The effect of strategic alignment of complementary IT and organizational capabilities on competitive firm performance

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Abstract. This study explores how firm performance can be explained from the strategic alignment of information technology (IT) and organizational capabilities, i.e., IT flexibility, dynamic capabilities, and absorptive capacity. We build upon dynamic capabilities theory and conceptualize our research model through the lens of strategic alignment methods. Then, we empirically test our main hypothesis using PLS-SEM analysis on a sample of 322 international firms. Outcomes show that measurements and indicators of all first-order and higher-order constructs are reliable and valid. Results also indicate that there is a positive relationship between strategic alignment and competitive firm performance. This study highlights the importance of alignment between IT and organizational capabilities. Strategic alignment can, therefore, be seen an important facilitator of competitive firm performance in constantly changing environments. We conclude with a discussion and conclusion, outline limitations of the current study and present some directions for future research.

Keywords: Strategic alignment, IT flexibility, dynamic capabilities, absorptive capacity, third-order factor modeling, structural equation modeling (SEM), firm performance

1 Introduction

During the past two decades, it has become apparent that firms that want to be more competitive need to align their business operations, information systems and information technology (IS/IT) resources and capabilities and take into account the dynamics of the changing environment [1-4]. Synthesizing from recognized sources on IS/IT development, effectiveness and IS/IT alignment [3, 5-8], we contend that a flexible IT infrastructure—as a key quality of IT capabilities [9, 10]—and other complementary organizational capabilities in harmony strengthen a firm's armory to drive a firm's competitive advantage [4, 11-14]. Organizational capabilities can be considered processes that facilitate the most efficient, effective and competitive use of firms' assets whether tangible or intangible [15]. Hence, capabilities, therefore, represent the potential of a firm to achieve certain objectives by means of focused deployment and are considered the building blocks on which they compete in the

market. IT capabilities can be defined as firms' ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities in order to differentiate from competition [16].

Synergies between a firm's IT and organizational resources and capabilities are the foundation of what is called 'strategic alignment' [5, 17-19]. Recently, a growing body of literature has stressed the importance of adopting a dynamic methodological approach, in which scholars and practitioners are equipped with adequate assessment tools and mechanisms for examining the processes when IT adds value under rapidly changing conditions [4] and increases levels of competitiveness and innovativeness [14, 20-22]. However, there is currently very little published IS/IT and management scholarship that addresses this particular challenge of simultaneously leveraging and aligning current IS/IT, complementary organizational resources and IT capabilities to improve competitive firm performance (and hereinafter referred to as performance) [3, 8, 9, 11, 13, 23].

Given the above, our main objective is to investigate whether, and if so, to what extent strategic alignment of complementary IT and organizational dynamic capabilities influences performance. Strategic alignment, in this particular context, refers to the degree of equilibrium between different organizational dimensions [5, 6, 13, 24, 25]. Hence, we draw from theoretical developments of the dynamic capabilities theory (DCT) [2]. This is an influential theoretical perspective that is feasible to identify and prescribe organizational and strategic routines and explains how firms must co-evolve and reconfigure their IS/IT operations and IT architecture. Additionally, we build upon novel work done by Van de Wetering [24, 25] who developed a novel approach toward strategic alignment [2]. To this end, we conceptualize our research model through the lens of strategic alignment theories and methods.

The remainder of this paper is outlined as follows. First, we review theoretical aspects relevant to this study. Next, we outline our research model which is followed by the methods and results section. We end with main findings, discussions, inherent limitations of this study and we outline future research opportunities.

2 Theoretical background

Emerging insights suggests that strategic alignment between IT and complementary organizational capabilities strengthen a firm's ability to generate IT business value and ultimately enhancing a firm's competitive advantage and innovativeness [11, 13, 14, 21]. Our current focus is on how firms can become more competitive by synchronizing their (a) ability to (re)use and reconfigure IS/IT strategically, (b) their capabilities to differentiate and compete in a turbulent environment, and (c) complementary IT-related capacities to learn and transform business operations. Thus, we now review the three core pillars of this research, i.e., (1) IT flexibility, (2) dynamic capabilities and (3) a firm's absorptive capacity.

2.1 Pillar I: IT flexibility

IT flexibility can be defined as 'the degree of decomposition of an organization's IT portfolio into loosely coupled subsystems that communicate through standardized

interfaces' [26]. Flexible and modular system design dates back to Simon's theory of near decomposability [27]. In essence, this theory argues that complex systems consisting of modular, or else nearly decomposable subunits, tend to evolve faster, increase the rate of adaptive response and tune towards stable, self-generating configurations [27]. Modularity is a characteristic which largely determines the effectiveness in implementing continuous change, and is suggested to be an antecedent of dynamic capabilities [23, 28], see next section. Abstracting these concepts to the IS domain, modularity has, e.g., been examined as the flexibility of the IT architecture and the decentralization of the IT governance structure [26]. It also emerged as a key competitive priority in many organizational activities and is considered as a critical component to efficaciously adapt and reconfigure IT architectures strategically [12, 29]. Moreover, flexible IT architectures have been labeled as a facilitator of IT-based competitive actions and recent work showed that characteristics of a firm's IT architecture facilitate and strengthen (IT-enabled) dynamic capabilities [23].

2.2 Pillar II: Dynamic capabilities

DCT has emerged as an influential perspective in the study of strategic management over the past decade and attempts to explain the processes through which a firm evolves in changing environments and maintains a competitive edge [2, 30, 31]. Due to conditions of high environmental uncertainty, market volatility, and frequent change, scholars have raised questions regarding the rate to which traditional operational and existing 'resource-based' capabilities erode and cease to provide competitive gains [32, 33]. Literature has suggested that under these particular conditions the focus should be shifted toward strengthening 'dynamic' capacities of change and readjustment of operational capabilities [32]. Dynamic capabilities, therefore, constitute the firm's ability to use resources—specifically processes to integrate, reconfigure, gain and release resources—to match and even create market change [1, 2]. Studies have relied on baseline work by Teece et al. [2] in order to isolate main routines that underpin dynamic capabilities and empirically measure them. Most recent work suggests that dynamic capabilities comprise of the following routines: (1) sensing, (2) coordinating, (3) learning, (4) integrating, and (5) reconfiguring [23, 34, 35].

Synthesizing from the above, the DCT is therefore considered an appropriate 'framework' 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 and IT architecture in order to remain competitive.

2.3 Pillar III: Absorptive capacity

Strongly related to DCT is a firm's absorptive capacity (ACAP). This capacity refers to the ability to identify and recognize the value of new, external information, acquire, assimilate or transform this information (or knowledge) into the firm's knowledge base, and apply this new knowledge through innovation and competitive actions [36, 37]. This 'hard-to-copy' capacity does not simply depend on firms' direct interface

with the external environment, but actually, also on the transfer of knowledge across and within the organization. ACAP is a multidimensional construct, through which a firm's long-term survival and success can be strengthened [36]. This particular concept has been studied in the context of many IS/IT domains, i.e., IT business value, knowledge management/transfer, IT assimilation and business-IT knowledge [11, 12, 38].

A key takeaway from a recent study [11] is that IT business value is a result of a synergetic and complementary relationship between an organization's IT capabilities and ACAP. Following the dominant perspective and approach that ACAP is an organizational capability and not an asset, we subsequently regard a firm's ACAP as the complementary IT-related capability (to dynamic capabilities and IT flexibility) rather than a firm's prior related knowledge [7] that affects its ability to reconfigure its existing substantive capabilities [11].

3   Research model

Within our research model we statistically and appropriately capture strategic alignment by a pattern of covariation, which coincides with the concept of (co-) alignment as a statistical scheme within Structural Equation Modeling (SEM) [24, 39]. Thus, strategic alignment of IT and organizational dynamic capabilities can be modeled using a generalized representation using higher-order latent constructs with underlying measurable indicators. Subsequently, we designed our model combining the three central pillars: (1) IT flexibility, (2) dynamic capabilities, (3) ACAP and the final construct 'Competitive firm performance' as the model's explanandum using a balanced and multifactorial evaluation perspective [40, 41].

In interconnecting the latent constructs and all manifest variables within our research model, we propose a reflective construct model, through which the manifest variables are affected by the latent variables [42, 43]. Our higher-order reflective construct model is specified as an alternative to a mode in which latent constructs are modeled using patterns of correlations (covariance based SEM). This is subsequently done using repeated indicators [42]. Indicators now share a common theme and are manifestations of key constructs. In addition, any changes in constructs cause changes in the indicators. Hence, variance in each measure is explained by a construct common to all measures and error unique to each measure, and covariance among the measures is attributed to their common causes.

Our research model perceives strategic alignment as a third-order latent construct representing three underlying second-order factors, i.e., IT flexibility, dynamic capabilities, and ACAP. First-order constructs represent the underlying dimensions of these respective pillars. Strategic alignment governs and represents the underlying second-order pillars and can be considered an overall trait that influences performance. The second-order latent constructs basically explain and encompass the first-order constructs in a more parsimonious way.

Given the above, we define the following hypothesis: *"Strategic alignment of IT flexibility, dynamic capabilities, and firms' ACAP is positively associated with competitive firm performance".*

Figure 1 portrays our research model and captures the theorized relationships.
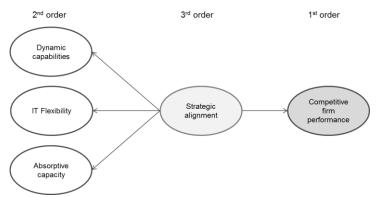
Fig 1. Research model showing hypothesized interrelations between constructs.

4 Methods

4.1 Data and Sample Collection Procedure

A survey was administered to key informants (C-level managers and executives). Survey items used a Likert scale from 1 – strongly disagree to 7 – strongly agree and were pretested [23]. Also, 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). In total 1500 firms were randomly selected from the ICAP business directory, comprising of firms from almost all industries and sectors. 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 duration of the data gathering process was approximately nine months (January 2015–September 2015). In total, we incorporated 322 usable questionnaires yielding a valid response rate of 21.4%, which is consistent with comparable studies using key informant methodology [44]. In order to control *ex-ante* for common method bias, respondents were assured that data collected would remain anonymous, and would be used solely for research purposes at an aggregate 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. The survey was in most cases completed by chief information officers (CIOs), chief executive officers (CEOs) and IT managers. In accordance with the EU commission size-class recommendation (2003/361/EC), firms were grouped into large (38%), medium (20%), small (26%), and micro (16%).

4.2 Variables and measurement

Our research model's constructs are all based on past empirical and validated work. *IT flexibility* is developed as a second-order construct in SEM reflectively connecting them to the block of the underlying first-order dimensions, with first-order

dimensions being, loose coupling, standardization, transparency, and scalability [26, 45].

Following established work, *Dynamic capabilities* were measured as a second-order construct, comprised of five first-order constructs. The dimensions that comprise dynamic capabilities are adapted measures of sensing, coordinating, learning, integrating, and reconfiguring routines [34, 35].

Absorptive capacity was also developed as a second-order construct with four underlying dimensions. Consistent with past research these dimensions include acquisition, assimilation, transformation, and exploitation [36, 46].

Finally, *Competitive performance* refers to the degree to which a firm performs better than its key competitors [47]. Specifically, respondents were asked to evaluate the relative performance of their firm in terms of profitability, market share, growth, innovativeness, cost leadership, and delivery cycle time [46, 47].

4.3 Model validation

We use PLS (Partial least squares)-SEM in order to simultaneously assess our research model's measurement ('outer') and the structural ('inner') model [48]. We applied a multi-step analysis approach estimating parameters in the inner and outer models using SmartPLS version 3.2.6. [49], which is a SEM application using PLS. Also, we used the path weighing scheme available within SmartPLS in addition to centroid and factor schemes with the knowledge that the choice of each scheme has a minor impact on the final result [50]. Next, we employed a non-parametric bootstrapping procedure [50], to compute the level of the significance of the regression coefficients, with 500 replications to interpret their significance and to obtain stable results. The current study has a sample size of $N = 322$. Given the rationale above PLS-SEM is deemed particularly appropriate for this study since it also permits the simultaneous estimation of multiple causal relationships between one or more independent constructs and one or more dependent variables [51]. In terms of sample size requirements, the 322 responses received exceeds all minimum requirements concerning the measurement and structural model [51].

5 Results

5.1 Measurement Model (the 'Outer' model)

In order to demonstrate the quality of the measurement model, we assessed the psychometric properties of the research model on satisfactory levels of validity and reliability. Thus, the measurement model was assessed for first-order constructs. To assess the convergent validity and reliability assessment of the indicators (i.e., manifest variables), composite reliabilities[1] (CR; [50]) and average variance extracted (AVE; [50])—i.e., the average variance of measures accounted by the latent

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[1] Composite reliability is similar to Cronbach's alpha without the assumption of the equal weighting of variables. Its mathematical formula (with the assumption that the factor variance = 1; standardized indicators) is $\rho = (\Sigma\lambda_i)^2 / ((\Sigma\lambda_i)^2 + \Sigma 1 - (\lambda_i)^2)$.

construct—were computed. As a general rule of thumb, variables with a loading less than 0.6 should be removed from the sample. We also calculated and analyzed cross-loadings of all the reflective constructs. All cross-loadings and reliability measures (including the higher order constructs and associated loadings and reliability measures) exceeded the threshold, indicating sufficient convergent validity. Next, discriminant validity was assessed by verifying (1) whether indicators loaded more strongly on their corresponding (first-order) constructs than they did on other constructs and (2) that the square root of the AVEs is larger than the inter-construct correlations (see entries in bold in Table 1 along the matrix diagonal). The off-diagonal elements are correlations between latent variables as calculated by the PLS algorithm. As can be seen from Table 1, all square root scores of the AVEs are higher than the shared variances of the constructs with other constructs in the model.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Acquisition	**0.901**													
2. Assimilation	0.665	**0.912**												
3. Exploitation	0.721	0.680	**0.874**											
4. Transformation	0.740	0.674	0.799	**0.888**										
5. Sensing	0.470	0.611	0.586	0.537	**0.844**									
6. Learning	0.493	0.543	0.631	0.583	0.708	**0.905**								
7. Integrating	0.430	0.545	0.537	0.514	0.738	0.645	**0.868**							
8. Coordinating	0.427	0.523	0.559	0.526	0.730	0.709	0.688	**0.830**						
9. Reconfiguring	0.434	0.519	0.593	0.525	0.737	0.732	0.695	0.700	**0.876**					
10. Loose Coupling	0.372	0.401	0.443	0.484	0.648	0.596	0.497	0.618	0.582	**0.820**				
11. Scalability	0.384	0.381	0.432	0.453	0.528	0.585	0.501	0.632	0.529	0.658	**0.896**			
12. Standardization	0.335	0.457	0.346	0.322	0.527	0.496	0.524	0.543	0.436	0.456	0.625	**0.811**		
13. Transparency	0.328	0.283	0.408	0.384	0.470	0.447	0.405	0.476	0.469	0.683	0.696	0.525	**0.811**	
14. Competitive Performance	0.423	0.466	0.428	0.367	0.506	0.386	0.382	0.459	0.497	0.493	0.319	0.399	0.389	**0.787**
AVE	0.812	0.833	0.764	0.789	0.712	0.820	0.754	0.689	0.767	0.672	0.804	0.658	0.657	0.620
Composite reliability	0.928	0.937	0.906	0.918	0.908	0.948	0.925	0.898	0.929	0.925	0.942	0.905	0.905	0.942

Table 1. Assessment of convergent and discriminant validity of reflective first order constructs[2].

Thus, adequate convergent and discriminant validity was found for all constructs. Further evidence of discriminant validity was obtained using cross-loadings as quality criteria [42]. These findings indicate that the loadings for each indicator were greater than the cross-loading on other latent variables in the model.

In summary, the outcomes of the measurement model suggest that the constructed PLS model is valid and reliable. The relationships between the latent construct 'Strategic alignment' and the underlying second-order factors are thereby confirmed. The same applies to the relationships between the second-order factors and their respective first-order constructs. The structural model can now be evaluated.

5.2 Structural Model (the 'Inner' Model)

Using SEM analysis we also estimated and validated the structural model and its relationship among (higher-order) latent constructs. We found support for our main hypothesis. There was a significant positive impact of Strategic alignment on performance ($\beta = .56$; $t = 10.77$; $p < .0001$). Although PLS modeling does not include a single proper single goodness-of-fit measure, the variance explained by the model (R^2)—the coefficient of determination—values of the endogenous constructs are commonly used to assess model fit. R^2 accounted for by Competitive firm

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[2] Entries 1-4 concern dimensions of ACAP, 5-9 concerns dynamic capabilities and the entries 10-13 concern dimensions of IT flexibility.

performance was 0.31. This coefficient of determination, as model's predictive power, represent moderate to substantial predictive power and accuracy [48]. Our hypothesis that strategic alignment of IT flexibility, dynamic capabilities, and firms' ACAP is positively associated with competitive firm performance, was thereby confirmed.

Next to the explained variance of our model (R^2), we subsequently calculated the Q^2 of our endogenous constructs (i.e., using Stone–Geisser's test) to assess the quality of each structural equation measured by the cross-validated redundancy and communality index (using the blindfolding procedure in SmartPLS v3.2.6) and to evaluate the predictive relevance for the model constructs [43]. Q^2 measures how well the observed values are reproduced by the model and its parameter estimates by using cross-validation [48]. Q^2 values > 0 imply the model's predictive relevance; values less than 0 suggest the model's lack of predictive relevance. In this study, all Q^2 values were above the threshold value of zero, thereby indicating the overall model's predictive relevance.

PLS-SEM studies rarely report critical heterogeneity issues concerning their data [52]. Traditional (sequential) clustering techniques (e.g., K-means, tree clustering) on manifest variables are ineffective to account for heterogeneity in path model estimates. We controlled for unobserved heterogeneity employing the finite mixture (FIMIX) PLS procedures. Doing so, we segmented the data sample into various segments (s2 – s5) to identify whether there are factors that are not included in our analysis which might explain differences across various groups of firms [53]. Results indicate that higher levels of explained variance can be achieved for various homogeneous sub-groups. Currently, we did not provide a comprehensive *ex-post* FIMIX-PLS analysis.

6 Discussion and conclusion

This research empirically supports the hypothesis that strategic alignment of IT and organizational dynamic capabilities is positively associated with performance. Results support the validity and reliability of our hierarchical higher-order model and the conceptualization and operationalization of strategic alignment using covariation as statistical scheme within SEM.

This study has some interesting findings that can be applied in practice as outcomes suggest that, to some extent, strengthening imperative pillars and firm investment cycles (or efforts) in isolation is not sufficient in order to enhance a firm's competitive edge. Rather, the complementarities, synergies and ongoing interactions among different capabilities are a key enabler of performance, which is consistent with the extant literature [5, 6], determining factors that facilitate a state of alignment [54], and capabilities and their ability to launch competitive actions [10, 23]. This is an important insight for business, IT managers and executives because they can look at strategic alignment, with the underlying pillars, i.e., IT flexibility, dynamic capabilities, and a firm's absorptive capacity, as a mean (and key toolbox) to drive firm performance and systematically enhance the evolutionary fitness of the firm.

Our research, thus, shows that decision makers should employ a value yielding strategy that is focused on synchronizing efforts, resources, and activities. This, consequently, raises the need for decision makers to form multi-disciplinary teams of

employees on all levels within the organization, including experts from both IT and the rest of the business functions.

Despite its contributions, the present study is constrained by a number of limitations that future research should seek to address. First, we currently did not perform a comprehensive *ex-post* FIMIX-PLS analysis through which multiple group and (sub)segments comparisons are analyzed in detail. Also, we currently did not compare outcomes of the model with respect to moderately turbulent and highly turbulent environments [55]. Outcomes of this study could then also be refined and substantiated by using configurational methods like e.g., fuzzy-set Qualitative Comparative Analysis (fsQCA). FsQCA enables the examination of interplays between elements of a messy and nonlinear nature [56, 57]. More detailed mechanisms will be unfolded concerning the limits and conditions to which alignment of IT and organizational dynamic capabilities add value. This perspective complements our theoretical 'lens'. Also, comparing results across industries, countries and distinct groups might also contribute to the generalizability of our findings.

Finally, we currently did not go into detail how firms can actually synthesize and define improvement activities that best meets a firms' current and future needs. Future work could address how managers should deploy improvement projects done simultaneously and hence by an integrated alignment perspective taking into account a variety of facets, e.g., risks, investment costs, critical success factors, and benefits.

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