Managing firms’ innovation capabilities through strategically aligning combinative IT and dynamic capabilities

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Abstract

This study explores how firms’ incremental and radical innovation capabilities can be explained from technological and dynamic capabilities and specifically their combinative alignment. We propose a strategic alignment model—grounded on dynamic capabilities and modular systems theory—and examine to what extent strategic alignment affects a firm’s innovation capabilities and how this potentially can be enhanced in practice. We then empirically validate our main proposition using regression analyses on a sample of 322 international firms. Results suggest that there is a positive relationship between a firm’s degree of alignment and innovation capabilities. Strategic alignment can therefore be seen as important condition that drives sustainable advantage in constantly changing environments. The proposed model helps firms assess and improve their level of IT flexibility, dynamic capabilities, absorptive capacity and their interdependent synchronization. Results are discussed and theoretical and practical implications are highlighted. We conclude with suggestions for future research.

Keywords

Innovation capabilities, strategic alignment, dynamic capabilities, IT flexibility, absorptive capacity.

Introduction

In response to an ever increasing competitive environment, contemporary firms are under pressure to become more agile in their operations, accelerate their innovation processes and capabilities and deliver products with more efficiency and effectiveness than ever before (Mikalef and Pateli 2017). It is within this complex process that firms apply innovative strategies and information technology and information systems (IS/IT) and develop strong IT capabilities in order to deal with a multitude of interrelated and multi-faceted challenges (Eisenhardt and Martin 2000; Lu and Ramamurthy 2011; Mao et al. 2015; Sambamurthy et al. 2003). Within the management IS domain, IT capabilities are broadly defined as “a firm’s ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities in order to differentiate from competition” (Bharadwaj 2000). Adding to the mentioned challenges, firms need to simultaneously leverage intangible internal (IS/IT) resources to build strong competences under high environmental uncertainty as a crucial determinant of survival in a competitive and rapidly changing environment (Teece et al. 1997).

The current study is motivated by various related factors. First, past literature has put forth the notions of IT(-enabled) competences and capabilities, as an attempt to measure an organization’s proficiency in exploiting their IT asset base and improve competitive performance and their ability to innovate (Gordon and Tarafdar 2007; Lu and Ramamurthy 2011). Over the years, literature on IT capabilities offered only scarce evidence on explaining performance and innovation gains through IS/IT, how firms can in fact drive sustainable innovation, collaborate with partners and achieve boundary-spanning arrangements,
and maintain a competitive edge in the business ecosystem (Agarwal and Selen 2009; Booch and Brown 2003). Second, studies used inconsistent conceptualizations of the term ‘IT capabilities’ and complementary perspectives that investigate the dynamics among different types of IT capabilities (e.g. IT flexibility, human and management capabilities), have been largely overlooked (Kim et al. 2011). Third, although IS/IT is considered an important enabler of process and product innovation within firms (Davenport 1993), there still is limited understanding on the required knowledge resources and working mechanisms necessary to innovate and how IS/IT and complementary organization aspects truly facilitates firms’ innovation capability and competitive advantage (Lyytinen et al. 2016; Mikalef et al. 2016; Nambisan 2013; Van de Wetering 2016). Against this background, it seems self-evident that firms need to align their business operations, IS/IT and dynamic capabilities and take into account the dynamics of the changing environment (Eisenhardt and Martin 2000; Teece et al. 1997) and drive organization-wide innovation (Ashurst et al. 2012; Teece 2010). Finally, early research on flexible and adaptability IS/IT infrastructures posited that IT flexibility, as a specific quality of IT capabilities, can be used by firms to maintain a competitive edge (Duncan 1995). It is conceivable, however, that IT flexibility, in isolation does not live up to this specific need and might well not be sufficient to drive firm performance and enhance a firm’s innovation capabilities.

In sum, we foresee synergies arising from IT capabilities and complementary organizational capabilities in strengthening a firm’s armory to innovate. Complementarities and fit are the foundation of what is called ‘strategic alignment’, i.e., equilibrium of different organizational dimensions, and external fit as strategy development that is based on environmental trends and changes (Chan and Reich 2008; Henderson and Venkatraman 1993; Van de Wetering and Batenburg 2014). We therefore assume that (IT or dynamic) capabilities - and their underlying dimensions - cannot be individually optimized to achieve a better performance (Milgrom and Roberts 1995). Thus, business value and innovation seems to be the result of complementary organizational resources and IS/IT dimensions (Melville et al. 2004; Wade and Hulland 2004). It is even argued that synergies arising from IT capabilities and complementary organizational capabilities in fact strengthen a firm’s ability to identify, assimilate, transform, and apply valuable external knowledge (Roberts et al. 2012). This is in fact also stressed by Pavlou and El Sawy (2006) who argue that absorptive capacity (ACAP), as a dynamic capability, complements IT capabilities in generating IT business value and ultimately enhancing a firm’s competitive advantage and innovativeness. Despite valuable IS/IT research contributions that draw upon IT flexibility, dynamic capabilities and ACAP, there has been no comprehensive assessment of their mutual and their simultaneous alignment. To bridge this knowledge gap, we want to understand how the combined synergistic effect of the underlying dimensions of IT flexibility architecture, dynamic capabilities and ACAP enables firms to cope with changing environmental conditions and drive innovation capabilities. Therefore, the current article touches upon an imperative question for contemporary firms:

“What is the impact of the strategic alignment of combinative IT and dynamic capabilities on a firm’s innovation capabilities in turbulent environments”

The remainder of the article is structured as follows. In the next section, we begin with theoretical underpinnings before we present our strategic alignment model. We then operationalize this model and formulate hypotheses after which the method section is presented. We subsequently outline analyses and results and end this article with a discussion section and concluding remarks.

**Theoretical underpinnings**

*Modularity and Enterprise IT architecture flexibility*

The concept of IT architecture flexibility has its roots in Simon’s theory of near decomposability, and specifically on the principles for modular systems and ‘loose coupling’ (Simon 1965). Simon’s theory highlights the importance for systems of having nearly decomposable (‘modular’) subunits, since these decomposable structures tend to evolve faster, increase the rate of adaptive response and tune towards stable, self-generating configurations. Modularity, as such, is a characteristic which largely determines the effectiveness in implementing continuous change (Pil and Cohen 2006). Firm’s IT architecture flexibility

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1 As a reflection of effectiveness in learning.
is a critical aspect and capability that enables contemporary firms’ ability to (re)use and reconfigure IS/IT strategically (Bharadwaj 2000; Bhatt and Grover 2005) and is also driven by pervasive digitization (Yoo et al. 2010). This specific constituent of IT capabilities (Kim et al. 2011) has recently been confirmed to increase levels of strategic alignment under volatile circumstances that require agile and swift responses by the firm (Tallon and Pinsonneault 2011). Thus, modular IT architectures facilitate a timely response in terms of IT-based competitive actions, geared towards sustained competitive advantage (Overby et al. 2006). A flexible IT architecture is consequently developed on the basis of constant adaptations, or as referred to, a platform for digital options (Overby et al. 2006; Sambamurthy et al. 2003) and appropriately addresses the aforementioned need: to deal with environmental dynamics, continuous organizational change and aligning complementary (IS/IT) resources and capabilities.

**Dynamic Capabilities theory**

The dynamic capabilities theory (DCT) was proposed as a more profound theory than the resources based view of the firm (RBV) in order to explain competitive performance gains as a result of their resources and capabilities, especially when faced with dynamic or unpredictable environments (Eisenhardt and Martin 2000; Teece et al. 1997). Dynamic capabilities constitute the firm’s ability to use resources—specifically processes to integrate, reconfigure, gain and release resources—to match and even create market change. Thus, they are the organizational and strategic routines by which firms achieve new resources configurations as markets emerge, collide, split, evolve, and die (Eisenhardt and Martin 2000). These capabilities differ from what is known as a ‘substantive’ (or ordinary) organizational capability (Roberts et al. 2012), i.e. a high-level routine (or set of routines) that confers a set of decision options on an organization’s management for producing significant outputs of a particular type (Winter 2003). Originating from the Schumpeterian logic of creative destruction, dynamic capabilities enable firms to holistically integrate, build, and reconfigure their resources and competencies in the face of changing business environments (Teece et al. 1997). Extant literature suggests that dynamic capabilities comprise of the following organizational and strategic routines: (1) sensing, (2) coordinating, (3) learning, (4) integrating, and (5) reconfiguring (Mikalef et al. 2016; Pavlou and El Sawy 2011; Protogerou et al. 2012). DCT is considered an appropriate theoretical perspective to explain how firms can differentiate and compete in a turbulent environment, taking into account that they must evolve and co-evolutionary reconfigure their (IS/IT) operations in order to remain competitive.

**Firms’ absorptive capacity**

Absorptive capacity (ACAP) theory is strongly related to dynamic capabilities (Joshi et al. 2010). ACAP is considered a multidimensional notion (Lane et al. 2001) through which a firm’s long-term survival and success can be strengthened (Zahra and George 2002). A firm’s ACAP heavily rests upon the transfer of information and knowledge assets across and within enterprises (Cohen and Levinthal 1990). As such, this capacity—enhanced through the use of IT—provides firms with the ability to identify and recognize the value of new, external information, acquire, assimilate and transform this information (or knowledge) into the firm’s knowledge base, and apply this new knowledge through innovation and competitive actions (Cohen and Levinthal 1990; Joshi et al. 2010; Zahra and George 2002). Recent IS management literature on ACAP shows that IT business value and innovation gains are the result of complementary relationships between an organization’s IT capabilities and ACAP (Bhatt and Grover 2005; Joshi et al. 2010; Lane et al. 2001; Roberts et al. 2012; Wade and Hulland 2004). We therefore regard this specific capacity as the complementary IT-related capability (Van Den Bosch et al. 1999) that affects a firm’s ability to build and reconfigure its existing substantive capabilities (Joshi et al. 2010; Pavlou and El Sawy 2006; Roberts et al. 2012). We thus foresee and propose that combinative alignment of the above IT and organizational dynamic capabilities will drive firms’ performance gains and innovation capabilities (Melville et al. 2004; Roberts et al. 2012; Wade and Hulland 2004). This is in line with a growing body of literature stressing the importance of adopting a dynamic approach and thus examining the processes by which IT and other organizational capabilities together generate IT business value to firms and ultimately enhance a firm’s competitive advantage (Kohli and Grover 2008; Pavlou and El Sawy 2006; Roberts et al. 2012).

**Innovation capabilities**

Innovation seems to be a major concern for modern organizations (Ashurst et al. 2012; Teece 2010), and organizations increasingly try to innovate the current market place using IS/IT and digital transformation
strategies as a foundational resource (Wang and Ahmed 2004; Wu and Chen 2014). It is within this process that organizations need to optimally deploy and enable their assets, resources, organizational, IT and knowledge capabilities to be innovative and hence to efficaciously respond to inherent changes in industry and market conditions faster than competitors (Aral and Weill 2007; Forés and Camísón 2016; Hitt et al. 1997; Joshi et al. 2010; Kostopoulos et al. 2002). A striking insight from these studies is that mutually reinforcing and complementary practices and competences lead to higher performance gains. An established classification of innovation recognizes the broad distinction between ‘incremental’ and ‘radical’ innovation (Dewar and Dutton 1986). Incremental innovations can be broadly classified as refinements of current products/services, and or technologies (Subramaniam and Youndt 2005). Accordingly, an incremental innovative capability is defined as: ‘an organization’s ability to generate innovations that refine and reinforce existing products and services’ (Subramaniam and Youndt 2005). The latter form, radical innovations, includes fundamental changes of existing products, services or technologies, and often make prevailing products, services, and technologies obsolete. Accordingly, a radical innovative capability is the capability of an organization to generate innovations that substantially transform existing products, services, and technologies (Subramaniam and Youndt 2005).

A strategic alignment model of combinative capabilities

Our conceptual strategic alignment model is illustrated in Figure 1. At the bottom of the figure, we depict the three combinative IT and organizational capabilities that need to be aligned in practice: (1) IT flexibility, (2) dynamic capabilities and (3) ACAP. Hence, we define (combinative) alignment as the degree of balance between all defined dimensions (Van de Wetering et al. 2011), while we acknowledge that the concept of alignment has been operationalized and measured in many ways (Tallon and Pinsonneault 2011).

**Figure 1. Strategic alignment model for combinative IT and dynamic capabilities**

Our operationalization follows the core idea of Turban’s alignment model (Turban et al. 1999), i.e., synchronizing or balance between all dimensions will significantly contribute to organizational performance gains. Alignment could conceptually be illustrated using a line connecting all successive capability dimension scores. Following this logic, the ‘smaller’ the difference between dimensions scores, the ‘better’ the alignment. Next, we claim that alignment of all IT and dynamic capability dimensions is positively related to a firm’s innovation capabilities. To be more specific, our model embraces the concept of decomposition into the core conceptual components (Overby et al. 2006) and is built on three foundations, i.e., (1) the alignment of dynamic capabilities, (2) additional contributions to a firms’ innovation capability through the ‘simultaneous’ alignment of all IT flexibility dimensions and (3) finally the contribution of alignment of all ACAP dimensions. As such, we want to investigate whether the combined (simultaneous) and synergetic effect of dynamic capabilities, IT flexibility and ACAP, i.e. strategic alignment (that is measured by three separate predictor variables), enables innovation capabilities. Hence, we define:
**Hypothesis 1.** Simultaneous alignment of dynamic capabilities, IT flexibility and absorptive capacity dimensions is positively associated with a firm’s incremental innovation capability.

**Hypothesis 2.** Simultaneous alignment of dynamic capabilities, IT flexibility and absorptive capacity dimensions is positively associated with a firm’s radical innovation capability.

## Methods

### Data and Sample Collection Procedure

Survey items were constructed using a Likert scale from 1 – strongly disagree to 7 – strongly agree. The applied survey has been pretested (Mikalef et al. 2016) and non-response bias actions were taken into account. The final survey was sent to key informants within firms, including Chief Information Officers (CIO), IT managers, Chief Technology Officers (CTO), enterprise architects, and Chief Executive Officers (CEO). We randomly selected 1500 firms from the ICAP business directory, including firms from a wide range of business, industries and segments. To assure a collective response, the instructions asked executives to consult other members of their firm for information they were not highly knowledgeable about. The data gathering process took place between January 2015 and September 2015. Based on usable response, we finally included a total of 322 usable surveys representing a response rate of 21.4%. We controlled for common method bias, assuring respondents that all collected would remain anonymous in, and hence would only be for research at an abstract level. The majority of responses were from consulting services (24%), high-tech (24%), financials (14%), consumer goods (10%), telecommunications (6%), industrials (6%), and consumer services (5%) industries. Less than 5% were obtained from the basic materials, healthcare, utilities, and oil & gas industries.

### Measurement constructs and items

Each of the included dimensions that comprise IT architecture flexibility is based on past empirical and validated work (Byrd and Turner 2000; Tafti et al. 2013; Tiwana et al. 2010). Hence, we define the following elementary dimensions for IT flexibility, i.e.: (1) loose coupling, (2) standardization, (3) transparency and (4) scalability. We adopt five elementary routines for dynamic capabilities, i.e.: (1) sensing, (2) coordinating, (3) learning, (4) integrating, and (5) reconfiguring routines (Mikalef et al. 2016; Pavlou and El Sawy 2011; Protogerou et al. 2012) Consistent with past research absorptive capacity included the acquisition, assimilation, transformation, and exploitation (Liu et al. 2013; Zahra and George 2002). Finally, incremental innovative capability was measured with three indicators assessing an organizations capability to reinforce and extend its existing expertise and product/service lines. Likewise, radical innovative capability was assessed through three indicators that asked respondents to evaluate their organizations ability to make current product/service lines obsolete (Subramaniam and Youndt 2005).

### Alignment measurement procedure

Before the operationalization of alignment, we checked the construct reliability through SPSS v22. As such, construct reliability was established by examining that all Cronbach’s Alpha values for both independent and depend constructs were above the threshold of 0.70 (Nunally and Bernstein 1978). Therefore, we continued the measurement procedure. To operationalize the proposed conception of alignment in we follow a rigorous and precise procedure of Batenburg et al (2004) by incorporating both mean scores (µ) as well as the difference between the maximum and minimum maturity scores of all dimensions as measure for alignment. Thus, we simultaneously and integrally include both deviations as well as the means of the score array, or maturity. This mean score is then multiplied by the ratio of the minimum [MIN[IT1..IT4] and [DC1..DC5]] and the maximum score (MAX [IT1..IT4] and [DC1..DC5]) within that same array².

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² Alignment in this context could be formalized using the following formula: **Alignment** = µ x (Min/Max).
Empirical results and hypotheses testing

Multiple regression analyses

The use of concepts and techniques of regression analysis is of vital importance since strict assumptions need to be taken into account. First, we first checked for normality of our data using the normal P-P plot and for homogeneity of variance (i.e. homoscedasticity) and linearity. Residual errors are in fact evenly distributed and not related to the value of the predicted value, confirming the homoscedasticity assumption (Kachigan 1991). Second, we checked for univariate and multivariate outliers and detected no influential outliers. Finally, we controlled for possible multicollinearity problems using variance inflation factors (VIF). Results of the final (hierarchical) regression analysis for 2 models, i.e., incremental innovation and radical innovation respectively as outcomes variables, are summarized in Tables 1 and 2.

<table>
<thead>
<tr>
<th>Model 1: Incremental innovation</th>
<th>N</th>
<th>R²</th>
<th>R² (Adj.)</th>
<th>Beta</th>
<th>Sig.</th>
<th>t-Value</th>
<th>VIF</th>
<th>F-scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment of abs. cap.</td>
<td>322</td>
<td>.293</td>
<td>.278</td>
<td>0.333</td>
<td>.000</td>
<td>5.468</td>
<td>1.648</td>
<td>18.622</td>
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<tr>
<td>Alignment of DCs</td>
<td></td>
<td></td>
<td></td>
<td>0.143</td>
<td>.043</td>
<td>2.034</td>
<td>2.185</td>
<td></td>
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<tr>
<td>Alignment of IT flexibility</td>
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<td></td>
<td></td>
<td>0.141</td>
<td>.026</td>
<td>2.231</td>
<td>1.774</td>
<td></td>
</tr>
<tr>
<td>Size*</td>
<td></td>
<td></td>
<td></td>
<td>0.03</td>
<td>.538</td>
<td>.617</td>
<td>1.083</td>
<td></td>
</tr>
<tr>
<td>Complexity*</td>
<td></td>
<td></td>
<td></td>
<td>-0.047</td>
<td>.367</td>
<td>-.904</td>
<td>1.183</td>
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<tr>
<td>Hostility*</td>
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<td></td>
<td></td>
<td>-0.109</td>
<td>.065</td>
<td>-1.850</td>
<td>1.538</td>
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<td></td>
<td>0.036</td>
<td>.019</td>
<td>2.355</td>
<td>1.476</td>
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</table>

Table 1. Regression analysis on ‘incremental innovation capability’ *Control variables

<table>
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<tr>
<th>Model 2: Radical innovation</th>
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<th>R²</th>
<th>R² (Adj.)</th>
<th>Beta</th>
<th>Sig.</th>
<th>t-Value</th>
<th>VIF</th>
<th>F-scores</th>
</tr>
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<td>4.544</td>
<td>1.648</td>
<td>22.994</td>
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<td></td>
<td>0.120</td>
<td>.079</td>
<td>1.762</td>
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<td>Alignment of IT flexibility</td>
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<td></td>
<td>0.278</td>
<td>.000</td>
<td>4.543</td>
<td>1.774</td>
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<td>Size*</td>
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<td>.166</td>
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</table>

Table 2. Regression analysis on ‘radical innovation capability’ *Control variables

Through multiple (hierarchical) linear regression analyses, we controlled for potential contextual influences and included various control variables into the regression equations, namely ‘size’ (based on the survey items: ‘Indication of the size-class of your company’), and three related variables concerning a firm’s environment (Chen et al. 2014). As suggested by Joshi et al. (2010), different industry and environment types have different emphases on innovation. We therefore included ‘hostility’ (Zahra and Garvis 2000) (resulting from various political, economic, societal, and technical factors), ‘complexity’ of the environment (where important business issues need to be addressed by applying complex and sophisticated knowledge and coping with varied external stakeholders (Chen et al. 2014; Wade and Hulland 2004) and ‘dynamism’ (where it might it may be difficult to create a competitive advantage because of many changes occurring simultaneously) (Chen et al. 2014) into the regression analyses. Results of the multiple (hierarchical) regression analyses show that for both models simultaneous alignment using three separate predictor constructs, i.e. (1) alignment of IT flexibility dimensions, (2) alignment of dynamic capability dimensions and (3) alignment of absorptive capacity dimensions, significantly predict a firm’s innovation capabilities; model 1: F (7, 314) = 18.622, p < .0001, R²(Adj.) = .278 and model 2: F (7, 314) = 18.622, p < .0001, R²(Adj.) = .324. In both cases, the multiple regression models show a good fit of the data. All VIF-values are within acceptable range and thus reveal no multicollinearity problems. F-scores indicate significant regressions suggesting the existence of a real effect of alignment as independent variables. Using these basic statistical analyses our two hypotheses are confirmed. For model 1, all three main constructs added statistically significantly to the prediction, p< .05
Discussion and concluding remarks

This study presented a strategic alignment model that proposed that the combined synergetic effect of IT and organizational dynamic capabilities enables organizations to drive innovation capabilities. We subsequently operationalized alignment through the use of three separate predictor variables within regression analyses. An important insight is that simultaneous alignment of IT flexibility, dynamic capabilities and ACAP enables a firm’s innovation capabilities and thereby supports evolutionary fitness of the firm. This is important for organizations that are operating in turbulent and unpredictable markets. Our study extends the current practical and theoretical knowledge base by providing a new perspective on how to deal with persisting challenges while simultaneously leveraging and aligning current IT and complementary organizational dynamic capabilities. Also, results imply that that to some extent strengthening imperative dimensions in ‘isolation’ is not sufficient in order to enhance firm innovation. Rather, the complementarities, synergies and ongoing interactions among different capabilities are a key enabler of firms’ innovation capabilities, which is consistent with extant literature (Chan and Reich 2008; Henderson and Venkatraman 1993), determining factors that facilitate a state of alignment (Mikalef et al. 2013), the application of more fine-grained approaches in alignment literature (Mikalef et al. 2014), the role of IT capabilities and their ability to launch competitive actions (Sambamurthy et al. 2003). A striking insight is that alignment of absorptive capacity dimensions in both tested models has a strong impact and contribution in explaining variance of a firms’ innovation capability, particularly in comparison to other predictor constructs. Apparently, this complementary IT-related organizational capability has significant impact on a firms’ ability to reconfigure and foster its existing (IT and dynamic) capabilities and drive innovation.

Despite its contributions, our study is constrained by a number of limitations that future research should seek to address. First, this study measures alignment in a single point in time. Using a longitudinal approach, we could explore whether strategic alignment goes through (stable or revolutionary) periods of time (Sabherwal et al. 2001). Second, we did not extensively use demographic variables (e.g. organization age, type, region) in our empirical analysis, nor did we consider possible differences among group segments and clusters. A configuration perspective is required toward this direction, since strategic alignment might be conditioned to certain contextual and organizational elements and factors (El Sawy et al. 2010; Mikalef et al. 2015). Third, alignment of dynamic capabilities dimensions did not demonstrate a significant regression coefficient (model 2, i.e., radical innovation). Informed by research on environmental conditions in the context of dynamic capabilities, further research should investigate the intervening and potentially moderating role of environmental conditions that facilitate the value-adding properties of IT-enabled dynamic capabilities (Pavlou and El Sawy 2006; Wilden and Gudergan 2015). Future research could then also explore how firms can synthesize and define improvement activities that best meets firms’ current and future needs.

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