

The strategy of human resource flexibility versus absorptive capacity of knowledge: an integrative framework in industrial firms

1. Introduction

Firms have to be flexible and innovative enough to compete in any market nowadays. It is no surprise that flexibility and innovation are hot topics of discussion within labour relations in some industries like, for instance, the automotive industry. Firms need trained and multiskilled employees as well as access to external knowledge to improve their production processes and develop new products faster and more frequently than before. These requirements make managers to pay greater attention to the implications of several dimensions of human resources (HR) flexibility on the firm's innovation performance. At the same time, firms have to update their technologies portfolio, either by internal research and development (R&D) or by external knowledge. The firm's absorptive capacity (AC) is relevant here because it assesses the firm's ability to identify, assimilate, transform, and exploit valuable external knowledge to their own innovation outputs (Fosfuri and Tribó, 2008).

Both HR flexibility and AC are capabilities that should be analysed together in search of synergies or trade-offs from an innovation strategy perspective. HR flexibility provides the capabilities to upgrade the firm's operations and to incorporate new knowledge within the employees' skills whereas AC allows the firms to keep technologically updated and adapted to market changes. However, the literature has paid little attention to the relationship between HR flexibility and AC. How can HR flexibility and AC be combined in a positive way to improve innovation performance? Are there trade-offs between some dimensions of HR flexibility and the different AC stages that might difficult innovative outputs? Are the firm's efforts to have flexible human resources and able to adopt new skills, related to the learning process from external knowledge? These are interesting examples of questions with potential managerial implications that are scarcely discussed in the managerial literature. Nevertheless, prior exploratory research indicates, for instance, that the use of firm-level antecedents such as job rotation and participative management may enhance AC (Jansen, Van Den Bosch and Volberda, 2005).

The study of HR flexibility related to AC is also theoretically appropriate because AC is deeply rooted in a firm's prior tacit and socially complex knowledge (Cohen and Levinthal, 1990); such knowledge often resides in important individual employees (Volberda, Foss and Lyles, 2010). The use of flexible HR systems may influence the context in which firms can nurture, retrieve, and utilize such knowledge among core employees. In stable environments, it is relatively easy for firms to develop human resources with a narrow range of skills and behaviors; however, in uncertain competitive environments, firms are expected to require flexible HR systems that promote employees with a broad range of skills or simply to be able to adapt to volume production changes (Wright and Snell, 1998). But, have different types of employment contracts the same impact on the firm's innovation performance? Some of these implications have been analyzed in the literature but others not.

Our research aims to link specifically HR flexibility and AC within the firms' innovative context in order to offer some strategic implications of the different combinations of the HR and knowledge management. By so doing, we contribute to the literature in two different ways. First, we analyse if firms with greater AC are more flexible than other firms. It is important to explore this relationship because some HR flexibility practices (i.e., cross-functional teams) contribute to the diffusion of knowledge within the firm, at the same time that other practices (i.e., external R&D employees) bring knowledge of occupational and industry best practices into the firm, and may stimulate exploration of ideas outside the firm's knowledge stock, even with a significant contribution to technology foresight activities. Second, our research analyses the potential consequences of different combinations of HR flexibility and AC for innovation and performance. Both contributions may have

important managerial implications: firms seeking innovation should focus simultaneously on HR flexibility and AC to keep ahead of competitors in some types of environments.

The paper is structured as follows. First we review the literature and develop the research objectives of the paper. After that, we explain the methodology of the empirical study followed by the results and their discussion with managerial implications. Finally, we end with conclusions and limitations.

2. Theoretical foundation and research proposition

2.1 The knowledge-based view

The resource-based view of the firm (RBV) and the dynamic capabilities perspective are frequent organizational theories that support innovation research. The RBV states that a firm's competitive advantage lies primarily in the application of bundles of resources that are valuable, rare, in-imitable and non-substitutable (Barney, 1991), whereas the dynamic capabilities perspective considers that accumulating valuable resources is not enough because firms need dynamic capabilities to create, apply, integrate, expand or modify those resources (Teece, Pisano and Shuen, 1997; Kohlbacher, 2013). In this paper, we focus in them because they highlight the importance of a very rare and valuable resource, the firm's knowledge, that it is closely linked to HR flexibility and AC.

A firm's ability to identify and integrate external with internal knowledge to create new knowledge gives it an advantage because the nature of knowledge as a strategic and intangible resource varies across firms and industries, and it is more difficult to imitate than other resources (Grant, 2013). The knowledge-based view considers that the competitive advantage does not lie in the knowledge itself but in how it is applied and managed. Firms that search widely from among multiple sources are better at creating new knowledge, because they increase their knowledge diversity, are able to create more combinations of knowledge, and may develop the right organizational context to integrate internal and external knowledge, for example, by providing their employees with the necessary motivation, mindsets, and abilities (Nonaka and von Krogh, 2009).

Human resources use technology and knowledge to develop sustainable competitive advantages based on innovation processes. The management of innovation requires a proactive management of both knowledge and human resources that contribute to innovation performance. On the one hand, firms formulate knowledge management strategies so as to create and employ appropriate individual and collective knowledge resources in the pursuit of competitive advantage. Identifying, creating, storing, sharing, and applying knowledge are the main activities that define knowledge management. On the other hand, the human resources present a certain degree of mobility, but the capabilities they possess can be valuable to a firm and not so for another firm, or competitor. Certain capabilities, based upon the tacit knowledge of the firm, are only valuable when integrated with other individual capabilities specific to that particular firm, and that capacity of being complementary is immobile. Therefore, the management of HR flexibility may also have implications for the firm's management of knowledge and processes of learning. The competitive advantage does not lie in the knowledge itself but in how it is applied (Alavi and Leidner, 2001), that is to say, the company needs an effective management of all the resources that own or control (Sirmon *et al.*, 2011).

Learning is a key process here because organizational learning is part of the foundation that underlies knowledge-based thinking. Knowledge is an indicator of organizational learning and organization learning happens when there is a change in the knowledge of an organization (Argote and Miron-Spektor, 2011). Learning itself can be defined as the process by which new information is incorporated into the behaviour of agents, changing their patterns of behaviour and possibly, but not always, leading to better outcomes. Although the initial focus of learning was basically on individuals, nowadays it is more usually conceptualized at the organizational level, where it is viewed as a key

process in the adaptation of organizations to the environment. Cohen and Levinthal (1990) related organizational learning and innovation to the evolving knowledge base of the firm and they develop the concept of absorptive capacity (AC) which is explained in the next section; according to the authors, AC is largely a function of the level of the firms' prior knowledge (which emphasizes the cumulative nature of knowledge) and is history or path dependent (which emphasizes the importance of earlier decisions).

2.2 Absorptive Capacity

The concept of absorptive capacity (AC) was initially proposed by Cohen and Levinthal (1990). They showed that companies cannot benefit from external flows of knowledge, simply by being exposed to them. Instead, companies must develop the ability to recognize the value of external knowledge to assimilate and use it afterwards for commercial purposes. Their initial typology of AC dimensions was later expanded by other scholars (e.g., Zahra and George, 2002; Todorova and Durisin, 2007). In this study, we conceptualize AC as a firm's ability to recognize the value of new external knowledge and assimilate it (i.e., potential AC or PAC) and to transform and exploit such knowledge to commercial ends (i.e., realized AC or RAC). PAC includes the phases of acquisition and assimilation of external knowledge whereas RAC includes the phases of transformation and exploitation inside the firm for innovation purposes.

Even though there are some reviews of the body of knowledge on AC (e.g., Duchek, 2013; Sakhdari, 2016), it is not our purpose to analyze all AC related topics but only those linked to our research, mainly the conceptualization of AC as a dynamic capability and its relationship with human resources. Regarding the theoretical aspects of AC, two important approaches have been taken to this construct. Some researchers have considered AC as a static firm resource and used R&D investments, the number of patents or the ratio of educated persons in the workforce as proxies for AC (e.g., Escribano, Fosfuri and Tribó, 2009). This approach, however, has been lately challenged by a second group of researchers who take a capability-based approach (e.g., Lewin, Massini and Peeters, 2011; Flatten *et al.*, 2011; Biedenbach and Müller, 2012). This latter group contends that these proxies do not reflect the complexity of this capability's dimensions and the content of knowledge (Flatten *et al.*, 2011). More importantly, considering AC as a capability and a higher order resource seems to be more consistent with the knowledge-based view. The latter stream essentially considers AC as a capability embedded in firms' routines and processes for acquisition, assimilation and exploitation of new external knowledge. As a dynamic capability, a firm's AC is valuable and difficult to imitate by competitors because it depends heavily on the trajectory and prior knowledge of each firm (Volberda, Foss and Lyles, 2010). Firms with higher levels of AC can manage external knowledge flows more efficiently, and stimulate innovative outcomes (Escribano, Fosfuri and Tribó, 2009); they may react much more effectively to customer's needs with new or adapted products, at the same time that they may improve their organizational routines and management practices which contributes positively to enhance firm performance (Lane, Koka and Pathak, 2006; Dobrzykowski *et al.*, 2015). Several empirical studies find a positive relationship between AC and innovation outputs (e.g., Huang, Lin, Wu and Yu, 2015; Hurmelinna-Laukkanen *et al.*, 2012) as well as firm performance (e.g., Martinez-Sanchez and Lahoz-Leo, 2018; Sciascia *et al.*, 2014; Tzokas *et al.*, 2015).

The literature review also reveals that in comparison to the impacts of AC (on innovation outputs, firm performance...) very little, yet increasing, theoretical and empirical attention has been given to its antecedents. A firm's AC is not just the sum of its employees and managers' AC (Cohen and Levinthal, 1990), because there are several organizational routines and management processes of the firm that may constitute important sources of AC by themselves. One source is rooted in the abilities and motivations of its human resources. Of course, AC relies on the individuals' knowledge involved in the absorption process which give a starring role to any organizational characteristic linked to social capital, employee reward systems and empowerment or R&D decision-making processes

(Volberda, Foss and Lyles, 2010; Ebers and Maurer, 2014; Mura *et al.*, 2014). Thus, Hughes *et al.*, (2014) show that social capital through enhancing AC increases the firm's innovative performance. Similarly, Ebers and Maurer (2014) conclude that relational embeddedness and relational empowerment help firms build up their AC. As a consequence, it is very important to analyze the implementation of those HR practices related to employees' training or flexibility in the deployment of knowledge because they may promote individual learning, combinative capabilities, and facilitate the knowledge flows that lead to AC. For example, employees' training programs continuously upgrade employees' skills and combinative capabilities, allowing them to keep up with latest technological developments. Given that investment in human resources is not easily imitated, firms that provide continuous training and workplace flexibility to employees may be in better position to manage the flows of knowledge more efficiently. However, the relationship between AC and human resource flexibility has been scarcely studied in the literature (e.g., Jansen *et al.*, 2005).

2.3 Human Resource Flexibility

Human resource (HR) flexibility has been conceptualized and defined in a wide variety of ways. For instance, (Milliman, von Glinow and Nathan, 1991, p. 325) define HR flexibility as "the capacity of human resource management to facilitate the organization's ability to adapt effectively and in a timely manner to changing or diverse demands from either its environment or from within the firm itself". In this sense, HR flexibility constitutes a valuable capacity and a specific resource for the firm difficult to imitate, capable of generating sustainable competitive advantages and improving performance. The classifications of HR flexibility in the literature reflect either a 'worker perspective' or an 'organizational perspective'. From a worker perspective, flexibility is conceptualized as flexible working arrangements, which encompass those practices that enable employees to choose the location, the time, and the duration with which they pursue tasks relevant to their jobs. From an organizational perspective, it is frequently cited the conceptual framework of (Wright and Snell, 1998) that distinguishes three components: flexibility of HRM practices, behavioural flexibility, and flexibility in employee skills (or functional flexibility). Other scholars (e.g., Atkinson, 1984) focus the differentiation on the two main sources of flexibility -internal and external- and thus encompass both worker and organizational perspectives. The internal-external approach is more suitable for our research because of their implications for the management of knowledge and innovation both inside and outside the firm.

According to this approach, HR internal flexibility includes actions and practices that increase the firm's capacity to face uncertainties by increasing the employees' skills or improving the organization of work, whereas external flexibility relies on the inputs from the external labour market through temporary employees (short-term hires, Temporary Agency Workers) and external R&D experts. Following the RBV and the KBV, we might expect that long-term and high-committed multiskilled employees (internal functional HR flexibility) would support innovation and knowledge creation more than temporary employees that may be laid off shortly (external numerical flexibility). A recent literature review (Seeck and Diehl, 2017) regarding the 'black-box' relationship between HR and innovation indicates that the theoretical underpinnings of that relationship should be strengthened, and that its measurement should be more consistent. Our research takes knowledge as an explanation to link HR flexibility and innovation. Seeck and Diehl (2017) also find that the individual HR practices that foster employee commitment, loyalty, learning and intrinsic motivation are more conducive to innovation; these practices are usually more frequent among core permanent employees. Other scholars show that some flexible employment contracts could even damage innovation or, at least, would not support the employee's contribution to innovation (Beugelsdijk, 2008). Our review of the empirical studies between HR flexibility and innovation shows a major agreement about the positive contribution of internal functional flexibility to innovation, whereas the contribution of external HR flexibility is less conclusive because it is necessary to distinguish between categories of external employees (Martínez-Sánchez *et al.*, 2011; De Spiegelaere, Van Gyes and Van Hootehem,

2014). On the one hand, temporary employment is usually negatively associated to innovation (e.g., Michie and Sheehan, 2005; Posthuma, Campion and Vargas, 2005; Buonocore, 2010; Martínez-Sánchez *et al.*, 2011). On the other hand, external R&D experts are a different type of HR flexibility because they bring knowledge of occupational and industry best practices into the firm, and may stimulate exploration of ideas outside the firm's knowledge stock. Firms may use external R&D experts to obtain knowledge and new ideas that in combination with in-house knowledge can be a source of innovation projects (Voudouris, Deligianni and Lioukas, 2017). Accessing external technology and expertise is important because the increasing complexity of markets makes it difficult for firms to have all of the knowledge resources required to innovate. Then, we should distinguish between temporary employees (external numerical flexibility) that may have a negative influence on innovation, and external R&D experts (external functional flexibility) who are found to be positively related to innovation (e.g., Nesheim, 2003; Martínez-Sánchez *et al.*, 2011; McKeown and Cochrane, 2017).

Following these categories of HR flexibility, we could conceptualize a 'good' and a 'bad' mix of HR flexibility according to the combination of functional flexibility (both internal and external) and external numerical flexibility (temporary employees). The basic difference between these 'good' or 'bad' combinations of HR flexibility lies in the degree of knowledge acquisition, accumulation, integration, and exploitation of the firm's capabilities (Sirmon *et al.*, 2011) associated to each dimension of HR flexibility. Figure 1 shows the four possible categories although this paper only focuses in the 'good' and 'bad' combinations. 'Good' HR flexibility relates to firms with low temporary employment and high functional flexibility (training effort, multiskilled employees and external R&D experts). On the contrary, 'bad' HR flexibility corresponds to firms with high temporary employment and low functional flexibility (training effort, multiskilled employees and external R&D experts). The level of functional flexibility indicates the firm's commitment to enhance the stock of knowledge and diffuse the best industry practices inside the firm: the hire of external R&D experts (external functional flexibility) contributes to knowledge development within the firm whereas multiskilled core employees (internal functional flexibility) contribute to the diffusion of knowledge throughout multifunctional teams that develop product and process innovations. We consider that most firms move along the diagonal of the four-position matrix from 'bad' to 'good' or vice versa whereas firms outside the diagonal are not in need of competition (State or administrative concessions) or are strongly focused on their core intangible assets. Other studies use other terms to differentiate between types of flexible employment, like "insecure work", "atypical work" or "contingent work". We prefer the categories of 'good vs bad' according to the influence that several dimensions of HR flexibility may have on the firm's knowledge development and transformation process.

2.4 Research proposition

Our research proposition basically states that high levels of AC and 'Good HR flexibility' are positively related for innovative firms whereas other combinations of AC and HR flexibility are only found in non- or less-innovative firms. The previous arguments have shown that AC and HR flexibility may influence the firm's innovation performance. For instance, several studies indicate that enhancing the firm's AC contributes to improve innovation performance (e.g., Fosfuri and Tribó, 2008; Huang *et al.*, 2015; Hurmelinna-Laukkanen *et al.*, 2012; Kostopoulos *et al.*, 2011). Other studies find a positive or negative relationships between dimensions of HR flexibility and innovation (e.g., Beugelsdijk, 2008; Martínez-Sánchez *et al.*, 2011; Michie and Sheehan, 2005). However, the interrelationship between AC and HR flexibility has been scarcely explored in the literature.

A firm's AC depends on its existing knowledge stock, much of which is embedded in the firm's products, processes and people. For some scholars, AC resides greatly in individual employees and that the learning behaviour of these employees collectively shapes the firm's AC (Cohen and

Levinthal, 1990; Volberda, Foss and Lyles, 2010). Nevertheless, not all employees are equally relevant for the firm's AC because, for instance, core knowledge employees are more critical for creating new knowledge or developing innovations in comparison to temporary employees just hired for adapting volume production changes. Then, a firm that focuses on developing core knowledge employees' skill and knowledge bases as well as redeploying these human resources for alternative uses, is making organizational efforts to benefit from its AC and develop innovations. Skilled and trained employees are important to benefit from AC because highly-skilled employees may be more productive to combine outsourced technological knowledge with in-house knowledge to innovate. This is because they are better at learning, and they are better at integrating knowledge. First, skills enable employees to learn better as they can use their prior knowledge and experiences as the base for understanding new and more sophisticated knowledge. The higher their skill levels are, the more effective and efficient they are likely to be in recognizing how external knowledge can be transformed with firm-internal knowledge to create new knowledge to innovate (Teece, 1986). Second, skilled employees have higher integrative capabilities, or the ability to integrate different types of knowledge to create new knowledge (Nonaka, 2007). These capabilities are important because to create new knowledge for new products, for example, employees need to be able to use and transform external knowledge with tacit or explicit knowledge that resides inside the firm.

Then, employees with a diverse repertoire of knowledge and skills might be better able to recognize and assimilate information from different segments of the external environment because they are more likely to have prior related knowledge for each segment and such knowledge overlap facilitates learning. For instance, extensive training that is not limited to core knowledge employees' current jobs improves their ability to respond more effectively to changing customer demands. HR internal flexible practices like cross-functional teams encourage employees to take on different roles and tasks and contribute to expand their knowledge base, thus enabling firms to transform better their AC into innovations. Although the acquisition and assimilation process of external knowledge may be done by a single key individual or department, the knowledge application process is rarely done by a single person or department (Nonaka, 2007). Instead, the knowledge application process requires intensive R&D management (Vicente-Oliva, Martínez-Sánchez and Berges-Muro, 2015), collaboration among departments such as R&D, marketing and sales, and manufacturing, and this is when the availability of core skilled employees with internal flexibility becomes relevant to develop innovations. Firms with polyvalent employees that fulfil different functions may apply and transfer knowledge more intensively in order to create or maintain competitive advantages. For instance, internal HR flexible practices like multi-skilled teams may contribute to a wider dispersion of abilities and in-house or external knowledge that make the deployment of individual employees to particular tasks more adaptable and, as a consequence, may positively influence innovation (Martínez-Sánchez *et al.*, 2011). Popaitoon and Siengthai (2014) in a study of project-oriented companies find that HR practices not only facilitate knowledge management from the current project to future projects but also strengthen the relationship between a project team's AC and long-term project performance. Un (2017) also finds that firms that have more skilled employees, and have more internal R&D investment tend to invest more in external R&D. According to the previous arguments, we propose that the development of a core of employees with more skills, training and internal functional flexibility may be positively associated to the conversion of AC in innovations.

Regarding HR external flexibility, we have already indicated the need to differentiate between temporary employees and external R&D employees. Both may be short-term employees in the firm but their implication related to knowledge and innovation is quite different. First, external numerical flexibility from temporary employees and Temporary Help Agencies may contribute to reduce labour costs but it may have negative outcomes for innovation because these short-term employees have lower organizational commitment than permanent employees (Michie and Sheehan, 2005). Other scholars (e.g., Broschak and Davis-Blake, 2006) also find that the percentage of temporary employees is negatively related to employee trust, internal workers' attitudes, and the quality of employee–

supervisor relationships which may negatively influence the process of knowledge assimilation and transformation at the firm level. Training, recruitment, and hiring costs are lower for temporary than for permanent core employees, and firms can manage knowledge accordingly. The firm's AC requires that tacit knowledge from external sources is transformed into explicit in-house knowledge to innovate. This process of transformation requires time and cross-functional interactions that can be out of reach for some temporary employees, especially those hired under specific purposes and limited knowledge requirements. These temporary employees may be left out from long-term innovation projects which can reduce the benefits of developing greater AC in firms with large percentages of temporary employment.

Second, external R&D employees may be more related to the knowledge processes within AC and innovation. External R&D employees bring knowledge of occupational and industry best practices into the firm, and may stimulate exploration of ideas outside the firm's knowledge stock. This external functional flexibility offers increased opportunities for potentially faster and lower-cost innovation to firms that develop their core competences and integrate outside knowledge properly. Hoecht and Trott (2006) indicate that hiring specific individuals with tightened legal contracts is a better option to benefit from external knowledge than participating in networks. Similarly, firms that conduct their own R&D and seek external knowledge related to their core competences can more effectively incorporate this external knowledge and use it to enhance innovation (Bierly, Damanpour and Santoro, 2009). Thus, external R&D employees may constitute a solid base to use the firm's AC and develop innovations because these employees may be more familiar with the best external knowledge or at least have the tacit knowledge required to improve, for instance, the technology acquired by the firm in machinery or equipment.

According to the previous arguments we have developed our stated research proposition: *High levels of AC and 'Good HR flexibility' are positively related for innovative firms whereas other combinations of AC and HR flexibility are only found in non- or less-innovative firms.* It is the combination of high internal and external functional flexibility with a low level of temporary employment (external numerical flexibility) what would make easier for a firm to create its AC and use it effectively to develop innovations. Then, we expect to find that innovative firms exhibit more intensive 'Good HR flexibility' in combination with greater AC. On the contrary, the so-called 'Bad HR flexibility' is going to disincentive or to make more difficult the creation of AC inside the firm and the development of knowledge-based innovations.

3. Methodology

To study the relationships between HR flexibility and AC we used the Spanish Survey of Business Strategies (SBS) questionnaire which contains a set of statements that permit the analysis of a great number of manufacturing firms. The SBS is an annual survey undertaken since 1990 and conducted by the SEPI Foundation¹ in collaboration with the Spanish Ministry of Industry with the objective of knowing the evolution of the characteristics and strategies of Spanish industrial firms. This survey contains information about markets, customers, products, employment, technological activities, and economic-financial data of the firms. The reference population comprises the group of industrial firms operating in Spain with 10 or more employees, classified by their main activity belonging to the divisions 10 to 32 of NACE-2009, excluding division 19 (industrial activities related to petrol refine and fuel treatment). The SBS uses a systematic and stratified random sample from the Spanish Social Security directory. Representativeness is one of its characteristics (the firm's response rate is high, around 91%), and as Almodóvar and Rugman (2014) argue, "it assures anonymity; it asks mostly for

¹ The SEPI Foundation is responsible for the survey design and control through the Economic Research programme. More information about the SBS can be found in the webpage <https://www.fundacionsepi.es/investigacion/esee/en/spresentacion.asp>

non-perceptual measurements; and Foundation SEPI carries out different criteria for content validity (if there is a failure to comply with the consistency controls the company is required to submit documental justification)". The response rates for different sectors and sizes are consistent with the overall response pattern. All the information incorporated in the SBS is subjected to validation and logical consistency controls.

We use data available from 1,666 industrial firms in the year 2015 (nevertheless, the statistical relationships we found for this year are consistent for the previous two years that were also available at the time of our research). The distribution of surveyed firms by size indicates that 17.5% have more than or equal to 200 employees and 82.5% less than 200 employees. In terms of economic activity, the sample is highly diversified because none of the industries exceeds 15% of total firms.

We differentiate our descriptive statistics between innovative and non-innovative firms: innovative firms are those that had developed at least a product innovation, a process innovation or a patent. We take into account the dummy variables of product and process innovation, and the number of patents as well as the ratio of number of product innovations divided by number of products.

Regarding the assessment of AC, we use the measure developed by Saiz et al., (2018) for the SBS. It is a construct of 6 items (dummies): the evaluation of alternative technologies by firms, the evaluation of technological change, the contracting of outside consultants as a mechanism for obtaining information about technology, the existence of a firm's technology management or committee, the preparation of a plan, and the measurement of results obtained in this management process. This variable takes values from 0 to 6. This methodology provides a capability 'profile' for each firm by identifying a differentiated set of practices that it is a more adequate measure of dynamic capabilities than the traditional perceptual measures of AC.

We have used some direct and indirect measures of HR flexibility provided by the SBS. Regarding HR internal flexibility there are not direct measures in the SBS but some proxy measures can be used such as the percentage of sales invested in training or the training expenditures by employee. These indicators are proxy measures of the firm's core workforce because core employees receive more training and organizational support to adopt internal flexible practices. Regarding external flexibility, the SBS does include some direct measures of this flexibility: the percentage of temporary employees in the workforce, the percentage of employees from Temporary Help Agencies in the workforce, the use of R&D external employees with private experience, and the use of external employees with experience in the public R&D sector.

Our methodology includes a cluster analysis and a case study of selected firms. First, we have carried out a k-means clustering analysis to explore how homogeneous may be the SBS firms according to HR flexibility and AC measures. We have used the following five standardized variables for clustering: AC, R&D effort (R&D expenditures by sales), training effort (training expenditures by employee), temporary employment (percentage of temporary employees and employees from Temporary Help Agencies in the workforce; a measure of external numerical flexibility), and external R&D experts. The purpose of clustering was to explore if these variables hold the sample in homogeneous groups of firms. We complement the clustering itself with some descriptive statistics for each cluster: the number of product innovations divided by the firm's number of products, the number of patents by firm, and the percentage of product and process innovative firms. Second, the statistical analysis is complemented by a selection of case studies from industrial firms in different positions regarding innovation, AC and HR flexibility. The information for the cases studies comes from secondary sources such as corporate governance reports and statements of managers and employees from company websites and public reports.

4. Results

4.1 Descriptive statistics

The descriptive statistics of the SBS' 1,666 firms indicate that in the year 2015, 42.4% were innovative firms: 15% of firms developed at least a product innovation, 37% obtained at least a process innovation, and 4% filed at least a patent or utility model. Regarding the performance of R&D activities, 17.6% of firms outsourced R&D at the same time that carried out R&D in-house, 11.3% of firms carried out R&D in-house but not outsourced, and 3.8% of firms contracted R&D activities externally but not in-house (67.3% of surveyed firms did not carry out any R&D activity).

Table 1 shows the mean differences of some HR flexibility indicators between innovative and non-innovative firms. Measures related to internal flexibility such as training and full-time qualified employees indicate that innovative firms have larger percentages of employees who are more qualified and receive more training than in non-innovative firms. Innovative firms also hire more external R&D experts to contribute to innovation. All these differences are statistically significant. Innovative firms have a greater percentage of temporary employees but this difference is not statistically significant; however, there is a statistically significant difference of the higher use of Temporary Help Agencies for innovative firms. Similarly, table 2 indicates that most HR flexibility indicators are greater for high-AC firms than for low-AC firms, and the differences are statistically significant except for temporary employment.

4.2 Cluster analysis

The cluster analysis is a statistical technique that seeks groups of firms that are internally homogeneous and externally heterogeneous among them. We have carried out a k-means clustering. The results indicate there are four groups of firms in the sample. The analysis converged to this optimal solution after eleven interactions with significant F-values ($p=0.000$) for all standardized variables. Alternative solutions of three or five clusters do not converge and do not offer significant F-values. Table 3 and Figure 2 show center-values for the four cluster solution.

The first cluster is the smallest in size: only 2.3% of firms have been classified in this cluster but almost a third (27%) are manufacturers of computer, electronic and optical products. The firms in this cluster have the highest values of R&D and training effort, and the second highest values of AC, but very similar to cluster 3. The external numerical flexibility in cluster 1 is the second lowest of all clusters but the access to external R&D experts (external functional flexibility) is the highest. Cluster 1 has the largest percentage of innovative firms (82%), patenting firms (33% national and 22% foreign), as well as the highest patenting rate and the second intensity of product innovation (tables 4 and 5). This higher level of innovative outputs is in line with the greater investments in R&D and training complemented by AC that enable the combination of external and in-house knowledge. Therefore, we have named firms in this cluster as "knowledge investors".

The second cluster (13% of firms) shows the highest values of temporary employment (external numerical flexibility) whereas the other three clusters have values of temporary employment below average. However, cluster 2 has the second lowest values of all other variables: AC, R&D effort, training effort and R&D experts. This indicates that the only strategic relevant variable for these firms is the flexibility of temporary employment since neither R&D efforts nor AC seems to be relevant for their innovation strategies. In fact, the quantitative indicators of innovation for this cluster are the lowest of all (table 5). Then, we have named cluster 2 as "temporary employers". Most of these firms are located in basic industries like manufacturers of food, beverages, tobacco, textiles and footwear (39.7%) followed by metal products (18.2%).

Cluster 3 (19.2% of firms) shows the highest value of AC (almost equal to cluster 1), and the second-highest values of training effort and R&D effort (although much lower than cluster 1). The percentage of innovative firms and innovation outputs are similar to cluster 1 (tables 4 and 5). We have named the firms in cluster 3 as “knowledge exploiters” because they show similar levels of product innovation outputs while having high values of AC (very similar to cluster 1) and a much lower investment in knowledge. The main industry in this cluster is the chemical industry (17%) that has in cluster 3 more than half (51.7%) of its firms.

Finally, cluster 4 is the largest cluster (65.8% of firms) but the center values of table 3 indicate that neither innovation nor flexibility seems to play an important role in the business strategy of these firms. In fact, table 4 shows that the lowest percentages of innovative firms are included in cluster 4. Like cluster 2, most of cluster 4 firms are located in basic industries like manufacturers of food, beverages, tobacco, textiles and footwear (29.2%) followed by metal products (15%).

An ANOVA with these four clusters indicates that the differences in firm size (measured by sales, employees or total assets), percentage of foreign capital, intensity of capital, outsourcing intensity, and market dynamism are not significant among clusters. This means that the previous arguments and analyses are not influenced by firm size, ownership and type of firm or market environment.

4.3 Case studies

There are five companies briefly described according to the research proposition of this paper. First, company A was established in Barcelona (Spain) in 1940 and with 20,000 employees across 30 countries, it is nowadays an industry leader in the production of plasma-derived medicines for patients. It also provides hospitals and healthcare professionals with the tools, information and services they need to help them deliver expert medical care. The company’s R&D effort (R&D expend as a % of revenue) in 2017 was 4.9%, one of the largest R&D budgets in Spain that year. The company collaborates and takes equity stakes in research companies and projects as an extension to its in-house R&D efforts and a vital platform to share scientific knowledge with renowned researchers. Company A’s human resource policy is committed to continued investment in training (572,606 training hours in 2017 or 36.3 training hours per employee) and development of employees. Among other programs, the company offers professional coaching, individual development planning, as well as personality and preference assessments. The goal is to help provide rich development paths targeted at the needs of both the individual and the company. The company looks for those who use their talent and determination to make a difference. The company’s culture values teamwork, responsibility and proactivity with efforts to incite and inspire collaboration and innovation.

Second, company B is a global company, a diversified manufacturer with several production facilities in Spain, the most important operating since 1958 with manufacturing of agricultural machinery components. The business strategy depends, to a considerable degree, on innovation and manufacturing capabilities but also on coordination amongst the company’s different areas. The manufacturing is agile with various small, flexible, twin production lines, flexible work cells operated by highly-trained multiskilled employees with greater responsibility and control over the management of their own work than in the past. The new product development process is currently being perfected to promote simultaneous or concurrent operations. Human resources are considered a key element of the factory’s agility and, in order to strengthen their results, emphasis is placed on training, empowerment and working-hour flexibility. Similarly, teamwork is a necessary element for improving the firm’s responsiveness to variations in medium and long-term market conditions, and models that have already proved their effectiveness in other plants are being used as a reference. For correct implementation, it has been considered necessary to: (a) broaden job responsibilities, (b) increase the versatility, responsibility and decision-making capability of workers, and (c) encourage self-management processes amongst the teams and workers. All these practices evidence a

commitment to HR functional flexibility in a context of cooperative technology development whereas HR numerical flexibility is kept to a minimum.

Company C is in the fiber manufacture business, has found strong international competition in its commoditized products and so had begun to focus on specific products. The company maintains a core staff with detailed knowledge and experience of implementation along the supply chain who acts as project managers of cooperation projects and technology development. The company brings in flexible external resources as, and when, required but it is reluctant to make further use of flexible labor because it did not want to farm out core capabilities to a third party. Company C lacked expertise in some specific areas and chose to sub-contract this work to universities although it is unlikely to bring this expertise in-house because it is something totally different to what they do and the cost of developing the expertise in-house would be prohibitive. As a result of its link with the universities the company now had most of the needed knowledge and could supplement it with input from R&D experts/consultants as and when required.

Company D is a home appliance manufacturer that sells worldwide and that sought to improve its customer-supplier interface by several initiatives such as locating its suppliers on site and collaborating with prime and first-tier suppliers on new product developments. The company treats now the supplier's staff as if they were its own, manifested, for example, in their participating in the contract staff's induction and training processes. Core employees pay visits to the technical facilities of first-tier suppliers (and vice versa) and the development of new parts and models are planned and carried out by cross-functional teams from both supplier and manufacturer. The company incorporates these experiences within its knowledge management system.

Finally, company E is a food distributor company founded in 1979 with a novel concept back then: the discount store. It was very successful during their first years based on a strategy focused on low-cost and HR numerical flexibility. However, the company's franchise strategy did not contribute to sustained growth because the franchises were too diverse to manage and some of the franchisees themselves did not have any business experience at all. There was not any management of knowledge from such diverse franchises and not a common price policy either; prices vary greatly among franchises which led to disputes of difficult resolution. Overall the company's growth was not sustainable and eventually it needed restructuring and capital injection.

5. Discussion and managerial implications

5.1 Implications for research

We first discuss the implications for research and afterwards we propose a strategic framework to analyse the managerial implications of our results. Regarding the theoretical implications of the study, we have followed the recommendation of Seeck and Diehl (2017) to strengthen the theoretical underpinnings of the HR-innovation relationship by focusing our arguments on the contribution to knowledge creation and deployment of the different HR flexibility dimensions. We think that this is a more straightforward method to explain how each HR flexibility dimension can contribute to innovation than analysing other intermediate variables like organizational commitment or quality of labor relations. The theoretical argumentation based on the knowledge processes connects to other studies that have also found that the most knowledge-intensive HR flexible practices are those that contribute most to innovation (e.g., Martínez-Sánchez *et al.*, 2011).

Taking all together our descriptive statistics, cluster analysis and case studies indicate that HR flexibility, AC and innovation are interrelated topics for firms focused on knowledge development. The fact that AC and innovation are positively related has already been found in other studies (e.g., Fosfuri and Tribó, 2008; Kostopoulos *et al.*, 2011) but our research suggests that HR flexibility plays

specific roles in that relationship. The clustering reveals that firms with greater AC, R&D effort and innovation outputs have less ‘bad’ HR flexibility (external numerical flexibility from temporary employees and Temporary Help agencies) and more ‘good’ HR flexibility (internal and external functional flexibility). On the contrary, firms with minimum or non-existent innovation and AC efforts have the highest levels of temporary employment and do not hire external experts in R&D. These results validate our research proposition and make a contribution to the study of the relationship between HR flexibility and innovation. As we indicate in the theoretical section of the paper, the difference between ‘good’ or ‘bad’ category of HR flexibility lies in the degree of knowledge acquisition, accumulation, integration, and exploitation associated to each dimension of HR flexibility. The hire of external R&D experts (external functional flexibility) contributes to knowledge development within the firm whereas polyvalent and multiskilled core employees (internal functional flexibility) contribute to the diffusion and deployment of knowledge throughout multifunctional teams that develop product and process innovations. The positive association between the more knowledge-oriented HR flexibility dimensions and innovation performance reinforces the use of knowledge has an explanation instead of other more ambiguous concepts to differentiate among external HR flexibility dimensions. The literature points out organizational commitment, trust or quality of labor relations (e.g., Michie and Sheehan, 2005; Broschak and Davis-Blake, 2006) as explanations for the lower contribution of some external flexibility dimensions to innovation. However, the use of knowledge is a more solid ground to base the theoretical argumentation, even more when AC is also involved in any empirical study of HR flexibility and innovation.

5.2 Implications for practice

Secondly, the implications for practice are discussed by proposing some strategic implications useful for the management of human resources that are based on the statistical analyses and the case studies. Figure 3 shows a matrix to analyze the firm’s innovation strategies according to the interactions between AC and the mix of HR flexibility dimensions. Given that our clustering and descriptive statistics show a strong relationship between PAC and RAC we have only included an aggregate measure of AC in one side of the matrix. Regarding the other side of the matrix, HR flexibility, we characterize this dimension as ‘good’ or ‘bad’ according to the combination of temporary flexibility and functional flexibility. ‘Good’ HR flexibility relates to firms with low temporary employment and high functional flexibility (training effort and external R&D experts). On the contrary, ‘bad’ flexibility corresponds to firms with high temporary employment and low functional flexibility (training effort and external R&D experts). The level of functional flexibility indicates the firm’s commitment to enhance the stock of knowledge and diffuse the best industry practices inside the firm.

The matrix of Figure 3 indicates four possible scenarios for the management of innovation: (1) high AC versus high ‘Good HR flexibility’, (2) high AC versus low ‘Good HR flexibility’, (3) low AC versus high ‘Good HR flexibility’, and (4) low AC versus low ‘Good HR flexibility’. In each scenario firms may position themselves following their innovation and competitive strategies. Figure 3 indicates several of these strategies and the next paragraphs explain why AC and ‘Good HR flexibility’ are required to develop competitive advantages under each framework.

Perhaps the firms that are more in need of both AC and ‘Good HR flexibility’ are the knowledge-based firms. Either new start-ups or R&D intensive firms have to develop breakthrough innovations to create new markets and keep ahead or differentiate themselves from other start-ups. They have to combine their innovative ideas with the best knowledge available and at the same time they have to incorporate the talent and contributions of core employees. AC and ‘Good HR flexibility’ are then necessary to short innovation development times and enhance the combination of knowledge from different sources. Another important competitive framework located within the first scenario of Figure 3 is agile manufacturing; in fact agile manufacturers usually need to be active innovators too and knowledge-based firms must be agile or quick-innovators as well. This means that agile and

knowledge-based firms are the most dynamic in terms of AC and ‘Good HR flexibility’. Regarding agile manufacturing, it may be conceptualized as a production strategy to introduce new products in highly changing markets; in practice, agile production enables the manufacturing of different innovative products in the same production line with very short set-ups (Narasimhan, Rajiv and Dutta, 2006). Agile firms must be organizations with higher stock and flows of knowledge both inside and outside the firm because they have to face up unpredictable competition with more innovative products that are developed alongside agile supply chains. Given that agile manufacturing seeks to produce more innovative products and faster than competitors, the firm’s capacities of product innovation and production flexibility are very relevant for the development of agility (Zhang, 2011). Similarly, other research findings (e.g., Tavani et al., 2014) suggest AC as a competitive factor that can provide the grounds for proactively winning in the product innovation game through increasing agility capabilities.

A third competitive option depicted in Figure 3 is Open Innovation (OI). OI is an innovation paradigm which argues that firms should use external knowledge in order to succeed in the innovation process. We have positioned OI firms with high needs of AC but not so high needs of ‘Good HR flexibility’. According to the author that first coined the term, OI is ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand markets for external use of innovation’ (Chesbrough, 2006, p. 1). AC and OI have been scarcely connected in the literature but some empirical studies show a positive relationship between them (e.g., Clausen, 2013). Our research about the interaction of AC and HR flexibility allows taking into account external sources of knowledge. The presence of valuable external sources of knowledge does not imply that the flow of new ideas and external knowledge into firms is an automatic or easy process. External knowledge can only be integrated and assimilated with the firm’s (internal) knowledge base when the firm has internal competencies that facilitate OI processes. The dispersion of knowledge within the firm is facilitated by the core-employees’ use of internal flexible practices like job rotation of cross-functional teams. External R&D experts provide access to best practices and knowledge outside the firm that can also contribute to facilitate the absorption process of new knowledge within the firm. Thus, the positive interactions between AC and ‘Good HR flexibility’ may contribute to the adoption of OI strategies that makes the firm more agile to react to frequent changes in technology and customer requirements.

On the contrary than open innovators, closer innovators are more focused on in-house processes of R&D and innovation development. They do not need to develop so greater AC as open innovators and may need to hire temporary employees to liberate ‘core knowledge’ employees from routine tasks in order to focus more on innovation. At the same time, these firms also pay less attention to hire external R&D experts because of their need to keep greater secrecy upon innovative developments. Both HR strategies have implications to the mix of HR flexibility in the way of reducing the share of ‘Good HR flexibility’.

Another scenario for the management of HR flexibility and AC is found among lean manufacturing firms. These firms share some manufacturing practices with agile manufacturing firms but they are less focused on delivery speed and innovation as competitive forces and react instead to predictable changes whereas agile firms face unpredictable changes (Narasimhan, Rajiv and Dutta, 2006). Lean firms focus more on cost reduction and efficiency and, as a consequence, they may hire a few more temporary employees than agile firms to reduce labor costs. Figure 3 also includes traditional firms and ‘on the edge’ (of crisis) firms, i.e. those with low values of ‘Good HR flexibility’ and AC. These firms do not develop competitive advantages based on knowledge and innovation and therefore they do not have to build capabilities of ‘core knowledge’ employees and external knowledge absorption.

Finally, we have also included in Figure 3 two particular kinds of firms: ‘hollow’ and ‘gazelle’ firms. On the one hand, a hollow or virtual firm is a firm wherein production of all goods and services are outsourced to suppliers and the only remaining corporate functions would be planning, coordination

and administration. Figure 3 considers that hollow firms may evolve from lean manufacturing firms although this is just a possible initial point of departure. The relevant issue here about hollow firms is that they are in need of more AC and ‘Good HR flexibility’ because of their specific requirements for a broader technological intelligence (Lin, 2012). Hollow firms only can develop competitive advantages based on their own knowledge stock or their abilities to manage the knowledge of others. Flexibility is also a key issue because hollow firms need to change direction easily according to demand or market fluctuation. On the other hand, a gazelle firm is an American expression for a high-growth company that has been increasing its revenues by at least 20% annually for four years or more, starting from a revenue base of at least \$100,000; they are also known for creating many new job opportunities (Anton, 2019). Gazelle firms are evolving firms because some gazelles keep bounding along, some get tired and slow down, some are eventually bought by larger firms. During their evolutionary trajectory, gazelle firms must be supported by innovation activities and high-qualified employees even though their origins are not so technologically-based. Colombelli et al. (2014) found that firms that achieve higher than average growth, especially gazelles, predominantly adopt exploration strategies and are key actors in the creation of new technological knowledge. Therefore, gazelle firms have to position themselves in Figure 3 along growing trajectories of AC and ‘Good HR flexibility’ in order to develop and reinforce their competitive advantages.

5.3 Implications for society

A final word of our study regards to how all this may affect society. We are living nowadays in a world of fast and frequent changes. Not only firms but also entire regions and countries do not want to be left behind in the innovation race. The discussion of our strategic matrix (Figure 3) goes beyond firms. Any innovation or industrial policy that promotes the development of training, technological transfer and research facilities would contribute to enhance processes of AC among firms. Similarly, a labor relations’ legislation that controls the abuse of temporary employment could facilitate the creation of stable employment with more positive impacts on innovation. Both ‘Good HR flexibility’ and effective AC processes would contribute to develop innovative firms with positive influence on the creation of high-quality employment and value-added economic activities that will eventually benefit society.

6. Conclusion, limitations and future research

This research has been a first step to understand the combined effect of HR flexibility and AC on innovation. The evidence found in the study of a sample of Spanish manufacturing firms indicates that some combinations of HR flexibility and AC are positively related to innovation outputs whereas others are not. Our results imply that managers should pay attention to the different consequences of each HR flexibility dimension for innovation activities since innovative firms value more those HR flexibility dimensions that contribute to the dispersion of knowledge within the firm.

HR flexibility plays specific roles in the firm’s innovation process because the need to develop a firm’s absorptive capacity, and also due to how the firm manages its previous stock of knowledge. ‘Good HR flexibility’, always according to knowledge as we described, requires employees with high functional flexibility, and able to remain in the firm for quite a long time in order to exploit their knowledge. Tacit knowledge is a trigger of innovation, and temporary employees (precarious work) are hardly able to develop key competences for transforming and integrating knowledge in benefit of innovation for their firms. Quite the opposite, the lowest levels of functional flexibility and the highest level of external numerical flexibility are not able to support the knowledge that firms must manage today, which can influence negatively their capability to create future innovations. Our research suggests that ‘Good HR flexibility (for knowledge)’ can be a mantra or leitmotiv for any firm that not only desires to innovate today, but also in the future.

Although we think our results and conclusions are promising, the limitations of the cross-sectional nature of our study make us to be cautious about any proposition that may suggest a causal relationship among the studied variables. Our article also suggests that more research is needed to address other important managerial issues: Under which conditions the strategy of HR flexibility and AC can be managed for increasing the competitive advantage of the firms? Are some managerial practices better than others for achieving a good HR-AC duality? Could the managers of the firm, regardless of sector, firm and R&D intensiveness display actions for HR flexibility in order to reinforce AC or vice versa? These and other related topics are a good starting point for future research.

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