DRUID Working Paper No. 08-11

Dynamic Capabilities and Their Indirect Impact on Firm Performance

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Abstract:
This paper investigates the relationship between dynamic capabilities and firm performance. In particular it addresses the question of whether dynamic capabilities impact directly or indirectly on performance. Using data from manufacturing firms, the paper articulates and measures dynamic capabilities as a multi-dimensional construct with three underlying factors: coordination, learning and strategic competitive response. Then, structural equation modelling is employed to explore the relationships among dynamic capabilities, functional competences and firm performance. Empirical findings suggest that dynamic capabilities are antecedents to functional competences which in turn have a significant effect on performance. Direct effects on performance are found to be insignificant. Furthermore, similar effects seem to hold for both higher and lower levels of environmental dynamism. Theoretical and practical implications are discussed.

Keywords: Dynamic capabilities; functional competences; firm performance; indirect impact environmental dynamism; competitive advantage

ISBN 978- 87-7873-265-1

INTRODUCTION

In the last decade a growing number of scholars consider dynamic capabilities to be at the heart of firm strategy, value creation and competitive advantage (e.g. Teece *et al*., 1997; Eisenhardt and Martin, 2000; Winter, 2003, Teece, 2007, Helfat *et al*. 2007). Theoretical arguments have been advanced about their nature and their relationship with firm performance. Existing research however is still loaded with vague assertions and interpretations which have not yet been confirmed by empirical analysis[1].

Many scholars are still skeptical about the role and conceptualizations advanced about dynamic capabilities (Winter 2003, Zahra et al, 2006). Dynamic capabilities have often been criticized for being tautological (e.g. Mosakowski and Mckelvey, 1997; Priem and Butler, 2001), vague and not operational. Furthermore, while organizational performance has been a core issue in the research on dynamic capabilities since the seminal article of Teece *et al*. (1997), the question of whether and how they affect performance is still open (Helfat *et al*. 2007).

This paper seeks to throw more light on the concept of dynamic capabilities and their impact on firm performance. In doing so it sets out to examine the logical links among dynamic capabilities, functional competences and firm performance. It proposes and tests a model which assumes that dynamic capabilities' influence on firm performance is mediated by functional capabilities. In this model dynamic capabilities can be conceptualized as higher-order strategic processes that integrate, recombine and generate new technological and marketing capabilities which in turn shape firm performance. In an effort to investigate this model empirically, the paper attempts to operationalize dynamic capabilities as a composite,

[1] In the DRUID Summer Conference 2007, during the debate Dynamic Capabilities vs. Organizational Adaptation, Gautam Ahuja and Kathleen Eisenhardt argued that the dynamic capabilities perspective lies at the heart of business strategy and might help us to further our understanding of firm performance. Nevertheless, it was also stressed that there is a need to settle on a field-wide definition of dynamic capabilities and to start emphasizing empirical studies and not theoretical discussion.

unified construct defined by three interrelated, although distinct, dimensions: coordination capability, learning capability and strategic competitive response capability. Such a construct has a value on its own as it provides practical ways of measuring dynamic capabilities with potential implications for theory and practise. In particular, this operationalization may open opportunities for further investigation of the nature and dimensionality of dynamic capabilities and their role in the business context.

The paper's contribution to the literature is threefold. First, it operationalizes the dynamic capabilities concept using three different organizational processes and it makes an explicit distinction between the dynamic capabilities higher-order construct and functional competences. Therefore is throws some additional light on the notion of dynamic capabilities. Second, it explores the exact link between dynamic capabilities and performance using a large dataset of manufacturing firms. Verifying the indirect link between dynamic capabilities and performance the paper brings evidence to bear on the debate about the role of dynamic capabilities showing that their relationship with performance is not tautological. Third, it empirically indicates that dynamic capabilities can be valid and useful in more and less dynamic business contexts confirming that they have a role to play in the whole spectrum of environmental dynamism.

The remainder of the paper is organized as follows: The subsequent section presents the theoretical background. The third section details the proposed model linking dynamic capabilities to functional competences and performance. The fourth section describes the research methodology; the fifth section presents the data analysis and the results obtained, the sixth section provides a discussion of the findings, while the last one discusses theoretical and managerial implications and conclusion.

THEORETICAL BACKGROUND

Dynamic capabilities

In their seminal contribution, Teece et al. (1997) argue that dynamic capabilities enable organizations to integrate, build, and reconfigure their resources and competencies and, therefore, maintain performance in the face of changing business environments. The notion of dynamic capabilities was subsequently refined and expanded (e.g. Eisenhardt and Martin, 2000; Zollo and Winter 2002; Teece, 2007; Helfat et al., 2007 among others). However, a concise and comprehensive definition of dynamic capabilities has not been reached yet.

In an effort to better understand the nature of dynamic capabilities, several scholars suggest to differentiate between dynamic and functional competences or operational capabilities. Collis (1994) distinguishes between lower-order operational capabilities, which are described as the purposive combinations of resources that enable an organization to perform functional activities, such as logistics, marketing and sales or manufacturing, and higher-order dynamic capabilities which deal with change. Zollo and Winter (2002) and Winter (2003) also distinguish dynamic capabilities from operational or ordinary capabilities. Operational capabilities enable firms to perform their every day living, "and while dynamic (as all processes are), they are used to maintain the status quo" (Helfat et al., 2007:34). The archetypical firm equipped with ordinary but lacking dynamic capabilities will, in equilibrium, earn "its living by producing and selling the same product, on the same scale and to the same customer population over time" (Winter, 2003:992). By contrast, dynamic capabilities are those that enable a firm to constantly renew its operational capabilities and therefore achieve long-term competitive advantage.

Teece (2007) similarly recognizes that operational capabilities help sustain an organization's technical fitness by ensuring its day-to-day operational efficiency, whereas dynamic

capabilities help sustain a firm's evolutionary fitness by enabling the creation, extension and modification of its resource base, thereby creating long-run competitive success.

Taking these suggestions into account it seems that consensus is emerging about the distinction between functional or operational and dynamic capabilities, along the following broad aspects:

i. capabilities can be either functional or dynamic and they both reflect the firm's capacity to perform a particular activity or function, but
ii. functional capabilities help the firm to perform basic functional activities
iii. while dynamic capabilities are referring to the transformation and reconfiguration of functional capabilities

This discussion implies that dynamic capabilities create value indirectly by changing functional capabilities (i.e. through their impact on functional capabilities). To capture this thinking, in the present paper dynamic capabilities are conceived as the capacity of an organization to purposefully and systematically create, extend or modify its operational capabilities (adapted from Eisenhardt and Martin, 2000 and Helfat et al., 2007).

Dynamic capabilities underlying processes

Although the literature has concluded that dynamic capabilities are a set of complicated routines (Zollo and Winter, 2002), it is also argued that their existence is taken for granted without indicating the specific processes that form these capabilities (Galunic and Eisenhardt, 2001). Responding to such a criticism, Eisenhardt and Martin (2000) comment that dynamic capability processes comprise "specific and identifiable routines" which have been extensively researched. In particular, they suggest that several processes can be used as examples of dynamic capabilities such as product development (combining various skills in cross-functional teams), strategic decision making (pooling of diverse business, functional

and personal expertise), alliance and acquisitions routines (new resources, pre- and post-acquisition routines) and many others.

In order to study in an integrated way the impact of dynamic capabilities on firm performance it is useful to abstract from specific routines and processes and to consider broader composite dimensions. This paper distinguishes three dimensions: coordinating/integrating activities, learning and strategic competitive response processes. It is thought that these constitute distinct, significant drivers that lead to the development of new configurations of functional competences.

Coordination/integration capability describes the firm's ability to assess the value of existing resources and integrate them to shape new competences (Iansiti and Clark, 1994; Amit and Schoemaker 1993). Moreover, the implementation of new configurations of functional competences lies in the effective coordination of a variety of tasks and resources and the synchronization of different activities (Collis 1994, Helfat and Peteraf, 2003). Coordination processes connect and interface single routines through communication, scheduling, task assignment and other related activities. Teece et al. (1997) suggest that the lack of efficient coordinating and combining of different resources and tasks may explain why apparently slight technological changes have overwhelming effects on incumbent firms' competitive positions in a market. For example, Henderson and Clark (1990) have indicated the devastating impact of seemingly minor innovations on incumbent firms in the photolithographic industry, which had a major influence on how systems had to be configured. They argue that this kind of systemic or "architectural" innovations require the efficient integration and coordination of multiple engineering tasks.

Learning capability can be conceived of as a principal means of attaining strategic renewal. Renewal requires that organizations explore and learn new ways while at the same time exploit what they have already learned (March, 1991). Teece *et al*. (1997) argue that learning

is a very important process which through experimentation and repetition leads to the better and quicker resolution of specific problems and at the same time enables firms to identify new production opportunities. Learning processes are dynamic and multi-level. Although insight and innovative ideas may occur to individuals, the individually generated knowledge is shared within the organization's context and then some of it becomes institutionalized as organization artifacts.

Strategic competitive response capability is based on the extended definition of dynamic capabilities proposed by Eisenhardt and Martin (2000) to include the creation of market change as well as the response to exogenous change (Helfat et al., 2007). This capability can be conceptualized as the ability of the firm to scan the environment, identify new opportunities, asses its competitive position and respond to competitive strategic moves. Even when a well-established firm is aware of a need for change to address shifting environmental requirements, it is often difficult to respond effectively. For example, empirical research provides evidence that changes related to even minor technology shifts are often hard to be addressed effectively (Tushman and Anderson, 1986; Henderson and Clark, 1990). However, the capability to sense and strategically respond to environmental challenges is of utmost importance as it enables the firm to reconfigure certain competences before they become core rigidities (Teece *et al*., 1997, Eisenhardt and Martin, 2000).

In sum, the preceding arguments indicate that the processes of coordination, learning and strategic competitive response seem to be important activities that facilitate change within an organization. Thus, they can be understood as sub-dimensions of a more complex, abstract construct representing dynamic capabilities. In this way, they may contribute to a better understanding and measurement of the composite concept of dynamic capabilities.

Dynamic capabilities and firm performance

Empirical testing concerning the influence of dynamic capabilities on firm performance has been hampered by difficulties regarding their description, operationalisation and measurement and by their assumed tautological relationship with firm performance. However, there is increasing evidence that a firm's dynamic capabilities significantly affect firm performance. For example, Henderson and Cockburn (1994) confirm that a firm's ability to integrate knowledge from external sources is positively related to its research productivity, measured by patent counts. Zollo and Singh (1998) in their study of post-acquisition integration processes in the banking sector, provide evidence that acquirers who invested more effort in codifying their integration processes achieve superior profitability performance compared to competitors. Similarly, Deeds *et al*. (1999) show that dynamic capabilities such as research personnel quality or alliance formation processes are significantly related to the number of newly developed products in the biotechnology sector.

Despite the ongoing progress made in the empirical inquiry of the differential effects of specific dynamic capabilities, it seems that few studies have provided a comprehensive account of their precise impact on firm performance. David Collis (1994) suggests that dynamic capabilities, which can be defined as higher-order or meta-capabilities are important because they may help firms to avoid path dependencies imposed by their current lower-order competences. Therefore, a firm has to develop capabilities to learn and redefine its resource base in order to overcome the trap laid by their existing competences and create new sources of competitive advantage.

Eisenhardt and Martin (2000) reach the same conclusion using a different argument. More specifically, they assume that although dynamic capabilities can be considered as valuable and rare, at the same time they are equifinal, i.e. similar across firms in terms of their key attributes, and therefore are neither inimitable nor immobile. Thus, dynamic capabilities

cannot in themselves be a source of sustainable competitive advantage; rather they contribute to the achievement of superior firm performance by combining and renewing functional competences which in turn affect performance.

In sum, we could argue that dynamic capabilities build and reconfigure resource positions (Eisenhardt and Martin, 2000), zero-order capabilities (Winter, 2003), operational routines (Zollo and Winter, 2002) or operational capabilities (Helfat and Peteraf, 2003) and, through them, affect performance. This chain of causality designates an indirect link between dynamic capabilities and performance. However, the mechanisms by which dynamic capabilities influence firm performance are not well understood (Zott, 2003).

HYPOTHESES

Assuming a hierarchical view of dynamic capabilities we propose a model where higher-order dynamic capabilities serve as a basis for acquiring and reconfiguring lower-level functional competences. Therefore, in the present theoretical framework marketing and technological competences can be understood as the zero-order competences needed for producing particular products or addressing specific customers' needs.

Hence, we suggest that while functional competences affect firm performance directly (H1), dynamic capabilities are the tools that shape marketing and technological competences (H2) and therefore their impact on performance is fully mediated by functional competences (H3).

Insert Figure 1 around here

Functional competences and firm performance

The effects of superior firm-specific competences on firm performance have been widely examined in the literature. For simplicity, the focus of this paper is on two key functional competences, i.e. marketing and technology-related competences, which enable firms to

perform effectively their day-to-day activities relative to competition (Danneels, 2002; Song *et al*., 2005).

Marketing competence enables firms to better understand their customers' current and future needs, to better serve these needs and to reach new customers as well as to effectively analyze competitors and competition (Fowler *et al*., 2000). Therefore, marketing-related competence has been considered as an important driver for superior performance (Day, 1994). Technologically competent firms develop systems and processes that allow them to engage in shared problem solving, implement and develop prototypes, and import and absorb technological knowledge from outside the firm (Leonard-Barton, 1995). Firms that fail to advance their technological capabilities may find that the product functions and features that embody these capabilities fail to create commercial success (Fowler *et al*, 2000). Superior technical capabilities gives the firm the ability to transform inputs into outputs in an efficient and effective way and therefore to meet an increasing variety of market expectations without excessive costs, time, organizational disruptions or performance losses.

We hypothesize that these two functional competences have a positive significant impact on firm performance assuming that they have the potential for producing competitive advantage. In other words, we suggest that the more a firm is endowed with capabilities that enable it to produce market offerings of superior value or at lower costs relative to competition, the more these capabilities can be translated into positions of competitive advantage and superior business performance. Thus, the following hypothesis is proposed:

Hypothesis 1: Functional competences have a significant positive impact on firm performance.

Although this hypothesis is not theoretically novel, it is a necessary building block for the completeness of the model. Our main aim here is to introduce a positive relationship between

functional competences and performance, in order to examine the effect of dynamic capabilities on competitive advantage through the mediating role of functional competences.

The impact of dynamic capabilities on functional competences

Dynamic capabilities, as defined by Teece *et al*. (1997), do not engage in the production of a marketable good or service. Instead, they build, integrate or reconfigure functional competences. Considering the notion of higher-order or meta-capabilities, Collis (1994) defined them as capabilities of the learning-to-learn type. In the same line, Winter (2003) argues that as capabilities are "complex, structured and multidimensional" concepts it is important to make effective use of 'zero-order' (functional competences) and higher-order capabilities. Dynamic capabilities govern the rate of change of functional capabilities and therefore can be understood as higher-order constructs.

In the present theoretical framework we define dynamic capabilities as higher-order competences that allow firms to exploit existing lower-order competences and more importantly to identify and acquire new technological and/or marketing competences.

The effective and efficient realization of coordination processes by the firm management is of particular importance. Coordination capabilities enhance the coordination and integration of tacit and codified knowledge allowing firms to more cost effectively deliver their products and acquire more information about their customers needs (Helfat and Raubitschek, 2000). Coordination capabilities are often related to new product development, where teams belonging to different firm departments work together combining their varied skills and backgrounds in order to design and develop the specific product (e.g. Garvin, 1988; Clark and Fujimoto, 1991; Dougherty, 1992; Helfat and Raubitschek, 2000).

Learning processes that promote, enhance and renew technological knowledge is of critical importance for sustainable competitive advantage, especially in high-technology industries

such as semiconductors, pharmaceuticals, etc (Helfat, 1997; Henderson and Cockburn, 1994; Bogner and Thomas, 1994). More specifically, processes such as team-working and job-rotation practices facilitate the distribution and sharing of knowledge within an organization, while at the same time, make the combination of new knowledge with existing skills and experience much easier. In particular, cross-functional teams enhance the absorption of new marketing or technological knowledge by encouraging interaction among employees belonging to different business functions and thus may have a positive impact on the transformation and recombination of marketing and technological competences. Furthermore, it is suggested that job rotation increases the effectiveness of knowledge absorption as it enhances the complementarity of experience inside the firm (Cohen and Levinthal, 1990). For example, one of the basic elements of Toyotas' dynamic capability is the inter-plant exchange of information and knowledge. In that way, promising production ideas, which may be accepted by the management, unions, and the shop floor, are quickly distributed across the plants using various channels, such as cross-functional meetings and projects, rotation of plant general managements and so on. In this way, expansion of new ideas, policies and technologies are disseminated across different plants contributing significantly to the re-organization and evolution of Toyota's manufacturing systems. (Fujimoto, 2002).

The firm's ability to reshape its asset base is also dependant on the mechanisms and processes it has developed in order to sense the changes taking place in the environment and to opt for efficient actions in its relations with other agents. For example, competitive benchmarking as an organized process can be valuable to that direction. Thus, the ability to scan the environment and evaluate markets' and competitors' moves may have a significant impact on the firm's capacity to redefine its technological and marketing competence and in consequence, result in an improved or refined product portfolio. Finally, the ability of an

organization to effectuate change is closely linked to its flexibility potential and its decentralized organizational structure.

Thus, the absence of dynamic capabilities may constrain the renewal opportunities that firms pursue. For instance, it is not enough for firms to just improve their internal competency in R&D. As history reveals, firms with considerable capability to perform successful R&D activities, such as IBM and Sun Microsystems, still found it difficult to compete when their business environment changed. Rather, firms need to develop higher-order capabilities that enable learning form and leveraging of both internal and external resources. On the other hand, dynamic capabilities may diminish the effect of path dependencies. For example, the renewal of marketing competence through dynamic capabilities serves to overcome the history of having a specific customer base.

Mere exploitation of already existing strategic assets will not lead to competitive advantage. Superior dynamic capabilities allow firms to continually build and renovate functional competences faster and cheaper than competitors. Simply holding some excellent competences do not enable firms to cope with the renewal challenges faced in the context of a more or less dynamic environment. Given the potential of dynamic capabilities on marketing and technological competences we set forth the following hypothesis:

Hypothesis 2: Dynamic capabilities construct is positively related to functional competences.

Hypotheses 1 (1a and 1b) and 2 (2a and 2b) suggest that dynamic capabilities have an indirect effect on firm performance through functional competences. This happens because superior firm performance at any point in time is directly influenced by the successful configuration of functional competences, which are shaped by dynamic capabilities. According to this line of reasoning we expect that:

Hypothesis 3: The relationship between dynamic capabilities construct and firm performance is mediated by functional competences.

Our proposition is in line with Teece et al. (1997) who argue that superior performance is dependent on superior firm specific assets or functional competences, which will, over time, be influenced by superior dynamic capabilities.

Eisenhardt and Martin (2000), also suggest that dynamic capabilities are equifinal and by themselves ineffective at providing a basis for sustainable competitive advantage. Thus, the potential for competitive advantage lies in using dynamic capabilities to create firm-specific functional competences that contribute to that advantage. Helfat and Peteraf (2003) propose that dynamic capabilities indirectly contribute to the output of the firm in which they reside through an impact on operational capabilities. Moreover, the results of a simulation analysis performed by Zott (2003) confirm the indirect link between dynamic capabilities and firm performance.

The impact of environmental dynamism

Business environments today are increasingly becoming more and more dynamic due to rapid and significant changes in technology, shorter product life cycles, escalating global competition and rapid diffusion of know-how and business practices. Since these environments erode the value of existing firm competencies (Fredrickson and Mitchell, 1984), building up of new functional competencies might be a prerequisite in order to stay at the leading edge of technological and or market developments. Therefore, in a dynamic environment the potential value of dynamic capabilities could be enhanced as they enable firms to renew and reconfigure their functional competencies and introduce new configurations that better fit to shifting environmental conditions.

Dynamism can be defined as the dynamic heterogeneity that characterizes the organizational environment. It is manifested by the amount of change in technologies, customer preferences and modes of competition in the firm's principle industries (Miller, 1987). Environmental context can be important to the analysis of resources and performance as diverse environments entail different valuations of resources (Penrose, 1959). Moreover, Teece and associates (Teece *et al*., 1997) explicate the meaning of dynamic capabilities and their importance for achieving competitive advantage in shifting environments. Dynamic environments cause organizations to engage in frequent resource reconfiguration and invest in new functional competencies that are most likely to support the ongoing development of valuable products and services. Therefore, the higher the environmental dynamism, the more likely dynamic capabilities will be valuable to the firm since they offer the firm the chance to pursue new and even more promising opportunities. Thus, we hypothesize that:

Hypothesis 4.1: Environmental dynamism has a significant positive impact on dynamic capabilities.

Nevertheless, although dynamic capabilities have mainly been assumed to address shifting environments, it is also suggested that they can be useful in environments which are not characterized by rapidly evolving conditions (Eisenhardt and Martin, 2000). Therefore, the value of dynamic capabilities in various degrees of environmental change should be further investigated in order to better understand the relationship between dynamic capabilities and the environment. Thus we hypothesize that:

Hypothesis 4.2: Dynamic capabilities can be useful in both high and low levels of environmental dynamism.

RESEARCH METHODOLOGY

Sample and Data Collection

The present study uses evidence from a sample of Greek firms belonging to various manufacturing industries, such as food and beverage industries, printing and publishing, chemical industries, industrial machinery and equipment etc. This wide range of sectors ensures sufficient sample size and contributes to generalizability of the results. Further, only firms with turnover exceeding 3 million Euros in 1999 were considered in the sample to ensure a minimum operating structure of each firm. Based on these, the original population included 1400 firms.

Data were collected through face-to-face interviews with CEOs using a structured questionnaire. A total of 280 CEOs accepted to participate in the study providing 271 usable questionnaires (response rate of approximately 20%). To minimize the potential measurement error that may result from the use of a single information source, we tried to identify the most knowledgeable informants by making several phone contacts with the individual firms. We selected corporate level managers who had been advanced to their current positions after gaining experience in the product, marketing, and strategic planning functions of their firms. In the majority of firms performance data were filled in by financial managers. Non-response bias was examined using a Chi-square test. A non significant χ^2 test indicates the representativeness of the respondents for the sampling frame. The results show that there is no significant difference between the sample and respondents for SIC code (χ^2=14.4, df=16 p> 0.250) and number of employees (χ^2=3.66, df=3, p>0.250).

Measures

A research instrument was developed to serve as the basis for collecting data pertaining to dynamic capabilities, functional competences and performance. All questionnaire items were operationalized using self-typing 7-point Likert scales, a well-accepted practice in this type of research. It should be noted that operationalization of resources and capabilities in empirical research has not yet reached standard measures. The way they are measured varies extensively and because of this variance their respective models and results presented in the empirical literature are often disjoint (Hoopes *et al*., 2003). In the present study the development of scales was based on theoretical contributions from resource-based scholars (e.g. Teece *et al*., 1997) and on extensive consultation with academics and managers. The items pertaining to each scale were pre-tested in two steps: face-to-face interviews with five academics and face-to-face interviews with 14 managers. At each stage, participants were asked to identify any problematic items which in turn were either revised or eliminated, and new ones were developed. By the end of the pre-testing process the practitioners reported no concerns and therefore the questionnaire was ready for final administration. The pre-testing process allowed us to assess the face and content validity of items and ensure that executives understood the research instrument as they were intended.

Dynamic capabilities measures

Dynamic capabilities construct was gauged by using three sub-dimensions, namely coordination, learning and strategic competitive response, while each of them was measured with specific items. CEOs were asked to indicate the extent to which the particular capabilities constitute their firms' distinctive characteristics. More specifically:

Coordination capabilities denote managerial and organizational processes that relate with the coordination and integration of different activities and different skills, through certain

organizational practices and internal policies, encouraging efficiency. They were measured with items related to effective integration and standardization of business processes, adoption of the latest management tools and techniques, and systematic implementation of business planning. Adoption of the latest management systems is used as proxy of the manager's ability to keep up with these management tools and decide which ones to use. These tools if used properly can be an important part of the change management process to improve organizational decisions and effectiveness. Systematic business planning is used as proxy to processes aiming at a continuous articulation of the organizational and financial architecture of the firm.

Learning relates to knowledge creation and development processes, knowledge sharing and integrating processes as well as procedures of experience-based learning. These processes were approximated with systematic in-house learning and knowledge development, effective team-working and well-organized 'on the job training'. *Strategic competitive response* refers to processes aiming at understanding and adapting to environmental trends. It was measured with items related to: effective benchmarking, systematic formulation of long-term strategy, timely response to competitive strategic moves and flexible adaptation of human resources to technological and competitive changes.

Functional competences

CEOs were asked to indicate in a seven-point scale to what extent their firms possessed marketing and technological competences, on several items each.

Marketing competences resemble Lado *et al's* (1992) output-based capabilities or Day's (1994) outside-in capabilities. They have an external emphasis and are evidently needed in assessing a firm's position within its environment, in evaluating customer and competitor behavior, as well as in managing the firm's relationships with its customers, competitors,

suppliers and distributors. Marketing capabilities were measured with three items: strong brand names, emphasis in strong sales force and well-organized marketing department.

Technological competences focusing on technology development, new product development and manufacturing processes were gauged with three items: continuous adaptation of manufacturing technology to the firm's requirements, emphasis in the organization of R&D department, and emphasis in the co-operation with universities, research institutes and /or other firms to acquire know-how.

Performance

Firm performance is commonly considered as a complex, multi-dimensional construct (Chakravarthy, 1986; Kaplan and Norton, 1996). The present study uses perceived measures to operationalize firm performance in terms of two dimensions: profitability and market performance. Profitability was measured with items reflecting profit margin, return on assets and net profits relative to competition, whereas market performance was measured with market share, sales volume and increase in market share and sales. CEOs were asked to indicate their firms' financial performance (for all the above mentioned items) relative to competition, for the last three years.

The use of subjective performance measures is a common practice in strategy related research when financial statement data are unavailable or they do not allow for accurate comparisons amongst firms (e.g. Dess, 1987; Powell, 1992; Powell and Dent-Micalef, 1997; Tippins and Sohi, 2003). Moreover, the literature shows that there are high correlations between objective and subjective measures. It is also worth noting that financial data obtained from SMEs are often criticized for being unreliable and subject to varying accounting conventions or even to managerial manipulation for a variety of reasons (e.g. avoidance of corporate or personal taxes; see Dess and Robinson, 1984; Sapienza *et al*., 1988). Finally, while self-reported scales

may be criticized for their validity, using perceived performance scales allows comparisons across firms and contexts, different industries and sector conditions etc.(Song *et al*., 2005).

Environmental dynamism

The characteristics of the environment that capture its dynamism and innovativeness were measured using items indicating technological and market change, notably, the rate by which products become outdated in the specific market, the rate of change in technology related to products and the intensity of innovation-based competition.

Controls

Finally, firm size, one of the most frequently studied contextual variables, was included in the model in order to control for effects it may have on firm performance. Organizational size was measured as the natural logarithm of the number of employees.

Validation of Measures

Particular efforts have been made to minimize measurement errors and potential bias. In essence, construct validation of the perceptual measures was tested in three basic steps. The first one checked for *content validity,* requiring the identification of a group of measurement items which are deemed to represent the construct of interest. The scales concerning dynamic capabilities measures, for which no established measures exist, were developed based on theoretical contributions and especially Teece's *et al*. (1997) dynamic capabilities framework. Furthermore, their development was enhanced by a series of in-depth interviews with CEOs as well as extensive discussions with academics during the pre-testing phase of the questionnaire development. The environmental dynamism, functional competences and performance scales employed have been adopted from existing and validated scales used in the relevant literature.

The second step addressed *construct validity,* seeking to establish the extent to which the empirical indicators actually measure the construct. To ensure construct validity, a series of empirical tests in order to examine the measurement properties of the indicators: *unidimensionality, reliability and validity*. The construct validity of our measures was tested by employing confirmatory factor analysis.

The measurement model of dynamic capabilities presented in the following section (see Table 2) and the additional model run for the remaining constructs fall within acceptable fit (χ^2=224.95, d.f.=136, χ^2 /d.f =1.65, CFI=0.96, GFI=0.92, AGFI=0.89, RMSEA=0.06) and moreover, the statistical significance of all indicator loadings is ensured. Thus, the unidimensionality and convergent validity of the proposed constructs is demonstrated.

Reliability was assessed using both the composite reliability score for each multiple indicator construct and Cronbach's a. As shown in Table 1 all constructs exceed the recommended level of 0.70 and therefore the specified indicators are sufficient in their representation of the constructs.

Insert Table 1 around here

Discriminant validity (Bagozzi *et al*., 1991) reflects the degree to which two conceptually similar concepts are distinct. The discriminant hypothesis can be empirically tested comparing the original CFA models (unconstrained models) with all competing models in which pairs of latent variables equal to 1. The Chi-square difference between all competing models was significantly higher than that of the unconstrained models, supporting the discriminant validity of all proposed constructs.

The final step concerned *nomological validity,* which involves the determination of the degree to which a construct relates to other constructs in a manner predicated by theory. The

issue of nomological validity is implicitly addressed in the context of the substantive relations examined in this study.

Therefore all analyses provide reasonable confidence that the measures used in the present study are valid and reliable.

EMPIRICAL RESULTS

Dynamic capabilities as a second-order construct

As we conceptualize dynamic capabilities as a multi-dimensional concept including three different dimensions or sub-capabilities, a second-order measurement model was estimated to arrive at a representative holistic construct using coordination, learning and strategic competitive response capabilities as first-order constructs.

In terms of overall fit of the model we get a significant Chi-square statistic (x^2=72.890, d.f.=42 p=0.022). If the model is to provide a satisfactory representation of the data the Chi-square value is supposed to be insignificant (p>0.05). Although the significance level is below the cut-off value of 0.05 we should consider the fact that in this study the sample size is sufficiently large (N=271) and therefore a strong possibility exists that Chi-square tends to indicate significant differences for equivalent models. Thus, we have to employ additional measures. Normed x^2 is 1.73 and RMSEA is 0.053, both indicating an acceptable model fit. Moreover, GFI=0.951, AGFI =0.924, and CFI=0.971. All indexes are well above the recommended level of 0.90, further supporting the acceptance of the proposed model.

Insert Table 2 around here

Table 2 contains EQS estimates for the second-order measurement model. All first-order and second-order loadings are significant (p<0.01). Moreover, validation of the proposed constructs provides reasonable confidence that the measures used are valid and reliable.

To verify the existence of a second-order model we compare it to a first-order model by calculating the Target (T) coefficient (Marsh and Hovecar, 1985). The target coefficient has an upper limit of 1.0, with higher values supporting the existence of a second-order factor. Importantly, the second-order factor model is merely explaining the covariance among first-order factors in a more parsimonious way. Therefore, even when the second order model is able to explain the factors' co-variations, the overall fit of the higher- order model can never be better than that of the corresponding first-order model. In this way, the first-order model provides an optimum fit for the second-order one. The calculated target coefficient between the first and second-order factor models is a very high 0.99, suggesting that the addition of the second-order factor does not significantly increase chi-square. Consequently, the second-order model being a more parsimonious one should be accepted over the baseline model as a 'truer' representation of model structure. A complementary set of statistics is given by the significance of the parameters reflecting the second-order factor loadings. All second-order factor loadings are highly significant (see Table 2) providing further justification for the acceptance of the second-order model

In sum, these results support our suggestion that dynamic capabilities can be conceptualized as a higher-order construct encompassing three sub-dimensions: coordination, learning and strategic competitive response capabilities.

Structural equation model results

The theoretical model illustrated in Figure 1 was tested using EQS 6.1. In order to check the presence of a mediating effect, we performed a competing model analysis (Singh *et al.*, 1994) using two different models for each performance measure (i.e. market performance and profitability). The first model examined the direct relationship between the dynamic capability construct and firm performance, whereas the second one examined the same

relationship with functional capabilities acting as mediators. The indirect influence of dynamic capabilities construct on performance through functional competences is supported when: (1) there is a significant relationship among the dynamic capabilities construct and functional competences, (2) there is a significant relationship among functional competences and performance, (3) the direct dynamic capabilities impact on performance is significantly reduced or eliminated in the partial mediation model and finally (4) the second model (partial mediation model) explains more variance in performance than the first one (direct model).

Table 3 shows the results of the competing model analysis which examines the mediating role of functional competences on the relationship between dynamic capabilities and profitability. The results indicate that very good overall model fit was attained for both models.

Insert Table 3 around here

Moreover, they show that the dynamic capabilities construct impact on profitability is mediated by marketing and technological competences. First, the dynamic capabilities construct has a significant, positive impact on both marketing (H_{2a}: β=0.72, t=7.41, p<0.01) and technological competences (H_{2b}: β=0.70, t=9.31, p<0.01). Second, marketing competence has a positive influence on profitability (H_{1a}: β=0.30, t=2.20, p<0.01) while technological competence (H_{1b}: β=0.17, t=1.50) has a positive, although not significant, influence on firm profitability. Third, the significant, positive relationship between dynamic capabilities construct and profitability in the direct model (β=0.20, t=2.71, p<0.01) becomes insignificant in the partial mediation model (β=0.14, t=0.86). Finally, the second model explains more variance in firm profitability than the direct model (0.10 vs. 0.04). All these points indicate that dynamic capabilities influence on firm profitability is mediated by marketing and technological competences.

Insert Table 4 around here

The results of the competing model analysis presented in Table 4 indicate that dynamic capabilities impact on market performance is also mediated by marketing and technological competences. Both models' overall fit is very satisfactory and furthermore, positive relationships exist among the dynamic capabilities construct and both marketing (H_{2a}: β=0.72, t=7.42, p<0.01) and technological competences (H_{2b}: β=0.70, t=9.24, p<0.01). Positive relationships are also identified between both marketing (H_{1a}: β=0.35, t=2.74, p<0.01) and technological (H_{1b}: β=0.21, t=1.96, p<0.05) competences and market performance. The significant influence of dynamic capabilities on market performance indicated in the direct effects model becomes insignificant in the partial mediation model, and finally, the partial mediation model explains more variance in market performance than the direct model (0.23 vs. 0.10). Thus, the partial mediation model represents a significant improvement over the direct effects model and further supports our contention.

In summary, the competing models analysis for both performance measures indicates that dynamic capabilities influence competitive advantage indirectly through functional competences.

In addition, the structural equation analysis results indicate that environmental dynamism has a positive impact on dynamic capabilities for both models examined. These results suggest that dynamic capabilities can be enhanced and more efficiently exercised in an environment characterized by uncertainty and frequent changes.

To provide further evidence of environment's influence on dynamic capabilities an additional analysis was performed by splitting our sample into two sub-samples with high and low levels of environmental dynamism. Cluster analysis was run using the three environmental variables. The analysis results provided in table 5 indicate that the 'high dynamism' sub-sample exhibits a higher degree of dynamism compared to the 'low dynamism' subsample in all environmental variables.

Insert Table 5 around here

The SEM results from the baseline models for each cluster indicate that both of them can be considered optimal in representing the data for the 'high' and 'low' dynamism levels. Overall fit of the 'high dynamism' model was χ^2 (59) =82.283, χ^2 /df = 1.39, CFI= 0.968, RMSEA= 0.06, while overall fit of the 'low' dynamism model was χ^2 (59) =97.792, χ^2 /df = 1.65, CFI=0.956, RMSEA=0.06

A multi-group analysis was performed to test for the equivalence of these two models across the two groups. In order to assure that both groups have the same measurement and structural models, we used a set of hierarchical tests as outlined by Byrne (1994). The tests indicated that the factor loadings of the measurement items and the error variances of the latent variables were invariant across groups. Moreover, the tests also showed that both groups had equivalent structural parameters. Table 6 presents the model's structural parameters for both clusters examining the impact of dynamic capabilities on market performance (the analysis testing the impact of dynamic capabilities on profitability in different levels of environmental dynamism provided similar results).

Insert Table 6 around here

These findings show that the model investigating the impact of dynamic capabilities on performance applies for both levels of environmental dynamism and therefore suggest that dynamic capabilities can be of value even in environments characterized by less dynamic conditions.

DISCUSSION OF RESULTS

This study throws some additional light on the relationship between dynamic capabilities and firm performance. In addressing the issue, it examines the links among dynamic capabilities, functional competences and performance outcomes. The literature on dynamic capabilities

generally asserts that they have a positive impact on firm performance. However, these assertions or explanations are not founded on clear empirical testing. This theoretical and empirical asymmetry can be partly attributed to the difficulties in measuring capabilities (Williamson, 1999), especially with publicly available data (Rouse and Dallenbach, 1999). This paper provides empirical evidence based on data pertaining to a large sample of manufacturing firms. The results suggest that dynamic capabilities impact on performance is mediated by functional competences. In other words, dynamic capabilities seem to support and enhance the reconfiguration and development of new marketing and technological competences which in turn lead to higher competitive performance in terms of market share and profitability.

By confirming the mediating role of functional competences results indicate that there is an indirect link between dynamic capabilities and performance. This result is in line with the arguments advanced by Eisenhardt and Martin (2000), Winter (2003) and the simulation results put forward by Zott (2003). The empirical results clearly suggest that the composite construct of dynamic capabilities do not directly affect firm performance but indirectly contribute to the output of the firm through their impact on functional or operational competences. This implies that while effective dynamic capabilities are essential for superior performance they cannot be in themselves sources of it.

The present research distinguishes higher-order dynamic capabilities from lower-order functional competences. In doing so it highlights the catalytic role of dynamic capabilities in the shaping and renewal of functional competences. Effective marketing and technological competences must be present for superior performance achievement. However, by merely exploiting already existing competencies, firms are not in a position to sustain their superior profitability or favourable market positions forever. Therefore, dynamic capabilities allow

firms not just to utilize resources in more effective ways but also to renew and reshape their strategic competences so as to respond to challenges in the face of environmental change.

The findings must be considered in the light of previous research which assumes a potential positive influence of dynamic capabilities on performance. However, the very concept of dynamic capabilities has not been adequately examined and therefore remains ambiguous to a large extent (Winter, 2003). Against this background, the present research attempts to go beyond existing theory and the results help us to obtain some empirical evidence to bear on the issue. The estimation of the second-order confirmatory model indicates that dynamic capabilities can be conceptualized as a higher-order construct encompassing three sub-dimensions: coordination, learning and strategic competitive response capabilities. Therefore, the proposed construct offers a quantified dynamic capabilities measure based on a set of three identifiable and measurable factors. In doing so, this study provides evidence that dynamic capabilities are not fuzzy and ambiguous abstractions, but represent composite organizational processes. Hence, it opens the way for further analytical and empirical work.

The composite, unified construct representing dynamic capabilities dimensions brings together the heterogeneous capabilities of coordination, learning and strategic competitive response. These dimensions may inter-relate and reinforce each other to cumulatively form the ability to effectively build and reconfigure competences. Taking this further, we would argue that the suggested, yet not exhaustive dynamic capabilities may have less value as isolates. For example, coordinative dynamic capabilities seem to advance the routines underlying inter-organizational knowledge. Such knowledge-sharing routines of new organizational knowledge are, for instance, those related to strategic alliances, cooperation with other firms, universities and research centers, or acquisitions (e.g. Caloghirou, Tsakanikas and Vonortas, 2001; Capron *et al*., 1998; Gulati, 1999; Lane and Lubatkin, 1998). Those are likely to be reinforced as learning takes momentum, as people start to cooperate

within and across organizations and competitive signals are integrated into the alliance processes, for example. Therefore, the different dimensions of dynamic capabilities coexist and reinforce each other.

The study also shows that environmental dynamism has a significant impact on dynamic capabilities. This finding is in line with the literature which suggests that a firm operating in a turbulent environment may be more aware of the need to transform or reconfigure its functional competences in order to compete. Most interestingly, the results also suggest that dynamic capabilities have a positive impact on functional competences and firm performance even in less dynamic environments. This finding may be attributed to the fact that dynamic capabilities are likely to lead to superior performance by reshaping more effectively existing competences (Penrose, 1959). While we cannot presume that our 'low dynamism' sub-sample is an example of firms operating in perfectly stable conditions, it is still important to understand in more depth the range of market dynamism in which dynamic capabilities are valuable. For example, even if a firm rarely has to change its functional competences because the technology or market conditions remain constant in the particular industry, its performance seems to be improved as findings suggest. However, overinvestment in dynamic capabilities may not pay off, i.e. firm performance may be harmed in the long run if it expends significant resources to develop and maintain dynamic capabilities that may never be used. On the other hand, when environmental contexts are supra-dynamic, dynamic capabilities may acquire a different role (Eisenhardt and Martin, 2000) and there might be a trade-off between developing dynamic capabilities and ad-hoc problem solving (Winter, 2003). Further research could shed more light on the role of dynamic capabilities under different levels of environmental dynamism in order to fully understand possible boundaries in their applicability.

Conclusion and implications

Theoretical and managerial implications

This study, using a large-scale survey, attempts to empirically validate the impact of dynamic capabilities on performance. By explaining the indirect link between dynamic capabilities and firm performance, it indicates that they cannot in themselves be a source of sustainable competitive advantage; rather they contribute to the achievement of superior firm performance by combining and renewing functional competences which, in turn, affect performance. It is also important to note that the identification of dynamic capabilities as processes that shape the firm's resource base, confronts satisfactorily the tautology problem arising when they are directly related to firm performance.

Furthermore, the results indicate that dynamic capabilities have a positive impact on firm performance in both high and low levels of environmental change, indicating their significant role in less dynamic environments.

In addition, by trying to provide a comprehensive account of dynamic capabilities the paper offers a unified, multidimensional measure of dynamic capabilities which encompasses explicit, identifiable and measurable factors. Thus, it shows that dynamic capabilities are not vague and fuzzy abstractions that cannot be measured and managed, but specific processes which can be further, theoretically and empirically, explored.

The above results run against the skepticism expressed by some scholars about the concept of dynamic capabilities, e.g. the claim by some that they are vague abstractions, or the doubt articulated about their practical use by managers engaged in efforts to deliberately strengthen them (Winter, 2003). This research indicates that the dynamic capabilities construct and its underlying dimensions are a set of identifiable, measurable and, therefore, managerially-amenable options that can be used to address changing environments and moreover to further enhance their firm's dynamic capabilities.

In particular, managers can use dynamic capabilities as tools to manipulate and recombine their firms' functional competences and furthermore, enhance their firm's performance. Sometimes it may be more effective to use them in order to enhance their existing competences. For example, they may choose to further leverage their technological or marketing competences through the development of a new product. On the other hand, they should also examine which competences are already in place and which need to be created in order to address environmental challenges. This exercise will indicate the extent to which specific technological or marketing competences need to be built.

The present study also implies that dynamic capabilities have a certain performance impact even in relatively less dynamic environmental conditions. In this respect this study empirically enhances the argument noted by Eisenhardt and Martin (2000) that dynamic capabilities can operate in environments other than those experiencing rapid change (Helfat *et al.*, 2007). Therefore, managers should probably continue to advance their firms' seemingly-adequate competences as there are always opportunities for superior performance.

The evidence has also a particular value as it comes from firms operating in smaller economies in the periphery of European Union, such as Greece. These firms face intense competitive pressures from their counterparts based in low-cost producing countries or from highly differentiated companies with roots in large developed economies. Results establish the importance of dynamic capabilities in this environment. Thus, investing in dynamic capabilities may have a positive impact on profitability of these firms and may enhance their attempts to achieve a better presence in the world market.

Study limitations

The findings and implications of this research should also be considered in light of its limitations. As already noted in the methodology section, we used self-reported data to test the model. Although considerable efforts were made to ensure data quality, both during the

data collection and construct validation phases, the potential of survey biases cannot be excluded. Admittedly, given the perceptual nature of the data used to assess the theoretical constructs of this study, it is important to recognize problems associated with the fact that the respondents' perceptions might not necessarily coincide with objective reality. Moreover, it is important to recognize that a single study is not enough to provide valid measures in the true spirit of instrument developments.

This study, through successive stages of analysis and refinement, has arrived at a final list of operational indicators that satisfied specific reliability and validity criteria. Such a list should be replicated and refined in other research contexts. In particular, the proposed multi-dimensional dynamic capabilities concept is not considered to be exhaustive, but merely as representative of the core processes that are needed to reconfigure a firm's functional competences. Further research could identify and test more additional processes that would more broadly capture the theoretical domain of dynamic capabilities.

Another limitation of the research is related to the time period used to assess the sustainability of performance. The time period used, i.e. the previous three years, is admittedly short to capture any business cycle effects or transient problems. Nevertheless, it is important to note that a longer time period would require longitudinal research methods.

Finally, despite the impact of dynamic capabilities on functional competences and performance, the cost of building and maintaining dynamic capabilities is an issue that has not been explicitly studied. For example, "ad hoc problem solving" could perhaps have comparable or superior outcomes (Winter, 2003). Future research could directly consider the costs and benefits of dynamic capabilities and evaluate their cost-effectiveness in comparison to ad hoc problem solving.

Conclusion

In sum, this study empirically attests the mediating role of marketing and technological competences on the relationship between dynamic capabilities construct and firm performance. Findings suggest that long-term competitive advantage lies in the functional competences that firms build and reshape using dynamic capabilities, not in the capabilities themselves. Dynamic capabilities are therefore the tools by which functional competences can be reconfigured and manipulated by managers so as to form new and innovative forms of competitive advantage. This study also sheds some light on the concept of dynamic capabilities by creating a higher-order structure which encompasses coordination, learning and strategic competitive response capabilities. It also shows that dynamic capabilities have a value in environments characterized by high, as well low, change. Further empirical and analytical study of dynamic capabilities concept and their precise impact on performance in different research settings and under varying environmental conditions would confirm and enrich those findings.

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Tables and Figures

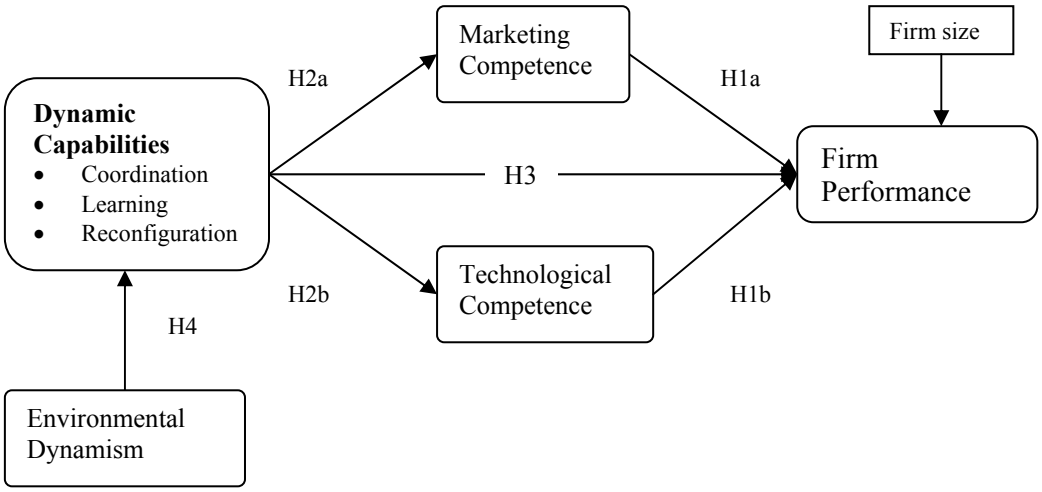

Figure 1. Impact of dynamic capabilities on functional competences and firm performance

Table 1: Reliability test

	Construct Reliability	Cronbach's a
Conceptual Domain:		
Environmental dynamism	0.71	0.70
Dynamic capabilities		
Coordination	0.72	0.73
Learning	0.74	0.74
Competitive response	0.83	0.84
Functional competences		
Marketing	0.72	0.72
Technological	0.81	0.80
Performance		
Profitability	0.88	0.88
Market performance	0.85	0.87

Table 2: Second-order model estimates

	Construct indicators	First-order loadings	Second-order loadings
Coordination capability	Integration and standardization of business processes	0.545[a]	
	Adoption of the latest management tools and techniques	0.762	0.920
	Systematic implementation of business plan	0.773	
Learning capability	Organized processes of in-house learning and knowledge development	0.562[a]	
	Systematic on the job training	0.777	0.962
	Efficient team-working	0.697	
Strategic competitive response capability	Effective benchmarking	0.703[a]	
	Systematic formulation of long term strategy	0.709	
	Timely response to competitive strategic moves	0.678	0.835
	Flexible adaptation of human resources to technological and competitive changes	0.607	

[a] Loadings are fixed to 1 for identification purposes. All factor loadings are significant at the 0.01 level.

Table 3: Structural equation modeling results: dynamic capabilities construct effect on profitability

Parameters	Direct model	Partial mediation model
Structural paths		
Environmental dynamism→ Dynamic capabilities	0.28*	0.30*
Dynamic capabilities→ Marketing competence		0.72*
Dynamic capabilities → Technological competence		0.70*
Dynamic capabilities → Profitability	0.20*	0.14
Marketing competence→ Profitability		0.30*
Technological competence → Profitability		0.17
Measurement model		
Environmental dynamism →Change in products	0.72 [a]	0.72 [a]
Environmental dynamism → Change in technology	0.67*	0.67*
Environmental dynamism → Intensity of innovation-based competition	0.61*	0.62*
Dynamic capabilities→ Coordination	0.84 [a]	0.81 [a]
Dynamic capabilities → Learning	0.76*	0.80*
Dynamic capabilities → Competitive response	0.77*	0.75*
Marketing competence→ Branded products		0.59 [a]
Marketing competence → Emphasis in strong sales force		0.67*
Marketing competence → Emphasis in marketing department organization		0.76*
Technological competence→ Organized R&D department		0.78 [a]
Technological competence → Co-operations to acquire know-how		0.82*
Technological competence → Technological infrastructure improvement		0.68*
Profitability→ Profit margin	0.85[a]	0.85 [a]
Profitability → Return on own capital	0.85*	0.85*
Profitability → Net profits	0.84*	0.84*
Control measure		
Firm size → Profitability	0.13	0.09
Goodness-of-fit statistics		
χ^2(d.f.)	$\chi^2(25)=33.92$ p=0.11	$\chi^2(84)=115.523$ p=0.02
CFI	0.99	0.98
RMSEA	0.04	0.04

[a] Loadings are fixed to 1 for identification purposes. * denotes p<0.01

Table 4: Structural equation modeling results: dynamic capabilities construct effect on market performance

Parameters	Direct model	Partial mediation model
Structural paths		
Environmental dynamism →Dynamic capabilities	0.28*	0.30*
Dynamic capabilities → Marketing competence		0.72*
Dynamic capabilities → Technological competence		0.70*
Dynamic capabilities→ Market performance	0.39*	0.00
Marketing competence → Market performance		0.35*
Technological competence→ Market performance		0.21**
Measurement model		
Environmental dynamism →Change in products	0.71 [a]	0.72[a]
Environmental dynamism → Change in technology	0.68*	0.68*
Environmental dynamism → Intensity of innovation-based competition	0.61*	0.62*
Dynamic capabilities→ Coordination	0.83[a]	0.81 [a]
Dynamic capabilities → Learning	0.76*	0.79*
Dynamic capabilities → Competitive response	0.78*	0.75*
Marketing competence→ Branded products		0.59 [a]
Marketing competence → Emphasis in strong sales force		0.67*
Marketing competence → Emphasis in marketing department organization		0.77*
Technological competence→ Organized R&D department		0.77 [a]
Technological competence → Co-operations to acquire know-how		0.82*
Technological competence → Technological infrastructure improvement		0.69*
Market performance→ Sales volume	0.58 [a]	0.56[a]
Market performance → Market share	0.57*	0.57*
Market performance → Increase in sales volume	0.93*	0.91*
Market performance → Increase in market share	0.93*	0.95*
Control measure		
Firm size → Market performance	0.18	0.07
Goodness-of-fit statistics		
χ^2(d.f.)	χ^2 (32)=57.39 p=0.00	χ^2(97)=141.53 p=0.00
CFI	0.99	0.98
RMSEA	0.06	0.04

[a] Loadings are fixed to 1 for identification purposes. *denotes p<0.01, **denotes p<0.05

Table 5: Cluster analysis results

Variables	High dynamism cluster	Low dynamism cluster	t-value
Rate of product change	4.57	2.13	13.74 ($p<0.01$)
Rate of technological change	5.00	2.84	11.95 ($p<0.01$)
Intensity of innovation-based competition	5.30	3.10	12.45 ($p<0.01$)

Table 6: Structural models across clusters

Parameters	High dynamism cluster (n=128)	Low dynamism cluster (n=143)
Structural paths		
Dynamic capabilities → Marketing competence	0.80	0.64
Dynamic capabilities → Technological competence	0.65	0.71
Dynamic capabilities→ Market performance	0.09	-0.07
Marketing competence → Market performance	0.29	0.35
Technological competence→ Market performance	0.04	0.32

Appendix: Pearson correlations among variables

Variable	Mean	SD	1	2	3	4	5	6	7
(1) Environmental Dynamism	3.70	1.34	1.000						
(2) Dynamic capabilities	4.64	0.99	0.194**	1.000					
(3) Marketing competence	4.84	1.50	0.202**	0.534**	1.000				
(4) Technological competence	3.71	1.74	0.142*	0.568**	0.420**	1.000			
(5) Profitability	4.35	1.17	0.059	0.160**	0.234**	0.202**	1.000		
(6) Market performance	4.65	1.15	0.143*	0.279**	0.318**	0.270**	0.574**	1.000	
(7) Number of employees (log)	4.62	1.10	0.009	0.289**	0.320**	0.309**	0.052	0.113	1.000

** Correlation statistically significant at the $p \leq 0.01$ level (2-tailed test).
* Correlation statistically significant at the $p \leq 0.01$ level (2-tailed test).