A bottom-up path for IT management success: From infrastructure quality to competitive excellence

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A bottom-up path for IT management success: From infrastructure quality to competitive excellence

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Abstract

Can an information technology (IT) infrastructure contribute to competitive advantage and firm performance, even if this infrastructure follows IT standards and best practices, and is then neither rare nor inimitable as a re- source? This study leverages the dynamic capability viewand the underpinning evolutionary theories ofroutines, learning, and cooperation to develop amodel analyzing and explaining the bottom-up path fromthe quality ofIT infrastructure to the competitive excellence of the firm in medium-to-fast-paced business environments. This three-step causal path links the following constructs: (1) IT infrastructure quality (ITIQ); (2) business–IT partner- ship (BITP); (3) strategic contribution ofIT (ITSC), and (4) firm's competitive excellence (CE). The study tests this model through a survey questionnaire to 212 Italian managers.

1. Introduction

Information systems and information technology (IT) scholars and practitioners often refer to the composite of hardware, software, and connectivity of an organizational system as its IT infrastructure. Both scholars and practitioners evaluate the quality of IT infrastructure through technical and efficiency measures, which include, for example, its robustness, reliability, usability, compatibility, integration, scalability, and modularity (Bhatt, Emdad, Roberts, & Grover, 2010). Does a high-quality IT infrastructure play a strategic role in organizations? This question gives rise to a lively, long debate. Today, many scholars agree that the IT infrastructure plays a strategic role and indirectly influences firm performance, but the process through which this influence unfolds is not completely clear (Kohli & Grover, 2008). The nature of mainstream theories that scholars traditionally use to address IT management issues may contribute to this gap in under- standing. Most scholars investigating information systems and information management topics build upon the resource-based view (RBV) of the firm (Wade & Hulland, 2004) and/or the literature on business–IT alignment (Luftman, 2000). Although the RBV and the alignment ap- proach suitably explain the top-down path from competitive strategic moves to IT management and, consequently, IT infrastructure, these theories do not provide effective tools to understand the possible feedback effects and bottom-up paths, leading from a high-quality IT infrastructure to strategic contribution of IT and competitive excellence. The RBV assumes that a firm's success depends on the firm's control over valuable, rare, and inimitable resources, because only this control would allow the firm to build and maintain a sustainable competitive advantage. This view often leads scholars to assume that an IT infrastructure may only play a strategic role when representing a rare and inimitable resource—that is, only when the IT infrastructure is high- ly idiosyncratic and very specific to the firm (Santhanam & Artono, 2003). In contrast, today's IT infrastructures often consist of standard solutions and thus are easily imitable, mainly because of the booming phenomena of IT outsourcing and cloud computing. Many components of IT infrastructures are, indeed, commodities. Therefore, the classical RBV has difficulties in explaining the potential strategic value of these IT infrastructures. In many cases, also the literature on dynamic capabilities (Teece, Pisano, &

Shuen, 1997) views the firm through the RBV strategic lens (Lin &Wu, 2014). According to the authors who follow this logic, organizational capabilities, and particularly the capability to change and adapt operational routines, should aim at the only strategic goal, which consists of transforming valuable, rare, inimitable, and non-substitutable (VRIN) resources into competitive advantage (Cepeda & Vera, 2007). In this view, dynamic capabilities are factors that investments must lever- age to achieve competitive advantage. Conversely, the efficiency with which IT infrastructures enable operational routines is unlikely to draw the attention of these scholars. The literature on business–IT alignment tends to follow a top-down logic similar to that which the RBV adopts. Alignment studies usually posit that a good fit between IT infrastructure and business needs derives from explicit planning and coordination at the top management level, for example, between the CEO and the CIO (Karahanna & Preston, 2013). In this view, scholars devote great attention to the CIO's characteristics (Li & Tan, 2013); change and innovation mainly result from strategic design, and effective operational alignment is a hierarchical consequence of strategic alignment. Although these approaches provide valuable contributions to understanding IT management value, they do not explain the social mech- anisms allowing improvisation, ad-hoc problem solving, and bottom- up and/or emergent innovation, which increasingly appear as the sole strategies underlying the survival of firms in turbulent markets (Sambamurthy, Bharadwaj, & Grover, 2003). Therefore, the alignment approach to IT, the RBV, and the literature on dynamic capabilities under the RBVmay fail to explain how (IT-supported) competition really occurs in fast-paced business environments (Barreto, 2010). For these reasons, this study adopts an evolutionary perspective rather than the RBV or alignment approach to examine the strategic role of IT infrastructure quality in today's turbulent business scenario. This study builds upon the seminal work of Sambamurthy et al. (2003), which analyzes organizational evolution following Schumpeter's adap- tive dynamics (Schumpeter, 1934). According to the Schumpeterian theory of disequilibrium and market disruption, fast-paced environments rapidly erode any competitive advantage. Predicting how the next wave of key competitive advantages will look like in the future is often impossible. Therefore, superior performance may stem only from continuous innovation and strategic moves disrupting the equilibria. The disruption of old equilibria generates options (Amram & Kulatilaka, 1999) that may provide a dramatic, although temporary, competitive advantage if firms exercise them timely. This strategy requires a coevo- lutionary attitude, because effective and systematic option seizing, de- velopment, and selection can only occur through a wide, diverse, an d dynamicweb ofcollaborative links, both within and across organizations (Eisenhardt, 2000). Sambamurthy et al. (2003) define this logic as the logic of opportunity, opposing to the logic of leverage typical of the RBV. The logic of opportunity focuses on evolutionary learning processes and therefore provides an interesting alternative approach to dynamic capabilities, by highlighting the importance of aspects that the mainstream logic of leverage overlooks. Under the Schumpeterian (Schumpeter, 1934) conditions of creative destruction and coevolutionary learning, second- level routines cannot deterministically predict and control all the possi- ble changes in first-level (i.e. operational) routines that the firm may need one day. Therefore, existing routines must (1) enhance explora- tion, sensing, and alertness, thus allowing a firm to be quickly aware of emerging threats and opportunities; (2) allow or facilitate the rapid seizing of opportunities; (3) allow rapid unlearning, knowledge, and process recombination, trial-and-error, and improvisation; and (4) sup- port cooperation (Eisenhardt, 2000; Teece et al., 1997). The above perspective supports the idea that the IT infrastructure may play a crucial role in the pursuit of competitive excellence. Any typical high-quality IT infrastructure today is scalable, modular, and fully compatible with web standards, and therefore has the potential to strongly support the four goals appearing above (Sambamurthy et al., 2003). Despite the explanatory power of the evolutionary vision, the information systems literature has yet to explore its potential, with few models leveraging a Schumpeterian (Schumpeter, 1934) view of rou- tines to explain the bottom-up path from IT infrastructure quality to competitive excellence. This study draws on the evolutionary theories of learning and cooperation and on themodel ofZollo and Winter (2002),which identifies three steps in the successful knowledge-based evolution of a firm: experience accumulation, knowledge articulation, and knowledge codification. Using these elements, this study develops a model that predicts a three-step bottom-up path from IT infrastructure quality to competitive excellence in turbulent business environments. This three-step causal path links the following constructs: (1) IT infrastructure quality (ITIQ); (2) business–IT partnership (BITP); (3) strategic contribution of IT (ITSC); and (4) firm's competitive excellence (CE). Through a survey questionnaire involving 212managers in northern Italy, the study tests this model. The analysis confirms that BITP fully mediates a positive relationship between ITIQ and ITSC and that ITSC fully mediates the positive relationship between BITP and CE. This study proposes an alternative way of looking at information systems management. As today's IT infrastructures are often modular, scalable, web compatible, and standardized, sometimes scholars consider them commodities: neither rare nor inimitable and then of little, if any, strategic importance. On the contrary, the outcomes of this study suggest that the modularity, compatibility, and standardization of an efficient IT infrastructure may be key to strategic success in turbulent environments.

2. Theoretical background and hypotheses

Recent interdisciplinary research streams in evolutionary studiesexplore how cultural and intangible entities, such as beliefs, practices, capabilities, relationships, technologies, and institutions, coevolve in changing and challenging environments (Nelson & Winter, 2002). These cultural and intangible factors, while evolving, shape organizational life through complex, non-linear paths, where feedback effects play an important role (Nelson & Winter, 2002). New evolutionary models are starting to replace the traditional, linear model ofevolution, which focuses on the key mechanisms ofvariation, selection, and reten- tion (Cepeda & Vera, 2007). Along with variation/change, competitive selection, and retention/inertia, also learning (Lorenz, 1973) and coop- eration (Fehr & Schmidt, 1999) nowadays authoritatively appear as basicmechanisms ofevolution. Themechanisms oflearning and cooper- ation are perhaps the most interesting conceptual tools complementing the classical Darwinian concepts. The conceptual model that this study presents herein builds upon studies ofcooperation and learning. More specifically, themodel focuses on the role of routines (Zollo & Winter, 2002) in turbulent environ- ments, in which the logic of opportunity tends to supersede the logic of leverage (Sambamurthy et al., 2003).

2.1. The role of routines in evolutionary theories of learning

In the evolutionary view, existing routines, which embed previouslysuccessful knowledge, both constrain and enable knowledge processes. At the organizational level of analysis, the pre-existing knowledge base includes a complex body of routines. This complex body of routines is hard-wired in the organization through culture, reward/sanction sys- tems, social bonds, and/or technological artifacts. These routines shape interactions and result in consequences, which, in turn, facilitate or hin- der further learning (Ricciardi, 2011). Learning processes, as evolutionary studies describe, embody para-

doxical tensions, with even the most creative learning activities, such as innovative trial-and-error, tending to result in rigidities—for exam- ple, in the form of new prejudices. Strong mechanisms, such as habitu- ation, conformism, and proceduralization, explain these phenomena (Ricciardi, 2011). Therefore, from an evolutionary standpoint, the key strategic goal is to re-activate cyclically the capability to question existing routines and to generate new ones. The organizations that achieve a competitive advantage are those that prove themselves capable of re-activating a learning process at a time and in a way that generates the best options to address emerging threats and opportunities. As future opportunities and threats are often unpredictable, especially in fast-paced environ- ments, the organizations that create the conditions for sustainable con- tinuous innovation and learning are the most likely to find themselves capable of change when change becomes suddenly advantageous.

These organizations are the most likely to survive and thrive (Li & Liu, 2014). The current management literature is growingly highlighting the importance of finding an equilibrium between exploration and ex- ploitation, learning and unlearning processes in organizations. Many scholars agree that cyclical, spiraling, or zigzagging dynamism rather than static balance is the best way to address such paradoxical tensions

(Boumgarden, Nickerson, & Zenger, 2012). Zollo and Winter (2002) propose a cyclical model of learning that seems ideal to illustrate this topic. Their model identifies three types of learning mechanisms that explain the generation and evolution of routines: experience accumulation, knowledge articulation, and knowl- edge codification.

1. At the level of experience accumulation, procedural memory stores organizational routines and allows automatic or quasi-automatic re- sponses building on the knowledge resources that the organizational eco-system selected in the past. The knowledge is mostly either tacit or stored as highly inertial routines (e.g., as software code). Low levels of conscious volition are enough to activate these knowledge resources.

2. Although the accumulation of routines from experience tends to re- sult in organizational inertia, Zollo and Winter (2002) emphasize that, paradoxically, existing routines also play an essential role in activating and enabling the creative processes through which the organizational eco-system changes the routines themselves. They propose that for these processes to be significant, social interaction, discussion, and negotiation must take place together, combining ef- forts to make tacit knowledge explicit and questionable. This second learning level, knowledge articulation, occurs at a different level than experience accumulation.

3. Knowledge codification is a step beyond knowledge articulation. During codification, people clarify their understanding ofcausal link- ages by translating their understanding in explicit and formalized routines. They then test the effectiveness of the new routines against real world situations to determinewhether the routine under analy- sis results in the expected outcomes. If the answer is surprising or unsatisfying, the actorswill probably activate new learningprocesses to find an explanation and/or a solution. The cycle closes with either the selection or the rejection of each routine. Successful routines will soon become habits and submerge in the deeper layers of expe- rience accumulation, fromwhich they will possibly influence further knowledge cycles.

As Prencipe and Tell (2001) argue, the learning processes underlying the accumulation-articulation–codification cycle may be crucial to a firm's success, with their importance often exceeding the tangible outcomes of codification. In fact, after each accumulation–articulation- codification cycle, not only do organizations increase their base of pos- sibly reusable and recombinable knowledge far beyond its current usefulness, but they can also reuse, recombine, and leverage the social mechanisms that people activate to pursue their paths through the learning cycle, thus enabling virtuous circles offurther, more purposeful learning and cooperation.

2.2. Critical transitions in the accumulation–articulation–codification cycle

The description of Section 2.1. depicts an optimal learning cycle, flowing seamlessly from old to new successful routines. In the real world, this cycle may fail at any moment, for innumerable reasons. For example, power conflicts may result in the selection of maladaptive new routines. The transition from accumulation to articulation is a particularly critical juncture to successful learning. To achieve this transition, some- one must successfully challenge the natural inertia of the system, and extract knowledge from the deepest knowledge layers, where old routines have been working automatically for a long time; in other words, someone must be able to make the knowledge accumulation base visible—and question this knowledge base. From the IT management standpoint, Zollo and Winter's model (Zollo & Winter, 2002) views the existing IT infrastructure as a key component of knowledge accumulation. In fact, the IT infrastructure provides a firm with a system of automatic routines, resulting from previous experiences and choices, and shapes most organizational processes. Therefore, if the infrastructure also includes effective routines for

sensing; if the infrastructure supports flexible and seamless exploration through the Internet; if the infrastructure is modular, standardized, and allows easy change and recombination; then, the infrastructure will encourage and facilitate the transition between accumulation and articulation—a transition that Zollo and Winter (2002) describe as cru- cial. Further, because the quality of the infrastructure usually enhances the reputation of IT managers and of the whole firm, then the quality of the infrastructure will probably result in better conditions for trustful collaboration between the IT department and other actors, both within and beyond a firm's boundaries (Chen, Preston, & Xia, 2010). This result is particularly important, because the success of the articulation phase requires intense and diverse social interaction and collaboration for ca- pability building (Sambamurthy et al., 2003). Therefore, wide-ranging, trustful, and purposeful relationships between the IT department and the business environment are important to allow a seamless transition to the next level, the codification phase. The capabilities that firms develop during knowledge articulation within the BITP will support business-oriented choices in IT manage- ment, design, and implementation. In this case, knowledge codification becomes a coevolutionary process involving both business and IT (Sambamurthy et al., 2003), with ITSC as part of successful knowledge codification. Building on these considerations, this study proposes to translate the accumulation-articulation–codification model of Zollo and Winter (2002) into IT management language as the causal nexus linking the quality of the IT infrastructure, the partnership between business and IT, and the strategic contribution of IT (ITIQ→ BITP → ITSC). The strate- gic contribution of IT, in turn, represents the successful completion of one (or more likely many) knowledge cycles; following Sambamurthy et al. (2003), the completion of coevolutionary knowledge cycles is a predictor of excellent competitive performance in moderate-to-fast- paced business environments (Fig. 1). The model above implies the following hypotheses:

H1. The BITP mediates the positive relationship between the ITIQ, the IT infrastructure, and ITSC.

H2. ITSC mediates the positive relationship between the BITP and CE.

3. Method and analytic results

3.1. Questionnaire development, sample, and data collection

To test the model presented in Fig. 1, the study uses the responses to a questionnaire survey by top managers (CEO,CIO,CFO, and COO) and senior executives from firms in Northern Italy operating in different industries (manufacturing, 50.6%; IT, 12%; logistics, 8.2%; utilities, 7%; professional services, 5.1%; other sectors, 17.1%). The respondents are members of three major Italian top managers' associations, who reported to perceive high levels of turbulence in their business environments during a previous survey. Following Bagozzi, Yi, and Phillips (1991), this study validates the questionnaire through a three-step process: (a) explorative semi-structured interviews with nine top managers from companies and industries with different sizes. (b) A focus group involving eight top managers (different from the previous phase) to achieve face validation of the measures. (c) A pilot questionnaire ad- ministered to another 14 managers to reduce the number of items. The study adapts the independent variable, ITIQin Figs. 1 and 2, from Bhatt et al. (2010). This research models BITP and ITSC as formative scales (Baxter, 2009). The performance variable measures CE in a moderate-to-fast-paced environment. CE includes three perceptual measures (Rosenzweig, Roth, & Dean, 2003). The study tests the scales through standard instrument development methods (Bagozzi et al., 1991). All items use a 5-point Likert scale (from 0: “strongly disagree” to 5: “strongly agree”). The main questionnaire-collection process took place between July 2012 and December 2012. Because of the confidential nature of some items investigating possibly awkward relational issues, most managers of the pilot study expressed confidentiality concerns; therefore, to en- courage open and sincere responses, this study provided the respon- dents with access to a fully anonymous online questionnaire. The response rate was 13.62% (245 questionnaires). The study only consid- ered complete questionnaires for data analysis (n= 212, 86.53% of the received questionnaires). A Mann–Whitney U test on organizational role, tenure, gender, and industry confirms that non-response bias should not be a concern. The Cronbach's alpha value for all four constructs (Table 1) exceeds 0.80, in- dicating acceptable reliability (Hair, Black, Babin, Anderson, & Tatham, 2006; Nunnally, 1978). The results demonstrate that the data are unidi- mensional. The study also tested the influence of four classical control variables: industrial sector, respondent's organizational role, firm size (employees), and firm size (revenues). None of these factors proved significant.

3.2. Model validity and reliability

The study used the Sobel test (Hair et al., 2006)toanalyze the multiple mediation models, by using bootstrapping (5000 times) to test the indirect and total effect of the independent variables (Shrout & Bolger, 2002). The remaining effect (or direct effect) emerges by subtracting the indirect effect from the total effect. Following Hayes and Scharkow (2013), the study employs bias-corrected bootstrap CIs. According to Hayes and Scharkow (2013), this test is the most reliable under sim- ulated conditions when an indirect effect exists and the focus is on de- tecting a non-zero effect rather than on interval estimation. To capture the theoretical interdependencies of ITIQ, BITP, and ITSC with CE, the study uses structural equation modeling (SEM) to analyze the data. SEM is a particularly attractive choice for testing mediating variables because SEMdirectly tests all the relevant paths and complica- tions (Barret, 2007; Ullman & Bentler, 2003). Following Byrne (2013), the study used IBMAMOS for the validation and reliability of the model. As Barret (2007) and Markus (2012) sug- gest, a sample size above 200 cases is a minimumgoal for SEM analysis. Therefore, the sample (212 valid questionnaires) in this study is accept- able. The results are the following: Chi-square/df= 1.878, $\rho = 0.000$, RMSA = 0.061, P-Close = 0.04, CFI = 0.945, TLI = 0.899, and NFI = 0.932. These results indicate an adequate model fit.

3.3. Mediating effects of the business–IT partnership

The first path analyzes whether the BITP mediates the positive relationship between ITIQ and ITSC. The results of the first regres- sion (ITIQ→ BITP) are as follows: coefficient = 1.379, SE = 0.211, and $\rho = 0.000$. In the second regression (BITP → ITSC), the results are as follows: coefficient = 0.60, SE = 0.098, and $\rho = 0.000$. The results confirm the path. The Sobel test ($t = 4.124$, and $\rho = 0.000$) confirms the results. The indirect effect of this mediation is 0.8274 ($1.379 * 0.60$), and the total effect has the same value: 0.8274. Therefore, the direct effect is zero. According to Hayes and Scharkow (2013),these measures canbe sufficient to claim a full mediation effect. Further, a direct regression (ITIQ→ ITSC) shows that no direct cause effect is present without the mediator. The main values of this regression are the following: coeffi- cient=0.029, SE=0.128, and $\rho=0.250$. These results further confirm the full mediation. Therefore, the analysis supports H1

3.4. Mediating effects of IT support of strategic capabilities

The second path analyzes whether ITSC mediates the positive relationship between BITP and CE. The results of the first regression (BITP → ITSC) are the following: coefficient = 0.60, SE = 0.098, and $\rho = 0.000$. The results of the second regression (ITSC → CE) are as follows: coefficient =1.182, SE=0.26, and $\rho=0.000$. These outcomes indicate that these regressions are acceptable. The indirect effect of this mediation is 0.7092 ($1.182 * 0.60$), and the total effect has almost the same value (0.7091). Therefore, the direct effect is almost zero (0.0001). The Sobel test value is 3.979, and $\rho = 0.000$, confirming the full mediation effect. As a final check, the direct regression (BITP → CE) results in the following outcomes: coefficient = 0.044, SE = 0.37, and $\rho = 0.291$. Therefore, the analysis supports also H2

4. Discussion and conclusions

The empirical findings of this study support an analytical model explaining the strategic potential of IT infrastructures, independently from their rarity or inimitability. This model suggests that a reliable, standardized, and modular IT infrastructure may facilitate and support continuous regeneration and re-integration in the organizational sys- tem at cognitive, relational, and strategic levels. Following Zollo and

Winter (2002), this study posits that organizational regeneration and re-integration occur through learning cycles or waves. Healthy organizational eco-systems periodically question and possibly modify their knowledge base; then, when the learning cycle ends, the knowledge accumulates again in deeper layers in the form of new tacit knowledge and/or automatized routines (e.g., habits, or software). From this standpoint, a flexible, high-quality IT infrastructure may support and facilitate rapid organizational changes, even disrupting, if necessary, previous equilibria and business–IT strategic alignment. According to this bottom-up strategic view, any competitive advantage is temporary, cooperation capabilities are at least as important as com- petitive capabilities, and agility may be evenmore important than con- trol on VRIN resources. By supporting the hypotheses on the existence of the bottom-up path from IT infrastructure quality to competitive excellence, this re- search confirms that dynamic capabilities are a two-sided coin. On the one hand, one can view dynamic capabilities as tools to generate and transform VRIN resources into competitive advantage (Cepeda & Vera, 2007) using the logic of leverage typical of the RBV (Sambamurthy et al., 2003). On the other hand, one can view dynamic capabilities as an engine that generates, senses, selects, and exercises options to face threats and to seize opportunities according to the logic ofopportu- nity typical of the Schumpeterian (Schumpeter, 1934) evolutionary approach. This study also contributes to the literature on theRBVby suggesting that a bottom-up approach may complement the mainstream top-down approach of the RBV, which traditionally focuses on investment strategies as the key path to competitive advantage. This study high- lights that organizations do not necessarily need VRIN resources to build other VRIN resources. The findings this study presents show that a non-VRIN resource, such as a standardized IT infrastructure, can be crucial to build a VRIN resource such as the idiosyncratic partnership between business and IT in a specific firm. Therefore, even the develop- ment of non-VRIN resources may be strategic. This idea may open fur- ther interesting developments in the RBV literature. This research also contributes to the literature on IT management and IT value by providing a novel theoretical explanation to the phe- nomena linking infrastructure quality and firm performance. The findings ofthis study encourage the community of information systems scholars to consider also an evolutionary approach to IT, thus inte- grating their traditional theoretical portfolio, which usually includes the classical RBV approach and the business–IT alignment. This research suggests that an information system should appear as a system of rou- tines and then as a generator of the basic bricks of dynamic capabilities in a Schumpeterian sense (Schumpeter, 1934). This approach may give way to many interesting research opportunities. Finally, this research has interesting managerial implications. The bottom-up causal links the study identifies and tests depict a clear three-step strategy for CIOs and IT managers (Fig. 1). First, IT managers should pursue infrastructure efficiency and flexibility, without hesitating to choose standardized IT and cloud com- puting if these solutions help to achieve their goals. In contrast to what many experienced CIOs think, IT standardization does not jeopar- dize, per se, the IT managers' role and reputation. Second, IT managers should leverage the reputation that they gain through infrastructure efficiency to nurture a wide range of purposeful relationships, not only within the organization (with the top manage- ment team, R&D department, operation departments, and IT users) but also beyond its boundaries (with the firm's customers, distributors, suppliers, and IT vendors). IT managers should leverage these relation- ships to build business-oriented partnerships where people discuss the positive and negative interplays between existing infrastructure and business needs. Third, IT managers should leverage the cognitive and relational capabilities they develop through wide-range BITP to launch a process of periodical, business-oriented IT innovations. In other words, the model this study presents offers a concrete three-step path, showing how IT managers can act as cognitive and relational bridges and govern the coevolution of business and IT. This approach offers a bottom-up view of strategic alignment, which may complement the traditional approaches.

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Figures and Tables

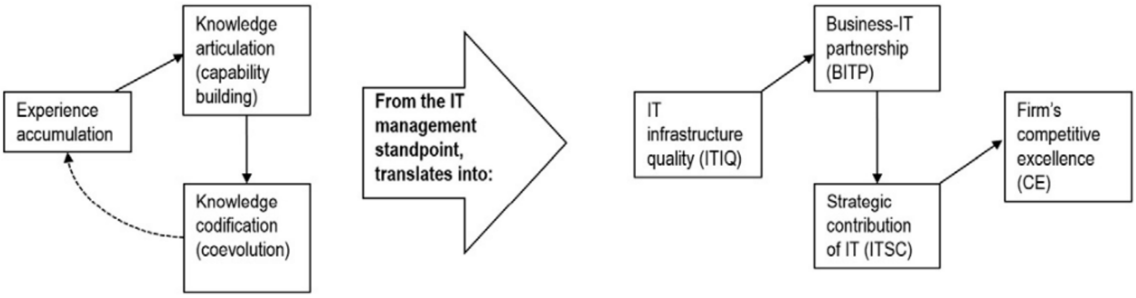

Fig. 1. The development of the research model, drawing on that of Zollo and Winter (2002) and the findings of Sambamurthy et al. (2003).

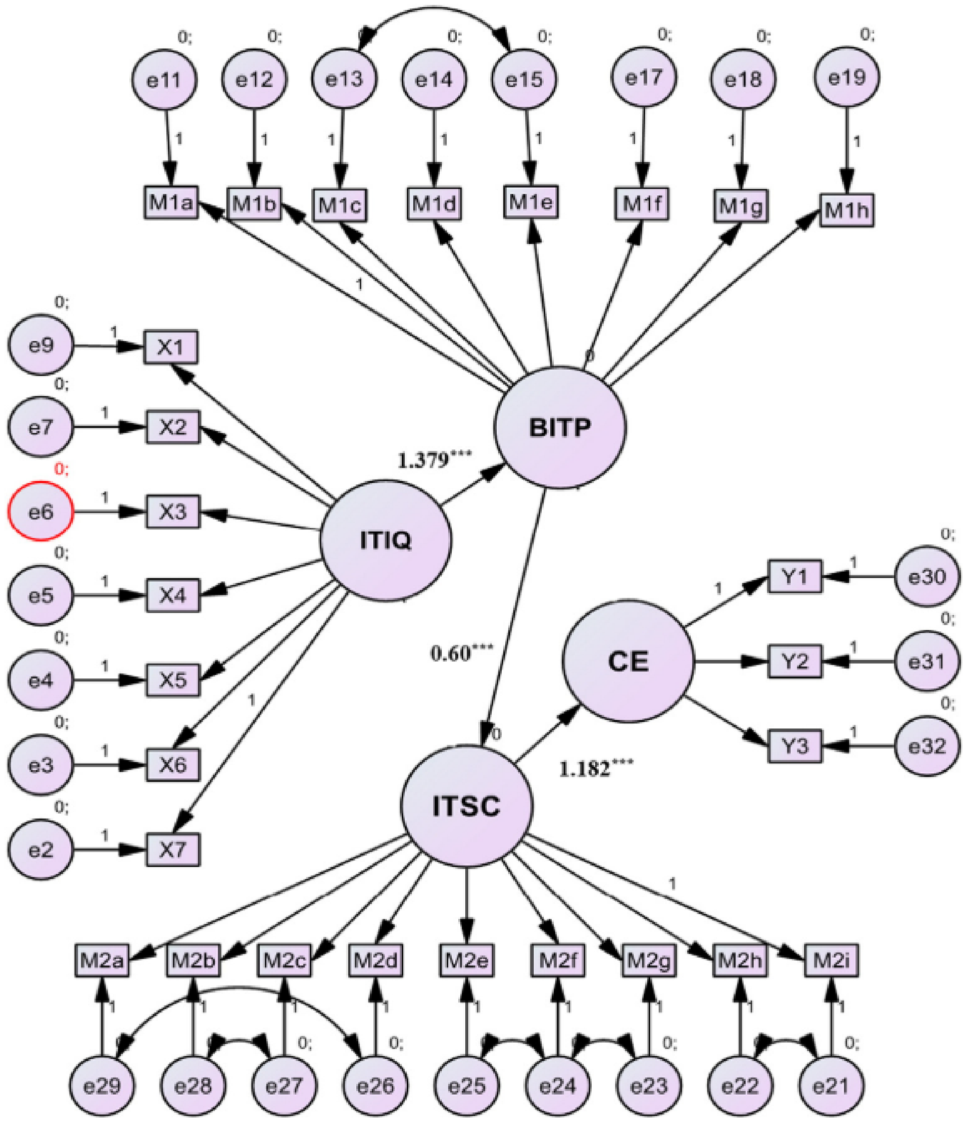

Fig. 2. The indirect influence of the quality of the IT infrastructure (ITIQ) on competitive excellence (CE) through the mediating effects of the business–IT partnership (BITP) and strategic contribution of IT (ITSC).

Table 1
Constructs and items.

Constructs	Items	Cronbach's alpha
IT infrastructure quality (ITIQ)	X1: Infrastructure includes legacy systems (reverse item) X2: Infrastructure is based on standardized application and best practice X3: Infrastructure is scalable and customizable X4: Infrastructure is fully web compatible X5: Infrastructure allows seamless information flows X6: Infrastructure is not integrated (reverse item) X7: Infrastructure is reliable	0.89
Business–IT partnership (BITP)	M1a: Effective interactions between IT management and top management team M1b: CIO involved in strategic decisions M1c: Effective interactions between IT management and operation departments M1d: Effective interactions between IT department and R&D M1e: Structured and effective IT audit M1f: Effective interactions between IT managers and IT vendors M1g: Effective interactions between IT managers and firm customers/distributors M1h: Effective interactions between IT managers and firm suppliers	0.92
IT strategic contribution (ITSC)	M2a: IT effectively supports customer loyalty M2b: IT effectively supports strategic changes M2c: IT effectively supports new product development M2d: IT effectively supports customer satisfaction M2e: IT effectively supports sales and/or market shares M2f: IT effectively supports multi-channel sales M2g: IT effectively supports organizational flexibility M2h: IT effectively supports knowledge sharing and cooperation M2i: IT effectively supports organizational climate	0.91
Competitive excellence (CE)	Y1: Shareholders are satisfied with firm performance Y2: Our firm outperforms competitors Y3: Our firm is successful under strong competitive pressure	–