Explaining the causes and effects of dynamic capabilities generation: a multiple indicator multiple case modeling approach

Paper published in

British Journal of Management

Full citation to this publication:

Barrales Molina, V.; Bustinza Sánchez, O.F. and Gutiérrez Gutiérrez, L.J. (2013): "Explaining the causes and effects of dynamic capabilities generation: a multiple indicator multiple case modeling approach". *British Journal of Management*, Vol.24, n.4, pp.571-591.

https://doi.org/10.1111/j.1467-8551.2012.00829.x

Explaining the Causes and Effects of Dynamic Capabilities Generation: A Multiple Indicator Multiple Cause Modelling Approach

Barrales-Molina, V.

Bustinza Sánchez, O.

Gutierrez-Gutierrez, L.

University of Granada (Spain)

Abstract

The purpose of this paper is to develop a multiple-indicator-multiple-cause (MIMIC) model to explain dynamic capabilities generation. We use one of the main common effects of dynamic capabilities (operational, structural and strategic flexibility) to design a measurement tool for dynamic capabilities generation. Based on this measurement tool, we test the influence of several factors identified in the specialized literature as potential causes that trigger and promote dynamic capabilities generation. We use data from a survey of 200 CEOs of Spanish firms to test the model. The results show that only organizations whose managers have perceived a high degree of environmental dynamism have generated dynamic capabilities. The results also show that knowledge codification and technical innovation are significantly related to dynamic capabilities generation. The paper attempts to shed light on current theoretical debates about dynamic capabilities generation and provides a

practical guide to explain the origin and results of dynamic capabilities that have been tested empirically.

Introduction

In recent years, dynamic capabilities have become one of the most active research areas in the field of strategic management (Hodgkinson and Healey, 2011). Teece, Pisano and Shuen (1997, 516) developed the first definition of dynamic capabilities, using it to refer to the *firm's abilities to integrate, construct and reconfigure internal and external competences and thus to respond to competitive environments rapidly*. Since the publication of this seminal paper, many scholars have attempted to develop a framework to explain how firms can generate and use such dynamic capabilities.

The growing interest in this topic has generated a rich but complex body of research that points in different directions (Barreto, 2010). Most contributions are theoretical and study the concept, nature and role of dynamic capabilities, the mechanisms for their creation and generation, and their results. Despite this effort, the concept is still in need of theoretical and empirical development (Ambrosini and Bowman, 2009; Di Stefano, Peteraf and Verona, 2010). There is still no consensus on the conceptualization of key features of dynamic capabilities, although scholars in the field express the urgent need for a coherent theory and model of dynamic capabilities (Arend and Bromiley, 2009; Katkalo, Pitelis and Teece, 2010). Empirical studies represent the main challenge in this field, as they may help to resolve the discrepancies between the diverse understandings and theoretical interpretations (Easterby-Smith, Lyles and Peteraf, 2009).

Recent empirical works on dynamic capabilities measure primarily either their components or a specific dynamic capability. For example, Pavlou and El Sawy (2011) measure four components of dynamic capabilities (sensing capability, learning capability, integrating capability and coordinating capability). Lee, Hung-Hsin and Shyr (2011) measure alliance development as a specific dynamic capability. We find few studies, however, that use the effects and outcomes to study dynamic capabilities. Moreover, many issues concerning the process of dynamic

capabilities generation have yet to be analyzed, enabling simultaneous integration of the origins and the outcomes.

To resolve the issues explained above, we have developed a multiple-indicators-and-multiple-causes (MIMIC) model (Bohrnstedt, 1977; Jöreskog and Goldberger, 1975). This methodology has not been used to explain how organizations develop dynamic capabilities, but it is appropriate for studying the theoretical causes and effects of a latent phenomenon (Maltrizt, Bühn and Eichler, 2012; Rahman, Mittelhammer and Wandschneider, 2010), such as dynamic capabilities generation. Our first goal will thus be to design a measurement tool for the level of dynamic capabilities generation, using the main outcomes or effects. Our second goal is to test the influence of a set of theoretical antecedents of dynamic capabilities generation, such as environmental dynamism, learning mechanisms and technical innovation.

The analysis was conducted using data from 200 CEOs of Spanish firms from different industry sectors in the economy. The results indicate that perceived dynamism in the competitive environment, technical innovation, and the promotion of learning mechanisms (such as knowledge codification) are significantly related to dynamic capabilities generation. The MIMIC model also allows us to study the relative importance of the causes of dynamic capabilities generation. We find that knowledge codification exerts the strongest influence on the process, although environmental dynamism has a nearly equivalent influence.

Our study contributes to the literature by developing a simple model to operationalize and measure dynamic capabilities generation. The empirical results of this model can be extrapolated to the study of any dynamic capability. The main difficulties in explaining dynamic capabilities derive from their heterogeneity: (i) organizations can use different dynamic capabilities to obtain the same goal (long-term competitive advantage), and (ii) the nature of dynamic capabilities is idiosyncratic (even when organizations generate the same dynamic capability). We thus find multiple different paths for generating dynamic capabilities. Despite this fact, scholars recommend focusing on commonalities of dynamic capabilities to develop

empirical studies (Barreto, 2010; Wang and Ahmed, 2007). This paper thus measures dynamic capabilities generation through three indicators of organizational flexibility that can be identified as the common outcome of any dynamic capability (Pavlou and El Sawy, 2011; Volberda, 1996; Zollo and Winter, 2002; Zott, 2003). Additionally, we study the influence of the most discussed antecedents of any dynamic capability with the aim of shedding light on theoretical debates in the specialized literature.

The paper proceeds as follows. We first describe the main features of the theory of dynamic capabilities. Next, we present the details of the MIMIC model used in this paper and the set of hypotheses. We then present the research methodology and results. The final section includes the discussion of results, managerial implications, future research lines and limitations.

Theoretical framework, MIMIC model and hypotheses

Literature review

The dynamic capabilities view has evolved from the resources and capabilities theory (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984). This theory proposes to identify the conditions under which firms achieve sustained competitive advantage based on their resources and capabilities (valuable, rare, inimitable and non-substitutable).

The theory is extremely valuable for developing studies in strategic management, but it has some limitations in explaining how competitive advantage evolves when firms are facing hypercompetitive environments. As a result, Teece, Pisano and Shuen (1997) published a seminal article to introduce the concept of dynamic capabilities. Since then, several authors have suggested alternative definitions of dynamic capabilities that highlight different aspects, including the nature, creation, specific role, purpose or results. Table 1 lists the main conceptualizations.

Table 1. Definitions of dynamic capabilities

First, according to these authors, dynamic capabilities are defined as internal processes, abilities or learned patterns. This definition highlights their inherent idiosyncratic nature (Easterby-Smith, Lyles and Peteraf, 2009; Teece, 2007), since they are the result of the firm's path dependence (Zollo and Winter, 2002). Dynamic capabilities are thus embedded in the organization; they cannot be bought (Makadok, 2001).

Based on the different conceptualizations, the management literature has established that new product development (Bruni and Verona, 2009; Eisenhardt and Martin, 2000), technical innovation (Danneels, 2002; O'Connor, 2008), absorptive capacity (Zahra and George, 2002), and alliance and acquisitions management (Karim and Mitchell, 2000; Zollo and Singh, 2004) can be viewed as dynamic capabilities. These are all developed within the organization and permit the organization to obtain new knowledge and apply it to renew organizational resources and capabilities (Cepeda and Vera, 2007; Easterby-Smith and Prieto, 2008).

Second, dynamic capabilities are an intentional and deliberate organizational response for managing the changing competitive environment (Helfat et al., 2007). The role of managers is thus crucial in promoting and initiating the generation of dynamic capabilities (Adner and Helfat, 2003; Augier and Teece, 2009).

Finally, dynamic capabilities are learned patterns that act systematically on resources and organizational capabilities (Zollo and Winter, 2002). They are persistent elements, not spontaneous reactions (Ambrosini and Bowman, 2009). Some authors even define dynamic capabilities as routines that change the firm's key internal resources and capabilities in a quasi-automatic way (Becker, 2004; Zahra, Sapienza and Davidsson, 2006).

Dynamic capabilities generation: model and hypotheses

Despite the remarkable progress made by researchers (e.g. Ambrosini and Bowman, 2009; Barreto, 2010; Wang and Ahmed, 2007; Zahra et al., 2006; Winter, 2003; Zollo and Winter, 2002), many questions remain unanswered concerning the underlying mechanisms of developing processes and effects or outcomes associated with dynamic capabilities (Barreto,

2010; Easterby-Smith, Lyles and Peteraf, 2009). The origin and effects of dynamic capabilities thus attract the attention of many researchers in the field (e.g. Pandza and Thorpe, 2009; Pavlou and El Sawy, 2011; Romme, Zollo and Berends, 2010). However, the heterogeneity and idiosyncratic nature of these capabilities hinders the measurement and application of the dynamic capabilities construct.

To overcome these difficulties, we use a MIMIC model, which allows us to treat dynamic capabilities generation as a latent variable approximated by its common outcomes or effects. A MIMIC model consists of two parts: a structural model and a measurement model (Bohrnsted, 1977; Jöreskog and Golberger, 1975).

The structural model can be represented as follows:

$$\eta = \gamma\, x_t + \zeta_t$$

where η is the latent variable (dynamic capabilities generation), x_t is a vector that consists of a set of theoretical causes of the latent variable and γ is a vector containing the coefficients to explain the relationships between η and its causes. ζ_t is the unexplained part of η.

Causes are potential antecedents or predictors of the latent variable. Causal priority between these variables and the latent variable is the factor that determines whether one considers them effects or causes (Diamantopoulos and Winklhofer, 2001). In the present study and according to literature in the field, we use causes to indicate internal and external variables that can influence dynamic capabilities generation. These causes therefore help us to explain the conditions under which dynamic capabilities have been generated in organizations.

The measurement model can be expressed as:

$$y_t = \lambda \eta_t + \varepsilon_t$$

where y_t is a vector containing several indicators or effects of the latent variable, λ is a vector consisting of factor loadings for each indicator and ε_t is a vector including the measurement errors of the indicators.

Indicators are measurable manifestations or results derived from the latent variable (Bollen and Lennox, 1991, Safón, 2009). We can thus use them as an approximate measure of the latent variable. In the present study, indicators are the expected effects of dynamic capabilities generation.

Most empirical papers on this issue use regression analysis to test the set of hypotheses. Such an approach implies using a single indicator as dependent variable. By using a MIMIC model, we consider three indicators simultaneously in order to capture different dimensions together (Maltritz, Bühn and Eichler, 2012; Safón, 2009). This methodology enables us to follow the recommendations of researchers who propose the aggregation of several correlate dimensions to measure dynamic capabilities (e.g. Barreto, 2010; Macher and Mowery, 2009; Wang and Ahmed, 2007).

The first step in developing a MIMIC model is to select the causes and indicators based on the specialized literature. We must choose accurate causes and indicators to define the latent variable and to propose the set of hypotheses (following section). The next step is to define a measurement method for causes and indicators. Finally, we test the model's coefficients and parameters.

According to these specifications, the path diagram of our MIMIC model is represented in the figure:

Figure 1. MIMIC model

The next section presents the causes and indicators and explains the reasoning behind their selection.

1. Environmental dynamism

When scholars define dynamic capabilities, they inevitably use the environment as a key factor to explain the value of dynamic capabilities (Aragón-Correa and Sharma, 2003; Oliver and Holzinger, 2008; Teece, Pisano and Shuen, 1997). According to some authors, highly dynamic

environments seem to be a necessary condition for an organization to generate dynamic capabilities (O'Connor, 2008). However, the literature includes a wide range of statements about the kind of external environments that are relevant to dynamic capabilities (Romme, Zollo and Brends, 2010). More empirical research is thus required to provide results that shed light on the current theoretical debates (Di Stefano, Peteraf and Verona, 2010)

Many researchers argue that dynamic capabilities are meaningless in stable and moderately stable environments (Teece, 2007; Zollo and Winter, 2002). They explain that these capabilities are costly mechanisms that are useless when the environment is stable. Following the argument proposed by Eisenhardt and Martin (2000), other authors argue the value of dynamic capabilities in stable environments. These authors use Eisenhardt and Martin's research to propose several kinds of dynamic capabilities according to the level of dynamism in the environment. For example, Ambrosini, Bowman, and Collier (2009) suggest three levels of dynamic capabilities based on level of dynamism that managers perceive (incremental, renewing and regenerative dynamic capabilities). Likewise, Zahra, Sapienza and Davidsson (2006) point out that dynamic capabilities are not only necessary to manage external changes but also valuable to overcome changes derived from internal conditions. Consequently, even though the level of environmental dynamism is low, firms may need dynamic capabilities to respond to internal changes. Madsen (2010) defines four different generic types of dynamic capabilities to overcome internal or external difficult contingencies (external observation and evaluation, internal resource renewal, external resource acquisition and internal resource reconfiguration).

Empirical research is also inconclusive in this debate. Romme, Zollo and Berends (2010), for example, find that the influence of environmental dynamism on dynamic capabilities development is non-linear and complex, since this relationship depends on other conditions, such as organizational history. Theoretical and empirical progress in the approach does not permit us to determine whether environmental dynamism causes dynamic capabilities generation. However, we can expect that managers will ultimately promote dynamic capabilities

generation when it is extremely necessary. Dynamic capabilities could damage performance, when firms use them under unnecessary conditions (Zahra, Sapienza and Davidsson, 2006).

According to the foregoing, we propose the following hypothesis:

> *H1:* Organizations whose managers perceive a high level of dynamism in the environment are more likely to generate dynamic capabilities.

2. Organizational learning

The literature in the field proposes several learning models to explain where dynamic capabilities come from and how they work as mechanisms of the firm's adaptation (e.g. Bierly and Chakrarti, 1996; Nielsen, 2006; Shimizu and Hitt, 2004; Zollo and Winter, 2002). We find, however, two diverging views of the creation and development of dynamic capabilities (Barreto, 2010). Some researchers highlight the idiosyncratic nature of dynamic capabilities (Romme, Zollo and Berends, 2010; Teece, Pisano and Shuen, 1997), arguing that it is difficult and risky to propose a set of mechanisms that claim to generate dynamic capabilities in any organization. Other authors assume that, despite the path-dependent features, it is possible to identify a set of commonalities in the dynamic capabilities generated in different organizations (Ambrosini and Bowman, 2009; Dunning and Lundan, 2010; Eisendhardt and Martin, 2000; Swift and Hwang, 2008; Wang and Ahmed, 2007; Zollo and Winter, 2002). It may therefore be valuable to study whether organizations use the same set of mechanisms to generate dynamic capabilities.

In the second group of authors, the theoretical model proposed by Zollo and Winter (2002) indicates that, if the organization promotes and develops a set of three learning mechanisms, it will be able to construct dynamic capabilities. These capabilities will then modify the organizational routines through the reconfiguration of existing knowledge in the organization. The three learning mechanisms proposed are: (i) knowledge codification, through which individuals express their knowledge in written tools, reports or work programs; (ii) knowledge articulation, processes by which individual knowledge is shared through collective discussions or information sessions; and (iii) accumulated experience, which consists of a partially

automatic process of tacit knowledge accumulation through experimentation. When functioning, these mechanisms constitute a cycle that combines the exploration and exploitation of organizational knowledge and that ultimately produces the firm's adaptation to its competitive environment.

Many empirical studies that attempt to explain the origin of dynamic capabilities have been based on the model developed by Zollo and Winter (2002). For example, Macher and Mowery (2009) develop a study of dynamic capabilities in the semiconductor industry. They observe that firms operating in this industry use knowledge codification and articulation to develop the main dynamic capability in this sector: new process development. Swift and Hwang (2008) use the three learning mechanisms to explain the adaptation value derived from some marketing services. Zollo and Singh (2004) analyze the role of the three learning mechanisms in strategic alliances management, finding great adaptation value in more deliberate mechanisms (such as knowledge codification and articulation).

From both the theoretical and the empirical point of view, the three learning mechanisms may be used in studying the process of dynamic capabilities generation. These mechanisms are considered to be triggers of the process and may therefore generate dynamic capabilities. We thus formulate the following sub-hypotheses:

H2a: Knowledge codification is positively related to dynamic capabilities generation.

H2b: Knowledge articulation is positively related to dynamic capabilities generation.

H2c: Accumulated experience is positively related to dynamic capabilities generation.

3. Technical innovation

The literature argues a close relationship between technical innovation and dynamic capabilities generation (Danneels, 2002; Lee and Kelley, 2008; O'Connor, 2008; Zheng et al., 2011; Verona and Ravasi, 2003) but discusses this relationship from different points of view. A general stance argues that technical innovation is a specific dynamic capability, such as absorption capacity or

alliance management. On the other hand, some scholars believe that technical innovation may be a necessary step in creating generic dynamic capabilities (e. g. Wang and Ahmed, 2007).

Eisenhardt and Martin (2000) show that product innovation (among other organizational capabilities) may be considered a "real" dynamic capability, because it promotes the renewal and reconfiguration of a firm's resources. Some theoretical and empirical studies have attempted to demonstrate that technical innovation is one of the essential traits that help firms to overcome uncertainty in their competitive environment and to adapt. For example, Danneels (2002) tests how technical innovation implies organizational renewal over time. Other theoretical studies argue that considering technical innovation as a dynamic capability is useful to understanding the role of dynamic capabilities (Ambrosini and Bowman, 2009; Dunning and Lundan, 2010; Lee and Kelley, 2008; O'Connor, 2008).

Studies from a different perspective attempt to divide dynamic capabilities into several components, of which innovation is one of the most significant. Wang and Ahmed (2007), for example, identify three components (adaptive capability, absorptive capability and innovative capability) that reflect the common features of dynamic capabilities across firms. Innovative capability expresses the firm's ability to develop new products and markets by aligning strategically with innovative behaviours and processes. This framework identifies technical innovation as a common element of dynamic capabilities across firms that helps to measure the construct in empirical studies (Ellonen, Wikström and Jantunen, 2008).

If we understand innovation as both a specific dynamic capability and a component, technical innovation may be considered one of the necessary steps in dynamic capabilities generation. This is due to the fact that technical innovation is a common feature in organizations where internal and external competences are reconfigured to respond to environmental demands.

H3: Technical innovation is positively related to dynamic capabilities generation.

4. Expected effects or indicators of dynamic capabilities generation

The main purpose of the dynamic capabilities view is to explain how firms generate these capabilities in order to adapt to dynamic environments. Although some scholars argue that superior performance can be considered an indirect result of dynamic capabilities (Drnevich and Kriauciunas, 2011; Zahra, Sapienza and Davidsson, 2006), the most consolidated direct effect is a high degree of flexibility to renew organizational processes (Barreto, 2010). According to Volberda (1996), the dynamic capabilities generated in an organization can be detected through its "flexibility mix" (a balanced combination of operational, structural and strategic flexibility).

To identify the effects of dynamic capabilities generation, we assume that an organization that has generated dynamic capabilities will show a high level of:

(i) operational flexibility, the ability to renew most day-to-day tasks or routines involved in basic processes. According to many scholars' conceptualizations, this is the specific role of dynamic capabilities (Barreto, 2010; Pavlou and El Sawy, 2011; Teece, 2007; Zollo and Winter, 2002)

(ii) structural flexibility, the ability of the firm to adapt its organizational structure to new conditions, such as creating multifunctional teams or purchasing components from suppliers. Karim (2006) argues that an organization that generates dynamic capabilities must be able to reconfigure its structure to adapt to environmental changes.

(iii) strategic flexibility, managers' ability to sense and respond quickly to external changes, such as political regulations or competitors' actions. Some scholars stress that dynamic capabilities generation is based on managers' ability to identify opportunities and threats (Adner and Helfat, 2003; Augier and Teece, 2009; Helfat et al., 2007).

If we consider "flexibility mix" as the effect of dynamic capabilities, we can measure dynamic capabilities generation through an aggregated construct composed of three weakly correlated dimensions that show the existence of such capabilities. (We follow the recommendations of some researchers on how to operationalize the construct, e.g. Barreto, 2010; Macher and Mowery, 2009; Wang and Ahmed, 2007).

According to literature on MIMIC models (e.g. Lim, Heinrich and Lim, 2009; Safón, 2009), we introduce an additional hypothesis to test whether our approximation meets the statistical requirements for measurement models.

H4: Dynamic capabilities generation can be considered an aggregated construct composed of a set of indicators: operational flexibility, structural flexibility and strategic flexibility.

Methodology, data and measures

Data

To obtain the data, we first designed a structured questionnaire to measure the set of variables included in the theoretical model. We used the Duns and Bradstreet Spain Database (2008) to obtain the study population. The questionnaire was sent to the CEOs of 1500 Spanish firms taken from any sector of the Spanish economy. This choice ensured a similar economic, political and legal framework for the firms of the study, minimizing the importance of other international variables that cannot be controlled in our empirical research (Adler, 1983; Jiménez-Barrionuevo, García-Morales and Molina, 2011). Testing the set of hypotheses in different sectors also helps to explain the role of dynamic capabilities across different economical activities, enabling better generalization from results (Gilsing et al., 2008).

The following table presents the technical details of our study.

Table 2. Technical details of the research

After two rounds of follow-up reminders, 200 valid responses were received. We studied the possibility of non-response bias. The sampling error, the error caused by observing a sample instead of the whole population, was calculated to be 6.5%. A maximum level of 10% is considered acceptable in social sciences studies (Scandura and Williams, 2000). We also compared the first and the last responses to analyze whether there were significant differences between them, using several extrapolation techniques proposed by Armstrong and Overton

(1977) (see table in Appendix 1). No significant differences were found regarding sales, assets or employees.

The measurement tool: the questionnaire

Because this study analyzes some constructs (for example, knowledge codification, knowledge articulation and accumulated experience) not operationalized in the literature for measurement through a questionnaire, we designed a specific scale to measure them. Our main objective was to fit our measurement scales to definitions proposed in the literature in the field, especially to Zollo and Winter (2002). In other cases (for example, environmental dynamism and flexibility), we employed measurement scales commonly used in a wide variety of empirical studies.

The items included in the questionnaire were evaluated by the interviewee according to a 7-point Likert scale (1=”totally disagree; 7=”totally agree). Although we employed different scales derived from several authors, we used the same number of points (1-7) following several scholars’ recommendation (e.g. Aiman-Smith, Scullen and Barr, 2002; Beal and Dawson, 2007; Bolton, 1993; Rusel and Bobko, 1992) to use response formats with a larger number of options (7 points or 9 points) to avoid loss of information.

Before using this questionnaire, we consulted four academics and four CEOs to discuss their impression of a pilot questionnaire (pilot and final questionnaire contained the same items). First, academics with extensive experience in management literature confirmed whether items were appropriate expressions to measure the theoretical constructs. Second, CEOs checked carefully that the items would be understood accurately by another CEO and proposed clarifications to improve comprehension. To confirm that the interviewee had understood correctly, we used different questions and methods proposed for pre-testing questionnaires (Bolton, 1993). We were also especially careful in translating the questionnaire. For example, since our questionnaire was addressed to Spanish CEOs, we had the items from scales originally written in English translated by a professional translator who specializes in management literature. The four academics also helped us to ensure consistency between English and

Spanish versions. Finally, we developed the final version of the questionnaire, incorporating their comments and suggestions, although the initial section of the final questionnaire did not change substantially.

Next, we explain how each scale was obtained or designed:

Learning mechanisms

To measure the three learning mechanisms (knowledge codification, knowledge articulation and accumulated experience), we developed three respective measurement scales, composed of 8 items each and based on the concepts and characteristics of the variables in the specialized literature.

Knowledge codification

Knowledge codification has been defined as the degree to which members of the organization express their knowledge through written tools, reports, memories or work programs. Various studies have described the main features of an organization with a high level of knowledge codification (e.g. Ancori, Buret and Cohendet, 2000; Cohendet and Steinmueller, 2000; Cowan, David and Foray, 2000).

First, codification is one of most deliberate learning mechanisms (Macher and Mowery, 2009; Zollo and Winter, 2002), since it is the result of managerial decisions. Although knowledge codification is an important tool for the identification of causal connections between practice and performance (Szulanski, 2000; Zollo, 2009), this learning mechanism requires great cognitive and economic effort, organizational commitment and important leadership tasks (Cohendet and Steinmueller, 2000). Thus, to measure the level of knowledge codification, we include four items that evaluate the organizational effort to promote and develop this tool (see items COD01, COD06, COD 08 and COD07 in Table 3).

According to Cowan, David and Foray (2000), we find different levels of knowledge codification. When the members of organization develop dictionaries and glossaries to facilitate

comprehension of manuals, guides or codes, the organization increased a higher level of knowledge codification. When these manuals or guides can be understood by people outside the organization, it has achieved a high level of codification (Cohendet and Steinmueller, 2000). We use items COD02, COD04 and COD05 to reflect these possibilities (see Table 3).

Last, successful codification, codes and manuals must be used by members of organizations (Cohendet and Steinmueller, 2000). Managers should promote the use of manual or guides and facilitate access to these tools (Ancori, Buret and Cohendet, 2000). To evaluate this condition, we have included item COD03.

Table 3. Items measuring knowledge codification (source: developed by authors)

Knowledge articulation

Knowledge articulation is the process by which individual knowledge is shared through collective discussions, information sessions and processes for evaluating performance (Nonaka, 1994; Spanos and Prastacos, 2004; Zollo and Winter, 2002). Organizations with a high level of knowledge articulation encourage discussion of ideas; organize meetings, seminars and debates regularly; and include in written tools the results obtained from discussion of the problems (Cohendet and Steinmueller, 2000). Items ART01, ART02 and ART08 measure the existence and frequency of such collective discussions (see Table 4).

Knowledge articulation is also a deliberate learning mechanism; it requires managers' leadership and organizational commitment (Nonaka, 1994; Zollo, 2009). Managers play a crucial role in developing this tool successfully. We thus include item ART03 (see Table 4) to evaluate whether managers encourage employees to participate assiduously in collective discussions.

Moreover, to achieve true knowledge articulation, managers should appreciate employees' proposals and should not block new and creative ideas (Spanos and Pastracos, 2004). Items ART04, ART06 and ART07 (see Table 4) were included to measure whether employees are encouraged to discuss different topics openly, thereby achieving true knowledge articulation.

Finally, item ART05 evaluates whether organizations codify the results of collective discussions, reporting the conclusions in memos or minutes, to promote an excellent level of knowledge articulation (Nonaka, 1994; Swift and Hwang, 2008).

Table 4. Items measuring knowledge articulation (source: developed by authors)

Accumulated experience

Accumulated experience is a quasi-automatic process of tacit knowledge accumulation through experimentation in the daily performance of the organization's members (Zollo and Winter, 2002). Past experiences, trial and error, and improvisation generate a stock of tacit knowledge that does not require a great cognitive and economic effort (Zahra, Sapienza and Davidsson, 2006; Zollo, 2009). EXP01, EXP06, EXP07 and EXP08 measure the knowledge generated through employees' past experiences (see Table 5).

When the organization uses its workers for an indefinite time, hires experts in each area, encourages the generation of new ideas and develops communication systems that are easy to access, the organization achieves a higher level of accumulated experience (Bontis, 1998; Paoli and Prencipe, 2003; Zollo and Winter, 2002). EXP02, EXP03, EXP04 and EXP05 were included to measure whether managers' decisions promote the accumulation of experience inside the organization.

Table 5. Items measuring accumulated experience (source: developed by authors)

Environmental dynamism

Several studies have measured the different dimensions of environmental dynamism. We used the scale designed by Tan and Litschert (1994). This scale included four items to measure managers' perceptions of dynamism in the general and specific environment.

Table 6. Items measuring environmental dynamism

Technical innovation

We find several valid measurement scales for studying technical innovation. We used a scale designed by Lloréns-Montes, Ruiz-Moreno and Molina (2003) and adapted from other authors' scales (Bennett and Gabriel, 1999; Kusunoki and Nonaka, 1998; Russel, 1990).

Table 7. Items measuring technical innovation

Flexibility

We used sixteen items to measure the different dimensions of organizational flexibility (operational, structural and strategic). These items were adapted from several studies (Sethi and Sethi, 1990; Jaikumar, 1986; Verdú-Jover, Lloréns and García, 2004, Verdú-Jover; Gómez-Grass and Lloréns-Montes, 2008; Volberda, 1996). The exploratory analysis revealed three factors corresponding to each theoretical dimension of flexibility.

Table 8. Items measuring flexibility

Validation of the measurement scale

To evaluate the psychometric properties of the construct, we developed exploratory and confirmatory analyses. We used SPSS 15.0 to perform a principal components analysis with Promax rotation (see results in Appendix 2). This exploratory analysis was used to identify the

key factors of the entire data set. As we expected, eight factors were extracted, corresponding to each construct. Furthermore, we proved that a single factor was included in each construct.

Second, confirmatory analysis helped to verify the validity and reliability of each scale. This analysis is recommended when the study variables are constructed using factors that contain the essential information of a set of items or responses (Reymont and Jöreskog, 1993). Confirmatory analysis helps us to identify those items that do not fulfil the recommended criteria. The first step is to estimate the factor loadings and individual reliability (R^2) of every item in a scale. To be accepted, each item must show a factor loading > 0.4 and an individual reliability of R^2 >0.5. Items that did not fulfil these conditions were eliminated and a new scale re-estimated. Table 9 shows the results of the final estimation of factor loadings, once inappropriate items have been removed.

Table 9. Results of final measurement model

We can see in the Table 9 that the final scales consist of items with acceptable factor loadings and individual reliability, confirming the convergent validity of each scale (Anderson and Gerbing, 1982; Hair et al., 1999). The global reliability of each scale (Cronbach-alpha) is higher than 0.7, the minimum value recommended for measurement tools (Cronbach, 1951; Hair et al., 1999). Achieving an acceptable level of global reliability indicates that the concept has been measured precisely, without errors (Jiménez-Barrionuevo, García-Morales and Molina, 2011) and has thus achieved internal consistency. We also confirmed that the fit indicators have acceptable values.

Finally, to confirm that the different constructs used in the study do not refer the same concept and that there is no overlap between variables, we performed a discriminant validity analysis. We applied the procedure suggested by Anderson and Gerbing (1988), which involves running a new principal component analysis, once the scales have been purified. The results show that each construct is finally built by the items used to measure it (see Appendix 2). Additionally, we calculated the composite reliability (must be greater than 0.70) (Fornell and Larcker, 1981) and

the average variance extracted (must be greater than 0.50) (Barclay, Higgins and Thompson, 1995). The values obtained for each indicator are above the acceptable limits in all cases. The results are presented in Table 10.

Table 10. Composite reliability and average variance extracted

Results

Table 11 displays the means, standard deviations and correlations matrix to enable a preliminary analysis from which to evaluate the potentially significant relationships.

Table 11. Descriptive Statistics

Based on the theoretical review, this study proposes and tests a MIMIC model (Bagozzi, 1980) in which dynamic capabilities generation is a latent construct measured through several indicators and influenced by different causes. We have defined a structural equations model to test the set of hypotheses, using the statistical package EQS 6.1. The main results of this study are presented in Figure 2.

Figure 2. Estimated MIMIC model

The model shows good measurements of global fit, supported by accurate indicators of absolute, incremental and parsimonious fit. To achieve absolute fit, the statistic $\chi 2$ must be significant ($\chi 2$ = 18.809, d.f. = 8, p=0.01592) and the RMSEA should be between 0.05 and 0.08; even 0.1 is acceptable for social science studies (Hair et al., 1999; Byrne, 1994). In this study, $\chi 2$ is significant, and RMSEA is 0.08. The analysis of absolute fit can be complemented by analyzing GFI, which takes a value of 0.974 in our study. Values higher than 0.90 and 0.95 are acceptable (Jöreskog and Sörbom, 1993). Incremental fit is measured through CFI and AGFI. Optimal values should be higher 0.9 and near 1 (Bagozzi, 1993; Bollen, 1989). In our study, the value of CFI is 0.966 and the value of AGFI 0.927. Finally, parsimony fit can be measured through the Normed Chi-Square, which should be higher than 1 and lower than 3 (Bentler, 1990). In our

model, the value of the Normed-Chi Square is 1.26. When the results are compared to optimal values, the study confirms that all measures of fit are within the recommended values.

In the measurement model, estimated coefficients are significant at the 0.05 level for the three indicators. The construct reliability is acceptable (0.82) according to the value recommended by Nunnally (1978). Furthermore, these indicators explain a high level of the variance in dynamic capabilities generation (ranging from 0.72 to 0.82). Based on these results, we can consider the latent variable (dynamic capabilities generation) to have been measured accurately through this measurement model. This result allows us to accept H4.

For the structural model, we present estimated parameters and standardized coefficients. Estimated parameters show a positive and significant influence (at the 0.05 level) of environmental dynamism, knowledge codification and technical innovation on dynamic capabilities generation. Additionally, standardized coefficients allow us to compare the relative influence of the five variables in dynamic capabilities generation. Knowledge codification is the most influential cause (0.27), followed by environmental dynamism (0.25) and technical innovation (0.21). However, the estimated parameters from knowledge articulation and accumulated experience to dynamic capabilities generation are not significant.

To complete the test of H1, we have performed a multi-sample analysis, as shown in Table 12. The first step is to confirm that we can identify three groups with significant differences in their level of environmental dynamism. We developed an optimal scaling process, using the statistical program SPSS 15.0. The arithmetic mean and standard deviation of perceived environmental dynamism are used to analyze the cases (Jaccard, Turrisi and Wan, 1990). We found that the sample could be divided into three statistically different groups. The second step is to estimate the MIMIC model, using the "multigroup solution", in which EQS estimates the MIMIC model for each group simultaneously with a single set of indicators of goodness of fit.

Table 12. Multiple sample analysis: level of environmental dynamism

These additional results show that the relationship between environmental dynamism and dynamic capabilities is only significant in the group with the highest level of environmental dynamism. It is important to note that the mean for perceived environmental dynamism in this group is 6.13, close to the maximum value. Consequently, we can accept H1.

Given the significant parameters estimated for knowledge codification and technical innovation, we can also accept H2a and H3. Because the calculated parameters for knowledge articulation and accumulated experience were not significant, however, the results do not support H2b and H2c.

Discussion, implications for managers and limitations

Discussion

This study develops an integrated model to explain dynamic capabilities generation. We used the effects of dynamic capabilities to measure the presence of these capabilities. The measurement model shows statistical properties that indicate their acceptability as a valid measure of the latent variable. The theoretical model allowed us to test the influence of theoretical causes on dynamic capabilities generation.

First, we tested the influence of environmental dynamism on dynamic capabilities generation. Past research has argued that dynamic capabilities are the organizational response to uncertainty and environmental dynamism, although some researchers also argue the value of dynamic capabilities in stable and moderately dynamic environments. Our study shows that only organizations whose managers perceive a high level of environmental dynamism promote and develop dynamic capabilities successfully. This fact could indicate that the generation of dynamic capabilities involves high costs and managerial commitment, such that organizations should not devote their resources and capabilities unless the environment requires frequent, rapid response. This argument is consistent with other authors (e.g. Barrales-Molina et al., 2010; Zahra, Sapienza and Davidsson, 2006), who suggest that dynamic capabilities generation could damage performance when used unnecessarily.

Second, when considering the influence of learning mechanisms on dynamic capabilities generation, we found a significant effect of knowledge codification, while the other learning mechanisms (knowledge articulation and accumulated experience) did not show significant influence. This finding contributes empirical evidence to a current debate in the literature in the field. Our study shows that knowledge codification is a common quality of organizations that generate dynamic capabilities. According to one of the theoretical views on this point (Eisenhardt and Martin, 2000), despite the idiosyncratic nature of dynamic capabilities, it is possible to identify common features in dynamic capabilities across firms. This result also confirms that most deliberate learning mechanisms show stronger influence on dynamic capabilities generation, a finding consistent with other empirical studies. For example, Zollo and Singh (2004) show that degree of knowledge codification has a stronger influence on acquisition performance than knowledge articulation and accumulated experience. Further, the empirical analysis by Macher and Mowery (2009) in the semiconductor industry highlights the importance of deliberate, as opposed to passive, learning for dynamic capabilities generation. Consequently, the value for adaptation of knowledge codification is supported by our data. Our result may help to explain that this learning mechanism not only functions as a tool for transforming the organization's tacit knowledge but can also serve as a source of adaptation and flexibility (Ancori, Buret and Cohendet, 2000; Nonaka, 1994). When a set of ideas or routines appears in writing, it promotes a valuable critical judgment to detect possible weaknesses or threats that require a response from the organization (Zollo and Winter, 2002). By contrast, the influence of knowledge articulation and accumulated experience on dynamic capabilities generation could be indirect, based on specific characteristics of organizational context that define the nature of organizational routines as affecting the development process significantly.

Third, we find a significant direct effect of technical innovation on dynamic capabilities generation. If organizations develop technical innovations, they will have excellent opportunities to renew their resources and capabilities, one of the essential effects of dynamic capabilities generation. This finding provides empirical support for theoretical propositions

which argue that, the more innovative a firm is, the more it possesses dynamic capabilities (O'Connor, 2008; Wang and Ahmed, 2007). Further, some empirical studies emphasize new product development as an internal enabler for firm change and renewal (e.g. Daneels, 2002; Zheng et al., 2011). These studies even suggest that innovative capability is the necessary condition for the firm's evolution and survival. These findings and reasoning could lead us to consider technical innovation as another common characteristic of dynamic capabilities.

To conclude, the MIMIC model approach has allowed us to measure and articulate a latent construct, that of dynamic capabilities generation. To do so, we follow the recommendations of researchers (Barreto, 2010; Wang and Ahmed, 2007) who suggest identifying the common features of dynamic capability when designing empirical studies. The presence of dynamic capabilities has therefore been assumed using their common effects. This approach enables greater generalization from the results, since we have measured and studied not a general but a specific dynamic capability, thereby avoiding the idiosyncratic features of each individual capability. Further, testing a set of potential causes provides new empirical evidence that sheds light on current theoretical debates and has been useful in explaining the origins and the outcomes of dynamic capabilities in a more integrated way.

Implications for managers

This study has several practical implications for managers. Our results are consistent with the views of other authors who place entrepreneurs and managers at the centre of dynamic capabilities generation (e.g. Adner and Helfat, 2003; Augier and Teece, 2009; Zahra, Sapienza and Davidsson, 2006).

First, managers should be aware that their perceptions of the environment are critical to evaluating the need for dynamic capabilities generation. Managers must collect information, analyze it and synthesize it (Augier and Teece, 2009), in order ultimately to decide whether dynamic capabilities are necessary and valuable in their organizations. If their perceptions of the environment are wrong, or if they choose to foster dynamic capabilities when the organization

does not need them, the outcomes will not compensate for the cost required to generate and maintain dynamic capabilities (Helfat and Winter, 2011).

Second, once managers see the need for dynamic capabilities, they should make learning a central element in dynamic capabilities generation. Learning is considered to be an enabler of reconfiguration, which helps to renew the existing organizational routines (Pavlou and El Sawy, 2011; Zollo and Winter, 2002). Further, learning mechanisms such as knowledge codification should be stimulated by investing effort and resources to achieve effective results.

Third, according to our results, innovative capability seems to be a common feature of organizations that have generated dynamic capabilities. Thus, managers who consider dynamic capabilities generation as a solution for survival in highly dynamic environment should be aware that developing innovative capability has been an unavoidable step for organizations that have succeeded in achieving dynamic capabilities. New product and market development is an excellent internal enabler of firm change and renewal (Daneels, 2002; O'Connor, 2008; Wang and Ahmed, 2007).

Limitations and future lines of research

This survey has some limitations, which could be considered as future lines of research. First, it develops a cross-sectional analysis. The data allow us to study the perceptions of CEOs of 200 firms at a specific point in time but it make impossible to examine their evolution. Dynamic capabilities generation must, however, be understood as a process that evolves over time. Although the MIMIC model (Jöreskorg and Goldberger, 1975) explains a latent variable based on its causes and effects, the cross-sectional nature of the data does not allow us to prove a causal relationship between causes and dynamic capabilities generation. The findings of this study should thus be tested further using longitudinal data. Second, our research uses managerial perceptions to measure the variables, introducing a significant degree of subjectivity. More objective measures or alternative sources of comparative data on the level of dynamism environment or adaptive capability of firms could enhance the contribution of future

research. Third, we have studied the direct influence of a set of learning mechanisms on dynamic capabilities. However, some scholars (e.g. Zollo and Winter, 2002) suggest in theoretical papers that such influence could vary depending on the organizational context and nature of routines (task heterogeneity, causal ambiguity, etc.). Learning mechanisms may even be interconnected and may produce mediating relationships amongst each other.

Table 1. Definitions of dynamic capabilities

Definition	*Study*	*Emphasis*
The firm's abilities to integrate, construct and reconfigure internal and external competences and thus to respond to competitive environments rapidly.	Teece, Pisano and Shuen (1997)	Purpose and specific role
The firm's processes that use resources – specifically the processes of integrating, reconfiguring, gaining, and releasing resources – to match and even create market change; dynamic capabilities are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve and die	Eisenhardt and Martin (2000)	Purpose and specific role
A dynamic capability is a learned and stable pattern of a collective activity through which the organization systematically generates and modifies its operating routines	Zollo and Winter (2002)	Generation and specific role
Dynamic capabilities can be disaggregated into the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets	Teece (2007)	Specific role
A dynamic capability is the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base	Barreto (2010)	Specific role and purpose

Table 2. Technical details of the research

Variables	Population	Responding firms
Geographical location	Spain	Spain
Number of companies	1500	200
Sector distribution	Primary: 15% Secondary: 29% Tertiary: 56%	Primary: 12% Secondary: 24.5% Tertiary: 63.5%
Average number of employees	471	415
Average sales	27.3 (million)	22.6 (million)
Average age	20.6 years	16.4 years
	Structured questionnaire	
	Random Sampling	
	Sampling error: 6.5%	
	Period of data collection: February 2008 to January 2009	

Table 3. Items measuring knowledge codification (source: developed by authors)

COD01	The members of our organization have produced manuals, guides or codes that help employees to perform daily tasks.
COD02	In our organization, the employees have produced dictionaries and glossaries in which they establish the main terms used in performing our work.
COD03	The members of our organization have easy access to these manuals and use them often.
COD04	These manuals have been marketed to other firms, technical schools or educational centres.
COD05	A person outside the organization could understand these manuals without having to be an expert in the subject matter.
COD06	Attempts to produce manuals and guides have succeeded in our organization.
COD07	The organization's management motivates the development of manuals that can help the organization's employees.
COD08	Our organization invests time and money in producing memoranda, manuals, dictionaries, etc. that facilitate the performance of daily tasks.

Table 4. Items measuring knowledge articulation (source: developed by authors)

ART01	The most frequent problems that emerge in performing our daily work are usually discussed as a group by the members of the organization.
ART02	The members of the organization usually meet often to resolve work issues.
ART03	Management of our organization promotes meetings to debate work problems, even though these meetings are held during the work day.
ART04	Any problem that emerges in any area of work is shared and discussed among the members working in this area.
ART05	The results and clarifications obtained at each meeting are recorded in written minutes.
ART06	In our organization, the employees propose new ways of doing things, which are well accepted by the other employees.
ART07	In general, there is good communication among the members of the organization.
ART08	Some members of our organization have given talks or colloquia for the other employees.

Table 5. Items measuring accumulated experience (source: developed by authors)

EXP01	Our organization has acquired important knowledge since its foundation.
EXP02	Most of the members of the organization have belonged to the organization since its foundation.
EXP03	Most of the members of the organization have indefinite contracts.
EXP04	Our organization manages to hire experts in each subject matter. These experts can provide new ideas, solutions and perspectives in the organization.
EXP05	The knowledge acquired by each member of our organization is easily shared with the other members of the organization.
EXP06	The members of our organization usually learn easily from the experiences of others.
EXP07	Our organization's systems enable employees to have easy access to different information sources.
EXP08	Our organization's members face new situations alone, resolving the problems that these situations pose on their own.

Table 6. Items measuring environmental dynamism (source: Tan and Litschert [1994])

DYN01	The legal, technological, economic, etc. demands imposed on the organization by its environment are changing constantly.
DYN02	The main agents in our organization's environment (government, providers, customers, etc.) change their demands unpredictably.
DYN03	Our organization's environment requires managers to react rapidly to the changes that occur.
DYN04	Normally, managers in our organization have advance knowledge of the changes that will occur in the environment.

Table 7. Items measuring technical innovation (Sources: Bennett and Gabriel, 1999; Kusunoki and Nonaka, 1998; Lloréns et al., 2003)

INN01	How many new products or services has your firm introduced?
INN02	How many new markets has your firm entered?
INN03	How many new production processes or processes for delivering services has your firm initiated?
INN04	How many new raw materials have been introduced in your firm?

Table 8. Items measuring flexibility (source: Jaikumar, 1986; Sethi and Sethi, 1990; Verdú-Jover, 2004, 2005; Volberda, 1996)

STRAT01	Speed of strategic change
STRAT02	Variety of alternatives for strategic change
STRAT03	Control over competitors
STRAT04	Control over regulations
STRUC01	Job enrichment
STRUC02	Job enlargement
STRU03	Multi-functional teams
STRU04	Polyvalent personnel
STRU05	Joint manufacturing
STRU06	Joint design
OPER01	Variation in production volume
OPER02	Surplus capacity maintenance
OPER03	Creation of multivalent teams
OPER04	Outsourcing
OPER05	Use of temporary staff
OPER06	Obtaining resources from various suppliers

Table 9. Results of the final measurement model

Variable	*Items*	λ^a	*Reliability* (R^2)	*Cronbach -alpha α*	*Goodness of fit statistics*
Knowledge codification	COD01	0.86***	0.74	0.896	χ^2 =16.86 RMSEA=0.066 NFI=0.98 CFI=0.99
	COD02	0.79***	0.62		
	COD03	0.92***	0.85		
	COD04	eliminated			
	COD05	0.73***	0.54		
	COD06	eliminated			
	COD07	0.84***	0.71		
	COD08	0.90***	0.81		
Knowledge articulation	ART01	0.89***	0.79	0.905	χ^2 =19.73 RMSEA=0.077 NFI=0.99 CFI=0.99
	ART02	0.99***	0.98		
	ART03	0.92***	0.84		
	ART04	0.88***	0.73		
	ART05	eliminated			
	ART06	0.82***	0.68		
	ART07	0.73***	0.69		
	ART08	eliminated			
Accumulated experience	EXP01	eliminated		0.823	χ^2 =4.66 RMSEA=0.082 NFI=0.99 CFI=0.99
	EXP02	eliminated			
	EXP03	eliminated			
	EXP04	0.68***	0.50		
	EXP05	0.89***	0.80		
	EXP06	0.80***	0.69		
	EXP07	0.77***	0.59		
	EXP08	eliminated			
Environmental dynamism	DYN01	0.95***	0.90	0.880	χ^2 =17.18 RMSEA=0.051 NFI=0.98 CFI=0.99
	DYN02	0.83***	0.68		
	DYN03	0.87***	0.75		
	DYN04	eliminated			
Technical innovation	INN01	0.88***	0.78	0.832	χ^2 =25.32 RMSEA=0.052 NFI=0.97 CFI=0.98
	INN02	0.81***	0.65		
	INN03	0.90***	0.82		
	INN04	0.85***	0.71		

	STRAT01	0.83***	0.69		
	STRAT02	0.81***	0.68		
	STRAT03	0.87***	0.66		
	STRAT04	eliminated			
	STRU01	0.77***	0.59		
	STRU02	eliminated			
(Strategic,	STRU03	0.70***	0.58		χ^2 =32.92
structural and	STRU04	0.69***	0.55	0.732	RMSEA=0.08
operational)	STRU05	0.70***	0.50		NFI=0.97
flexibility	STRU06	0.84***	0.70		CFI=0.94
	OPER01	0.75***	0.50		
	OPER02	eliminated			
	OPER03	0.71***	0.57		
	OPER04	0.77***	0.54		
	OPER05	0.77***	0.69		
	OPER06	eliminated			

*** t-values > 1.96

Table 10. Composite reliability and average variance extracted

Scale	*Composite reliability (>0.7)*	*Average variance extracted* (>0.5)
Knowledge codification	0.94	0.71
Knowledge articulation	0.86	0.51
Accumulated experience	0.87	0.64
Environmental dynamism	0.94	0.84
Technical innovation	0.96	0.74
Strategic flexibility	0.88	0.66
Structural flexibility	0.76	0.52
Operational flexibility	0.72	0.60

Table 11. Descriptive Statistics

Variable	*Mean*	*s. d.*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1.Environmental dynamism	4.49	1.51							
2.Knowledge codification	3.76	0.17	0.13						
3.Knowledge articulation	3.46	0.86	0.09	0.29***					
4.Accumulated experience	4.06	0.06	0.18***	0.31***	0.64***				
5.Technical innovation	3.01	0.11	0.12***	0.34***	0.09	0.16**			
6.Strategic flexibility	4.50	1.16	0.03	0.34***	0.17**	0.22***	0.28***		
7.Structural flexibility	5.27	0.49	0.14**	0.27***	0.09	0.15**	0.27***	0.57***	
8.Operational flexibility	4.78	0.56	0.11	0.18**	0.07	0.01	0.16**	0.28***	0.27***

**p<0.05
***p<0.01

Table 12. Multiple sample analysis: level of environmental dynamism

Level of environmental dynamism	Mean (perceived environmental dynamism) Minimum value:1 Maximum value: 7	Parameters Environmental dynamism → Dynamic capabilities generation	Result
Group 1: low (63 cases)	2.65	0.063	N. Sig.
Group 2: Medium (70 cases)	4.58	0.094	N. Sig.
Group 3: High (67 cases)	6.13	2.659**	Sign.
Goodness of fit: χ^2 =694.85 RMSEA=0.081 NFI=0.93 CFI=0.94			

Significance level: ***p<0.001 **p<0.05