Information Technology and the Search for Organizational Agility: A Systematic Review with Future Research Possibilities

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Abstract

Organizations are increasingly turning to information technology (IT) to help them respond to unanticipated environmental threats and opportunities. In this paper, we introduce a systematic review of the literature on IT-enabled agility, helping to establish the boundary between what we know and what we don't know. We base our review on a wide body of literature drawn from the AIS Basket of Eight IT journals, a cross-section of non-Basket journals, IT practitioner outlets, and premier international IS conferences. We review the use of different theoretical lenses used to investigate the relationship between IT and organizational agility and how the literature has conceptualized agility, its antecedents, and consequences. We also map the evolution of the literature through a series of stages that highlight how researchers have built on previous work. Lastly, we discuss opportunities for future research in an effort to close important gaps in our understanding.

The complacent company is a dead company. Success today requires the agility and drive to constantly rethink, reinvigorate, react, and reinvent (Bill Gates, co-founder, Microsoft)

INTRODUCTION

As we contemplate the rise in uncertainty facing organizations, whether due to volatile prices, trade wars, new sources of global competition, fickle consumers, new regulation or other such factors, there is a lingering question as to how easily and quickly organizations can sense and respond to change and the role that information technology (IT) plays in either enabling or hindering such change. The issue of IT-enabled organizational agility is not new. Yet, in recent years, it has become increasingly concerning for information systems (IS) practitioners when there is a realization that past IT decisions could hinder agility (Kappelman et al., 2017).[1] But what do we really know about IT-enabled agility and, more importantly, what do we need to know as IT continues to evolve and as business models come under renewed attack from innovators such as Amazon? While evidence points to IT as a key driver of past performance (Melville et al., 2004), it would be difficult to infer that IT *must*, as in the past, allow organizations to sustain or even to improve their future firm performance if environmental conditions were to unexpectedly change. Grounded in some two decades of research, the literature on IT-enabled agility has gone so far as to suggest that organizations should spare no expense to be agile (Teece et al., 2016). However, balancing the desire to be agile with ongoing pressure to streamline IT operations and limit IT spending suggests that organizations face some difficult decisions.

So what then should organizations do? Defunct industry icons such as Polaroid and Sears show that complacency is not an option and that having an ability to easily and quickly sense and respond to threats and opportunities is critical to survival and success (Lucas, 2012). There are even suggestions that managers should focus more on making sense of, and responding to, market risk and opportunities as they arise rather than rely on future planning or prediction. In other words, it may be better to consider IT solutions that deal with events as they occur rather than relying on an increasingly complex strategic planning process to create plans for each and every scenario. At the same time, we are reminded that in stable and predictable markets,

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[1] All references throughout the paper to agility, unless otherwise noted, are to organizational agility. We adhere to the definition of agility from Sambamurthy et al. (2003) – see Table 2 for a list of definitions from the literature.

organizations might justifiably limit efforts to bolster agility if there is so little at stake. But do such markets even exist today and could the emergence of threats in a previously stable industry doom these legacy firms? Answering these questions means that we need to know more about the relationship between IT and agility, particularly as organizations encounter new disruptive technologies and unanticipated business challenges. It also means knowing the boundaries of the extant agility literature and deciding where it needs to go next with the ultimate goal of creating what DeSouza (2007) calls the *Agile Information Organization* and, thus, avoiding what Van Oosterhout et al. (2007) call agility gaps occasioned by excessive or insufficient agility.

As such, this paper has three goals. First, we examine the current state of knowledge on IT-enabled organizational agility in terms of its definition, composition, antecedents, and consequences. Doing so helps to articulate the extent to which researchers agree on the definition of what agility is (or what it is not) and whether there is evidence that research on IT-enabled agility is evolving over time. Second, by investigating the research questions on IT-enabled agility and the constructs used to answer these questions, we can offer a perspective on *what we know about IT-enabled agility*. This step can unearth themes that have motivated the literature but it can also expose *outliers* that help to redirect the literature in a new direction. Third, by uncovering gaps in our understanding, we can consider *what we don't know about IT-enabled agility* and translate these gaps into opportunities for future research. We address these three goals using a systematic review of the literature on IT-enabled agility from 2000 through mid-2018. As Rowe (2014) suggests, such reviews guide our current thinking, discover gaps and limitations in our understanding, and thus prompt the development and subsequent execution of a broad agenda for future, targeted IT research.

The structure of this paper is as follows. In the next section, we describe the research methodology underlying our review. We then move towards a detailed assessment of the conceptualization, antecedents, and outcomes of agility. After this detailed analysis, we review various theoretical lenses through which IT researchers have considered IT-enabled agility. Next, we review different research questions and constructs that have shaped the literature on IT-enabled agility, using these questions to identify how the literature has evolved through different stages. Finally, we outline a future research agenda to address questions that CIOs are facing and challenges that IS academics may need to address as they propose answers to these questions.

SYSTEMATIC REVIEW: METHODOLOGY

In order to gain an understanding of the breadth of the literature, we conducted a targeted search of peer-reviewed research published across four databases (Business Source Premier, AIS Electronic Library, ACM Digital Library, and IEEE Digital Library). In each instance, we first searched for *agile* or *agility* in the title or among a list of author-supplied keywords. We then refined our search results by adding keyword, abstract or publication title search terms (business, corporate, enterprise, company, firm or organization) in order to narrow our focus to organizational agility or similar terms such as enterprise agility and then further refined our search results by adding search terms for information systems or information technology. In the specific case of ACM Digital Library, we restricted our search to journals and magazines in order to identify research in ACM outlets such as Communications of the ACM or ACM Computing Surveys. In the case of AIS Electronic Library, we limited our search to *completed research* papers in premier conferences, notably AMCIS, ECIS, HICSS, ICIS, and PACIS. We then manually worked through our entire set of search results to ascertain if the publications we found were relevant to a discussion of IT and organizational agility. Next, we looked through the website of the Journal of Strategic Information Systems (JSIS) – one of eight journals in the AIS Senior Scholars' *Basket of Eight* Journals – since JSIS is not indexed by any of the four databases we used. A summary of our search appears in Table 1. For comparison purposes, we show studies appearing in the Basket of Eight, in non-basket journals, in IS conference proceedings, and in IT practitioner journals.[2]

Insert Table 1 about here

FRAMING THE REVIEW

The strategy, management, and IS literature has, for more than two decades, adopted a consistent view of agility as reflecting a symbiosis of sensing and responding capabilities. Teece et al. (2016) provide an argument in favor of agility (equally described in the literature as strategic agility, organizational agility,

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[2] We conducted our literature search in May 2018. We limited our search to publications appearing in or after 2000 as all pertinent studies on IT-enabled agility appeared in or after this time. We also searched through forthcoming papers published on websites of the Basket of Eight but did not find any studies to add to our results. In order to avoid double counting, when searching for conference papers, we omitted papers that were found to have been subsequently published under a similar title in journals that were picked up by our other searches. Hence, a paper that appeared in ICIS and then subsequently in EJIS, for example, would only be counted as appearing in EJIS.

flexibility or adaptiveness), saying that "business firms should doggedly seek to become agile no matter the cost, keeping options open all the time, maintaining redundancy at all times, and staying in a constant state of radical transformation" (p. 13). While this might imply that digital options that confer upon organizations the act in a particular way are always valuable, it is still an open question as to whether agility is consistently valuable and under what conditions value arises. One can also ask whether agility is equally driven by sense and response capabilities or whether certain types of capabilities – ordinary, dynamic, general-purpose or market-specific – are more important. Sense and response capabilities may be classified as dynamic if they permit organizations to repurpose or reposition their resources as conditions shift. As such, agility may be more value sustaining – serving as a protective buffer against a decline in performance – than value creating.

Our efforts to understand the link between IT and organizational agility are rooted, in part, in a rich literature on agility in IS development. In an introduction to a special issue of ISR on flexible and distributed IS development, Agerfalk et al. (2009) ask, with a focus on agility at the organizational level, "how best to grow agile beyond the system development team to accommodate the required interactions [with functional areas]". The focus here is on moving beyond the agile development of IT to IT use for organizational agility. Conboy's (2009) definition of agile IS development as creating, anticipating, reacting to, and learning from change applies equally to how the output of an IS development process impacts organizational agility. Yet, there is also a dark side to using IT for organizational agility with such factors as information overload, IT dependence, selective data censoring, and an inability to question data contributing to organizations moving too quickly in the wrong direction or failing to sense threats in a timely manner (Seo and La Paz, 2008).

CONCEPTUALIZATION OF ORGANIZATIONAL AGILITY

Part of the challenge of synthesizing findings from a body of work is recognizing that key variables can mean different things to different people. While researchers may agree that agility is about sensing and responding to change, there is some variation in the level at which agility is considered (corporate, business unit, process or work group) and the composition of the construct (see Table 2). For example, Sambamurthy et al. (2003) conceptualize agility as a process-level construct representing, "a firm's capabilities related to interactions with customers, orchestration of internal operations, and utilization of its ecosystem of external

business partners" (p. 245). Similarly, Zain et al. (2005) regard agility as customer enrichment, cooperating with stakeholders to expand competitiveness, mastering change and uncertainty, and leveraging human and information-based resources. This process view contrasts with Hovorka and Larsen (2006) who view agility as speed of IT adoption; Lowry and Wilson (2016) who view agility as a combination of information agility (access to, and use of IT), system agility (IT development, implementation, modification, and maintenance), and strategic agility (ability to take advantage of IT capabilities); Liang et al. (2017) who view agility as a variety of sense and respond capabilities around customers, competitors, and economic shifts; Sorensen and Laudau (2015) who see agility in a narrow sense as researchers' ability to keep abreast of IT innovations in their publications, and Lu and Ramamurthy (2011) who see agility as comprising market capitalizing agility (changing products and services to reflect customer needs) and operational adjustment agility (how internal business processes can cope with changes in demand). Lastly, Chakravarty et al. (2013) regard agility as a combination of entrepreneurial agility (an ability to anticipate and seize market opportunities that permit a firm to revise "its positioning and strategies and organize new business approaches to gain early advantages in changing conditions" (p. 978)) and adaptive agility (a more defensive view of agility if firms seek to protect themselves or recover from a market disruption rather than seeking a first-mover advantage). Hence, agility can be offensive or defensive or both – reflective perhaps of the fact that a firm's products or markets do not evolve at the same speed or reside at the same point on the product lifecycle curve and yet a recurring theme running through these conceptualizations is the ease and speed of sensing and responding to change.

Insert Table 2 about here

ANTECEDENTS OF AGILITY

In order to facilitate a deeper study of agility, as seen in Table 2, we divide the literature into studies that are purely conceptual, empirical papers that rely on case data, and empirical papers that rely on survey data. Based on this clustering, we find that the antecedents or enablers of agility can be subdivided into four general categories: technological, behavioral, organizational / structural, and environmental. We summarize the antecedents of agility in Table 3 and discuss these four general antecedent categories below.

Insert Table 3 about here

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Technological Enablers

IT antecedents describe key properties of IT resources (hardware, software, and networks) in terms of their modular form, compatibility with, and connectivity to other IT resources. Flexibility means that IT infrastructure (storage, memory, microprocessor capacity or network bandwidth) can, for example, scale as demand grows. It also means that developers and operations support personnel can easily and quickly build, test, and deploy new or revised applications based on user requirements. The role of data or information as an enabler of agility is also relevant. While there are important questions around the ownership of data and whether data can be shared across the organization (Khatri and Brown, 2010; Sun and Wang, 2013), there are also questions about data architectures that may prevent data from driving organizational agility (Ahsan and Ngo-Ye, 2005; Morris and McManus, 2002; Weber et al., 2009). Research by Ross (2003) and Ross et al. (2006) found in the early 2000s that 60% of organizations used siloed applications or were in the process of moving to standardized IT; these organizations struggled to gain an enterprise-level view of their data to where data could truly enable organizational agility. Only 6% of organizations at that time had a sufficiently flexible architecture to where data could begin to drive agility (Ross, 2003, p. 40; Ross et al., 2006, p. 77).[3]

Rather than thinking about IT as supporting a single process and creating agility within that process – supply chain logistics or customer service being two examples – there are arguments that spillover effects due to process linkages can either enable or hinder how IT facilitates process agility (Swafford et al., 2006). For example, increased use of IT within production processes could expand the rate of output but this could create logistical bottlenecks later in the value chain that make it difficult for customers to receive orders on time. Rather than consider IT as enabling organizational agility in some overarching sense, it makes sense to identify instead how IT facilitates agility at the process-level. This is consistent with Sambamurthy et al. (2003) who view firm-level agility as representing operations agility, supplier agility, and partnering agility.

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[3] In a survey of senior IT executives in 120 large U.S., German, and Australian corporations conducted more than a decade later, the authors found using the diversification, coordination, replication, unification typology from Ross et al. (2006) that 43% of respondent corporations were still siloed; 28% of respondent corporations had a modular architecture. While these results show some progress over the results reported by Ross and her colleagues, there is still evidence that, even today, with the growing popularity of highly standardized systems, IT is siloed in some of the largest global corporations. We thank an anonymous reviewer for drawing our attention to this issue.

Behavioral Enablers

In terms of behavioral antecedents of agility, research has considered IT and management practices and their association with sense and response capabilities. Environmental scanning allows organizations to sense market threats and opportunities. Strategic planners can then decide on a plan of action and what level of resources are needed to assure an appropriate response. However, these decisions are not straightforward as investment in IT involves considerable risk placing strong demands on managerial foresight. The way in which managers develop this insight to support IT-enabled agility is limited and remains obscured by high levels of technical and market uncertainty (Richard et al., 2012). Tallon (2008) sees that closer collaboration between IT and business executives in terms of IT planning and post-implementation reviews of prior IT investments allow organizations to better sense threats and opportunities and decide, with the benefit of hindsight, how best to react to changes in their environment. Even as managers are expected to sense the need for change, they are equally expected to manage against a set of current performance goals. Lee et al. (2015) find that IT ambidexterity – the ability to use existing IT resources and practices while experimenting with new IT resources and practices – contributes to operational ambidexterity, meaning the ability to invent or change business operations while improving current business operations, and to greater organizational agility. They portray agility as representing radicalness, proactiveness, responsiveness, and adaptiveness. In studying the effects of employees on organizational agility, Breu et al. (2002) find while the use of IT is important to agility, the novel, networked, virtual, and collaborative ways of working enabled by IT are just as relevant. While Ravichandran (2018) finds that digital platform capabilities are associated with higher organizational agility, this relationship is moderated by innovation capacity in the form of risk taking, tolerance for making mistakes, and openness to innovation. Certainly, IT may be important to agility but it is equally important that managers promote a culture of calculated risk taking in order that employees have a way to test their ideas without fear of failure or retribution from superiors. Westerman (2009) discusses the nature of IT risk and how, in the search for greater agility, there is inherent tension between the need to *do it right* versus *do it right now*. Managing such risk calls for managers to first address questions

around the timing, availability, accessibility, cost, and accuracy of information needed for decision making (Park et al., 2017).

The literature also recognizes that, while sensing can be shaped by IT that shows anomalous events, there is still a need for managers to stay alert and mindful if they want to make sense of what IT is reporting. Building on work by Sambamurthy et al. (2003), Richardson et al. (2014) define entrepreneurial alertness in a healthcare context as the, "ability to recognize and respond to opportunities to detect market ignorance and identify appropriate actions that result in improved competitive actions" (p. 4). Alertness resembles the notion of mindfulness – meaning attention to detail and an ability to remain vigilant – and is noted in recent work on IS development (Cram and Newell, 2016; McAvoy et al., 2013; Nagle et al., 2011). Thatcher et al. (2018) suggest that IT mindfulness is dynamic or malleable, meaning that IT managers can learn to be more vigilant of how IT can facilitate agility rather than simply assuming that IT must, by default, benefit agility.

In the practitioner literature, Lewis et al. (2014) and Fourné et al. (2014) see a need for leadership and integrative thinkers so firms can sense and respond to uncertain events. Indeed, Lewis et al. (2014) call for *paradoxical leadership* to help managers avoid defensiveness. Such leadership is vital since agile firms, as argued by Aghina et al. (2016) in a special issue of McKinsey Quarterly on the topic of agility, need "to be both stable (resilient, reliable, and efficient) and dynamic (fast, nimble, and adaptive)" (p. 58). This sense of combining stability and dynamism, exploration and exploitation is a recurring theme in the IS literature.

Organizational and Structural Enablers

Organizational and structural enablers of agility are concerned with high-level issues pertaining to strategic orientation, business model selection, matters of centralized or decentralized decision making, and the locus of environmental scanning and control. Tan et al. (2009) use the literature on business ecosystems to study agility in Alibaba. Ecosystems allow organizations to take a holistic view of their capabilities and resources, business partnerships, and the nature of competition. Bouwman et al. (2018) go further by stress testing business models to ascertain their ability to change under market pressure. Stress testing, they argue, "aims to make explicit in which scenarios the [business model] components might be at stake" (p. 152). Data operations platforms are a recent innovation for using real-time streaming data for IT decision making.

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Real time information can prove useful if organizations are structurally able to act on what they see but the reality for most organizations is that information must be batched and aggregated before being presented to decision makers. Depending on the structure of the organization, there may be significant delays in getting information to top executives while the richness and immediacy of the source information may also be lost. Other challenges are triggered by the need to route information to the right person but information overload and bureaucracy may cause managers to miss insights that are obvious in hindsight (Seo and La Paz, 2008).

From a structural perspective, strategic business units are the front line of many organizations. With multi-business organizations – configured by product, territory or customer segment – as the most prevalent organizational form in use today, business unit managers are among the first to identify the need for change. Relationships between the corporate unit and the business units can be significantly impacted by IT in both positive and negative ways (Tanriverdi, 2005, 2006). IT can expedite the exchange of information between corporate decision makers and the business unit, helping to increase the speed with which critical decisions are reached but conflicting standards and a lack of system integration can equally slow down the exchange of information. As such, IT could limit agility in more centralized organizations leading to a decline in firm performance (Hovorka and Larsen, 2006). Teoh and Chen (2013) outline a need for "governance for agility" as a way to overcome the obstacles imposed by organizational structure. In the context of an Indian hospital setting, they argue that agile IT implementation is based on phase-based IT governance strategies – starting with a needs assessment and culminating in an ability to dynamically allocate IT resources as events unfold.

Environmental Enablers

The literature also reveals that environmental factors play a role in shaping agility. The environment provides a context within which other relationships play out. Using the language of moderation, Tallon and Pinsonneault (2011) find that organizations in more turbulent settings are more likely to observe a positive moderation effect of IT infrastructure flexibility on the link between strategic alignment and process agility. Rather than finding that alignment between IT and business strategy could create IT rigidity, causing a drop in agility, they instead found that alignment could enable agility, particularly in the presence of flexible IT. This result is echoed by Lee et al. (2015) who show that environmental dynamism positively moderates the

link between IT and operational ambidexterity, although it contradicts a finding in Chakravarty et al. (2013) who report that the effects of IT competences on organizational agility fall as the pace of change grows. In a Chinese study, Mao et al. (2015) show that environmental uncertainty positively moderates the effects of IT and knowledge capabilities on organizational agility and that information intensity further moderates the effect of knowledge capabilities on organizational agility. The implication of this finding is that IT is more likely to facilitate agility during volatile environmental conditions and that an organization's ability to sense what is happening in its environment and react to what it sees is contingent on information. Chakravarty et al. (2013) go further by noting that environmental effects stimulate different types of agility (entrepreneurial vs. operational) in unique ways. In terms of digital options, one could argue that market uncertainty provides a context within which firms can opt to exercise their options to use IT to respond to environmental change (Sambamurthy et al., 2003). Indeed, one could argue that the adoption and use of IT – rather than ownership of or access to different IT resources – is ultimately what triggers agility (Tan et al., 2017; Zain et al., 2005).

CONSEQUENCES OF ORGANIZATIONAL AGILITY

In the preceding paragraphs, we touched briefly on a number of firm-level performance outcomes attributed to agility such as increased alignment between IT and business strategy. Similar to arguments in the IT business value literature that IT can create primary (first order) and secondary (second order) impacts and that these impacts materialize at the process and firm-levels, respectively, the agility literature suggests that agility can be an end in itself (a first order impact at the process-level) and a means to an end (a second order impact in the form of higher firm performance at the firm-level). The empirical literature outlined in Table 2 highlights a number of these first and second order impacts. For example, Zaheer and Zaheer (1997) study the effect of alertness and responsiveness of global foreign exchange traders at a large institution on market influence (a first order impact signifying the number of incoming phone calls to a currency trading desk in a 24-hour period). Similarly, Fink and Neumann (2007), Lu and Ramamurthy (2011), Tallon (2008), Bradley et al. (2012), and Lee et al. (2015) see agility as an end in itself. Meanwhile, Swafford et al. (2008), Bhatt et al. (2010), Vickery et al. (2010), Tallon and Pinsonneault (2011), Roberts and Grover (2012), Chen et al. (2014), and Chakravarty et al. (2013) regard agility as a first order effect with firm performance as a

second order effect. Besides financial performance metrics found in the IT impacts literature, we note that Roberts and Grover (2012) view agility in terms of competitive activity. This is consistent with conceptual work by Sambamurthy et al. (2003) who regard agility as affecting the number and variety of competitive actions (the scale and scope of competitive activity, respectively) taken by a firm in response to a changing environment. Overall, the literature views agility as both an end in itself and a means to an end. This implies that research will be valuable whether agility is seen as a first (process-level) or second order (firm) effect.

THEORETICAL LENSES

Agility – its composition, antecedents, and consequences – have been investigated through a variety of theoretical lenses. As reported in Table 2, the resource-based view and the theory of dynamic capabilities are especially prominent among agility-related studies published in the *Basket of Eight*. The resource-based view is appropriate to the extent that organizational agility is attributable to a resource that is valuable, rare, inimitable or non-substitutable whereas a dynamic capabilities perspective asks whether the firm can adapt, reconfigure or redeploy resources according to the evolving needs of the market. In the case of IT, however, understanding the properties of capabilities that make IT adaptable is important, but it represents only one element of a firm's agility challenge. Organizations need to make IT resource and capability choices. They must decide, for example, which IT resources or capabilities should be acquired, retained, and discontinued in order to produce an appreciable impact on organizational agility (Queiroz et al., 2018b; Zain et al., 2005).

Theories of alignment or fit between IT and business strategy or between IT and sense and response capabilities are a further lens through which to view agility. Since environmental turbulence can disrupt the fit between IT and business strategy – prompting fears that IT will be unable to support a change in business strategy and could, instead, lock the firm into a certain way of doing business (Jarvenpaa and Ives, 1994) – there is a question as to whether organizations should tradeoff alignment for increased agility. Glaser (2008) – a healthcare CIO – agrees that tradeoffs exist with IT resources moving to applications that benefit agility and away from automating activities that drive IT effectiveness and strategic IT alignment in the short term. Tallon and Pinsonneault (2011) show that when IT is created with flexibility, modularity, connectivity, and compatibility in mind, IT can create a form of continuous or dynamic alignment which can, in turn, enhance

process agility. Liang et al. (2017) offer a different assessment based on a study of the Chinese shipbuilding industry. They report that intellectual alignment (fit between IT and business strategy) and social alignment (where IT and business executives have a shared vision for IT) have no direct effect on agility. Instead, the effects of intellectual alignment on agility are fully mediated by inertia: higher intellectual alignment creates rigidity which restricts agility while the effects of social alignment on agility are positive and fully mediated by IT and non-IT executives collaborating on how to respond to change. Combining these results says that alignment helps agility but, for this to occur, IT decisions should be shaped by interactions between business and IT managers – interactions that allow common goals for IT to emerge (Bassellier and Benbasat, 2004).

Looking to the strategy and management literature illuminates other theoretical lens that shape our understanding of IT and organizational agility. For example, Brueller et al. (2014) posit that platform-based (a means to corporate-level diversification) and bolt-on (extending business unit reach) acquisitions impact agility differently. The backward and forward compatibility demands imposed on legacy IT and the way IT teams work will influence the relationship between IT and agility. This relationship will likely be different in each instance. Platform acquisitions will likely lead to massive integration issues such as when Bank of America merged with Merrill Lynch whereas bolt-on acquisitions pose IT scale challenges such as Cisco's takeover of Linksys in 2003. Elsewhere, Franken and Thomsett (2013) use war-gaming to understand how networked organizations can be more agile, the main argument being that wargames (scenario testing) allow problems to be surfaced and discussed before actual strategies are enacted. The same argument might apply to IT if cost-benefit analysis and post-implementation reviews allow CIOs to better understand the value of IT and why actual benefits can diverge from expectations. The larger question perhaps is whether CIOs can or should factor agility into any cost-benefit analysis of IT. Somewhat related, Tiwana and Kim (2015) use IT governance to assess agility. Arguing that, "the secret sauce for exploiting IT for strategic agility is how it is governed" (p. 656), they propose that, "IT governance amplifies … IT strategic agility only when it is discriminatingly aligned with the IT unit's and line functions' peripheral knowledge." (p. 657). Queiroz et al. (2018b) make a similar claim when showing that IT portfolio management, with an underlying focus on building, buying, and retiring IT applications, has a positive and significant effect on business unit agility.

Overall, among those theories that dominate the IT-enabled agility literature, there is a tendency to depict agility as one of sensing change and choosing among different types of IT resources and capabilities.

BUILDING ON PRIOR RESEARCH: EVOLUTION IN THE LITERATURE

Understanding the definition, composition, antecedents, and consequences of organizational agility gets us part of the way but does not indicate everything we might ever need to know about agility. Knowing the nomological network behind how these pieces fit together is what ultimately will unmask the *cause and effect* relationships surrounding organizational agility. Equally, looking at the research questions that have shaped the literature over time identifies critical insights into how our knowledge of agility has evolved and matured over time by virtue of how IS researchers build on one another's work. Early studies on agility are now *classics* in IS research and in the sub-field of organizational agility more generally: Sambamurthy et al. (2003) is especially notable in this respect. Sambamurthy et al. (2003) represents an important inflection point in the literature. Before 2003 – with some exceptions such as Zaheer and Zaheer (1997) – studies on IT and agility primarily focused on agile IS development where the unit of analysis was the IS project, the IS development team or the IS function (Abrahamsson et al., 2009; Agerfalk et al., 2009; Conboy, 2009). Drawing on three separate IT research streams around entrepreneurial alertness, IT capabilities, and agility, Sambamurthy et al. (2003) moved beyond a focus on agile IS development to focus on how IT can serve as a platform for increased customer, partnering, and operational agility. Their call for future IS researchers to, "critique, illustrate, expand, and investigate the model in order to unlock the mysteries of an increasingly important, but complex set of relationships between IT investment and firm performance [in] reframing the role of IT in firms in the contemporary digital economy" (p. 258) was dutifully noticed by researchers with citations to Sambamurthy et al. (2003) appearing in 27 of 32 non-IS development papers on the topic of IT and organizational agility published in the Basket of Eight after 2003.[4] The research questions motivating these and other studies underscore an important evolution in our understanding of the nomological network underlying organizational agility. Researchers have sought to resolve whether agility is, as Sambamurthy

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[4] Based on Google Scholar, as of Sept. 29, 2018, Sambamurthy et al. (2003) has received 2,557 citations, making it the 34th most cited MISQ paper of all time and the 12th most cited MISQ paper since its publication in June 2003.

et al. (2003) argue, a key mechanism through which IT impacts firm performance, to assess various enablers or inhibitors of agility, the conditions (or moderating circumstances) under which IT influences agility, and whether there are important mediators of this relationship. In Table 4, we highlight the research questions underlying studies in our review, classifying each study based on whether it views agility as an independent, mediating or dependent variable. We also classify each study into one of four stages of development as a way to note the evolution of the literature: descriptive, nomological, contextual, and refinement. Descriptive studies emphasize conceptual and definitional clarity of organizational agility with a specific focus on sense and response capabilities. Nomological studies explore the antecedents and consequences of organizational agility, possible mediators of the link between IT and organizational agility, and how organizational agility mediates the relationship between IT resources or capabilities and firm performance. The contextual stage sees research asking whether the relationships detected in the nomological stage are contextually bound by environmental conditions or whether other moderators might influence the nature of the links between IT, organizational agility, and firm performance. Studies at the refinement stage emphasize the changing nature of critical constructs emerging from the earlier stages. We now investigate these four stages in greater depth.

Insert Table 4 about here

Stages in Literature Development: An Evolution in Understanding IT-Enabled Agility

The research questions outlined in Table 4 demonstrate how academic inquiry has evolved from an acknowledgement that agility matters (Sambamurthy et al., 2003) to investigations of whether and how IT influences agility (Chakravarty et al., 2013; Overby et al., 2006). Over half of the empirical studies in Table 4 view agility as a dependent variable. For example, Van Oosterhout et al. (2006) study how organizational factors such as price wars (as evidenced by declining margins), rising IT costs, and declining rates of return create a need for agility. They introduce the concept of an *agility gap* that reflects the degree to which firms "find it difficult to cope with major changes which go beyond their normal level of flexibility" (p. 137). IT is presented as one way to close this gap. Other researchers go one step further by asking how IT does this. For example, Fink and Neumann (2007) ask how IT infrastructure capabilities influence agility while Tallon (2008) asks whether IT infrastructure flexibility is specifically tied to increased agility. Lu and Ramamurthy

(2011) ask a related question but then, like Tallon and Pinsonneault (2011), ask whether IT could ever hurt agility since legacy systems might be so embedded within an organization as to limit the potential to respond to change. Later, Lee et al. (2015) evolve the literature by bringing in the concept of ambidexterity, meaning that firms can equally use IT to explore opportunities in new markets or to exploit opportunities within their existing markets. Either way, ambidexterity means that firms are aware of the threats posed by rigid systems and can take steps to avoid being locked into a specific way of doing business (Nazir and Pinsonneault, 2012).

In terms of research on agile IS development, while the focus of this work is often on the production and deployment of IT rather than the use of IT, that literature is nevertheless instrumental in allowing us to gain insights into the link between IT and organizational agility. As proposed by Mooney and Ganley (2007) and later by Agerfalk et al. (2009) in a special issue editorial, agile IS development relates to organizational agility. However, in a world where organizations appear increasingly willing to buy rather than build critical applications, there is a need for transformative leadership in order to evolve the identity of the IS function, moving it from focusing on delivering operational efficiency (transactional speeds and feeds), to operational agility (agile IS development), and finally to how IT can enhance organizational agility (Wang et al., 2014). Yet, the fact remains that factors that often pervade IS development such as event pacing (waiting for events to trigger an IT response), centralized IS management, a lack of resources for IT exploration, and distributed IS development can impose limits on agile IS development that produce a knock on effect on organizational agility (Ramesh et al., 2012; Sarker and Sarker, 2009; Vidgen and Wang, 2009). Globalizing businesses, as noted by Morris and McManus (2002), may find limits on their ability to be agile due to information barriers imposed by weak and ineffective infrastructure in global markets. As such, there are limits on how agile IS development may be able to improve organizational agility if IT infrastructure is itself a limiting factor. As such, agility could be impeded if organizations are unable to retire legacy IT systems (Queiroz et al., 2018b). In another sense, as suggested by Sengupta and Masini (2008), organizations may be too agile for their own good. Their interpretation of agility as range (broader range of external outputs or internal capabilities) and time agility (the time needed to retool IT capabilities) show that there are limits to what can be achieved. It is possible, for example, for organizations to obtain diminishing returns from efforts to improve time agility.

After the descriptive and nomological stages, the literature on IT and organizational agility has also evolved to consider the role of moderator variables. Research questions indicate this important evolution in the literature. For example, Tallon (2008) asks how the relationship between IT and agility is moderated by environmental turbulence. Tallon and Pinsonneault (2011) pose a similar question in the context of the link between strategic IT alignment and agility. Tiwana et al. (2010) ask if decentralized IT governance – a topic that garners considerable interest from IS practitioners – moderates the relationship between IT architecture modularity (meaning the degree of flexibility of IT infrastructure) and the ability of IT to respond to internal demands and opportunities. Their results reveal that decentralized IT governance is a boon to organizational agility. Since IT governance points to organizational maturity, Bradley et al. (2012) asks whether enterprise architecture maturity can explain how IT resources help hospitals to be more responsive – the answer being that maturity is a significant predictor of agility and of IT alignment and IT operational effectiveness more broadly. Queiroz et al. (2018b) also find that strategic orientation moderates the link between IT application orchestration – the ability to maintain an IT portfolio by building, buying, and retiring IT applications – and business unit agility. This link is more significant for firms with differentiated business strategies than those pursuing operational excellence with the implication being that organizational agility may be more difficult to achieve when organizations emphasize product leadership or customer intimacy over low cost operations.

If we look to the most recent evolution in the literature and the questions that are being posed today, we see – not surprising perhaps – that the literature is posing questions involving data analytics. This focus is consistent with the ability of firms to use data to enhance their sensing capabilities and to confirm, through data analysis, that their response capabilities are performing exactly as expected. Much of the literature has emphasized response capabilities which, while necessary and important, are not the only predictor of agility. Thus, Ghasemaghaei et al. (2017) find that the use of data analytics is only useful to agility insofar as firms master the fit between their data analytics tools, data, people, and tasks. Anand et al. (2016) report that the business value from digital data streams and business analytic applications is positively connected to agility in resource allocation processes. Similarly, Park et al. (2017) explain that business intelligence technology, in isolation, is less predictive of sensing, decision-making, and acting agility than when such technology is

combined with environmental and organizational factors. Furthermore, as we look to the rise of IT services, we find Ravichandran (2018) asking how digital platform technologies relate to agility. Digital platforms are a means to build integrated systems from commoditized IT components that can quickly scale and adapt to meet a diverse range of business needs (Richardson et al., 2014; Tiwana et al., 2010). IT platforms reduce the cost of application sharing by allowing IT architects to create new ways for component modules to work together. Modular systems has enabled distributed innovation to occur in a digital ecosystem. Ecosystems can encompass individuals, corporations and communities that are individually autonomous but connected through an underlying technical system. Ecosystems provide an explanation for why digital initiatives fail even when a firm can deliver critical projects to scope, on time, and on budget. In any ecosystem, agility is shaped not just by what the focal firm does but by what its ecosystem peers are doing (Tsatsou et al., 2010).

Cloud technology has also received attention with an eye toward offering flexible IT infrastructure. For example, in an era where organizations are increasingly using a cloud-first approach to IT infrastructure, Gill et al. (2014) show how different divisions of the Australian government are using the cloud to transform their operations and, thus, improve their agility. As new IT innovation allows users to perform detailed data analysis, Hani et al. (2017) find that for a Norwegian digital marketplace, self-service business intelligence helps market capitalizing agility (faster insights into market participants) and operational adjustment agility (changes to organization structure, employee empowerment, equal access to data, and opportunities for data access). Hence, the refinement stage of the literature shows how IT innovation has altered the dynamics of organizational agility, not just in how IT can deliver better, faster, and cheaper ways to sense change but in how IT can enable the locus of agility to transition from the organizational level to a process or user level.

After some two decades of published research in academic and practitioner journals, the literature on IT-enabled agility has evolved beyond the conceptual arguments in Sambamurthy et al. (2003) to include a rich panoply of *cause and effect* models. Research also notes that the relationship between organizational agility and performance is contingent on factors that may be beyond the control of management. In the next section, we consider how future research can expand the extant literature on IT-enabled agility. In particular, we consider the potential for applying different theories than those outlined in Table 2 as a way to elucidate

new research questions that, while increasingly important, have yet to be fully investigated by either the IT, strategy or management literature. Answering these questions, we argue, could generate important insights.

WHAT'S NEXT? FUTURE RESEARCH OPPORTUNITIES

In his critical discussion of literature reviews, Rowe (2014) argues that in any substantive literature review, "the identification of new research directions is not an option… Future research directions… should be proposed and justified" (p. 243). While we can look at the body of work on organizational agility as seen in the preceding pages and try to isolate gaps that could be addressed in future research, it is just as important to approach the issue of future research by looking from outside the existing literature. Future research ideas can be presented as a way to obtain finer insights into what we already know by using a new level of analysis or by incrementally adding new variables to our current models, for example, but it can also help to look at how new theories can develop insights into previously-overlooked but yet important relationships. For that reason, we come at the question of future research from two angles. First, we look for gaps in our knowledge by considering questions that the current literature could answer with minimal incremental effort. Second, we look beyond the theoretical lenses that have dominated the organizational agility literature (the resource-based view and capabilities perspectives) for new theories – potentially from research traditions outside IS – in order to consider different perspectives and new research questions that might otherwise be overlooked.

Research Questions based on Gaps in the Existing Literature

As indicated in Table 2, organizational agility has been conceptualized in different ways and yet a consistent theme found in the literature is that organizational agility reflects sense and response capabilities. Both types of capabilities are necessary; firms are likely to struggle if either capability is limited or impeded in some way. An open question, however, pertains to the interface between sensing and responding. There is likely a time delay between sensing and responding and a tension underlying the use of scarce resources. The presence of sensing capabilities does not mean that the right response or indeed *any* response is sure to follow, no matter how evolved those capabilities might be. There is, in effect, a step between sensing and responding where decision making needs to translate sensing into responding. We found just one paper in our literature review by Park et al. (2017) that looked at *decision agility*. While they found a relationship

between IT and both sensing and responding agility, they did not find a link between IT and decision making agility for large firms in fast-paced or volatile settings. In contrast, there was mixed support for small firms using IT to achieve decision making and acting agility. They interpret this to mean that some firms are likely to "experience difficulties in making timely decisions for rapid and unpredictable business events" (p. 671). This might suggest that decision making agility is a potential bottleneck or, more troubling, a way that observations from the sensing phase are delayed, ignored or misinterpreted. While research notes the effects of data and data analytics on decision making agility (Ghasemaghaei et al., 2017), delays are still possible creating a risk that decision making agility could still fail to materialize. Response ability, as argued by Dove (2001), reflects "an organizational structure that enables change and an organizational culture that facilitates change" (p. 11). This does not necessarily mean that highly centralized firms cannot be agile but it does mean that decision making agility could either be an obstacle to change or an accelerant for change.

Findings from Liang et al. (2017) also suggest that we have not yet reached conclusive evidence of the supposed positive link between alignment and agility. Whereas, Tallon and Pinsonneault (2011) uncover a positive link between intellectual alignment and business process agility and Tallon (2008) finds a positive link between social alignment and agility, Liang et al. (2017) find an insignificant link between both forms of alignment and agility. Instead, they show that intellectual alignment foments inertia but that this inability to embrace change is at least partially ameliorated by social alignment between IT and business executives. So the question still remains: are efforts to forge tight alignment between IT and business strategy good or bad for firms in the short or long term? As noted earlier, Liang et al. (2017) assess alignment and agility in the Chinese shipbuilding sector, a sector that may be prone to inertia due to the scale and capital-intensive nature of shipbuilding and the sunk nature of capital costs. Research in the shipbuilding industry shows that firm size and performance below an aspiration level affect risk-taking behavior and can create inertia (Audia and Greve, 2006). This then raises an important question: how does the link between alignment and agility vary between industries that may be characterized by different levels of inertia and risk-taking behavior?

Furthermore, in considering the evolution of the organizational agility literature over the last twenty years from an initial descriptive stage to a more recent refinement stage, it may be time to take a fresh look

at what constitutes agility in volatile markets when low decision making agility is found to negatively affect business performance (Baum and Wally, 2003). While sense and response capabilities are a feature of agile organizations, the presence of these capabilities does not answer the question of how long it takes for a firm to sense new market threats and opportunities, how long it takes to translate sensing into competitive actions or how the pace of decision-making affects the transition between sensing and responding. The concept of mindfulness from research on agile IS development is useful in bridging sense and response capabilities as it calls for managers to be alert and aware of their surroundings yet it does not say what occurs outside the IS function when decisions are commonly made by non-IS executives that have a direct bearing on IT. Even if IT executives are *mindful* and their IS functions can develop and deploy effective IT solutions rapidly, it still does not mean that IT will improve organizational agility. Organizations could deploy IT solutions that address the wrong threat or that double down on a business strategy that is no longer relevant; Blockbuster's misguided response to the existential threat posed by Netflix is particularly illustrative in that regard. Hence, an effective response to a perceived threat requires more than mindfulness on the part of management. As we explore in the next section, other theories that focus on the formulation of actions might help in refining our knowledge of IT and organizational agility and thus bridge the gap between individual and group-based sense and response capabilities and the subsequent realization of clear and pressing business and IT goals.

New Theories, New Questions

Organizational agility does not exist in a vacuum. It is, as Ngai et al. (2011) suggest, as much driven by managerial factors as by IT resources and capabilities.[5] Part of the challenge in explaining organizational agility is realizing that sensing is impacted to a significant degree by cognitive factors regardless of the role played by IT. Sensing is a boundedly rational exercise that bears all the hallmarks of group think (Starbuck, 1985). Decision-makers rely on simplified mental models to organize their thoughts and make sense of their environment (Cyert and March, 1963; Gary and Wood, 2011). Psychology research shows that perceptions,

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[5] Interestingly, Bhatt et al. (2010) found that while information generation contributes to increased organizational responsiveness, information dissemination does not. While it is unclear if this result is tied to organization structure, suggests that researchers may want to ask how decision makers sense and communicate the need for market change. If sensing is biased, future research could investigate ways of allowing executives to better judge signal from noise.

information processing, problem solving, judgment, learning, and decision making are affected by cognitive representations and perceived models of reality (Anderson, 2015; Johnson-Laird, 1983; Rehder, 2003).

Sensemaking – an individual-level theory – and distributed sensemaking – a group-level equivalent – explain how individuals and groups notice, filter, weigh, and combine observable facts to form an opinion (Weick, 1995; Weick et al., 2005). There is no requirement that all facts must be noticed. Equally, there is no guarantee that two persons, when presented with the same facts, will notice the same things or reach the same conclusion. Sensing is, therefore, fallible and error prone and as claimed by Weick (1993), susceptible to peer pressure, bias, and habit. If organizations are unable to accurately sense what is glaringly obvious in hindsight, how then can they respond correctly? Organizations could clearly respond but if their sensing capabilities are flawed in some way, they could unfortunately end up responding to the wrong thing. One might also question if information overload could limit the degree of accuracy of firms' sensing capabilities.

The strategy-as-practice literature offers pragmatic insights into how businesses approach strategic planning (Arvidsson et al., 2014; Jarzabkowski and Spee, 2009; Peppard et al., 2014). This literature focuses on the emotions, prejudices, and biases of managers whose sensing, acting, and decision making shape the strategic planning process and the strategy that in time emerges from that process (Jarzabkowski and Spee, 2009). Sensemaking, as Jarzabkowski and Spee (2009) highlight in their literature review, is part and parcel of how strategy is crafted. The same factors that cause strategic planners to misinterpret, overlook or distort environmental cues can equally apply to those who are tasked with sensing the need for strategic change. Strategic blindness – a term coined by Arvidsson et al. (2014) reflecting an "organizational incapability to realize the strategic intent of implemented, available IT capabilities." (p. 45) – can be triggered by a lack of clear understanding of goals for IT, IT-induced misalignment, and cognitive entrenchment. Each of these could help to explain why organizations fail to adapt or offer erratic knee-jerk responses to the wrong cues.

At its core, agility is an ability to do something, contingent on opportunities or threats in the internal or external environment. The quote cited previously by Teece et al. (2016) that firms should be agile at all times regardless of cost ignores the reality that the digital options that confer agility are risky and expensive. This implies that careful consideration be given to what specific IT capabilities are agile or not. For CIOs

tasked with deciding whether and how much of a firm's limited resources to assign to new versus existing IT, the cost of remaining agile could be seen as the cost of staying in business or the price of failure through intransigence. Rather than argue that firms must be agile at all times, it may be better for firms to pick their battles by questioning where should they be agile and where they can afford to be intransigent. If agile firms need to balance stability with dynamism (Aghina et al., 2016) but are instead compelled to choose between commitment and flexibility (Ghemawat and del Sol, 1998), executives will have to invest wisely. Firms do not need to be agile in every sense of the word. The question then is where should they build their digital options and what resources to allocate for that task. The answer could depend on business strategy. A firm with a highly focused strategy around operational excellence, customer intimacy or product leadership may need to be agile in processes that are key to the success of their business strategy. If a firm opts for a multi-focused strategy instead, a more sophisticated understanding of what level of operational, general-purpose, and market-specific capability is needed to support agility may be desirable (Coltman and Devinney, 2013). Organizations may also face pressure from an IT architecture defined by rigid structures and tightly coupled processes where there is a reluctance to invest in IT with a long payback and a reluctance to halt failing IT projects (Keil, 1995; Smith et al., 2001). This implies that opportunities to develop digital options that give firms the ability to easily and quickly respond to change may be more the exception than the norm. Equally, in an era of platform, infrastructure, and software as a service, CIOs accept that they do not have to own IT to be able to tap incremental IT resources. Beyond recent work by Ravichandran (2018) that considers the effects of enterprise IT platforms on agility, there is an opportunity to explore the broader role of IT services and cloud-based systems and whether increased IT commoditization due to widespread use of services like Amazon Web Services, Azure, and Google Cloud could mean that firms in any industry are equally capable of reacting to the same changes in the same way, at the same pace, and at the same price.

We must also recognize the ongoing movement around digital business transformation and the role that IT platforms are expected to play in this endeavor (Sia et al., 2016). Regulatory and governance issues have emerged as part of this transformation and are taking a toll on organizations' ability to be agile; this is especially evident in the EU with the introduction of GDPR [General Data Protection Regulation: 2018].

The reality is that such rules create new bureaucratic hurdles and IT governance requirements which further burden already-tight IT budgets, leading to the very real possibility to placing further restrictions on agility.

Another way to deal with organizational agility challenges is to structurally separate operations that depend heavily on agility. IBM adopted this approach, for instance, when developing its personal computer, as did General Motors when designing its Saturn car. Spin-off business units are especially well known for their ability to act quickly but once they grow beyond a certain point, they struggle to maintain that initial momentum. At this point, the challenge is to absorb the spin-off into the firm to take the innovation to scale. Proving the reverse – that large businesses can be agile – is still possible but difficult as Lou Gerstner found after becoming CEO of what was then a large, struggling, mainframe-based, IBM in 1993 (Gerstner, 2002).

The changing nature of organization structure and the complexity that follows the pursuit of myriad business partnerships raises important questions. Organizations are often divided for operating or reporting purposes into territorial, customer or product/service strategic business units; most operate independently of the corporate unit or in a loose configuration where corporate-sponsored IT platforms are used to push shared services to all business units even while allowing some business units to make unique IT investments (Reynolds et al., 2010; Ross et al., 2006). This creates tension between centrally managed IT that generates economies of scale and decentralized IT that is locally scalable but limited in scope (Queiroz et al., 2018a). Even if it benefits business unit agility, CIOs may not want to grant broad autonomy to each business unit to decide their own IT except within narrow parameters. If they force each business unit to use the same IT platform, there is a risk that what works for some business units may not work for all and so agility for the firm as a whole may suffer. Our review indicated that the organizational agility literature is mainly focused on the organization as the unit of analysis with few exceptions around process agility. If most organizations are designed as multi-business organizations with an array of different business units, it may be appropriate to follow the recent lead of Queiroz et al. (2018b) and consider factors relating to process agility in business units and their implications for individual business unit agility and for corporate performance more broadly.

Organizational Agility, Tension, and Learning Opportunities

What distinguishes agile organizations from their lethargic or slow-moving rivals is their ability to manage tension between the corporate unit and their many business units or between a need to fund current IT needs versus shifting resources toward the creation of pricey digital options. When faced with competing tensions, the natural tendency is to seek order and engineer a trade-off by weighing up the pros and cons. Recall that March and Simon (1958) regard organizations as systems of embedded routines through which information is processed, coded, and evaluated. This computational approach works in an IT context when the issue is isolated and immediate such as a decision to outsource IT or to buy standardized, off-the-shelf applications or build customized capacity internally to meet ongoing business demands. When faced with more intricate and persistent tensions, a typical approach that calls on CIOs to choose one and only one option could prove counterproductive. There is always a possibility that CIOs will select the wrong thing – deciding against creating digital options only to discover later on that the firm lacks flexibility when a need arises. Moreover, favoring one side over another can spur defensive reactions that impede agility. Managers may, for example, remember past IT failures in the form of expired digital options that failed to generate a sufficient return and use this perceived failure to decline an opportunity to invest in future digital options.

Sensemaking – previously shown as a way for individuals to make sense of cues in the environment – can also help to assess the competing tensions that can undermine agility (Maitlis and Christianson, 2014). Sensemaking involves analyzing a situation to identify and, if possible, to resolve competing forces, while simultaneously trying to deal with uncertainty (Weick, 1995). Sensemaking comes before decision-making since it is about the interplay of action and interpretation, not choice (Weick et al., 2005). This shifts the focus from decision making attributes, mindfulness, choices, and bounded rationality toward situational factors that affect search and response capabilities. From an agility perspective, this then directs us to ask: what data could organizations use to ensure consensus among managers allowing them to sense and respond more effectively to change? Organizations that react to myriad opportunities and threats do so with no firm guarantee of success. Practitioners often talk about a desire to *fail early* if failure should occur. This means that inasmuch as firms want to respond easily and quickly to whatever they sense in their environment, they must be also ready and able to quickly stop or reverse course should the need arise. The sense that the link

between IT and organizational agility is also about easily and quickly escaping from a bad business decision is something that the agility literature has not yet considered and yet, anecdotally, there are multiple cases where, with hindsight, we wonder what would have happened if organizations had only acted sooner.

MOVING FORWARD: AN AGENDA FOR ACTION

Having uncovered gaps in our knowledge of the link between IT and organizational agility, several questions arise that can help to frame future research. These questions point to a potential expansion of the organizational agility construct in the area of decision making agility, a need to examine the still unresolved link between IT alignment and agility, the role of mental models and how cognitive limitations affect sense and response capabilities, business unit-level agility, the management of tensions that determine if agility is successful or not, and the role of learning. These potential research questions are articulated as follows:

1. What is the role of decision making agility and what can firms do to better connect their search and response capabilities in order that sensing is accurate, timely, and unbiased?

2. To what extent are sensing capabilities distorted by cognitive limitations and therefore likely to hurt agility? Can sensemaking theory help to uncover and potentially remove these limitations?

3. What can organizations do to achieve managerial consensus in what is sensed and how to respond?

4. Is it better to be agile in processes that are vital to the success of the business strategy or to be agile in all processes at the same time?

5. How can organizations reconcile the desire for greater alignment between IT and business strategy with the possibility that alignment – at least in an intellectual sense – could undermine agility? Is the firm or the process the preferred primary level of analysis (Tallon et al., 2016)?

6. How can multi-business organizations achieve agility in business units that have different IT needs?

7. What are the tensions underlying agility and how can these tensions be resolved? How can agile firms, as reported by Aghina et al. (2016), be both stable and dynamic? How can organizations balance the need for investment in current and future IT when their short-term agility needs may be different from their longer-term needs?

8. How can mindfulness be used to ensure that organizations learn from past agility shortcomings and can such learning help to boost the future relationship between IT and organizational agility?

In outlining the evolution of the IT-enabled agility literature, we noted that the literature has moved from a descriptive stage to a nomological stage to a contextual stage and, more recently, a refinement stage. One aspect of refinement that can lead to new discoveries is, as Kuhn (1962) declared, the emergence of a

paradigm shift. New research questions afford an opportunity for such paradigm shifts. One area that deserves attention is the belief, common among IS practitioners and academics, that organizational agility is always a good thing and that firms should try to be agile at all times. The reality, of course, is that one could be agile when pursuing the wrong thing in which case it helps to fail early but the broader question here is whether there is a paradox in the literature: how can organizational agility be both good and bad at the same time and how can the discovery of a paradox trigger theory refinement (Poole and Van de Ven, 1989). What organization would not want to be agile may appear rhetorical but if IT alignment has, as Liang et al. (2017) show, the ability to create organizational inertia (which limits agility), then we have a seeming contradiction when other researchers find that alignment is an important predictor of firm performance and that CIOs rate alignment as one of their primary IT concerns (Tallon and Pinsonneault, 2011). Thus, can organizations be both aligned and agile at the same time? Must they choose one or the other and does it matter which one? Organizational agility is not free but if the price can be cut by making the cost of digital options less onerous (using cloud computing, for example), it may be easier for firms to maintain continuous alignment between IT and business strategy. This could mean that firms are in perpetual alignment and, as market conditions shift, can easily and quickly change the form of their strategic alignment so that firm performance remains unaffected. In this way, agility is perhaps the incremental benefit that flows from being perpetually aligned.

Research has proposed that organizations should use IT resources to both explore new opportunities and exploit existing opportunities but the idea that agile firms can be both stable and dynamic causes us to accept that organizational agility might be good *and* bad (Aghina et al., 2016). We also recognize that firms are unlikely to respond to change by buying new IT resources – the ability to buy and customize IT is today preferred to building unless there is a compelling argument to the contrary. Hence, organizational agility is likely to hinge on the ability of firms to reconfigure existing resources to work at scale. The ability of firms to test new ideas and to then scale up rapidly to operational levels and to quickly discontinue those products at the end of their lifecycle, as Capital One continues to do with many of its credit card products, highlights the opportunities available when organizations are able to adapt IT to new uses in a culture that is not averse to change but, instead, openly welcomes it (Anand et al., 2001).

CONCLUSION

So why might this be the right time for a systematic review of the literature on IT and organizational agility? The simple answer may be that there is now a sufficient body of work stretching back almost twenty years to justify a systematic review but, beyond the volume of published work, this is more about the reality facing businesses who are increasingly expected to *spin on a dime* and who are looking to IT to do just that.

In terms of the importance, relevance, and timing of the research questions we described earlier, IS researchers might be tempted to view each question as equally important. The reality, however, is that some questions might be riskier than others, easier than others or better able to advance the study of IT and agility than others. As researchers in pursuit of that all-important contribution to the literature, we routinely grapple with the question of whether to advance current theory or to create and test new theory. There are merits to both and yet, facing resource and time pressures, researchers must choose which to study. For organizations, the cost of intransigence or the cost of a false move is perhaps higher now than at any time in the past. The end goal for organizations is to execute the right move at the right time with the right resources and for the right price. As such, some of our research questions, notably those involving consensus building and group-based decision-making could help to uncover reasons for why organizations are slow to react despite having amble evidence of an impending environmental change. Equally, knowing that IT alignment and agility are linked and of critical importance to organizations, researchers could study the moderating conditions under which alignment might impact agility and those other conditions where no such relationship exists.

We began this review by addressing the *so what* question to emphasize this very issue about timing. What we know about IT and firm performance – as exemplified in studies on IT business value – is that IT has contributed to profit, revenue growth, market capitalization, return on equity, return on assets, and other such performance metrics. However, answers to the question of what can IT do in the future is not the same as what IT has done in the past. An organization could readily point to IT as a contributor to its past success and yet, at the same time, admit that they would struggle to adjust easily and quickly to a new market reality. Organizational agility, by definition, is forward looking; it is an ability to take some action based on external stimuli. It may correlate with past success but it need not be *caused* by past success. The same IT that drove

success in the past could be problematic in the future if it is inflexible, difficult or costly to scale or incapable of supporting a revised business strategy. As such, it is important to know what factors can better allow IT to prepare organizations for change and so, to answer this, we turn to a systematic review of the literature. Our review uncovered relatively few publications on the topic of IT-enabled agility in top tier IS journals. Indeed, as claimed by van Oosterhout et al. (2006) in a special issue of EJIS on the subject of IT and agility, "research that assesses the current level of agility is scarce. The few studies that aim for this are [as of mid-2006] generally limited in their sector focus (usually manufacturing) and research method (mostly only a questionnaire or single case study)" (p. 133). As they argued, there is a need for research in this area for the simple fact that organizational agility matters and firms are looking to IT for help. While we have added to the body of literature on IT-enabled agility since 2006, key questions remain. Systematic literature reviews help to draw attention to, and shape, those research questions (Paré et al., 2015; Webster and Watson, 2002). Given the attention being directed at agility as a key organizational concern as noted in annual SIM surveys of top IT and business executives, we see further study of agility as clearly warranted.

The reality of academic publishing is that even with a growing number of studies in conferences, the AIS Basket of Eight or other IS journals, and the IT practitioner press, there are still important questions that the literature has yet to consider. As outlined during our review, the use of special issues in the academic and practitioner domain has played a key role in shaping the literature to this point. Several publications in our review appeared in special issues: EJIS (2006), ISR (2009), and CMR (2014). We further observed that papers in the 2006 EJIS special issue helped to introduce and accelerate the nomological development stage of the literature. The ISR special issue linked work on agile IS development with other agility themes, while the CMR special issue examined critical managerial issues involving organizational agility in global firms.

Certainly, applied and basic research are key to moving our understanding of IT and organizational agility forward. Given the types of research questions and research opportunities that we explore above, the time may be ripe to address such questions through special issues in IS journals or mini-tracks at our premier IS conferences. We encourage our fellow academics to consider this an *invitation* to work together to move

this topic forward. It is very likely that organizational agility is going to become more – not less – important

to *all* organizations in future and so we need to tackle this subject with renewed vigor and urgency.

Table 1. Summary of Search Results on IT and Organizational Agility

Description	Count
Basket of Eight IS Journals (N=43)	
European Journal of Information Systems (EJIS)	10
Information Systems Research (ISR)	9
Journal of Strategic Information Systems (JSIS)	7
Journal of the AIS (JAIS)	5
Management Information Systems Quarterly (MISQ)	4
Journal of Management Information Systems (JMIS)	3
Information Systems Journal (ISJ)	3
Journal of Information Technology (JIT)	2
Other Non-Basket IS Journals (N=40)	
Communications of the AIS (CAIS)	5
Information & Management (I&M)	4
International Journal of Information Management (IJIM)	2
Journal of Global Information Management (JGIM)	2
Others (1 publication per journal)	27
Premier IS Conferences (N=59)	
International Conference on Information Systems (ICIS)	17
Pacific Conference on Information Systems (PACIS)	16
Americans Conference on Information Systems (AMCIS)	13
European Conference on Information Systems (ECIS)	7
Hawaii International Conference on System Sciences (HICSS)	6
Practitioner Outlets (N=27)	
California Management Review (CMR)	9
MIS Quarterly Executive (MISQE)	9
Communications of the ACM (CACM)	7
Sloan Management Review (SMR)	2

Note: a complete listing of all 169 publications appears in the appendix.

Table 2. Analysis of Publications on IT and Organizational Agility in the Basket of Eight IS Journals

Study	Characterization of Agility	Theoretical Lens	Key Arguments and Findings
Conceptual Studies			
Sambamurthy et al. (2003)	The ability to detect and seize market opportunities with speed and surprise.	Resource and capability building; Dynamic capability	IT resources provide digital process and knowledge options which, in turn, enable agility. Entrepreneurial alertness moderates the relationships between these enablers and agility.
Vervest et al. (2004)	The ability to respond quickly to fulfil an unpredictable client order.	Networking theory	Smart business network structures enhance agility.
Overby et al. (2006)	The ability to sense environmental change and to respond readily.	Dynamic capability	IT capabilities improve a firm's process and knowledge reach and richness, thus creating a platform of digital options that can enable the firm to sense and respond to rapidly changing market conditions.
Nazir and Pinsonneault (2012)	The ability to sense and respond to opportunities and threats with ease, speed, and dexterity.	Electronic integration perspective	IT applications electronic integration leads to sensing and responding capabilities through knowledge exploration, exploitation, and process coupling.
Empirical Studies using Case Study Data			
Holmqvist, and Pessi (2006)	An organization's ability to sense and respond rapidly to unpredictable events in order to satisfy changing customer demands.	Capabilities perspective	Agility is achieved by working continuously with scenario development and keeping implementation projects to a comprehendible size in order to nurture learning and innovation.
Hovorka and Larsen (2006)	The ability to detect opportunities for innovation and seize opportunities by assembling requisite assets, knowledge, and relationships.	Knowledge acquisition and absorption	A network organization's characteristics (e.g., decentralized planning and control) and communication processes that reinforce social influence and support knowledge transfer positively influence IS adoption agility.
Sarker and Sarker (2009)[6]	The ability of distributed IS development teams to anticipate, recognize, and react to changes in the environment, including organizational changes, and changes in partner organizations.	Contingency theory	The systemic ability to scan and interpret the distributed IS development environment depends on the implementation of organizational tactics, such as the monitoring of all aspects of the project environment (possibly by arranging weekly meetings with representatives of all locations, vendors, partner organizations, and clients), and instituting formal sense-making processes.

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[6] While Sarker and Sarker (2009) examine the agility of distributed IS development (ISD) teams, one of the dimensions of ISD team agility, namely *environmental awareness-based agility*, captures elements of partnering agility, which is a key aspect of organizational agility (Sambamurthy et al. 2003).

Ngai et al. (2011)	The organization's ability to respond to unexpected market changes and convert these changes to business opportunities.	Resource-based view	Supply chain competencies, i.e. IT competence, operational competence, and management competence, support supply chain agility for competition in turbulent business markets.
Huang et al. (2014)	The ability of firms' business processes to accomplish speed, accuracy and cost economy in the exploitation of opportunities for innovation and competitive action.	Information processing view	The construction of IT-enabled information processing network and the implementation of organizational control enhance information processing capability which, in turn, enable operational agility.
Richardson et al. (2014)	The capability to recognize opportunities for leveraging IT in order to rapidly sense and respond to market opportunities by shaping digital options into competitive actions that result in improved business outcomes.	Capabilities perspective	A social enterprise's IT platform and related digital options impact customer, partnering, and operational agility, which lead to improvements in firm performance.
Empirical Studies using Field Survey Data			
Breu et al. (2002)	A workforce's capabilities of intelligence, speed of skills development, collaboration, culture, and IS in responding to changing business environments.	Capabilities perspective; Knowledge creation	IS-related determinants of workforce agility include the use of flexible infrastructure platforms and the enhancement of IT competencies across the entire workforce. Information and communication technology applications increase workforce agility most when used for collaboration.
van Oosterhout et al. (2006)	Ability to swiftly change businesses and business processes beyond the normal level of flexibility to effectively manage unpredictable external and internal changes.	IT architecture; Capabilities perspective	IT can be both an enabler and disabler of agility. While inflexible legacy IT systems hurt agility in the face of unpredictable changes, agile processes and integrated IS architecture enable agility.
Fink and Neumann (2007)	The ability to respond efficiently and effectively to emerging market opportunities.	Behavioral and technical capability development	Technical and behavioral capabilities of IT personnel impact infrastructure capabilities. In turn, infrastructure capabilities affect strategic agility directly and indirectly via IT-dependent system and information agility.
Tiwana and Konsynski (2010)	The ability of the IT function to rapidly adapt to new line function demands and opportunities.	Modular systems theory; Theory of IT alignment	IT agility mediates the link between IT architecture modularity and IT alignment. Decentralized IT governance positively moderates the link between IT architecture modularity and IT agility.

Lu and Ramamurthy (2011)	The ability to cope with rapid, relentless, and uncertain changes and thrive in an environment of continually and unpredictably changing opportunities.	Capability development and complementarities	IT capability has a positive effect on market capitalizing agility and operational adjustment agility. The study also finds a positive joint effect of IT capability and IT spending on operational adjustment agility, but not on market capitalizing agility.
Tallon and Pinsonneault (2011)	The ability to detect and respond to opportunities and threats with ease, speed, and dexterity.	Resource-based view; Theory of IT alignment	Strategic IT alignment has a positive effect on agility. In addition, agility mediates the effect of alignment on firm performance.
Bradley et al. (2012)	The ability to sense environmental change and respond readily.	IT governance; Theory of IT alignment	IT alignment and operational IT effectiveness enhance agility. Also, enterprise architecture maturity has an indirect effect on agility through IT alignment.
Roberts and Grover (2012)	The degree to which a firm is able to sense and respond quickly to customer-based opportunities for innovation and competitive action.	Dynamic capability; Knowledge creation	IT infrastructure capabilities facilitate agility. The transparency, consistency, and communication capabilities provided by IT enable business functions to share information that, when combined with complementary coordination mechanisms, allows the firm to quickly respond to customer-based opportunities.
Chakravarthy et al. (2013)	The ability to sense opportunities for competitive action and marshal the necessary resources to seize those opportunities.	Contingency theory	IT competencies enhance agility. In addition, they moderate the relationship between agility and firm performance. Environmental dynamism moderates the effect of IT competencies on agility and the effect of agility on performance.
Chen et al. (2014)	The ease and speed with which firms can alter their business processes to respond to threats in their markets.	Resource-based view	IT capability enhances agility, which in turn improves firm performance. The effect of IT capability on agility depends on the levels of environmental hostility and environmental complexity.
Lee et al. (2015)	The ability of firms to continually sense and respond to market changes.	Capability-building and ambidexterity	Operational ambidexterity has a positive effect on agility. It also mediates the effect of IT ambidexterity on agility. This mediation effect depends on the level of environmental dynamism.
Tiwana and Kim (2015)	The degree to which the IT unit furthers a firm's pursuit of strategic business opportunities.	Colocation of decision rights (based on Jensen and Meckling)	IT governance enhances IT strategic agility only when it is discriminatingly aligned with departments' peripheral knowledge.
Lowry and Wilson (2016)	The ability to respond operationally and strategically to changes in the external through IT.	Contingency theory	IT agility is positively influenced by both IT service quality and internal IT service perceptions.
Park et al. (2017)	A combination of sensing agility, decision making agility, and acting agility.	Dynamic capabilities and information processing theory	IT's effect on agility is embedded in a configuration of organizational and environmental elements.

Liang et al. (2017)	The firm-wide capability to sense and respond effectively to market opportunities and threats.	Capabilities perspective, Theory of IT alignment	Agility is negatively related to inertia but positively related to emergent coordination. Intellectual alignment drives inertia (rigidity) but the scale of this undesirable impact is reduced in part by social alignment.
Queiroz et al. (2018b)	The ability to detect and respond to opportunities and threats with ease, speed, and dexterity.	Dynamic capabilities	The effect of IT application orchestration on performance is mediated by process agility. A firm's strategic orientation moderates the effect of IT application orchestration on process agility.
Ravichandran (2018)	Agility is a competence that allows firms to adapt to contingencies posed by the environment.	Capabilities perspective	Innovation capacity is positively associated with organizational agility while firms with higher innovation capacity are better able to leverage their digital platforms to enhance agility. Organizational agility is also positively associated with increases in firm performance.
Zhou et al. (2018)	The capability to detect and respond to demands embedded in customer online reviews.	Innovation management; Knowledge creation	Online customer review volume has a curvilinear relationship (U-shaped) with customer agility. Number of sibling products and variance of the product ratings moderate this relationship. Customer agility, in turn, has a curvilinear relationship (inverted U-shaped) with product performance.

Note: the above list excludes research by Piccoli and Ives (2005), Mathiassen and Pries-Heje (2006), Abrahamsson et al. (2009), Agerfalk et al. (2009), Sorensen and Laudau (2015), and Jia et al. (2016) as these studies are primarily either literature reviews or, in the case of Mathiassen and Pries-Heje (2006), Abrahamsson et al. (2009), and Agerfalk et al. (2009), an editorial or introduction to a special issue or, in the case of Jia et al. (2016), a brief commentary on Lowry and Wilson (2016) regarding previous studies by Jia and colleagues on the effects of IT service climate. It also excludes research by Conboy (2009), Vidgen and Wang (2009), Hong et al. (2011), Ramesh et al. (2012), Wang et al. (2012), Cao et al. (2013), Goh et al. (2013), McAvoy et al. (2013), and Cram and Newell (2016) who study agile IS development methods and related topics such as user acceptance of agile IS; and Leidner et al. (2011) who mention agility when discussing the importance of dynamic capabilities and IS strategy decisions, but do not study organizational agility or its antecedents/consequences.

Table 3. Antecedents of Organizational Agility

Study	Antecedents of Agility	Characterization of Antecedents
Breu et al. (2002)	Adoption of mobile devices for internet access; Online collaboration tools and community sites; Videoconferencing; Extranets	Information and communication technologies (e.g., mobile devices, collaboration tools, and videoconferencing apps) make quality information widely accessible, thus adding value to businesses.
Sambamurthy et al. (2003)	Digital options; Entrepreneurial alertness	Digital options concern process reach/richness and knowledge reach/richness, while entrepreneurial alertness encompasses strategic foresight and systemic insight.
Vervest et al. (2004)	Network structure; Business relationships	Network structure depends on the properties of the network, including the hardware and software infrastructure used, asset and event management, and the dynamic control and governance of the business network. Business relationships concern the engagement and the smartness of the businesses in the network.
Holmqvist and Pessi (2006)	Continuous project implementation; Innovation	Continuous project implementation includes scenario development and follow-on implementation projects, i.e., directly succeeding projects that can almost be regarded as a single flow of activities within the organization. Innovation is examined in the context of concepts such as new market channels and stakeholders' management.
Hovorka and Larsen (2006)	Absorptive capacity; Social information processing	Absorptive capacity concerns an organizations' ability to acquire, assimilate, and exploit knowledge, while social information processing is a key aspect of the system adoption process during which supporting or discouraging knowledge is differentially attended to for decisions regarding the adoption of a system.
Overby et al. (2006)	IT capability; Digital options	IT capability captures the ability to use of IT to sense environmental change and to respond readily. Digital options concern process reach/richness and knowledge reach/richness.
van Oosterhout et al. (2006)	Agile IT architecture; Legacy IT systems (disabler)	Agile IT architectures may be analyzed at four different levels of the business network: hardware and systems infrastructure, IT application software, management of an individual business and dynamic control and governance of the business network. Legacy IT systems are associated with the use of complex and often outdated architecture.
Fink and Neumann (2007)	Infrastructure capabilities; IT-dependent information agility; IT-dependent system agility	Infrastructure capabilities reflect the ability of the IT unit to provide extensive IT infrastructure services that support business processes. IT-dependent information agility is the ability to easily accommodate change in the way organizational users access and use information resources, while IT-dependent system agility refers to the ability to accommodate change in IS without incurring significant penalty in time or cost.

Sarker and Sarker (2009)	Sophistication of processes for scanning the client and partner organizations; Rapid transmission of scanned and processed information; Decision making speed	The sophistication of processes for scanning the client and partner organizations, rapid transmission of scanned and processed information, and decision-making speed are critical for the successful use of globally distributed IS development teams.
Tiwana and Konsynski (2010)	IT architecture modularity	The degree to which an organization's IT portfolio is decomposed into relatively autonomous subsystems.
Ngai et al. (2011)	IT competence; Operational competence; Management competence	IT competence is the extent to which a firm is knowledgeable about and effectively utilizes IT to manage information. Operational competence concerns the ability of an organization to use its resources to facilitate supply chain capability, while managerial competence refers to the ability to use human resources to facilitate supply chain capability, particularly supply chain agility.
Lu and Ramamurthy (2011)	IT capability	The degree of IT infrastructure capability (the technological foundation), IT business spanning capability (business–IT strategic thinking and partnership), and IT proactive stance (opportunity orientation).
Tallon and Pinsonneault (2011)	Strategic IT alignment	The extent of fit between information technology and business strategy.
Bradley et al. (2012)	IT alignment; Operational IT effectiveness	IT alignment is examined in the context of hospitals' use of IT. It concerns the extent of fit between a hospital's business and IT plans, priorities and strategies, while operational IT effectiveness focuses on the improvement of business operations.
Nazir and Pinsonneault (2012)	Knowledge exploration; Knowledge exploitation; Process coupling	Exploration refers to acquiring new knowledge from the environment, while exploitation is characterized by the use and sharing of knowledge existing within the firm. Process coupling concerns the integration of business processes across internal units.
Roberts and Grover (2012)	Web-based customer infrastructure; Inter-functional coordination; Chanel coordination	A web-based customer infrastructure concerns the set of IT infrastructure components that facilitate customer-based knowledge creation. Inter-functional coordination refers to the degree to which a firm's functions develop a mutual understanding of each other's capabilities and align their goals and activities based on such understanding. Channel coordination refers to the extent to which the activities of a focal firm are coordinated with its business partners such that the processes spanning firm boundaries are operationally integrated.
Chakravarthy et al. (2013)	IT competencies	These competencies include both aspects of firms' IT infrastructure and the capabilities for selecting, acquiring, configuring, and implementing IT.
Chen et al. (2014)	IT capability	The ability to mobilize and deploy IT-based resources in combination with, and leveraging the value of, other resources and capabilities.

Huang et al. (2014)	Information processing capability	The ability to gather, synthesize and disseminate information properly to cope with uncertainty.
Richardson et al. (2014)	Entrepreneurial alertness; Digital options; IT platform flexibility (open source architecture, user-generated content information mechanisms)	Entrepreneurial alertness refers to a firm's ability to recognize and respond to market opportunities and identify appropriate actions that result in improved competitive actions. Digital options concern process reach/richness and knowledge reach/richness. IT platform flexibility enables a business infrastructure that shapes the capacity of firms to launch frequent and varied competitive actions.
Lee et al. (2015)	Operational ambidexterity	The ability to simultaneously pursue operational exploration and exploitation.
Tiwana and Kim (2015)	Discriminating alignment	The interaction between IT governance and departmental peripheral knowledge.
Lowry and Wilson (2016)	IT service quality; Internal IT service perceptions	IT service quality refers to the perceived performance of the level of IT customer service provided to an organization, while internal IT service perceptions concern an employee's perceptions of the behaviors that are rewarded with respect to IT customer service.
Park et al. (2017)	Information technology; Organizational factor; Environment velocity	Information technology is examined in the context of business intelligence and communication technologies. Organizational factor includes top management team energy and organizational size, while environment velocity accounts for speed of change and unpredictability.
Liang et al. (2017)	Intellectual alignment; Social alignment; Inertia; Emergent coordination	Intellectual alignment refers to the state in which a set of interrelated IT and business strategies exists, while social alignment is the state in which business and IT executives within an organizational unit mutually understand and are jointly committed to each other's mission, objectives, and plans. Inertia is a firm's tendency to maintain stability of its organizational arrangements such as strategy and structure in spite of environmental change, while emergent coordination is the contextualized process of input regulation and interaction articulation to realize a collective performance based on informal communication and mechanisms.
Queiroz et al. (2018b)	IT application orchestration	The ability of firms to renew the IT applications portfolio through developing IT applications, purchasing IT applications, and discontinuing less-relevant ones.
Ravichandran (2018)	Digital platform capabilities; Innovation capacity	Digital platform capabilities relate to the flexibility of the IT infrastructure of the firm and the scope of the application platforms that have been adopted. Innovation capacity captures firm innovativeness and the nature of coupling between new initiatives and core activities of the firm.
Zhou et al. (2018)	Online customer review volume	The number of customer reviews that a (sequential) product receives. The volume of customer reviews matters because it influences not only the business value but also the difficulties in utilizing online review data.

Table 4. Research Questions posed by the Literature

Study (listed chronologically)	Stage	Research Question(s)
Agility as Means to an End		
Sambamurthy et al. (2003)	D	What are the mechanisms through which IT impacts firm performance?
Vervest et al. (2004)	D	What can organizations do to build a better business network?
Bhatt et al. (2010)	N	How do IT infrastructure flexibility and market orientation (information generation, information dissemination, and organizational responsiveness) affect competitive advantage?
Tiwana and Konsynski (2010)	C	How do organizational IT architecture modularity and IT governance structure – independently and jointly – influence IT alignment?
Ngai et al. (2011)	N	What aspects of supply chain competence enable supply chain agility? How do information technology, operational, and management competencies enable supply chain agility? How does supply chain agility enhance firm performance?
Tallon and Pinsonneault (2011)	C	Does strategic IT alignment help or hurt firm agility? How does firm agility influence the relationship between strategic IT alignment and performance?
Chen et al. (2014)	C	Does business process agility play a mediating role in the relationship between IT capability and performance? What are the effects of environmental factors (hostility, dynamism, and complexity) on the relationship between IT capability and business process agility?
Roberts and Grover (2012)	N	How does IT facilitate the sensing and responding components of customer agility? How does customer agility impact competitive activity?
Richardson et al. (2014)	R	How do social enterprises utilize IT to enhance agility and improve firm performance?
Queiroz et al. (2018b)	C	How does IT application orchestration capability affect agility and firm performance?
Zhou et al. (2018)	C	How does review volume influence a product developer's customer agility? Do factors such as number of sibling products and product rating variance affect the relationship between review volume and customer agility? How does customer agility influence product performance?
Agility as End Goal		
Breu et al. (2002)	N	How do environmental pressures for increased agility impact on managers and non-production workers?
Overby et al. (2006)	N	How does IT investment enable agility?
Holmqvist and Pessi (2006)	N	How can organizations achieve agility in practice, specifically, in the context of global aftermarket logistics?
Hovorka and Larsen (2006)	N	How does a network organization structure affect an organization's ability to develop agile IT adoption practices?
Van Oosterhout et al. (2006)	N	What are the key internal and external change factors that point to a need for greater organizational agility?
Fink and Neumann (2007)	N	How do IT infrastructure capabilities affect IT dependent organizational agility?
Tallon (2008)	C	What is the relationship between managerial and technical IT capabilities and business process agility? Does environmental volatility moderate the link between each of these IT capabilities and business process agility?
Lu and Ramamurthy (2011)	C	Does IT capability enhance or impede agility? How does IT capability complement other organizational resources to enhance agility?

Bradley et al. (2012)	C	To what degree does a hospital's stage of enterprise architecture maturity influence the organizational impact of its IT resources? What is the nature of the relationship between a hospital's stage of enterprise architecture maturity and the organizational impact of its IT resources?
	N	How does electronic integration – i.e., internal and external IT applications integration – affect firm agility?
Chakravarty et al. (2013)	N	How do IT competencies enable and facilitate organizational agility?
Huang et al. (2014)	N	How can organizations develop an information processing capability in order to improve operational agility?
Lee et al. (2015)	N	How does IT ambidexterity enhance organizational agility? How does the firm's business environment affect the capability-building processes between IT ambidexterity and organizational agility?
Tiwana and Kim (2015)	R	How does the interplay between firms' IT governance choices and departmental peripheral knowledge influence IT strategic agility?
Lowry and Wilson (2016)	N	How does an organization's internal IT service perceptions influence its IT agility?
Ghasemaghaei et al. (2017)	R	How does use of data analytics influence firm agility?
Liang et al. (2017)	R	How does IT-business alignment (intellectual and social alignment) shape organizational agility?
Park et al. (2017)	R	How do business intelligence and communication technologies affect organizational agility in different organizational and environmental contexts?
Ravichandran (2018)	R	How does IT competence and the innovation capacity of a firm enable agility?

Note: we use the following abbreviations to indicate the stage that each paper occupies in the evolution of the literature: Descriptive (D), Nomological (N), Contextual (C), and Refinement (R).

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