1	1	1	0	1	1	3	1	0.84	0.62
0	1	1	1	1	1	2	0	0.79	0.33
1	0	1	1	1	1	2	0	0.76	0.46
0	0	0	0	0	0	10	0	0.34	0.07

Table C4. Truth Table for High Financial and Customer Performance in the Service Sector

Leadership	Information Analytics	Strategic Planning	Customer Focus	HR Focus	Process Mgmt	Number	Financial Performance	Raw Consistency	PRI Consistency
1	1	1	1	1	1	14	1	0.96	0.95
1	1	1	1	0	1	2	1	0.91	0.85
1	0	0	1	1	1	2	1	0.87	0.71
0	0	0	0	0	1	3	0	0.75	0.47
0	0	0	0	0	0	10	0	0.51	0.15
Leadership	**Information Analytics**	**Strategic Planning**	**Customer Focus**	**HR Focus**	**Process Mgmt**	**Number**	**Customer Performance**	**Raw Consistency**	**PRI Consistency**
1	1	1	1	1	1	14	1	0.86	0.79
1	1	1	1	0	1	2	1	0.82	0.60
1	0	0	1	1	1	2	0	0.73	0.45
0	0	0	0	0	1	3	0	0.65	0.30
0	0	0	0	0	0	10	0	0.38	0.05

Appendix D

Additional Details on the Analyses and Robustness Checks

We provide further details here about the configurational approach, fsQCA, and analyses reported in the paper.

The fsQCA approach uses two measures to validate solutions. First, the consistency measure indicates the degree to which a configuration consistently results in the outcome (Fiss 2007), which is roughly comparable to the concept of the significance level in a regression analysis, and a threshold of 0.75 indicates good consistency (Fiss 2011; Ragin 2008), indicating that the configurational solutions reliably result in high performance. The overall solution consistency indicates the degree to which all configurations together consistently result in high performance with a usually acceptable level of 0.75. Second, fsQCA uses a coverage measure to validate a configurational solution. Raw coverage roughly indicates the extent to which a configuration covers the cases of an outcome (Ragin 2008). Unique coverage indicates how uniquely (and without an overlap with other configurations) a particular configuration captures high-performing organizations (Ragin 2008). Thus, coverage is a validation measure similar to the coefficient of determination (R^2) in a regression analysis and shows the empirical relativity of each configuration to the outcome, such that larger coverage empirically implies more relevant or important configurations (Ragin 2008). For example, H1d has the largest raw/unique coverage in Figure 2 in the paper for the healthcare industry, empirically indicating that it is the most relevant and important solution for high financial performance and high customer performance. Thus, organizations can achieve high performance with different pathways, but individual paths can be different in their empirical importance and effectiveness.

Figure D1 describes how the configurational approach differs from the correlational approach.

Figure D2 compares configurations for high financial performance and high customer performance across sectors, where we list all configurations in Venn diagrams to show the intersections between the two sets of configurations (i.e., configurations of high financial performance and configurations of high customer performance) for every economic sector.

Table D1 shows the fsQCA results for configurations that produce sufficient solutions for high performance and not-high performance in the form of a Boolean expression.

We conducted additional analyses for robustness. First, because some organizations are repeated over time in our dataset, one might have concerns about such organizations influencing our results parallel to such concerns in the conventional regression models, where firms or units serve as observations.[20] Note that, in our configurational approach and fsQCA, multiple appearances of the same firm in our dataset is not a serious concern because a firm may have different configurations over time. We nonetheless conducted additional analyses for robustness tests by using only one observation per firm for each unique configuration of capabilities over time (see Table D2).[21] Each row in the truth table in fsQCA is a unique combination of a case's attributes (i.e., six capabilities in this study), and each case is allocated to one of the rows/combinations, based on its set memberships in the attributes. As previously explained, in our dataset, not all but for some firms, there are two or more cases over the years. When two or more cases from the same firm are allocated to the same row/combination, we first checked whether their outcome values were same or not, and found almost the same or no significant difference. Then, we dropped such duplicate cases, leaving only one case in the row (the number of cases dropped were: 20 in healthcare, seven in education, four in manufacturing, and five in the service sector). Note that in cases where a firm had the same capability configurations, but potentially different performance outcomes, they were already accounted for appropriately through the consistency measures in the fsQCA approach (see notes to Table C1 in Appendix C).

In other words, we dropped redundant observations for a firm showing exactly the same combination of capabilities when it appeared multiple times in our data. Doing so resulted in a minor loss of observations, and we were left with 142, 108, 50, and 41 unique observations in the healthcare, education, manufacturing, and service sectors—the original sample used 161, 115, 54 and 46 cases, respectively. With the new analyses using this dataset, we obtained essentially the same results in terms of the configurations for both high financial performance and high customer performance, as we reported earlier, thus suggesting that our findings are not sensitive to multiple appearances of the same firm over time. These additional results show insignificant and small differences in the coverage and consistency measures, as one would expect. Interestingly, we obtained the same configurations for not-high performance in the healthcare and education sectors, and very similar, but slightly different configurations for the manufacturing and service sectors. However, because the focus of the paper is on understanding and explaining high performance, and not-high performance results are used to demonstrate asymmetric causality, these additional analyses provide confidence in our main findings.

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[20] We thank an anonymous reviewer for suggesting this robustness check.

[21] We thank Peer Fiss for his advice on this issue in our personal communications with him.

Second, we did a sensitivity analysis by changing the calibration anchors, based on the data distribution. According to the guidelines of the QCA literature for calibration, in the case that there is no knowledge on the elements and cases, the data distribution statistics can be used for calibration (Ragin 2008), e.g., the 75th, 50th, and 25th percentiles for full membership, cross-over, and full non-membership, respectively. From our descriptive statistics, we found that the 75th, 50th, and 25th percentiles of the performance measures are very close to the 50th, 40th, and 20th percentiles, respectively. For organizational capabilities, the 75th and 50th percentiles are close to the 60th and 50th percentiles, and the 25th percentile is slightly different, around the 20th to 40th percentiles, thus supporting our primary criteria for calibration. With this new calibration, we conducted new fsQCA analyses and found no difference in the final fsQCA configurations with slightly different consistency and coverage measures.

Finally, we conducted an additional analysis for small organizations in the Baldrige data (Tables D3 and D4, and Figure D3). We find a relatively simple pattern for high performance in small organizations, compared to those in medium and large organizations (as we reported earlier), which involves the presence of all capabilities, except for strategic planning. One limitation of this analysis is that for these small organizations, we do not know their industry sectors (the Baldrige data do not disclose the industry sectors for small organizations); nevertheless, we believe that our findings appear plausible, given what we know about small organizations.

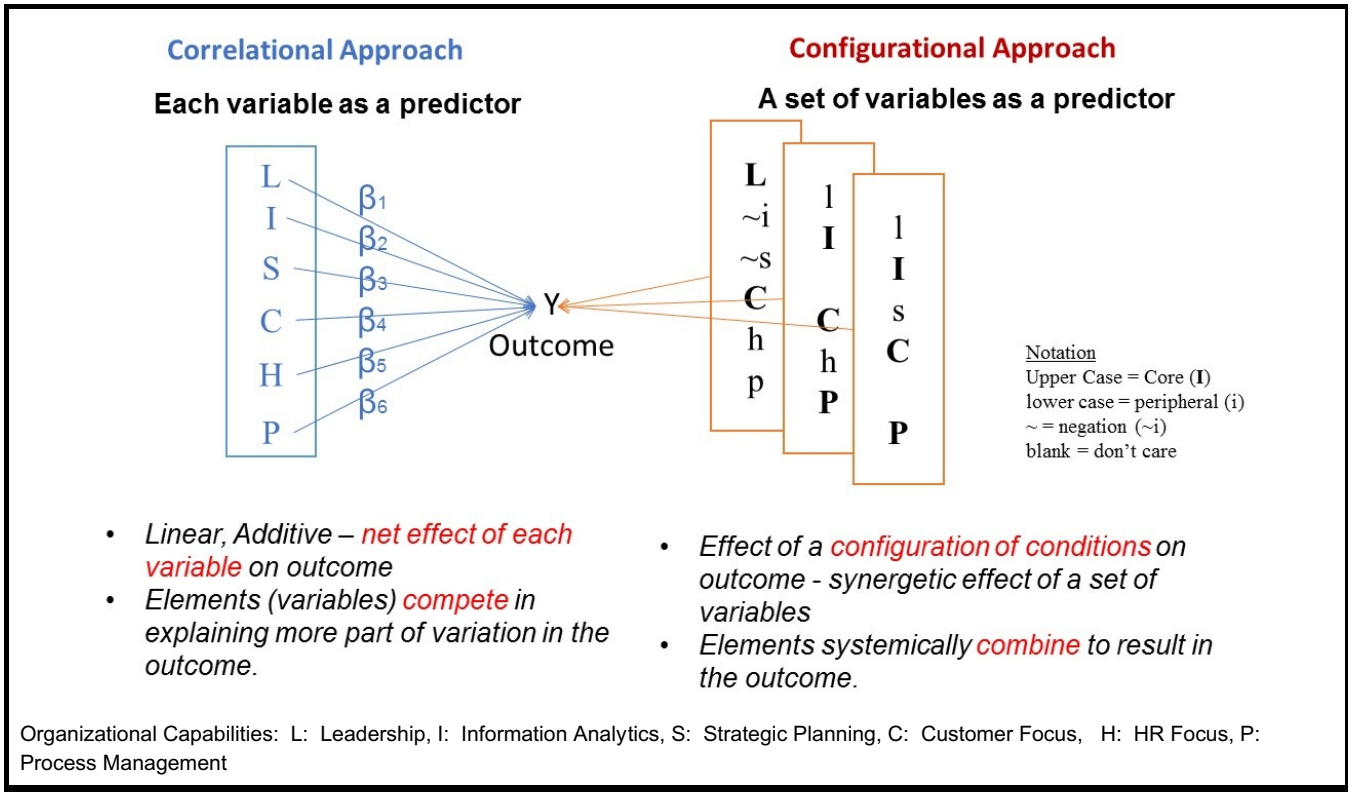


Figure D1. How the Configurational Approach Differs from the Correlational Approach

Notes: This figure shows a sharp departure of the configurational approach from the conventional correlational approach, which often assesses effects in terms of "a unit change in X is associated with some delta change in Y," as is commonly done in the current dominant strategy and information systems research. For clarity, we do not show all possible interaction effects among the six variables in the correlational approach, as depicted above. The variance-based approaches that fully specify the interaction terms start to break apart when the interactions involve more than two or three variables; this situation becomes even worse with sparse data (Misangyi and Acharya 2014). That is where the complexity perspective, and in particular, the configuration perspective becomes valuable, in particular, when explaining complex nonlinear interactions among all capabilities and the multifaceted nature of IT-enabled information analytics capabilities within a holistic configurational dynamic.

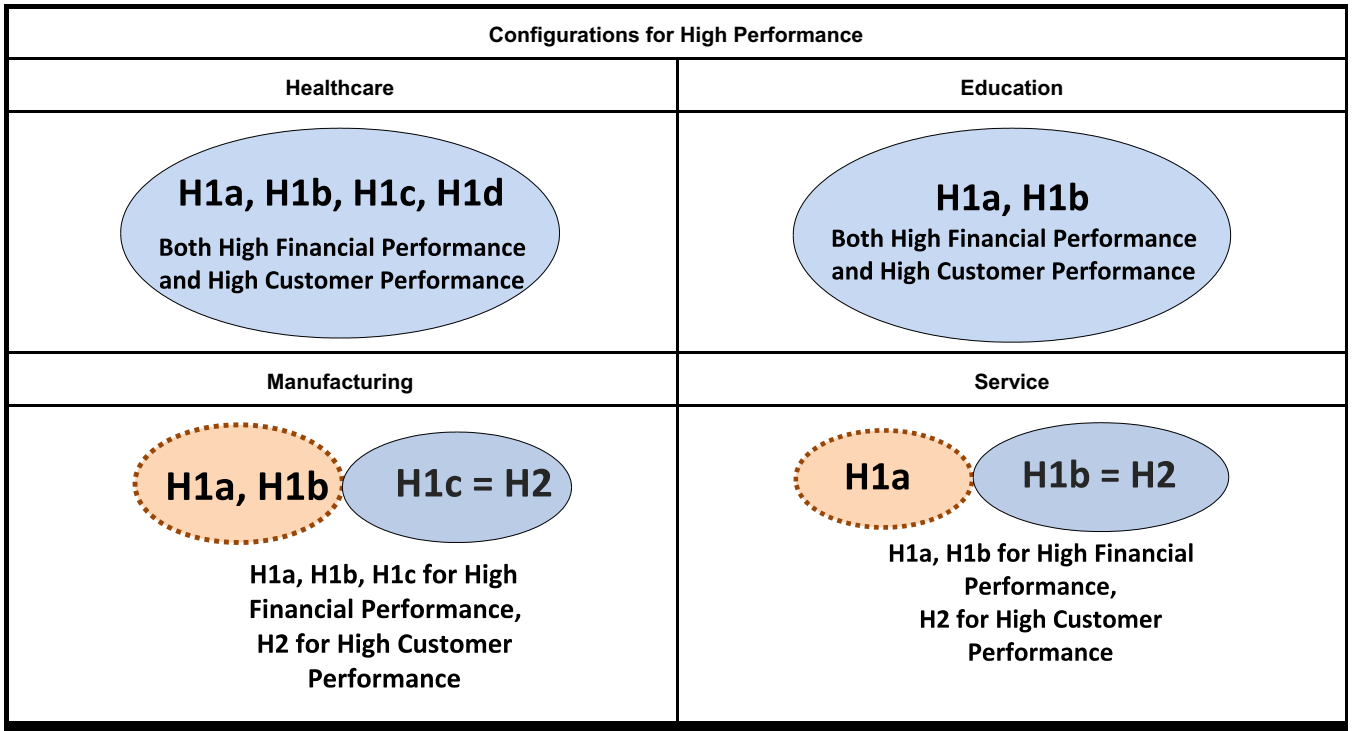
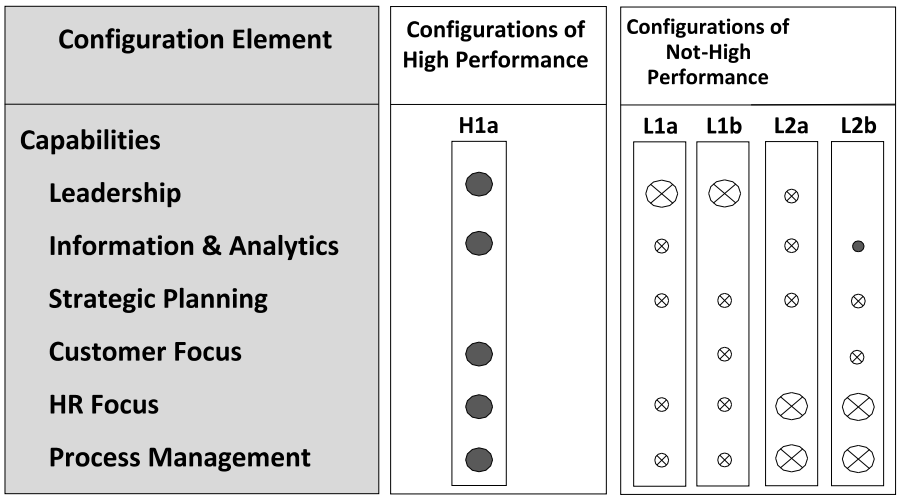


Figure D2. Comparison of Configuration for Financial Performance and Customer Performance

Notes: In the healthcare sector and the education sector, configurations for both high financial performance and high customer performance are the same. In the manufacturing sector, the H1c and H2 configurations have the same structure of capabilities. In the service sector, H1b and H2 are the same. Thus, these findings show the existence of isomorphic patterns in the solutions to achieve different types of performance.



High Financial Performance					
Consistency	0.93	0.90	0.91	-	-
Raw Coverage	0.55	0.69	0.70	-	-
Unique Coverage	0.55	0.02	0.04	-	-
Overall Solution Consistency	0.93	0.87			
Overall Solution Coverage	0.55	0.66			
High Customer Performance					
Consistency	0.87	-	-	0.95	0.90
Raw Coverage	0.67	-	-	0.58	0.21
Unique Coverage	0.67	-	-	0.43	0.05
Overall Solution Consistency	0.87			0.94	
Overall Solution Coverage	0.67			0.63	

Figure D3. Configurations for High Versus Not-High Performance (Small Organizations)

Notes: Black circles indicate the presence of a condition, and circles with "X" indicate its absence. Large circles indicate core conditions; small ones indicate peripheral conditions. Blank spaces indicate "don't care." The dash (–) presents no configuration that consistently produces the outcome.

Table D1. Sufficient Configuration Solutions for High Versus Not-High Performance

Outcomes	*Configurations — Sufficient Solutions*
1. Healthcare Sector (161 Cases)	
High Financial Performance and High Customer Performance	**L**i~shp + **L**i~scp + **L**i~sch + **L**ichp
Not-High Performance	**~L**~s**~C**~h**~P** + **~L**~i~s**~C~P**
2. Education Sector (115 Cases)	
High Financial Performance and High Customer Performance	li**S**cp + l**S**c~hp
Not-High Performance	Financial: ~i~s**~C**~h~p + l~i~s**~C**~h Customer: ~i~s~c~h**~P**
3. Manufacturing Sector (54 Cases)	
High Financial Performance and High Customer Performance	(1) Financial: l**I**s**CP** + l**IC**h**P** + **I**s**C**h**P** (2) Customer: **L**i**S**cp
Not-High Performance	(1) Financial: **~L**~i**~S**~c~h~p (2) Customer**:** **~L**~i~s~c~h~p
4. Service Sector (46 Cases)	
High Financial Performance and High Customer Performance	(1) Financial**:** **L**is**C**p + **L**~i~s**C**hp (2) Customer**:** l**IS**cp
Not-High Performance	~l~i~s~c~h**~P**

(1) L = Leadership, I = Information Analytics, S = Strategic Planning, C = Customer Focus, H = HR Focus, P = Process Management.

(2) In Boolean expression, + means OR, ~ means negation. For example, A~B means "A and not B."

(3) Uppercase indicates **core** elements, which have a strong causal relationship with the outcomes. Lowercase indicates **peripheral** elements, which have a weaker causal relationship with the outcomes. Core and peripheral conditions involve the strength of causal relationships. The presence of capability relates to a high level of capability; its absence indicates that a high level of capability should not exist.

(4) To illustrate our interpretation following the above notation, a configuration **L**i~shp can be interpreted such that organizations with "strong leadership and high information analytics capability and high HR focus and high process management capability, but without high strategic planning capability" consistently produce high financial performance, and leadership plays an essential core role.

Table D2. Robustness Check Using a Dataset for Each Sector, Including Only Unique Configurations for an Organization

Sector	*Total Unique Firms in the Initial Sample*	*Total Cases in the Initial Sample*	*Dropped Cases (Number of Firms)*	*Firms with Only One Case*	*Multiple Unique Cases (Number of Firms) after Dropping Duplicated Observations*	*Total Unique Cases after Dropping Duplicated Observations*
Healthcare	85	161	19 cases (13 firms)	48	94 cases (37 firms)	142 unique cases from 85 firms
Education	77	115	7 cases (5 firms)	56	52 cases (21 firms)	108 unique cases from 77 firms
Manufacturing	35	54	4 cases (4 firms)	25	25 cases (10 firms)	50 unique cases from 35 firms
Service	33	46	5 cases (4 firms)	29	12 cases (4 firms)	41 unique cases from 33 firms
Small Firms	53	77	7 cases (5 firms)	41	29 cases (12 firms)	70 unique cases from 53 firms

Notes: We drop multiple redundant observations belonging to a firm if they appear in the same row of the truth table to avoid any potential overweighting of any configuration.

Table D3. Summary Statistics and Calibration for Small Organizations (N = 77)

Elements and Outcomes	*Mean*	*SD*	*Min*	*Max*	*Anchors*		
					Full Membership	*Cross-Over*	*Full Non-Membership*
Financial performance	38.47	18.77	0.00	80.00	50	40	20
Customer performance	34.32	16.97	10.40	70.66	50	40	20
Leadership capability	45.63	15.29	15.83	75.83	60	50	20
Information analytics capability	42.27	14.74	5.00	71.11	60	50	20
Strategic planning capability	40.00	14.12	12.94	65.88	60	50	20
Customer focus capability	46.48	13.95	15.29	72.94	60	50	20
HR focus capability	44.86	12.02	10.59	68.24	60	50	20
Process management capability	43.53	13.73	14.12	74.12	60	50	20

Table D4. Sufficient Solutions for High Versus Not-High Performance for Small Organizations

Small Organizations (77 Cases)	
High Financial Performance and High Customer Performance	***LICHP***
Not-High Performance	(1) Financial: ***~L***~i~s~h~p + ***~L***~s~c~h~p (2) Customer: ~l~i~s***~H~P*** + *i~s~c****~H~P***

(1) In Boolean expression, + means OR, ~ means negation. For example, A~B means "A and not B."
(2) Uppercase indicates **core** elements, which have a strong causal relationship with the outcomes.
(3) Lowercase indicates **peripheral** elements, which have a weaker causal relationship with the outcomes.
(4) L= Leadership, I = Information Analytics, S = Strategic Planning, C = Customer Focus, H = HR Focus, P = Process Management

Appendix E

Necessary Condition Test

Table E1 show the results of the necessary condition tests for all capabilities for the four economic sectors. Consistency in a necessary condition test indicates how consistently a condition becomes a necessary condition for the outcome, while coverage indicates its empirical relevance as a necessary condition. If the coverage of a necessary condition is very small (e.g., 0.01), then the condition is meaningless or trivial.

The results show that in the healthcare and education sectors, no single capability has a consistency greater than 0.9, which means that none of the individual capabilities alone is a necessary condition for high performance. In the manufacturing and service sectors, there is no single necessary condition for financial performance, but leadership, customer focus, and process management can be considered as almost necessary conditions for customer performance.

Table E1. Necessary Condition Tests

	Financial Performance		*Customer Performance*	
Healthcare	***Consistency***	***Coverage***	***Consistency***	***Coverage***
Leadership	0.80	0.86	0.88	0.76
Information Analytics	0.80	0.83	0.85	0.71
Strategic Planning	0.65	0.91	0.73	0.81
Customer Focus	0.75	0.85	0.83	0.76
HR Focus	0.73	0.86	0.82	0.78
Process Management	0.76	0.86	0.83	0.76
Leadership + Information Analytics	0.88	0.81	0.93	0.68
	Financial Performance		***Customer Performance***	
Education	***Consistency***	***Coverage***	***Consistency***	***Coverage***
Leadership	0.81	0.72	0.78	0.78
Strategic Planning	0.72	0.83	0.68	0.87
Customer Focus	0.75	0.77	0.71	0.82
HR Focus	0.69	0.74	0.67	0.80
Process Management	0.77	0.75	0.75	0.81
Information Analytics	0.74	0.74	0.72	0.80
	Financial Performance		***Customer Performance***	
Manufacturing	***Consistency***	***Coverage***	***Consistency***	***Coverage***
Leadership	0.82	0.78	0.92	0.70
Strategic Planning	0.71	0.89	0.81	0.82
Customer Focus	0.84	0.81	0.95	0.74
HR Focus	0.78	0.79	0.84	0.69
Process Management	0.88	0.80	0.95	0.69
Information Analytics	0.80	0.80	0.86	0.69
	Financial Performance		***Customer Performance***	
Service	***Consistency***	***Coverage***	***Consistency***	***Coverage***
Leadership	0.86	0.91	0.90	0.71
Strategic Planning	0.72	0.94	0.79	0.77
Customer Focus	0.83	0.86	0.88	0.69
HR Focus	0.75	0.87	0.80	0.70
Process Management	0.84	0.84	0.90	0.68
Information Analytics	0.76	0.87	0.82	0.70

Appendix F

Organized Complexity in Digital Environments, and How the Configurational View of Causality Complements Other Notions of Causality in the Complexity Literature

We discuss some ideas related to complexity and the configuration view here that we could not discuss in the main paper, due to space limitations.

First, to illustrate another example of organized complexity in digital environments, let us consider the case of digital platforms. The success of digital platforms (e.g., mobile operating systems, such as iOS or Android) often depends on getting a complex interplay of factors relating to strategy, governance (e.g., Gawer and Henderson 2007), and platform engineering and design (Eaton et al. 2015) to support uncoordinated and generative complementary innovation (Foerderer et al. 2018). From a strategy and governance perspective, platform owners have a continuum of choices between market-based competitive policies and relationship-based commitment to complementors (Gawer and Henderson 2007; Huber et al. 2017).

From an engineering and design perspective, the components in digital platforms are layered modular architectures that are product-agnostic, given that they can be bundled in many different ways with other platform components or external components, in contrast to components in traditional modular architectures, which are product-specific (Yoo et al. 2010). In turn, these architectures enable or constrain platforms to choose between purposed and unpurposed innovation: purposed innovation indicates that the platform owner seeks innovation in particular areas, while unpurposed innovation indicates that the platform owner seeks to stimulate unprompted innovation without coordination (Foerderer et al. 2018). Often the success of coordinated innovation and uncoordinated innovation depends on the actions of complementors because complementors prefer to join a platform when they can safeguard against appropriation through patents, copyrights, and downstream capabilities (Huang et al. 2013).

The complexity of digital platforms arises because strategy and governance variables simultaneously interact in complex ways with platform engineering and design variables. For example, governance decisions in digital platforms can be the result of a complex and dynamic socio-technical negotiation between platform owners and complementors, mediated through technical artifacts, such as boundary resources (Eaton et al. 2015; Foerderer et al. 2018; Ghazawneh and Henfridsson 2013) or platform modularity (Tiwana et al. 2010). Platform evolution adds further complexity because platforms can use different approaches to governing their mobile platforms and balancing the discipline and autonomy of complementors over time (Mithas and Kude 2017). For example, while Apple was careful in opening the iPhone platform and allowed very few complements in the beginning, it gradually increased access to the platform over time; Google's Android platform shows a largely uncontrolled mode of governance (Foerderer et al. 2018). Because the number of potential configurations in such environments is often many times more than the actual number of observations available to researchers (very few platforms actually succeed, and data on unsuccessful platforms are also not always easily available), digital platforms exhibit limited diversity. However, it is difficult and often infeasible to predict in which ways the elements combine into bundles, and which configurations emerge to succeed and persist in reality.

Second, we draw on the complexity literature (Rivkin and Siggelkow 2007; Simon 2001) to posit that the unsolved, most difficult issue is a problem of organized complexity, in which the variables are simultaneously interrelated into an organic whole, making the phenomena complex not in a disorganized way, but an organized way. Then, we defined three aspects of organized complexity in terms of conjunctural causation, equifinality, and causal asymmetry (Misangyi et al. 2017), and we empirically investigated and explained these in the context of digital business strategy with a configurational approach and the fsQCA method.

References

Angell, L. C. 2001. "Comparing the Environmental and Quality Initiatives of Baldrige Award Winners," *Production and Operations Management* (10:3), pp. 306-326.

Barney, J. B. 1991. "Firm Resources and Sustained Competitive Advantage," *Journal of Management* (17), pp. 99-120.

Barney, J. B., and Wright, P. M. 1998. "On Becoming a Strategic Partner: The Role of Human Resources in Gaining Competitive Advantage," *Human Resource Management* (37:1), pp. 31-46.

Chadwick, C., and Dabu, A. 2009. "Human Resources, Human Resource Management, and the Competitive Advantage of Firms: Toward a More Comprehensive Model of Causal Linkages," *Organization Science* (20:1), pp. 253-272.

Davenport, T. H. 1993. *Process Innovation: Reengineering Work Through Information Technology*, Boston: Harvard Business School Press.

Davenport, T. H. 2000. *Mission Critical: Realizing the Promise of Enterprise Systems*, Cambridge, MA: Harvard Business School Press.

Earl, M., and Feeny, D. 2000. "How to Be a CEO for the Information Age," *Sloan Management Review* (41:2), pp. 11-23.

Eaton, B., Elaluf-Calderwood, S., Sorenson, C., and Yoo, Y. 2015. "Distributed Tuning of Boundary Resources: The Case of Apple's iOS Service System," *MIS Quarterly* (39:1), pp. 217-243.

Fiss, P. C. 2007. "A Set-Theoretic Approach to Organizational Configurations," *Academy of Management Review* (32:4), pp. 1180-1198.

Fiss, P. C. 2011. "Building Better Causal Theories: A Fuzzy Set Approach to Typologies in Organization Research," *Academy of Management Journal* (54:2), pp. 393-420.

Flynn, B. B., and Saladin, B. 2001. "Further Evidence on the Validity of the Theoretical Models Underlying the Baldrige Criteria," *Journal of Operations Management* (19), pp. 617-652.

Flynn, B. B., Schroeder, R. G., and Sakakibara, S. 1995. "The Impact of Quality Management Practices on Performance and Competitive Advantage," *Decision Sciences* (26:5), pp. 659-691.

Foerderer, J., Kude, T., Mithas, S., and Heinzl, A. 2018. "Does Platform Owner's Entry Crowd Out Innovation? Evidence from Google Photos," *Information Systems Research* (29:2), pp. 444-460.

Fornell, C., Mithas, S., Morgeson, F. V., and Krishnan, M. S. 2006. "Customer Satisfaction and Stock Prices: High Returns, Low Risk," *Journal of Marketing* (70:1), pp. 3-14.

Frei, F. X., Kalakota, R., Leone, A. J., and Marx, L. M. 1999. "Process Variation as a Determinant of Bank Performance: Evidence from the Retail Banking Industry," *Management Science* (45:9), pp. 1210-1220.

Garvin, D. A. 1991. "How the Baldrige Award Really Works," *Harvard Business Review* (69:6), pp. 80-93.

Gawer, A., and Henderson, R. 2007. "Platform Owner Entry and Innovation in Complementary Markets: Evidence from Intel," *Journal of Economics & Management Strategy* (16:1), pp. 1-34.

Ghazawneh, A., and Henfridsson, O. 2013. "Balancing Platform Control and External Contribution in Third-Party Development: The Boundary Resources Model," *Information Systems Journal* (23), pp. 173-192.

Greckhamer, T., Misangyi, V., and Fiss, P. 2013. "The Two QCAs: From a Small-N to a Large–N Set Theoretic Approach," *Research in the Sociology of Organizations* (38), pp. 49-75.

Hendricks, K. B., and Singhal, V. R. 1996. "Quality Awards and the Market Value of the Firm: An Empirical Investigation," *Management Science* (42:3), pp. 415-436.

Hendricks, K. B., and Singhal, V. R. 1997. "Does Implementing an Effective TQM Program Actually Improve Operating Performance? Empirical Evidence from Firms That Have Won Quality Awards," *Management Science* (43:9), pp. 1258-1274.

Huang, P., Ceccagnoli, M., Forman, C., and Wu, D. J. 2013. "Appropriability Mechanisms and the Platform Partnership Decision: Evidence from Enterprise Software," *Management Science* (59:1), pp. 102-121.

Huber, T. L., Kude, T., and Dibbern, J. 2017. "Governance Practices in Platform Ecosystems: Navigating Tensions Between Cocreated Value and Governance Costs," *Information Systems Research* (28:3), pp. 563-584.

Kalakota, R., and Robinson, M. 2003. *Services Blueprint: Roadmap for Execution*, Reading, MA: Addison-Wesley Pub Co.

Kathuria, R., and Davis, E. B. 2001. "Quality and Work Force Management Practices: The Managerial Performance Implication," *Production and Operations Management* (10:4), pp. 460-477.

Kaynak, H. 2003. "The Relationship Between Total Quality Management Practices and Their Effects on Firm Performance," *Journal of Operations Management* (21:4), pp. 405-435.

Kettinger, W. J., and Grover, V. 1995. "Special Section: Toward a Theory of Business Process Change Management," *Journal of Management Information Systems* (12:1), pp. 9-30.

Misangyi, V. F., and Acharya, A. G. 2014. "Substitutes or Complements? A Configurational Examination of Corporate Governance Mechanisms," *Academy of Management Journal* (57:6), pp. 1681-1705.

Misangyi, V. F., Greckhamer, T., Furnari, S., Fiss, P. C., Crilly, D., and Aguilera, R. 2017. "Embracing Causal Complexity: The Emergence of a Neo-Configurational Perspective," *Journal of Management* (43:1), pp. 255-282.

Mithas, S. 2014. *Dancing Elephants and Leaping Jaguars: How to Excel, Innovate, and Transform Your Organization the Tata Way*, North Potomac, MD: Finerplanet.

Mithas, S. 2015a. *Making the Elephant Dance: The Tata Way to Innovate, Transform and Globalize*, New Delhi: Penguin Portfolio.

Mithas, S. 2015b. "A Saga of Excellence," *Indian Management* (54:9), pp. 47-50.

Mithas, S., and Kude, T. 2017. "Digitization and Disciplined Autonomy," *IEEE IT Professional* (19:5), pp. 4-8.

Mithas, S., Ramasubbu, N., and Sambamurthy, V. 2011. "How Information Management Capability Influences Firm Performance," *MIS Quarterly* (35:1), pp. 237-256.

Nambisan, S. 2002. "Designing Virtual Customer Environment for New Product Development: Toward a Theory," *Academy of Management Review* (27:3), pp. 392-413.

NIST. 2012. "How the Baldrige Program Began: The Birth of a Unique Public–Private Partnership," Baldridge Performance Excellence Program, National Institute of Standards and Technology, Department of Commerce, Gaithersburg, MD (http://www.nist.gov/baldrige/25th/upload/How_the_Baldrige_Program_Began.pdf).

Park, Y., El Sawy, O. A., and Fiss, P. C. 2017. "The Role of Business Intelligence and Communication Technologies in Organizational Agility: A Configurational Approach," *Journal of the Association for Information Systems* (18:9), pp. 648-686.

Porter, M. E., and Rivkin, J. W. 2000. "Industry Transformation," Case Study, Harvard Business School, Boston, MA.

Ragin, C. C. 2008. *Redesigning Social Enquiry: Fuzzy Sets and Beyond*, Chicago: University of Chicago Press.

Rivkin, J. W., and Siggelkow, N. 2007. "Patterned Interactions in Complex Systems: Implications for Exploration," *Management Science* (53:7), pp. 1068-1083.

Robinson, J. D., Poling, H. A., Akers, J. F., Galvin, R. W., Artzt, E. L., and Allaire, P. A. 1992. "An Open Letter: TQM on the Campus," *Harvard Business Review* (Nov/Dec), pp. 94-95.

Saldanha, T., Mithas, S., and Krishnan, M. S. 2017. "Leveraging Customer Involvement for Fueling Innovation: The Role of Relational and Analytical Information Processing Capabilities," *MIS Quarterly* (41:1), pp. 267-286.

Schaefer, C. (ed.). 2011. *Baldrige20|20: An Executive's Guide to the Criteria for Performance Excellence*, NIST (http://baldrige.nist.gov/).

Schaefer, C. 2012. "Tata's Baldrige Advantage: A Multinational's Model for Performance Excellence," September 4 (available at http://nistbaldrige.blogs.govdelivery.com/2012/09/04/tatas-baldrige-advantage-a-multinationals-model-for-performance-excellence/.)

Segars, A., and Grover, V. 1999. "Profiles of Strategic Information Systems Planning," *Information Systems Research* (10:3), pp. 199-232.

Simon, H. A. 2001. "Science Seeks Parsimony, Not Simplicity: Searching for Pattern in Phenomena," in *Simplicity, Inference and Modelling: Keeping it Sophisticatedly Simple*, Cambridge, UK: Cambridge University Press, pp. 32-72.

Singhal, K., and Hayes, R. 1992. "An Open Response to 'TQM on the Campus': We need TQM … and More," *Harvard Business Review* (Jan/Feb), p. 148.

Srivastava, A., Bartol, K. M., and Locke, E. A. 2006. "Empowering Leadership in Management Teams: Effects on Knowledge Sharing, Efficacy, and Performance," *Academy of Management Journal* (49:6), pp. 1239-1251.

Tiwana, A., Konsynski, B., and Bush, A. A. 2010. "Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics," *Information Systems Research* (21:4), pp. 675-687.

Wade, M., and Hulland, J. 2004. "*Review*: The Resource-Based View and Information Systems Research: Review, Extension, and Suggestions for Future Research," *MIS Quarterly* (28:1), pp. 107-142.

Yadav, M., and Pavlou, P. 2014. "Marketing in Computer-Mediated Environments: Research Synthesis and New Directions," *Journal of Marketing* (78:1), pp. 20-40.

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.