TITLE

Business Processes, Technology and Organizational Agilities: A Dynamic Capability Framework

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ABSTRACT

Organizational agility has been regarded as one of the most important critical resources for enabling better firm performance. This study extends the existing literature by introducing technology agility as an antecedent to organizational agilities, which, subsequently, impacts business processes and, ultimately, firm performance. Technology agility is the firm's ability to quickly react to technological changes. Our conceptual framework bridges the dynamic capabilities framework with the process-based view of the organization. We test our conceptual framework using a survey data set from the Brazilian automotive industry. The results confirm that technology agility is a significant antecedent to key organizational agilities and these agilities impact both financial and market performance through intermediate business processes. We conclude that technology agility plays a key strategic role in shaping the firm's dynamic capabilities that further enhance firm performance.

Keywords: Technology agility, organizational agility, dynamic capabilities, process based view, firm performance

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INTRODUCTION

Organizational agility is recognized as a critical factor for helping firms to achieve competitive advantages. Under uncertain conditions, firms need to stress continuing agility, rapid innovation and learning in order to support business processes (Farjoun, 2007). Scholars (e.g., Amit and Zott, 2001; Choudhury and Xia, 1999; Holström, 2001; Kambil et al. 1999; Nambisan, 2002; Venkatraman and Henderson, 1998) agree that the construct of organizational agility has three important dimensions: customer agility, partner agility and operational agility. The dynamic capabilities framework (Teece, Pisano and Shuen, 1997) has been used extensively as a theoretical basis to test the relationships between organizational agility and firm performance (Amit and Schoemaker, 1993; Eisenhardt and Martin, 2000; Garvin, 1988; Zahra and Nielsen, 2002). In line with the dynamic capabilities perspective, researchers (e.g., Helfat and Peteraf, 2009; Sambamurthy et al., 2003) have argued that organizational agility is one of the most important dynamic resources and capabilities, which allow firms to address rapidly changing business environments. Ferrier et al. (1999) suggest that firms can enhance their competitiveness by effectively integrating and developing these internal and external complex resources and capabilities. Sambamurthy et al. (2003) further argues that by developing collective, organizational agility resources, firms are better able to perform more complex repertoires, which, in turn enhance their competitive advantage.

While the research of Sambamurthy et al. (2003) have established that the three dimensions of organization agility impact on firm performance, the key factors that help a firm to reshape and reconfigure these agilities to sustain competitive advantage remain

unexplored. Our study extends the existing literature on organizational agility and firm performance by investigating the role of technology agility in influencing the three dimensions of organizational agility (customer, partner and operational). It introduces technology agility, which is defined as an organization's ability to quickly react to technological changes, as an antecedent of the organizational agility. Given today's rapidly changing technological environment, firms must rely on and take advantage of IT changes if they want to remain agile. For example, Dell's constant segmentation of operating businesses to match shifting customer demands allowed it to achieve competitive advantages over its rivals such as Compaq and Hewlett-Packard (Magretta, 1998). However, such constant business process reengineering requires support from flexible technologies. From a theoretical perspective, our model argues that technology agility is a significant antecedent to all three these organizational agilities: customer, partner and operations. That is, how organizations react to external technological changes determines how agile they are in the marketplace.

In addition to extending the dynamic capabilities perspective (e.g., Helfat and Peteraf, 2009) to include technology agility, this research also incorporates the process-based view into our theoretical framework. The process-based view of IT (Markus and Soh, 1993; Soh and Markus, 1995; Barua et al., 1995; Mooney et al., 1996) regards business processes as mediating variables between IT enablers and firm performance. Our theoretical framework extends the view by suggesting that the link between organizational agilities to firm performance specified by dynamic capabilities is mediated by business processes. In summary, we introduce technology agility, establish it as an

antecedent to organizational agilities, and examine business processes as mediators between organizational agilities and firm performance.

The rest of our paper is organized as follows. First, we provide a literature review along with theoretical foundations for our hypotheses. Second, we provide a discussion about our research design and methods. Lastly, we present our empirical results and conclude our research with a discussion of our major findings, implications, limitations, and future research suggestions.

THEORETICAL FRAMEWORK

The Mediating Role of Business Processes

Our theoretical framework builds upon and is consistent with the empirical evidence from two relevant theories--the dynamic capabilities framework and the process-based view. The root of the dynamic capabilities framework is based on the resource-based view. RBV suggests that there can be heterogeneity or firm-level differences among firms that allow some to sustain competitive advantage over other competitors. It holds that firms can earn sustainable supra-normal returns if and only if they have superior resources and these resources are protected by some form of isolating mechanism preventing their diffusion throughout the firm's industry competitors. In essence, the RBV emphasizes strategic choice, charging the firm's management team with the important tasks of identifying, developing and deploying key resources such as patents, properties, technologies, or specific relationships to maximize returns (Barney, 1991; Wernerfelt, 1984). Many scholars (e.g., Mosakowski and McKelvey, 1997; Priem and Butler, 2001a;

Priem and Butler, 2001b) have pointed out the inability of RBV studies to describe the mechanisms by which resources contribute to a firm's competitive advantage.

Teece et al. (1997, p. 516) defined the dynamic capabilities view 'as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.' The dynamic capability perspective has extended the RBV to the realm of evolving capabilities. Dynamic capabilities are enhanced because of the firm's ability to acquire, integrate, and shed resources (Eisenhardt and Martin, 2000) and to reconfigure internal and external competencies to address rapidly changing environments (Teece et al., 1997). By developing capabilities based on sequences of path-dependent learning, a firm can stay ahead of its imitators and continue to earn superior returns (Dierickx and Cool, 1989; Teece et al., 1997). Zahra, Sapienza, and Davidsson (2006) point out that dynamic capabilities are necessary but not sufficient conditions for a sustained advantage and given two firms with equivalent substantive capabilities, those firms with superior dynamic capabilities are more likely to meet emerging challenges in a timely fashion (Helfat and Peteraf, 2009).

The process-based view of the business value of IT focuses on the interactions between enablers, such as IT, and business processes in an attempt to explain how and where IT processes take place within a firm (Markus and Soh, 1993; Soh and Markus, 1995; Barua et al., 1995; Mooney et al., 1996). This view regards enablers as a necessary, but not sufficient condition for superior performance. Using IT as an enabler, Soh and Markus (1995) determine that in order for IT to have an impact on firm performance, three actions must interact: (1) the IT conversion process in which the IT investments become IT assets, (2) the IT application process in which IT assets create

impacts, and (3) the competitive process in which IT impacts are converted into organizational performance. Furthermore, each of these processes is moderated by a multitude of technological, organizational, and environmental factors. Barua et al. (1995) suggest that if IT first impacts operational level variables, such as capacity utilization and inventory turnover for a manufacturing firm, then these intermediary variables influence higher level variables such as firm productivity and profitability. In essence, the process-based view regards business processes as mediating variables between IT investments and firm performance.

By integrating these two theoretical perspectives in our research design, we purport that if firms want to succeed in the marketplace, they must be both timely responsive to today's rapidly changing and flexible business processes. Moreover, they must possess the management capability to effectively coordinate and deploy the internal and external competences to achieve these goals (Teece et al., 1997).

Technology Agility and Organizational Agilities

Organizational agility is defined as the firm's ability to detect competitive market opportunities for innovation and captures these opportunities by acquiring, assembling and reassembling requisite resources such as assets, knowledge, and relationships, with speed and surprise (e.g., Sambamurthy et al., 2003). Sambamurthy et al. (2003) further refines organizational agility into three inter-related organizational capabilities: customer agility, partner agility and operational agility. Building on the dynamic capabilities perspective, we argue that organizational agilities are dynamic capabilities that firms can leverage and create to develop a sustainable competitive advantage. Sambamurthy et al.

(2003) argue that firms that develop all of these dimensions of agility are in a better position to engage in more competitive actions, which ultimately translates into competitive advantage opportunities for these firms. In industries and markets that are dynamic and fast-changing, organizational agility has been shown to aid firms in their pursuit of competitive advantage (e.g., Eisenhardt and Sull, 2001).

One of the key relationships examined in this study is how technology agility affects organizational agilities. Technology agility is defined as the firm's ability to respond to rapid technology changes in a firm's internal environment. In dynamic environments in which technological innovations are constantly emerging, a firm faces pressures to be agile enough to adapt to changes and to reassemble the resources necessary to respond to and take advantage of these changes. We argue that organizational agility also depends on how a firm reacts to technological changes. For example, when a new version of customer relationship management (CRM) is published, user firms must be able to quickly reassemble the technology professional teams to update the software throughout organization. If this is not done in a timely fashion, the ability to respond to customers may be compromised. Similarly, speedy responses to changes in supply chain management (SCM) and enterprise resource planning (ERP) software can significantly impact organizational agilities of partners and operations. As a result, we propose a framework highlighting technology agility as an important antecedent to the other well-studied organizational agilities.

As a summary, we present our theoretical framework as shown by Figure 1.

INSERT FIGURE 1 ABOUT HERE

HYPOTHESES

The focus of the current literature, which has examined the organizational impact of technology, has focused more exclusively on the use of technology itself (Weill 1992; Lucas 1993; Soh and Markus 1995; Sambamurthy et al., 2004; Overby et al., 2006). As IT becomes more of a commodity, its ability to create firm competitive advantage diminishes (Carr, 2003). In such an environment, how an organization manages IT and reacts to the constant changes determines its abilities to react to changes in its environment and ultimately, its ability to sustain competitive advantage. Hence, we theorize that technology agility, rather than technology itself, is the critical antecedent to the construct of organizational agility. It is this ability to react quickly to technological innovations that allows organizations to develop customer, partner and operational agilities. The infrastructures needed to support one of these agilities may differ from that needed to support another. Customer order processing uses functionalities that differ from those used for knowledge management. Supply chains often require collaborative planning with partners that uses still another set of functionalities. To enable technology agility, the technology infrastructure must also be agile. This flexibility requires technology vendors to constantly change and update their offerings. As organizations move quickly to respond to changes in their competitive environment, their abilities to be

flexible in their reactions to customers, partners and operations are largely dependent on how flexibly they are in their acquisitions and utilizations of technology. Hence, we propose the following hypotheses:

H1: ***Technological agility has a positive impact on the firm organizational agilities (customer agility, partner agility, and operational agility).***

The dynamic capabilities perspective focuses on how firms possess unique and idiosyncratic strategic and organizational processes, such as product development, by manipulating resources into new value-creating strategies. Resources are the necessary inputs that form the basis of unique value-creating strategies that enable a firm to respond to specific markets and customers in distinctive ways, thereby leading to firm competitive advantage over industry rivals (Eisenhardt and Martin, 2000). Hence, we argue that the successful management of business processes such as the firm's speed to market, product quality and production efficiency are essential to the sustainability of a firm's long-term survival.

As mentioned earlier, the dynamic capability framework focuses on the impact of an organization's capacity to adapt, integrate and reconfigures skills, resources and competencies in response to changes in their business environment affecting performance (Teece et al. 1997). Sambamurthy et al. (2003) identify organizational agilities as key dynamic capabilities and further define the three dimensions of organizational agilities as customer agility, partner agility and operational agility. Teece et al. (1997) identify such processes as the fundamental unit of analysis for the dynamic capabilities framework. On the one hand, the dynamic capabilities framework defines the organizational agility-firm performance relationship suggesting that organizational agilities lead to superior firm

performance. Zúñiga-Vicente, J. Á. and Vicente-Lorente (2006) study the Spanish banks from 1983-97 and find that the banks with dynamic capabilities enjoy higher survival rates. On the other hand, the process-based view argues that any impact of organizational enablers must impact business processes first and then, ultimately, firm performance. According to this perspective, we purport that the relationship between organizational agility and firm performance relationship, as defined by the dynamic capabilities framework, must be mediated by business processes. This rationale leads to following hypothesis:

> **H2:** *Firm organizational agilities (Customer, Partner, and Operational) have positive impacts on business processes such as the firm's speed to market, product quality and production efficiency.*

> **H3:** *Business processes (speed to market, product quality, and production efficiency) that are enabled by organizational agilities have positives impacts on organizational performance (financial and market performance).*

RESEARCH METHODS

Our research used the survey method to collect primary data on a population of manufacturers in the automotive industry. The unit of analysis in our study was at the business plant level. Multi-item measures were used to represent all of the variables, except for firm age and firm size (i.e., our control variables in this study). We measured multi-item variables using a 5-point scale (1=Strongly Disagree, 2=Disagree Somewhat, 3=Neither Agree or Disagree, 4=Agree Somewhat, 5=Strongly Agree) with some items adapted from those used in similar studies (e.g., Lanctot & Swan, 2000; Worren, 2001; Worren et al., 2002). In some instances, because it was difficult to apply existing scales in their entirety, we developed and refined new key constructs based on the information

that we gained in our fieldwork from semi-structured interviews with executives and experts in the Brazilian automobile industry.

In order to ascertain non-response bias across the survey instrument itself, we performed t-tests comparing early and late respondents. The first 70 percent of the returned questionnaires were defined as early responses and the remaining 30 percent as late responses and thus deemed representative of firms that ultimately did not respond to the survey. The t-tests found no significant differences between early and late respondents on any one of the selected variables, suggesting that non-response bias did not likely exist in our survey instrument.

We avoided social desirability effects (Ghoshal & Moran, 1996), which is an important component of the common rate effect (Podsakoff et al., 2003), by explaining in the questionnaire introduction section that: a) our survey was a quantitative study and was not intended to make judgments on individuals and/or institutions, b) our questionnaire responses were not linked to the identity of the respondent or to the name of the company where the respondent was employed, and c) our data would be treated with strict confidentiality in accordance with the ethical norms of our sponsoring institutions. We also avoided item ambiguity (Peterson, 2000), which is an important component of item characteristic effect (Podsakoff et al., 2003) through the pre-test of the questionnaire with executives working in the Brazilian automotive sector. Our pre-test efforts were indeed useful since they provided insights for the improvement of item clarity. In addition, we reverse coded some items in the questionnaire and also interspersed the open-ended questions pertaining to some constructs throughout the

questionnaire so that respondents would not fall into a pattern linked to Likert or semantic differential scales.

After collecting the data, we used Harman's one-factor test to address the common method variance concern. Neither a single factor from the factor analysis nor a general factor in accounting for the covariance of independence nor criterion variables emerged in our analysis as a confirmation of the lack of common method variance disturbances (Podsakoff & Organ, 1996).

We also developed a specific strategy to reduce the incorrect answers caused by the use of a single informant response. First, informants were asked questions related to their current production method. Prior research suggests that informant recollections are stable over short periods of time (Huber, 1985). Second, we used the field studies in conjunction with plant tour observations, and our literature review to verify respondents' consistency and reliability as mentioned earlier. Finally, we compared informants' responses to archival and public data (e.g., company profiles and articles from the business press) where available. All of these comparisons and procedures provided us with confidence that our informants were accurate and competent sources and as such we did not need to reduce our questionnaire from our original database because of reliability concerns.

Sample and Data Collection

The automobile industry in Brazil is ideal for applying dynamic capabilities because of the rapidly changing tastes of its customers, the demand for reasonable cost, and multifaceted partner relationships. For example, Clark and Fujimoto (1991) conclude that integrative capabilities help Toyota to achieve competitive advantage. Brazil is the

only country in which all of the global car manufacturers from the United States, Europe, and Japan have operating manufacturing facilities that produce vehicles for the internal market as well as for exporting. Facing increasingly intense competition from abroad, the automakers and suppliers in Brazil have implemented flexible technologies strategically to improve their organizational agilities in response to rapid changes in customers, partners and operations. The booming technological infrastructure provides ample opportunities for firms to explore technological means of creating competitive advantages (Kotabe, Parente and Murray, 2007).

We selected to a sample of 493 manufacturing business units (including assemblers and suppliers) in the automobile industry of Brazil identified through lists provided by ANFAVEA (the Brazilian Automobile Manufacturers Association) and by SINDIPECAS (the Brazilian Automobile Suppliers Association) as well as the annual Brazilian magazine *Automotive News.* We mailed the survey to senior managers at the plant/divisional level. For purposes of our control variables, we collected information on the firms' ages, sizes, and geographical scope. All of the respondents held high-level positions (e.g., plant manager, manufacturing supervisor, purchasing manager, etc.) in the organization in which they worked for and on a daily basis were responsible for making key strategic decisions. After the initial mailing, a total of 37 questionnaires were returned because of incorrect addresses, which reduced the sample size to 456 business units. After two follow-ups, we received 136 usable questionnaires for a response rate of 27 percent.

Construct Measurements

From the data collected, we created three-level variables related to organizational agility, business processes and firm performance. Our first-level organizational agility constructs were Technological Agility (TA), Customer Agility (CA), Operational Agility (OA), Partner Agility (PA). Our second-level business process constructs were Speed to Market (SM), Product Quality (QU) and Production Efficiency (EF). Finally, our third-level performance constructs were related to firm performance and Market Performance (MF) and Financial Performance (FF). See our Appendix for specific details about the measurement of these constructs.

We conducted confirmatory factor analysis (CFA) and assessed construct reliability. The measurement properties are reported in Table 2. For all constructs, the composite reliabilities measured by Cronbach's α are well above the cutoff of 0.70, as suggested by Straub (1989). Convergent and discriminate validity for each construct is confirmed by its 'AVE', which is larger than its correlation with other constructs (Gefen, Straub and Boudreau, 2000).

INSERT TABLE 2 ABOUT HERE

We checked for the skewness and kurtosis of all items in our database to assess the normality of data distribution. All items show a skewness value between '+/- 2' and kurtosis inferior to two times the value of the standard deviation, as suggested by previous literature standards (Howell, 2003). As a consequence, the conditions necessary to assume normality were met.

ANALYSIS AND RESULTS

We chose partial least squares (PLS) as the most appropriate estimation methodology for our study (cf. Gefen, Straub and Boudreau, 2000). PLS is a structural equation modeling technique that uses a component-based approach to estimation. This method places minimal demands on sample size and residual distributions (Chin 1998). Given these assumptions, PLS offers no statistical test to assess the significance of the path coefficients. However, bootstrapping can be used to build a distribution by repeatedly analyzing different subsets (with replacement) of data to determine the statistical significance of path coefficients. We used this method to calculate the path coefficients and test their significance. Loadings of measures of each construct can be interpreted as loadings in a principal components factor analysis. Paths can be interpreted as standardized beta weights in a regression analysis. Results from the PLS analysis and the bootstrap test are presented in Table 3.

INSERT TABLE 3 ABOUT HERE

Among the first-level paths from technological agility to organizational agilities (Hypotheses 1) the paths from technological agility to customer agility and partner agility were significant at the 1% level and the path to operational agility was significant at the 5% level. These results strongly support Hypothesis 1, which states that technological agility positively impacts organizational agilities. Technology agility impacts partner agility most strongly with a path coefficient of 0.53, followed by customer agility (0.45) and operational agility (0.19).

Our second-level paths had somewhat mixed results. Hypothesis 2 stated that organizational agilities impact business processes. For customer agility, the path to product quality was significant at the 5% level with a path loading of 0.19. The paths to speed to market and production efficiency were not significant. For partner agility, none of the paths to the business process measures were significant. For operational agility, the paths to speed to market and product quality were significant at the 1% level with path loadings of 0.32 and 0.17, respectively; the path to production efficiency was not significant.

Our third-level paths from the business processes to firm performance (Hypotheses 3) were strong. Two of the three intermediate business process variables (speed to market and product quality) had positive and significant paths leading to market performance (both at the 1% level with path loadings of 0.17 and 0.63, respectively). All three business process variables had positive and significant paths leading to financial performance (speed to market at the .10 level with path a loading of 0.17, and product quality at the 1% level with a path loading of 0.57). Overall, given these results, Hypothesis 3 was supported.

In summary, our results supported our theoretical framework, which states that technology agility is an important antecedent to organizational agilities and these organizational agilities impact firm performance through intermediate business processes.

DISCUSSIONS AND IMPLICATIONS

This study bridges the strategic management and the technology fields of research by integrating the dynamic capability perspective with the process-based view. Adopting a wider focus of organizational impact of technology than specified by the process-based

view, we developed and tested a theoretical framework that included two layers of input variables: the first-layer was technology agility and the second-layer was the other dimensions of organizational agilities (customer, partner and operation). In other words, we proposed that technology agility impacted organizational agilities which, in turn, impacted intermediate business processes and, ultimately, impacted firm performance.

Studies on the organizational impact of technology have traditionally focused on technology itself. This research investigates the ability of firms to react to technology changes and its organizational impact, instead. Our results provide strong support for the hypothesis that technology agility is an antecedent to the organizational agilities. This is an important finding for scholars and managers. It highlights technology agility as a significant contributor to the other highly valued organizational agilities. For scholars, our framework contributes to the existing body of knowledge for organizational agilities. For managers, it suggests that in order to make their organizations more agile, they are required to have some technology agility first.

Since our findings indicated that technology agility impacts partner and customers agility more strongly than operational agility, this implies that the firms' focus on technology should be placed more strategically on external relationships with partners and customers than on internal operations. Further, these findings confirm the notion that it is not technology itself, but the strategic use of technology that creates organizational value. A caveat to this conclusion may be that our sample pertained only to the automobile industry in which relationships with partners and customers are paramount. However, in today's competitive landscape in the global business environment, most

firms are in the similar circumstances in terms of working with multiple partners and satisfying customers.

The second tier of impact in our study, which examined the relationship among organizational agilities and business processes, was partially confirmed. Among the three traditional dimensions (customer, partner and operational), only two (customer and operational) had significant impacts on some of business processes such as speed to market, product quality, and production efficiency. For customer agility, the path to product quality was statistically significant. This finding emphasizes the role of agility in meeting customers' quality expectations. Intuitively, however, it may not have meaningful impact on the business processes of speed to market and production efficiency. For operational agility, the paths to speed to market and product quality were statistically significant with equal path coefficients. It is somewhat unintuitive that its path to production efficiency was not significant. One possible explanation is that operational agility is the ability to reconfigure business processes when needed since changes are not without cost and sometimes become disruptive. Interestingly, we found that for partner agility none of the paths to the business process measures were significant. Given that the three business process measures were primarily internal, it was not surprising that we saw this result. The implication for managers is that they should be highly responsive to their customer needs and design their products accordingly. In addition, it is important for them be able to reconfigure their product lines so that they can move the products quickly to the market.

Finally, two of the business processes (speed to market and product quality) had positive and significant impacts on both market and financial performance. The impact

of product quality had a particularly pronounced impact on market performance and financial performance. This finding underlines the importance of product quality in the automobile industry. The success of Japanese car makers, especially Toyota, in the US, is largely due to their quality reputations. In addition, the finding that market performance is more impacted by business processes than financial performance implies that improved business processes may lead to a larger market share but may not directly impact the bottom line. The long struggles of the US automobile makers against their Japanese rivals are good examples of our finding. Another interesting finding from our study was that production efficiency does not have any impact on performance. This may be indicative that production efficiency may be over emphasized in automobile industry. To improve production efficiency requires changes and these changes are costly. The costs sometimes may prove to be too high, and firms may be in the ironic position of failing to change due to being overly focused on change (Amit and Schoemaker, 1993; Winter, 2003; Zollo and Winter, 2002).

In spite of the significant results, several limitations of this study should be addressed. First, this study is subject to the usual limitations inherent in cross-sectional research designs employing subjective measures. Second, we must be cautious in drawing conclusions and generalizing the implications outside the scope of this research, because results are from an industry-specific research, with data collected in a global industry (i.e., the automobile industry) operating in the context of an emerging economy (i.e., Brazil). Finally, a majority of the firms in our study were privately held and did not publish separate specific and objective performance data at the business unit level. As a result, our study has to rely on subjective performance data collected through

questionnaire. Although extreme care was taken to compare subjective performance measures, when possible, with objective performance measures of public firms, some biases may still remain.

CONCLUSION

In contrast with the current literature on organizational impact of technology that has been on the technology itself, this research investigates how organizations react to external technology changes and how these reactions impact the organizations. To measure the ability of how organizations react to technology change we introduce technology agility as a new dimension of organizational agility that traditionally has customer, partner and operation dimensions. To measure the impact of technology agility on firm performance, we integrate dynamic capability framework and process-based view and propose a complete impact chain of technology agility -> organizational agilities -> business processes -> firm performance. We test such a chain in the context of the automobile industry in Brazil using PLS. Our results show that 1) technology agility is a significant antecedent to organizational agilities (customer, partner and operational); 2) organizational agilities partially impact business processes measured by speed to market, product quality and production efficiency; and, finally, 3) business processes overall impact firm's market and financial performances.

Our study provides several important contributions to the fields of information systems and strategic management. The first key contribution is the introduction of a new dimension of organization agility, technology agility. Second, we examine how technology agility serves as an important antecedent to the other three organizational agilities. Our framework identifies technology agility as the starting point of how

organizational agilities impact business processes which ultimately impact firm performance. As such, technology agility can be thought of as an important resource that creates dynamic capability for sustainable competitive advantage in dynamic and competitive environments. By studying this new dimension of organizational agility, our research provides a new direction for future research on how technology agilities impact organizations.

Another important theoretical contribution of our research is that we answered the research call from researchers, which suggests there is a further need to develop and empirically test a normative framework that is anchored on both a dynamic capability approach (Teece, Pisano and Shuen, 1997) and the process-based view (Soh and Markus, 1995; Mooney et al., 1996). Our framework creates an additional theoretical lens through which we argue that the impact of technology agility and the other dimensions of organizational agility on firm performance are mediated by intermediate business processes. Our framework emphasizes the strategic role that technology agility plays in shaping dynamic capabilities, which leads to enhanced firm performance. The strategic role of technology in our framework differs from prior conceptualizations of the business value of technology, which have focused on the infrastructure and configuration of technology resources (e.g.. Weill 1992; Lucas 1993; Sambamurthy et al., 2004; Overby et al., 2006). Instead, our framework focuses on the impact of the firm's ability to react to changes in technologies on organizational agilities, which, ultimately, impact firm performance through business processes.

Our research offers several important managerial implications as well. First, firms must be technology agile before they can create customer, partner and operational

agility. Second, strategic focus of technology should be emphasized. In a competitive environment, such a focus should be on a firm's external relationships with customers and training partners. Third, quality is number one. High quality leads to both significantly better market and financial performances. Finally, we found a strong link from organizational agilities to production efficiency suggesting that it could be the case that firms should not be overly change-oriented because these changes can be costly and disruptive. Thus, future researchers should more clearly help firms to identify high return-on-investment changes based on environmental scans.

To broaden the applicability of our results, future research may want to extend our framework to other industries. Alternative operationalizations of the constructs in our model can also be explored. More specifically, future research could try to incorporate other potentially relevant constructs to the study of organization agilities such as entrepreneurial orientation, firm nationality, and the role of government incentives and labor regulations. Additional efforts to investigate the processes through which organization agilities get converted to firm performance are needed.

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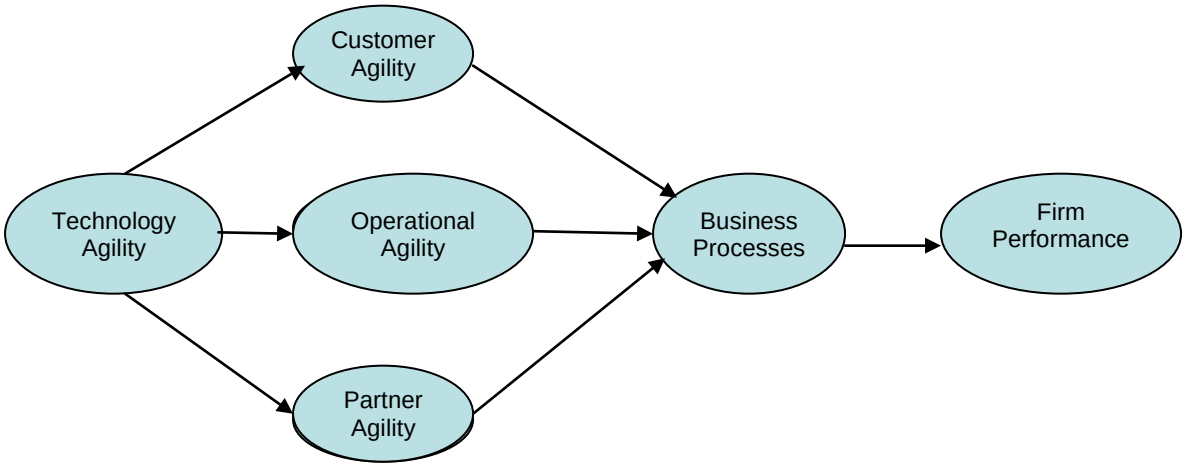

Figure 1: Theoretical Framework

Table 1. Research Hypotheses

Hypothesized Link	*Testable Hypotheses*
Hypotheses 1:	$H1_{tc}$: Technological agility has a positive impact on a firm's customer agility.
Technological agility has a positive impact on organizational agilities.	$H1_{tp}$: Technological agility has a positive impact on a firm's partner agility.
	$H1_{to}$: Technological agility has a positive impact on a firm's operational agility.
Hypotheses 2:	$H2_{cs}$: Customer agility has a positive impact on a firm's business processes measured by speed to market.
Organizational agilities have positive impacts on business processes.	$H2_{cq}$: Customer agility has a positive impact on a firm's business processes measured by product quality.
	$H2_{ce}$: Customer agility has a positive impact on a firm's business processes measured by production efficiency.
	$H2_{ps}$: Partner agility has a positive impact on a firm's business processes measured by speed to market.
	$H2_{pq}$: Partner agility has a positive impact on a firm's business processes measured by product quality.
	$H2_{pe}$: Partner agility has a positive impact on a firm's business processes measured by production efficiency.
	$H2_{os}$: Operational agility has a positive impact on a firm's business processes measured by speed to market.
	$H2_{oq}$: Operational agility has a positive impact on a firm's business processes measured by product quality.
	$H2_{oe}$: Operational agility has a positive impact on a firm's business processes measured by production efficiency.
Hypotheses 3:	$H3_{sm}$: Speed to market has a positive impact on a firm's market performance.
Business processes have positive impacts on organizational performance.	$H3_{sf}$: Speed to market has a positive impact on a firm's financial performance
	$H3_{qm}$: Product quality has a positive impact on a firm's market performance.
	$H3_{qf}$: Product quality has a positive impact on a firm's financial performance
	$H3_{pm}$: Production efficiency has a positive impact on a firm's market performance.
	$H3_{pf}$: Production efficiency has a positive impact on a firm's financial performance

Table 2. Measurement Model: Loadings and Reliability

Constructs	Indicators[a]	Loadings	Composite Reliability	AVE
		Agility Variables		
Technology agility (TA)	S3Q10	0.55	0.83	0.57
	S3Q22	0.60		
	S3Q23	0.91		
	S3Q24	0.87		
Customer agility (CA)	S5Q16	0.66	0.83	0.50
	S5Q19	0.75		
	S5Q20	0.74		
	S5Q22	0.69		
	S5Q24	0.67		
Partner agility (PA)	S4Q26	0.83	0.87	0.70
	S4Q27	0.89		
	S4Q28	0.79		
Operational agility (OA)	S4Q3	0.85	0.85	0.54
	S4Q4	0.79		
	S4Q5	0.44		
	S4Q6	0.65		
	S4Q10	0.85		
		Business Process Variables		
Speed to Market (SM)	S6Q4	0.78	0.92	0.71
	S6Q5	0.89		
	S6Q6	0.86		
	S6Q7	0.85		
	S6Q8	0.82		
Product Quality (PQ)	S6Q16	071	0.88	0.65
	S6Q17	0.83		
	S6Q18	0.75		
	S6Q31	0.92		
Production Efficiency (PE)	S6Q33	0.76	0.85	0.59
	S6Q34	0.84		
	S6Q35	0.78		
	S6Q38	0.67		

Table 2. Measurement Model: Loadings and Reliability (Continued)

Constructs	Indicators	Loadings	Composite Reliability	AVE
		Performance Variables		
Market (MP)	S6Q21	0.63	0.88	0.534
	S6Q22	0.66		
	S6Q24	0.68		
	S6Q25	0.81		
	S6Q30	0.81		
Financial (FP)	S6Q23	0.89	0.93	0.77
	S6Q26	0.89		
	S6Q27	0.87		
	S6Q28	0.86		

Note: [a] the definitions for the indicators are in Appendices A, B and C.

Table 3. PLS Estimates and Hypothesis Results

Hypothesis	Path	Estimate	t-ratio	α
$H1_{tc}$	TA -> CA	0.45	6.22	<0.01
$H1_{tp}$	TA -> PA	0.53	6.37	<0.01
$H1_{to}$	TA -> OA	0.19	1.97	<0.05
$H2_{cs}$	CA-> SM	0.11	1.07	ns
$H2_{cq}$	CA-> PQ	0.19	2.28	<0.05
$H2_{ce}$	CA-> PE	-0.20	1.18	ns
$H2_{ps}$	PA-> SM	0.02	0.20	ns
$H2_{pq}$	PA-> PQ	-0.13	1.24	ns
$H2_{pe}$	PA-> PE	0.01	0.05	ns
$H2_{os}$	OA-> SM	0.32	2.63	<0.01
$H2_{oq}$	OA-> PQ	0.32	3.18	<0.01
$H2_{oe}$	OA-> PE	-0.03	0.17	ns
$H3_{sm}$	SM -> MP	0.17	2.52	<0.01
$H3_{sf}$	SM-> FP	0.17	1.55	<0.10
$H3_{qm}$	PQ -> MP	0.63	10.74	<0.01
$H3_{qf}$	PQ-> FP	0.57	7.47	<0.01
$H3_{pm}$	PE -> MP	-0.01	0.11	ns
$H3_{pf}$	PE-> FP	-0.20	1.62	<0.10
Nodes				$\mathbf{R^2}$
CA				0.21
PA				0.28
OA				0.04
SM				0.15
PQ				0.15
PE				0.04
MP				0.56
FP				0.42

Appendix A. Organizational Agility Variables and Indicators

Organizational Agility Variables	**Indicators**	**Content**
Customer Agility (H1)	S5Q16	It is typical practice for this business unit or its major competitors to frequently change all or part of the line of products offered in order to satisfy customer needs.
	S5Q19	Our customers are increasingly expecting that we customize our products online.
	S5Q20	Our customers are increasingly demanding more product variety.
	S5Q22	Our customers demand that we offer different configurations of the same model.
	S5Q22	Product variety is an important feature for our customers.
Operational Agility (H2)	S4Q3	Most of our products have been decomposed into separate modules that can be re-combined into new product designs to achieve higher variety and reduce development time.
	S4Q4	For our main product(s), we can make changes in key components without having to redesign other components.
	S4Q5	For our current main product(s), we have re-use components (carry-over) from previous product generations.
	S4Q6	We have a high degree of component sharing between different products in our main product line.
	S4Q10	Overall our business unit adopts a high degree of modularity in production.
Partner Agility (H3)	S4Q26	We frequently use cross-functional teams composed with our people and with people from our major suppliers to carry out key activities in the development stage.
	S4Q27	We frequently use cross-functional teams composed with our people and with people from our major suppliers to carry out key activities in the assembly line.
	S4Q28	We frequently cooperate with our major suppliers in order to resolve problems whenever an unexpected situation arises.
Technology Agility (H4)	S3Q10	In the event of a major change in technology, our business is prepared to quickly make adjustments in production to adapt to new technological standards.
	S3Q22	We have a business plan to use existing technology to enter new market segments
	S3Q23	We have a business plan to develop new technologies for new kinds / variations of products.
	S3Q24	We have a business plan to develop collaboration and strategic alliances for developing and exploring new technologies.

The Likert-type scale: *1. Strongly Disagree, 2. Disagree Somewhat, 3. Neither Agree nor Disagree, 4. Agree Somewhat, 5. Strongly Agree*

Appendix B. Business Process Variables and Indicators

Business Process Variables	Indicators	Content
Speed to Market[1]	S6Q4	Our time to determine the feasibility of proposed technologies was …
	S6Q5	Our time to determine the plan for product development and introduction was …
	S6Q6	The time RandD and manufacturing spent on determining how to produce a product at a desirable price was …
	S6Q7	The time spent from commitment to manufacture and to the occurrence of sales was...
	S6Q8	The overall speed to market of our products from initial idea to the occurrence of initial sales was …
Quality[2]	S6Q12	Overall product performance was …
	S6Q13	Number of unique product features was …
	S6Q16	Ease of product serviceability was …
	S6Q17	Product reputation was …
	S6Q18	Product prestige was …
Efficiency[3]	S6Q33	Our Dock-to-Dock (time from start to end of assembly) indicator has been shorter
	S6Q234	Our First-Time-Through (percentage of final products without any problems) indicator has been better
	S6Q35	We have been able to improve the ratio of the number of final products produced by number of employees
	S6Q38	Our Greening (quantity of waste per unity produced) indicator has been reduced

[1]*The* Likert-type scale: *1. Much Slower, 2. Slower, 3. About the Same, 4. Faster, 5. Much Faster*
[2]*The* Likert-type scale: *1. Much Lower, 2. Lower, 3. About the Same, 4. Higher, 5. Much Higher*
[3]*The* Likert-type scale: *1. Strongly Disagree, 2. Disagree Somewhat, 3. Neither Agree nor Disagree, 4. Agree Somewhat, 5. Strongly Agree*

Appendix C. Performance Variables and Indicators

Business Process Variables	**Indicators**	**Content** *In the last 12 months, in comparison to our three major competitors,*
Market[1]	S6Q21	Our business unit's performance measured by sales growth rate was …
	S6Q22	Our business unit's performance measured by market share was …
	S6Q24	Or business unit's performance measured by customer loyalty was …
	S6Q25	Our business unit's performance measured by customer satisfaction was
	S6Q30	Our business unit's market share has been …
Financial[1]	S6Q23	Our business unit's performance measured by profitability was…
	S6Q26	Our business unit's performance measured by return on investment was
	S6Q27	Our business unit's performance measured by return on sales was …
	S6Q28	Our business unit's financial performance has been …

[1]*The* Likert-type scale: ***1. Much Lower, 2. Lower, 3. About the Same, 4. Higher, 5. Much Higher***