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Dynamic capabilities, human resources and operating routines

A new product development approach

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Abstract

Purpose – The purpose of this paper is to explain the outcomes and role of dynamic capabilities (DCs). To explain the outcomes, the authors study the relationship between new product development (NPD) (an example of DCs) and metaflexibility. To explain the role of DCs, the authors study how human resources and operating routines moderate the role of DCs in achieving adaptation in the firm.

Design/methodology/approach – Using data from 200 managers of Spanish firms, the authors apply regression analysis to test the moderating role of human resources and operating routines in the relationship between NPD and metaflexibility.

Findings – The results demonstrate that highly qualified and committed workers enhance the effectiveness of NPD, while high frequency in repetition of operating routines significantly damages such effectiveness.

Research limitations/implications – This study is limited to analysing a unique DC (NPD), but future research could explore contributions on other consolidated DCs (e.g. alliance management capability) and compare results. Also, the database on managerial perceptions rather than objective measures.

Practical implications – Managers who must address environmental changes should connect generation of DCs to complementary functional strategies, especially human resources strategy.

Originality/value – This paper suggests additional outcomes derived from DCs, such as metaflexibility. It attempts to understand the complex process by which DCs interact to modify operating routines in order to respond to environmental changes.

Keywords Dynamic capabilities, Routines, Human resources, New product development, Metaflexibility

Paper type Research paper

Introduction

Over the past two decades, dynamic capabilities (DCs) theory (Teece *et al.*, 1997) has become one of the most active research areas in the field of strategic management (Helfat and Peteraf, 2015; Katkalo *et al.*, 2010; Schilke, 2014). As the basis of firms' abilities to renew internal and external competences, DCs are commonly used to explain how firms respond successfully to environmental changes. DCs theory evolved from the resource-based view to explain how firms achieve sustainable competitive advantage. Due to their specific role and stable nature, DCs can be seen as meta-routines designed to reconfigure firms' operating routines (Winter, 2003; Wilhelm *et al.*, 2015; Zollo and Winter, 2002).

Increasing interest in DCs theory has produced a substantial body of research. For some time, most studies have been theoretical, with the aim of consolidating the field's

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main constructs. Important literature reviews have provided solid foundations for empirical papers (e.g. Ambrosini and Bowman, 2009; Barrales-Molina *et al.*, 2014; Barreto, 2010; Loasby, 2010; Vogel and Güttel, 2013; Zahra *et al.*, 2006). While initial empirical contributions were based on case studies that describe how a particular organization generates DCs (e.g. Bruni and Verona, 2009; Danneels, 2010; Newey and Zahra, 2009), the most recent studies propose and test theoretical models using large surveys of firms and provide more generalizable results (e.g. Barrales-Molina *et al.*, 2013; Drnevich and Kriauciunas, 2011; Hsu and Wang, 2012; Pavlou and El Sawy, 2011; Rodenbach and Brettel, 2012; Schilke, 2014; Wilden and Gudergan, 2015; Wilhelm *et al.*, 2015). This trend shows that study of DCs is evolving to a more mature stage, becoming a theory.

More recently, and following important contributions in DCs literature (e.g. Eisenhardt and Martin, 2000), some studies focus on specific organizational processes to explain the abstract nature of DCs. New product development (NPD) is attracting the most attention as a true DC (see, e.g. Barrales-Molina *et al.*, 2014; Bruni and Verona, 2009; Danneels, 2002, 2010; Pavlou and El Sawy, 2011; Schilke, 2014). Such studies explore how organizations with outstanding NPD (Apple, Nestlé, Procter & Gamble) regularly modify their operating routines to respond to environmental changes. Some scholars argue that NPD is useful in explaining how firms develop different levels of DCs based on environmental uncertainty (e.g. Ambrosini *et al.*, 2009). Firms that successfully generate DCs are expected not only to reconfigure their operating routines but also to achieve the precise level of adaptation needed to respond environmental demands.

Although many studies shed light on key features of DCs and extend knowledge of them, research focuses mainly on strategic issues, paying less attention to the complex interaction between DCs and operating routines in the reconfiguration process (Vogel and Güttel, 2013; Wilhelm *et al.*, 2015). To advance this line, many scholars note the need for in-depth studies that combine the most solid pillars of organization theory and human resources management (see, e.g. Arend and Bromiley, 2009; Kok and Ligthart, 2014; Vogel and Güttel, 2013). Significant effort should thus be devoted to explaining how workers, internal context, and the nature of operating routines alter the expected outcomes of DCs (Vogel and Güttel, 2013). Some contributions draw on resource-based view to provide valuable insights into how human resources contribute to competitive advantage (e.g. Chadwick and Dabu, 2009; Chatterji and Patro, 2014; Nijssen and Paauwe, 2012; Wright *et al.*, 1994). Initial empirical studies provide crucial primary evidence (e.g. Judge *et al.*, 2009; Wei and Lau, 2010), but additional effort is needed to understand the involvement of workers and operating routines in achieving sustainable competitive advantage.

The aim of this paper is thus twofold. First, we explore the relationship between a particular DC – NPD – and metaflexibility. Second, we seek to advance understanding of the influence of operating routines on the results of DCs by analysing the characteristics of individuals who perform these routines, such as their qualifications or commitment to the organization, and the nature of the routines themselves, specifically task frequency and heterogeneity. To achieve these goals, we use data from 200 Spanish firms. Empirical analysis shows that worker qualification and retention improve the relationship between NPD and metaflexibility. Our results suggest, however, that this relationship is damaged by high task frequency. Finally, our data do not support the moderating role of task heterogeneity.

This paper is structured as follows. First, we present an overview of DCs theory that focuses on the characteristics of NPD as a DC. Second, we develop a set of hypotheses

to construct an integrated theoretical model of moderating variables. Next, we explain the methodology used and its results. Lastly, we discuss the findings as well as the implications for managers, limitations and future lines of research.

Theoretical background and hypotheses

DCs theory

The most important antecedents of DCs theory can be found in the resource-based view (Barney, 1986; Rumelt, 1984; Wernerfelt, 1984). This theoretical approach establishes that valuable, rare, inimitable and non-substitutable (VRIN) resources are the main source of competitive advantage. However, its static vision of successful firms does not address how they survive in changing environments. Teece *et al.* (1997) thus defined DCs as the firm's abilities to integrate, build and reconfigure internal and external competences to achieve sustainable competitive advantage.

Some scholars have tried to achieve more precise definitions of DCs to understand their nature, proposing best practices that can be seen as DCs. Eisenhardt and Martin (2000) initiated this approach, claiming that DCs are embodied in particular organizational processes, such as product development routines, strategic decision making or alliance and acquisition routines. This approach may make it easier to understand the general nature of DCs, and ensure major management applicability. Since Eisenhardt and Martin (2000), many scholars have identified prospective DCs and characterized their general nature using one specific DC (e.g. Karim and Mitchell, 2000; Moliterno and Wiersema, 2007). NPD and alliance management capability are now the most solidly established DCs (Barrales-Molina *et al.*, 2014; Pavlou and El Sawy, 2011; Schilke, 2014).

As specific DCs, NPD and alliance management capability have the role of reconfiguring the operating routines that ensure the organization's operational, functional and daily tasks (Wilhelm *et al.*, 2015; Winter, 2003). Along these lines, Zollo and Winter (2002) define DCs as "learned and stable patterns through which the organization systematically modifies its operating routines". It follows that DCs are high-level routines or meta-routines that act on the other operating routines (Winter, 2003; Wilhelm *et al.*, 2015; Zollo and Winter, 2012).

In addition to analysing the nature and specific role of DCs, some studies focus on explaining creation and development of these capabilities (see, e.g. Eisenhardt and Martin, 2000; Helfat *et al.*, 2007; Katkalo *et al.*, 2010; Zollo and Winter, 2002). First, they generally assume that DCs are generated inside the organization and cannot be bought as a market factor (Makadok, 2001). Second, it is strongly accepted that DCs reside in organizational learning (Barrales-Molina *et al.*, 2010; Cepeda and Vera, 2007; Easterby-Smith and Prieto, 2008; Zollo and Winter, 2002). Scholars have proposed several learning models to explain the process of DC generation (see, e.g. Bierly and Chakrabarti, 1996; Nielsen, 2006; Shimizu and Hitt, 2004; Verona and Ravasi, 2003; Zahra *et al.*, 2006; Zollo and Winter, 2002). The widely acclaimed model proposed in Zollo and Winter (2002) argues that DCs can be created by promoting three learning mechanisms: accumulated experience, knowledge articulation and knowledge codification.

NPD and metaflexibility

Among the outcomes expected from DCs, sustainable competitive advantage is argued to be their primary effect, although some scholars test other related effects of DCs, such as performance, competitive advantage and flexibility (see, e.g. Barrales-Molina *et al.*, 2013; Pavlou and El Sawy, 2011; Schilke, 2014). Further, some literature theorizes different adaptation levels based on environmental dynamism, as prospective results derived from

DCs (Ambrosini *et al.*, 2009; Collis, 1994; Danneels, 2002; Winter, 2003). The same DC (e.g. NPD) can achieve a specific level depending on perceived environmental dynamism. Ambrosini *et al.* (2009) define three levels of adaptation – incremental, renewal and regenerative – and argue that NPD can be incremental or regenerative if the environmental dynamism perceived by managers increases.

Research is beginning to explore these theoretical foundations at the empirical level. In particular, the initial connection between DCs and adaptation, or different dimensions of flexibility, has been solidly proven in the literature (see, e.g. Barrales-Molina *et al.*, 2013; Singh *et al.*, 2013; Malik and Kotabe, 2009; Vanpoucke *et al.*, 2014). Findings in other related studies show the interest of analysing empirically how DCs respond to different levels of environmental dynamism. Schilke (2014) shows that two specific DCs (NPD and alliance management capability) are strongly related to competitive advantage when firms face an intermediate level of environmental dynamism, but this connection is also positive and significant in highly dynamic environments. Pavlou and El Sawy (2011) analyse how the relationship between a specific DC (NPD) and operating capabilities is moderated by the level of environmental dynamism. These findings suggest the positive role of DCs across the spectrum of environmental turbulence and support the value of DCs in matching organizational responses to environmental demands for adaptation.

Volberda (1996) calls this process of matching metaflexibility[1] – the ability to determine sufficient flexibility mix (strategic, structural and operational flexibility). Metaflexibility involves creation, integration and application of flexible capabilities in a flexible way (Verdú-Jover *et al.*, 2008). Previous studies of flexibility (e.g. Verdú-Jover *et al.*, 2004, 2006, 2008) provide empirical evidence on the relationship between metaflexibility and flexibility fit (required flexibility – realized flexibility). Metaflexibility may therefore be an additional expected outcome consistently produced by DCs like NPD. We expect organizations with extraordinary NPD to develop superior capability to recognize the adaptation-level needed, based on managers' perceptions:

H1. NPD and metaflexibility are positively related.

Moderating role of workers in the outcomes of DCs

The relationship between DCs and their expected outcomes can be moderated by many internal and external variables (see, e.g. Schilke, 2014; Wilhelm *et al.*, 2015). Various factors participate in the complex process of interaction between DCs and operating routines to determine the success derived from DCs. These factors include managerial cognition, human resources, organizational culture, leadership and trust (Ambrosini and Bowman, 2009; Teece, 2007). Some authors point to human resources as a major factor explaining DCs' effectiveness (Arend and Bromiley, 2009; Colbert, 2004; Kok and Ligthart, 2014). Still, some recent papers suggest attending not only to the nature of human resources but also to learning power in the workplace to understand how competitive advantage is created in firms used to responding to constantly changing contexts (see, e.g. Crick *et al.*, 2013; Matsuo and Nakahara, 2013). In any case, since managers are responsible for promoting and creating DCs and since human resources regularly perform operating routines, great attention should be paid to who performs such routines when explaining the specific role of DCs. It is thus useful to understand how human resources features and practices moderate the relationship between DCs and metaflexibility.

Prior studies highlight the importance of worker qualification to the resource-based view and competitive advantage (see, e.g. Barney and Wright, 1998; Beugelsdijk, 2008; Chadwick and Dabu, 2009; Colbert, 2004; Wright *et al.*, 1994). Wright *et al.* (1994), for

example, argue that, the more qualified human resources are, the rarer they are, ensuring fulfilment of one attribute of VRIN resources. Some research on DCs theory argues that highly qualified workers tend to show greater ability to sense changes and monitor environmental variables (Wei and Lau, 2010; Nijssen and Paauwe, 2012; Wright *et al.*, 2001). Studies that attempt to integrate the resource-based view and human resources management thus claim the importance of highly demanding recruitment processes and training programs in obtaining strategic human resources that guide the firm to competitive advantage (see, e.g. Barney and Wright, 1998; Colbert, 2004).

In essence, the literature argues that highly qualified workers can make decisions in their work that enable adaptation of operating routines. Professional workers are more likely to use their own judgement, to evaluate the outcomes of an operating routine and change it if they perceive inaccurate results (Beugelsdijk, 2008; Feldman, 2000; Feldman and Pentland, 2003; Teece, 2012). Emirbayer and Mische (1998) term this ability individual agency, a characteristic commonly assumed in professional jobs that grant employees autonomy (Feldman, 2000; Feldman and Pentland, 2003; Howard-Grenville, 2005).

From an empirical perspective, prior studies focusing on NPD context analyse how qualified workers adopt flexible behaviour depending on the level of environmental dynamism. For example, Kok and Ligthart (2014) demonstrate that firms use training and education programmes to achieve flexible human resources capable of responding to environmental changes with NPD ranging from incremental to major. Additionally, Martínez-Sánchez *et al.* (2011) find that the flexibility-level derived from human resources is positively related to product innovation when environmental dynamism is high. Similarly, Newey and Zahra (2009) study how specialized teams of experts are responsible for monitoring and understanding environmental changes in the pharmaceutical industry to develop regular anti-influenza drugs depending on annual conditions.

We thus expect NPD to have the proper effects on operating routines when workers are qualified. Whereas managers trigger change of routines in different types of product development based on their environmental perceptions (Ambrosini *et al.*, 2009), expert employees (e.g. designers, process engineers, marketing analysts) apply individual agency to implement the necessary level of change. Unqualified employees have less individual agency, making it more difficult to convert a manager's suggestions or guidelines into real changes in operating routines:

H2. Worker qualification improves the relationship between NPD and metaflexibility.

Although individual workers' characteristics, such as qualification or expertise, are a source of value, human resources practices can also enhance workers' value. Given human resources' potential for mobility, practices that promote job retention increase the value of these resources. Wright *et al.* (1994) argue that human resources can become inimitable when embedded in a strong organizational culture and complex social systems as a result of permanent contracts. Job retention practices may enable human resources to fulfil another attribute of VRIN resources. This argument agrees with Chadwick and Dabu (2009), which proposes job retention as a critical practice in human resources management architectures related to competitive advantage.

Mechanisms that focus on reducing worker turnover (e.g. permanent contracts, compensation, participation in long-terms projects) achieve greater involvement of human resources (Ax and Marton, 2008; Chadwick and Dabu, 2009; Curado *et al.*, 2011; Fu *et al.*, 2015; Paoli and Prencipe, 2003). Participation in several new projects in the

firm can help workers apply knowledge acquired from previous experiences when reconfiguring operating routines (Chiang and Shih, 2011; Nijssen and Paauwe, 2012). Permanent and committed workers are more likely to use their individual experience and agency to reconfigure operating routines to respond to environmental changes.

From an empirical point of view, some studies of the NPD context and human resource management demonstrate that achieving involvement and commitment of permanent human resources increases the likelihood that new product projects will succeed. For instance, Chiang *et al.* (2014) demonstrate that human resource practices that promote high commitment to work achieve better NPD results due to the transactive memory systems developed. Further, Beugelsdijk (2008) finds that short-term employment contracts are negatively related to the expected outcomes of NPD. Along the same lines, Martínez-Sánchez *et al.* (2011) argue that short-term hiring leads to lower levels of human resource flexibility, a capability needed to respond to highly dynamic environments. Finally, Chiang and Shih (2011) support similar results, demonstrating that learning processes generated in NPD take several years to conclude.

In summary, whereas managers are responsible for generating DCs such as NPD, permanent workers show major commitment and regular participation in determining the optimal level of flexibility required by current operating routines. We thus conclude that worker retention policies will improve the expected results of DCs:

H3. Worker retention will improve the relationship between NPD and metaflexibility.

Moderating role of tasks in the outcome of DCs

According to Zollo and Winter (2002), the relative effectiveness of DCs also depends on the characteristics of the tasks performed by workers. Since operating routines are embedded in tasks, the nature of these tasks may condition the potential for change in operating routines (Enberg *et al.*, 2006; Feldman, 2000; Feldman and Pentland, 2003; Pentland *et al.*, 2012; Rerup and Feldman, 2011; Teece, 2012; Zollo and Winter, 2002). Consistently, some recent works are focused on explaining how some specific features of operating routines can influence on the performance of crucial capabilities (Day *et al.*, 2015; Ferreras-Méndez *et al.*, 2015; Wilhelm *et al.*, 2015).

One of the most analysed task features is frequency – how often the task is triggered and executed in a period of time (Zollo and Winter, 2002). The management literature shows that task frequency may provide advantages in achieving efficiency in performing routines, although high-task frequency could block the potential for changing routines. Enberg *et al.* (2006) find that NPD projects benefit from high-task frequency because it enables individuals to retain and remember lessons learned from one project to the next.

Because high-task frequency imposes automatic repetition without the opportunity to reflect on prospective improvement actions, it can affect change in operating routines. Feldman (2000) studies university housing services to analyse what factors contribute to stability and flexibility in operating routines. Her findings show that routines in this organization have great potential for change. She recognizes, however, that the annual occurrence of these routines and thus ample time between iterations could enhance the potential for change. When routines are repeated fairly often, changing them may be more difficult because workers are involved in the next iteration soon after experiencing the previous one (Feldman, 2000). Similarly, Zollo and Winter (2002) argue the need for a balance between thinking and doing to achieve the right level of change in operating routines.

These results are consistent with other empirical results (e.g. Cohen and Bacdayan, 1994; Howard-Grenville, 2005; Turner and Fern, 2012; Wood and Neal, 2007). Turner and Fern (2012) find that actors who have extensive experience performing a routine are likely to develop habits that impose pressures towards stability, reinforcing maintenance of existing routines. When actors have not performed a routine frequently in a previous situation, they have little experiential support and are more likely to accept change in future performance. Other empirical papers (Betsch and Brinkamann, 1998; Narduzzo and Warglien, 2008) find that, since actors do not feel time pressure, they tend to evaluate new ways of performing a routine.

We can thus conclude that, even if managers promote DC generation, strong habit formation will make it difficult to achieve real adaptation of operating routines if workers are involved in high-frequency tasks. Consequently, the role of DCs can be blocked by high-frequency routines:

H4. A high task frequency will damage the relationship between NPD and metaflexibility.

Additionally, Zollo and Winter (2002) argue the role of task heterogeneity in DCs' success. Task heterogeneity is the variability of possible task characteristics, and it presents a different type of challenge in each situation. Task heterogeneity can also derive from changes in the surrounding context, such that performing a routine may be appropriate under some conditions but not others (Turner and Fern, 2012). Actors are unlikely to develop the habit of resolving a task if they must seek more appropriate solutions in the new context. When task heterogeneity is high, individuals must make inferences to discover the applicability of lessons learned from past experiences. Such inferences involve great cognitive effort to distinguish between effective and ineffective solutions. In other words, high-task heterogeneity requires a significant selection process to evaluate the outcomes of each iteration of a routine (Pentland *et al.*, 2012). Task heterogeneity thus blocks possible generalization from solutions, requiring major use of actors' agency to judge the best solutions in each context. Further, task heterogeneity encourages intensive communication or interaction between workers (Enberg *et al.*, 2006), ensuring collective evaluation of outcomes of operating routines.

In sum, the greater the need for actors' agency (Feldman, 2000; Howard-Grenville, 2005) and knowledge articulation to resolve a task (Zollo and Winter, 2002), the more opportunities exist to change operating routines. One can thus argue that DCs will achieve a more accurate level of flexibility when tasks require regular discussion and articulation of knowledge, since generalizations and standardized solutions are not valid:

H5. High task heterogeneity will improve the relationship between NPD and metaflexibility.

Research model

Based on the research hypotheses, Figure 1 presents a study model relating the six factors taken into account to explain DCs are NPD (as an example of a DC), metaflexibility, worker qualification, worker retention, task frequency and task heterogeneity. *H1* proposes a positive and direct relationship between NPD and metaflexibility: firms that develop DCs (such as NPD) will show high levels of metaflexibility. In contrast, *H2*, *H3*, *H4* and *H5* draw the moderating role of characteristics of workers and routines in the relationship between NPD and metaflexibility. Whereas *H2, H3* and *H5* propose a positive moderating role, *H4* establishes a negative influence in the first relationship. We also consider three control variables: size, age and sales.

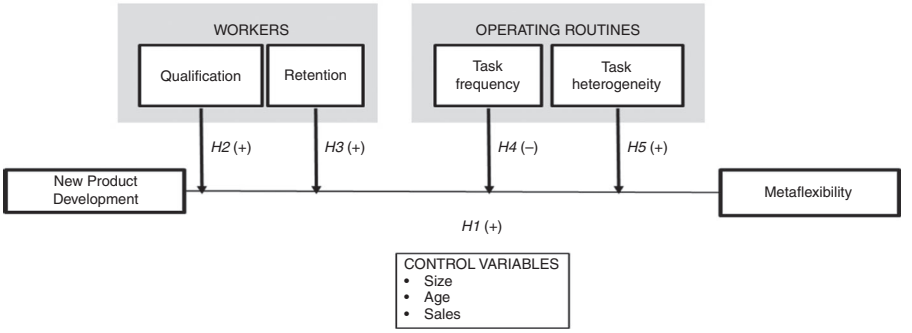

Figure 1.
Research model

Methods

Sample and procedure

We developed a structured questionnaire to measure the variables in the research model. This questionnaire was addressed to the senior managers (e.g. CEO or managing director) of each organization. Senior managers were chosen as the key informants because they receive information from a wide range of departments and play a critical role in DC development (Ambrosini and Bowman, 2009). The empirical context for this study is Spanish firms. We study a multi-industry sample (primary sector[2], manufacturing and service firms) to ensure generalizability of our findings (e.g. Chari *et al.*, 2014; Guthrie, 2001). Initially, we contacted 1,500 Spanish firms. The set of firms and mailing addresses was drawn from a database of firms published by the Spanish journal *Actualidad Económica*. A cover letter was included to explain that the questionnaire was part of a study examining the flexibility and adaptation of Spanish firms. Hard copies were sent to the researchers in a self-addressed pre-paid response envelope. The cover letter included a direct link from which informants could fill out the online questionnaire and send their responses with anonymity. The initial and the second, follow-up mailing yielded a total of 206 responses (13.7 per cent response rate). Missing responses for some essential data reduced the number of valid responses to 200 (13.3 per cent). Both number of responses and response rate compare favourably to those of other similar studies (e.g. Pavlou and El Sawy, 2011; Rodenbach and Brettel, 2012). Non-response bias was used to test for significant differences between early and late responses. A *t*-test procedure for an early and a late sample (Armstrong and Overton, 1977) detected no significance differences between the two subgroups. This result improves generalizability of the study findings. Table I summarizes the descriptive details of the final survey.

Variables	Responding firms
Number of firms	200
Geographical location	Spain
Sectors	Primary 12%
	Manufacturing 25%
	Services 63%

Table I.
Brief descriptions of survey firms

Constructs and measures

Table II shows the theoretical definitions, measures and related studies of six variables used in our analysis. We based measurement of these variables on managerial perceptions obtained using the above-mentioned questionnaire. Because we use some constructs that are not widely operationalized in the literature, we drew up new ad hoc items by exploring definitions and arguments in a systematic literature review. We used six Likert-type scales in which informants were asked to choose a response ranging from 1, strongly disagree, to 7, strongly agree (the Appendix provides a sample of the questionnaire). To ensure correspondence between the English definitions in the literature and the items designed in Spanish, we used professional translating services and had four academics and four senior managers review the items to facilitate comprehension of the measures employed.

Metaflexibility. The dependent variable was measured using a four-item scale developed and validated by Verdú-Jover *et al.* (2004, 2006, 2008). We drew on the initial definition of metaflexibility by Volberda (1996) to develop a scale to measure this variable. The set of items measures the level of balance between developing new flexible capabilities and preserving or improving existing ones. The interviewee was asked whether the organization preserved shared norms and routines while absorbing and considering new information to adapt to the environment.

NPD performance. Previous studies have employed subjective scales to measure NPD performance, determining level of regularity in developing new products, effort devoted and effectiveness of this strategy in achieving competitive advantage (Bruni and Verona, 2009; Sethi, 2000; Pavlou and El Sawy, 2011; Song and Parry, 1997). Since each scale designed consists of very similar items, we used a scale with four of the most common items to operationalize measurement of NPD performance.

Variable	Operational definition	Measures	Sources
Metaflexibility	Managerial ability to achieve the right level of flexibility to match organizational variables with environmental requirements	4 items	Volberda (1996); Garg and Deshmukh (2009); Verdú-Jover *et al.* (2004, 2006, 2008)
NPD performance	Successful and regular modifications of products, basing on technically sophisticated processes to meet customer needs	4 items	Ambrosini *et al.* (2009); Bruni and Verona (2009); Ortega-Egea *et al.* (2014); Pavlou and El Sawy (2011); Sethi (2000); Song and Parry (1997)
Worker qualification	Level of education and expertise shared by majority of employees	3 items	Bontis (1998); Black *et al.* (2003); Curado *et al.* (2011); Doms *et al.* (1997)
Worker retention	Set of human resources policies to reduce worker turnover and achieve long-term commitment to the organization	3 items	Ax and Marton (2008); Bontis (1998); Bose (2004); Clarke (2003); Curado *et al.* (2011); George (2014); Guthrie (2001); Hallier and Lyon (1996); Stavrou and Kilaniotis (2010)
Task frequency	Number of times a routine is performed in a short period of time, without opportunity to reflect on its results	3 items	Cohen and Bacdayan (1994); Becker (2004); Betsch and Brinkamann (1998); Knott (2003); Zollo and Winter (2002)
Task heterogeneity	Variability in features of the task as it appears in different occurrences	3 items	Enberg *et al.* (2006); Nembhard *et al.* (2005); Zollo and Winter (2002)

Table II.
Operational definitions and measures

Worker qualification. To measure general worker qualification in each organization, we designed a three-item scale to assign a quantitative value to this construct, taking into account recommendations for measuring drivers of the firm's intellectual capital (Bontis, 1998; Curado *et al.*, 2011). Sample items included statements to verify whether the organizations as a rule hire experts with a university degree and broad expertise in the field. We also inquired whether employees were considered professional workers able to make decisions and act with autonomy in their work.

Worker retention. Worker retention was also measured using a subjective three-item scale, since we are interested in determining not only the organization's turnover level but also the presence of solid commitment between employees and the organization (George, 2014; Guthrie, 2001; Huselid, 1995). In addition to asking if turnover level was low, we considered whether human resource practices attempted to achieve employee involvement through permanent contracts and career development.

Task frequency. A three-item scale was used to measure the level of task frequency. Following other authors who study this variable (e.g. Feldman, 2000; Turner and Fern, 2012; Zollo and Winter, 2002), we evaluated not only task frequency but also whether there was sufficient lack of time between performance of the same tasks and automation level of these tasks.

Task heterogeneity. This variable was measured with a three-item variable. To capture quantitative level of task heterogeneity, we used the definitions in the literature (e.g. Enberg *et al.*, 2006; Nembhard *et al.*, 2005; Nätti *et al.*, 2006; Zollo and Winter, 2002), asking whether new challenges arose when employees develop a task or whether, in contrast, learned patterns could be applied to new circumstances.

Control variables. We included three additional questions to measure the firms' size, age and sales. We controlled for firm size using number of employees as an approximation. For each control variable, we used intervals of number of employees, years and sales to simplify the work required of the interviewee.

Empirical study

Measure validation

We followed several statistical procedures recommended in the literature to assess measurement validity and evaluate the psychometric properties of the data (e.g. Bagozzi, 1980; Hair *et al.*, 1999; Jöreskog, 1966). The exploratory analysis was performed using SPSS 20.0 and the confirmatory analysis with EQS 6.1. Scales have content validity either because they have been used and validated previously in the literature (e.g. scales for NPD and metaflexibility) or because the items in each scale adhere to the theoretical papers that define and conceptualize these constructs (Jiménez-Barrionuevo *et al.*, 2011). As shown in Table II, each scale is based on previous scales or definitions from the literature. For convergent validity, we confirm that all items load accurately on their posited constructs, showing significant *t*-values and acceptable individual reliability ($R > 0.5$) (see Table III). We omit items that do not fulfil these requirements, maintaining the scale's acceptable composite reliability (CR > 0.7 and AVE > 0.5) and ensuring that loss of information does not damage the scale's properties. Additionally, we confirm appropriate levels of fit indicators for the measurement model. All indicators provide evidence of convergent validity.

Finally, we assessed discriminant validity following the procedure in Anderson and Gerbing (1988), which involves constraining the correlation of each pair of constructs to unity and confirming that new estimation of the measurement model worsens the fit

Variables	Items	λ	R^2	CR	AVE	Goodness of fit statistics
Metaflexibility	MET01	0.77***	0.59	0.81	0.58	$\chi^2 120 = 113.30$
	MET03	0.91***	0.82			($p = 0.042$)
	MET04	0.86***	0.74			GFI = 0.903
NPD performance	NPDP02	0.72***	0.52	0.74	0.51	NFI = 0.933
	NPDP03	0.85***	0.72			IFI = 0.952
	NPDP04	0.76***	0.58			CFI = 0.951
Worker qualification	QUAL01	0.80***	0.64	0.77	0.53	RMSEA = 0.06
	QUAL02	0.73***	0.54			
	QUAL03	0.90***	0.81			
Worker retention	WRET01	0.78***	0.61	0.75	0.51	
	WRET02	0.79***	0.62			
	WRET03	0.79***	0.63			
Frequency of routines	FREQ01	0.94***	0.88	0.75	0.61	
	FREQ02	0.79***	0.66			
Task heterogeneity	HET 01	0.71***	0.50	0.70	0.55	
	HET 02	0.91***	0.84			

Notes: GFI, goodness of fit index; NFI, non-normed fit index; CFI, comparative index; RMSEA, root mean-square of approximation. λ, standardized structural coefficient; R^2, reliability; CR, composite reliability; AVE, average variance extracted. ***Significant at $p < 0.001$ level, according to *t*-students

Table III.
Measurement model

indicators. Table IV presents the correlations, means and standard deviations and a preliminary analysis to evaluate potentially significant relationships. We observe, for example, a positive and significant relationship between NPD performance and metaflexibility.

Hypothesis testing

To test the hypotheses, we conducted a moderated hierarchical regression analysis, shown in Table V (Cohen and Cohen, 1984). Interaction or moderating effects were introduced multiplicatively, which required centring the variables to avoid problems of multicollinearity. We also tested for multicollinearity using the tolerance indices and variance inflation factor for each regression model. The statistics show acceptable values.

Model 1 presents a regression analysis of metaflexibility considering only control variables and NPD performance. This model is statistically significant ($F = 5.90$, $p < 0.001$). *H1* states that NPD is positively related to metaflexibility. The coefficient

Variable	Mean	SD	1	2	3	4	5	6	7	8
1. Metaflexibility	4.66	1.22								
2. Size	2.63	1.17	0.09							
3. Age	2.55	0.73	0.02	0.37**						
4. Sales	3.13	0.97	0.02	0.58**	0.51**					
5. NPD performance	4.40	1.45	0.32**	0.13	0.08	0.13				
6. Worker qualification	4.79	1.07	0.38**	−0.01	−0.00	−0.01	−0.04			
7. Worker retention	4.46	1.43	0.13	-0.02	0.02	0.02	0.08	−0.33**		
8.Task frequency	3.47	1.63	−0.07	0.03	0.09	0.02	0.00	0.10	0.17*	
9.Task heterogeneity	4.13	1.37	0.28**	−0.00	−0.03	−0.07	0.03	−0.51**	0.35**	0.06

Note: *; **Significant correlations at $p < 0.05$; $p < 0.01$ levels, respectively

Table IV.
Correlations, means and standard deviations

	Model 1			Model 2			Model 3		
	β	SE	t	β	SE	t	β	SE	t
Intercept	4.51***	(0.33)	13.61	4.57***	(0.34)	13.50***	4.63***	(0.33)	13.85
Size	0.03	(0.09)	0.35	0.02	(0.08)	0.26	0.05	(0.08)	0.65
Age	−0.06	(0.13)	−0.79	−0.06	(0.12)	−0.76	−0.09	(0.12)	−1.21
Sales	0.09	(0.11)	0.94	0.1	(0.11)	1.17	0.10	(0.10)	1.25
NPD performance	0.31***	(0.06)	4.48	0.30***	(0.05)	4.63	0.64***	(0.14)	3.91
Worker qualification				−0.31***	(0.09)	−4.04	−0.25***	(0.09)	−3.28
Worker retention				−0.03	(0.06)	−0.43	−0.05	(0.06)	−0.70
Task frequency				−0.04	(0.05)	−0.69	−0.06	(0.05)	−0.90
Task heterogeneity				0.13*	(0.07)	1.79	0.12	(0.07)	1.62
NPD performance × worker qualification							0.20**	(0.06)	2.29
NPD performance × worker retention							0.14**	(0.04)	2.10
NPD performance × task frequency							−0.36**	(0.03)	−2.17
NPD performance × task heterogeneity							0.03	(0.06)	0.33
Model R^2	0.11			0.26			0.30		
ΔR^2	0.11***			0.15***			0.04**		
Adjusted R^2	0.09			0.23			0.26		
F	5.90			12.50			12.62		
ΔF	5.90***			9.60***			3.02**		

Notes: Metaflexibility is the dependent variable. *$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table V.
Regression analysis

for NPD was positive and statistically significant ($\beta = 0.31$; $p < 0.001$), confirming *H1*. Control variables do not, however, exert significant influence on metaflexibility.

In Model 2, we introduced the direct effects of worker qualification, worker retention, task frequency and task heterogeneity. This model is also statistically significant ($F = 9.60$; $p < 0.001$). Although we set out to test moderating influence, we found that the direct influence of worker qualification on metaflexibility is also significant ($\beta = -0.31$; $p < 0.001$).

In Model 3, we introduced the moderating effects of the variables considered in Model 2. This model is statistically significant ($F = 12.62$; $p < 0.05$), showing the strength of the moderating effects. *H2* and *H3* state a positive moderating role of worker qualification and worker retention on the relationship between NPD and metaflexibility. The coefficient for moderating effects of worker qualification ($\beta = 0.20$; $p < 0.05$) and worker retention ($\beta = 0.14$; $p < 0.05$) are statistically significant and positive, supporting *H2* and *H3*. It is interesting that the coefficient for direct effect of worker qualification is negative and statistically significant, whereas its moderating effect is positive and statistically significant. This result supports our reasoning that worker qualification leads to a positive relationship between NPD and metaflexibility. *H4* states a negative moderating role of task frequency on the relationship between NPD and metaflexibility. The coefficient for this moderating effect is negative and statistically significant ($\beta = -0.36$; $p < 0.05$), also confirming *H4*. Although *H5* asserts a positive moderating effect of task heterogeneity, the estimated coefficient does not show a significant moderating effect, preventing confirmation of *H5*. The next section discusses possible theoretical reasons for lack of support for this relationship.

The significant moderating effects are shown in Figures 2, 3 and 4. We considered low (−1 SD) and high (+1 SD) levels of each moderating variable. Figures 2 and 3 represent the slope increase for high levels of worker qualification and worker retention and this positive moderating role graphically. As Figure 4 illustrates, the slope of the relationship between NPD and metaflexibility is slightly higher when we consider low levels of task frequency, due to the negative moderating role of task frequency.

Discussion

Since the literature has advanced in defining DCs, it crucial to explain the complex interaction process between DCs and operating routines. For Feldman and Pentland (2003), this fundamental question can be answered by analysing the psychological and organizational variables. Our findings are consistent with their position, and this study constitutes a first step towards understanding the role of human resources

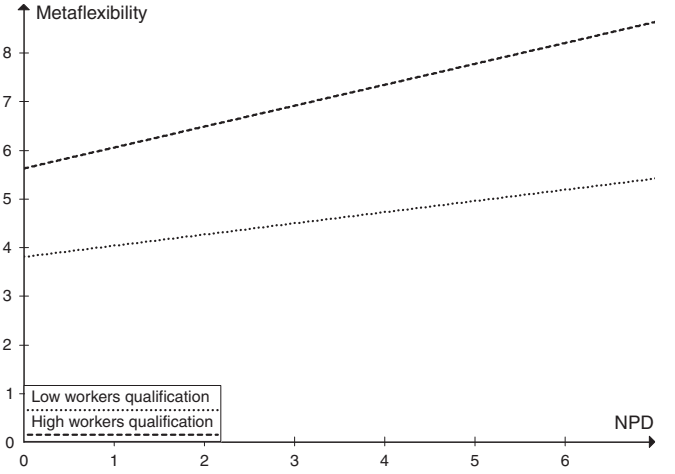

Figure 2.
Interaction between worker qualification and NPD

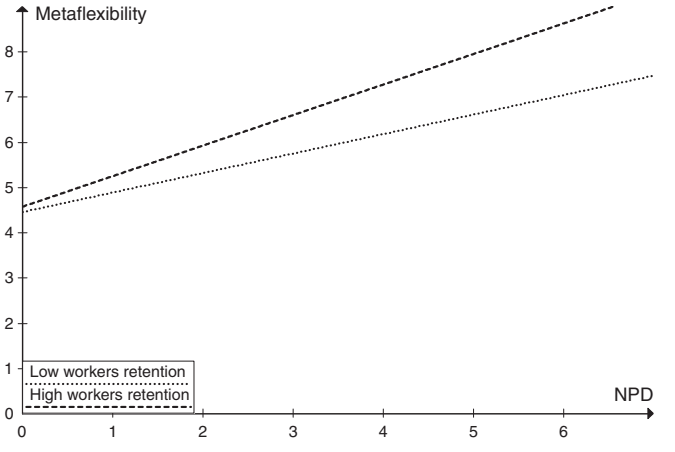

Figure 3.
Interaction between worker retention and NPD

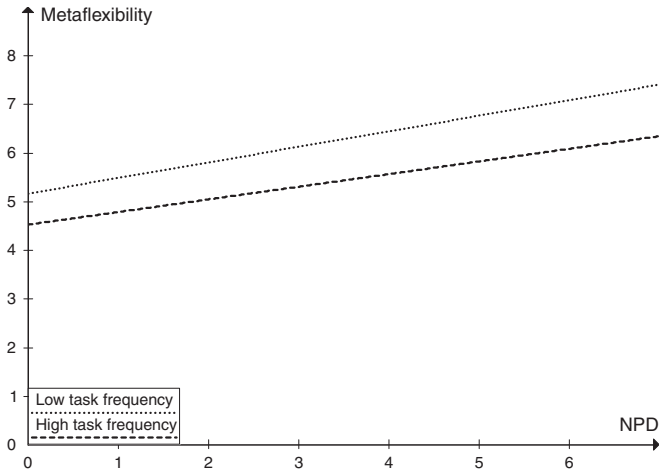

Figure 4.
Interaction between task frequency and NPD

and operating routines in the expectable outcomes of DCs. To articulate how DCs work, we consider NPD as one of the most consolidated DCs and metaflexibility as one of the expectable results of any DC. In this context, our study contributes to both theory and practice.

Theoretical contributions

This study makes three central contributions to the literature. First, we confirm a positive relationship between a specific DC and metaflexibility. This finding suggests that NPD allows organizations to develop superior managerial capability to match required and realized adaptation to the environment. This result occurs because organizations can use different levels of this DC to respond to different environmental changes (Ambrosini and Bowman, 2009; Pavlou and El Sawy, 2011). Although the relationship has not been explored previously in the DCs literature, it is consistent with other theoretical contributions suggesting that DCs can adopt different renewal levels depending on the environmental dynamism perceived by managers (e.g. Ambrosini *et al.*, 2009; Malik and Kotabe, 2009). Our study also adds new evidence to the stream of works that analyse empirically the relationship between DCs and the different dimensions of flexibility (see, e.g. Barrales-Molina *et al.*, 2013, Singh *et al.*, 2013; Vanpoucke *et al.*, 2014). Our research goes beyond prior studies, however, by demonstrating that DCs can also lead to achieving the optimal level of flexibility. This connection between DCs and metaflexibility could thus be useful in explaining how firms achieve sustainable competitive advantage in the long run through DCs such as NPD. In other words, this finding provides new insight into the current debates in the literature concerning the more direct effects derived from building DCs.

Our second contribution is a better understanding of the role of human resources in DCs' performance. To date, the literature has suggested only indirectly some features or ideas concerning the importance of HR's characteristics in the interaction between DCs and operating routines (see, e.g. Vogel and Güttel, 2013). More specifically, our findings support the idea that highly qualified and committed

workers enhance the relationship between NPD and metaflexibility. In other words, qualified and involved employees will be more prepared and willing to apply their individual agency to trigger the right levels of change needed in operating routines. These results are consistent with theoretical contributions arguing that qualification and job retention practices transform human resources into VRIN resources, ensuring their more direct connection to competitive advantage (see, e.g. Chadwick and Dabu, 2009; Colbert, 2004; Wright *et al.*, 1994). Our results also provide additional evidence for previous studies that explain DC creation in research centres and the semiconductor industry (e.g. Bruni and Verona, 2009; Beugelsdijk, 2008; Chiang and Shih, 2011; Danneels, 2010; Newey and Zahra, 2009), where employees integrate their extraordinary qualifications and are involved in long-term organizational projects. Further, the results support prior studies of the NPD context proving that training and permanent programs enhance and organizational agility (see, e.g. Beugelsdijk, 2008; Chiang and Shih, 2011; Chiang *et al.*, 2014; Kok and Ligthart, 2014; Martínez-Sánchez *et al.*, 2011; Nijssen and Paauwe, 2012; Wei and Lau, 2010). Our findings thus highlight that human resource management decisions (related to recruitment, training and retention practices) should be taken into account when studying the role and efficacy of DCs.

Our third contribution enables us to connect DCs theory and operating routines research. This study has analysed the role of task frequency and task heterogeneity as moderators in the relationship between NPD and metaflexibility. On the one hand, we find support for a negative moderating role of task frequency in the relationship between NPD and metaflexibility. In other words, very frequent and automatic routines can block the role of DCs. This finding supports some theoretical proposals arguing that frequently repeated routines can become sources of inertia in some organizations (Feldman, 2000; Teece, 2012; Zollo and Winter, 2002). The result concurs with evidence from other empirical studies that demonstrate that high frequency of routines blocks the opportunity to evaluate new ways of performing a regular routine (see, e.g. Betsch and Brinkamann, 1998; Feldman and Pentland, 2003; Narduzzo and Warglien, 2008). On the other hand, our results do not confirm the positive influence of task heterogeneity as a moderator variable. Despite some theoretical contributions highlighting its value as enabler of DCs (see, e.g. Zollo and Winter, 2002), our data could show that task heterogeneity is more closely related to extraordinarily high levels of flexibility than to the balance of adaptation that metaflexibility reflects. This explains why some scholars argue that it is difficult to consolidate stable operating routines when task heterogeneity is relatively high (Pentland *et al.*, 2012; Turner and Fern, 2012).

Lastly, three control variables (firm size, age and sales) were included in the contrasted model. Based on our results, these control variables do not show significant influence in explaining the relationship between DCs and metaflexibility. Prior findings on DCs have also demonstrated the limited or null role of control variables in explaining DCs (see, e.g. Barrales-Molina *et al.*, 2010; Wilden and Gudergan, 2015; Wilhelm *et al.*, 2015). Only a few studies show a moderate influence of firm size in creating DCs (Pavlou and El Sawy, 2011; Schilke, 2014). Such findings suggest that DC creation is based on more idiosyncratic features of the firm, as well as on path-dependent variables beyond size, age and sale. These results show that developing a contingency approach to understanding DC creation requires more in-depth research on the characteristics of firms with successful DCs.

Implications for practice

This study also provides some lessons for managers. First, our study finds that a DC such as NPD can lead to the optimal level of flexibility depending on the perceived dynamism in the competitive environment. Although the majority of works on DCs have emphasized their value in hypercompetitive environments (see, e.g. Barreto, 2010; Pavlou and El Sawy, 2011; Zollo and Winter, 2002), managers should note that a DC such as NPD also responds to a wide range of levels of environmental dynamism.

Second, our analysis indicates that a firm should be pay attention to its human resource strategy to ensure that DCs modify operating routines regularly. To date, analysis of DCs has focused on the strategic level (see, e.g. Helfat and Peteraf, 2015). Our results indicate that human resource managers should be integrated into strategic decisions related to creating and developing DCs. These results thus suggest that policymakers concerned with DC creation should be cautious in selecting, incentivizing and designing the human resources workstation. For instance, if an organization faces the challenge of generating DCs, it will have to seek qualified employees and retain them with long-term incentives. Strategic decisions related to creating and developing DCs should definitely not be independent of human resource management practices.

Finally, our study suggests attending to the features of the tasks workers perform, since some characteristics, such as frequency in repetition, may block the optimal interaction between DCs and operating routines. Although certain levels of routine repetition will always be desirable to achieve efficiency and stability (Feldman, 2000; Feldman and Pentland, 2005), managers should recognize the negative side of very frequent routines. It may thus be advisable to promote task rotation to avoid automatic repetition of some processes.

Research limitations and future research directions

Although our study makes important contributions to DCs theory, it has several limitations related to generalization of the results. First, we analyse a single DC. Although NPD is consolidated in the upper echelon literature as a good example of a DC, it is advisable to test similar models with other DCs. Such testing could confirm that the role of human resources is a common feature shared by DCs. Second, the subjective nature of our data may have drawbacks. Although we attempted to ensure the reliability and validity of the measurement model and informed respondents of their anonymity in the study, managers' responses could be biased towards providing a desirable image of the firm they manage. Finally, understanding the impact of DCs on routines would benefit from longitudinal studies, as several scholars suggest (e.g. Malik and Kotabe, 2009).

Future studies could advance this preliminary step by attempting to explain the characteristics of workers in organizations with a successful microfoundation of DCs. Studies could, for example, compare how human resources affect different DCs. Alliance management is another solid DC to analyse in this context, and other variables could be considered to describe workers and internal context to develop a contingency approach to microfoundation of DCs. Individual psychological characteristics should not be ignored, as several scholars highlight that inherent routine flexibility goes beyond strategic issues. An important opportunity for future research in this field thus involves separating strategic and operational aspects of DCs by explaining the involvement of both managers and workers.

Conclusion

Despite its limitations, our study contributes to the literature on DCs in several ways. First, we explore additional effects derived from creating DCs. Our study demonstrates that a specific DC, such as NPD, can ensure a level of flexibility adjusted to environmental dynamism. This contribution supports some theoretical proposals that argue this attribute of DCs. Second, our study highlights the involvement of human resources in the role of DCs. Our study can thus serve as a starting point for additional empirical studies that attempt to explain how to integrate the development of DCs and functional strategies. Finally, this paper advances our ability to address the question of how DCs interact with operating routines. Our study highlights the complexity of this interplay, suggesting the need for a more in-depth contingency study to explain which features of routines promote or block the reconfiguring role of DCs.

Notes

1. An interesting connection exists between metaflexibility and ambidexterity. Tushman and O'Reilly (1996) introduce the term ambidexterity to refer to the organizational ability to combine complementary learning modes for exploration and exploitation. While the concept of ambidexterity highlights the balance needed between flexibility and efficiency, metaflexibility focuses on the degree of flexibility needed to respond correctly to environmental changes.
2. The primary sector includes economic activities related to agriculture, hunting and forestry (Divisions 01, 02 and 03 of NACE classification).

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Appendix

Questionnaire

Code	Statement
NPDP01	Our firm invests significant effort in developing new products.
NPDP02	We regularly introduce both incremental and substantial improvements in our products.
NPDP03	New products have provided a crucial source of outcomes for the company.
NPDP04	Developing new products has given us an advantage over our competitors.
MET01	In our firm, we usually check for mistakes, deviations and problems through previously tested solutions that do not alter our shared values and norms.
MET02	In our firm, we solve problems while respecting existing norms or modifying them slightly.
MET03	In our firm, we seek a balance between maintaining existing values and creating new ones.
MET04	In our firm, we recognize the value of new information and make a special effort to absorb and assimilate it.
QUAL01	Our firm only hires experts from different areas
QUAL02	The formal education of our employees is supplemented by extensive job expertise.
QUAL03	The qualification of our workers allows them to develop tasks with autonomy.

Table AI.
Questionnaire

(continued)

WRET01	Most members of the organization have permanent contracts.
WRET02	One of the goals of our human resources department is to reduce worker turnover.
WRET03	We encourage our employees to stay in the firm to develop their careers in the long term.
FREQ01	Our employees perform the same task several times a day.
FREQ02	Employees have little time to analyse results between different executions of the same task.
FREQ03	Employees repeat tasks automatically.
HET 01	Each time an employee performs the same task, new difficulties arise.
HET 02	Each situation requires new solutions for a specific task.
HET 03	Learned patterns for resolving a task cannot be applied in full to future situations.

Size. The number of employees in this firm is approximately:

☐ Fewer than 50 ☐ Between 50 and 250 ☐ Between 250 and 1,000 ☐ More than 1,000

Age. The age of this firm is approximately:

☐ Less than 5 years ☐ Between 5 and 10 years ☐ More than 10 years

Sales. This firm's sales are approximately:

☐ Less than 1 million € ☐ Between 1 and 7 million € ☐ Between 7 and 40 million € ☐ More than 40 million €

Table AI.

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