

**HRM AND RADICAL INNOVATION: A DUAL APPROACH WITH EXPLORATION
AS A MEDIATOR**

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7 **AS A MEDIATOR**
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11 **Abstract:** Radical innovation is crucial for a firm's success, and organisations should
12 promote it. Prior research has argued that human capital is essential for a company's
13 innovation. However, the direct and indirect effects of Human Resource Management (HRM)
14 on radical innovation have not yet been determined. Therefore, the present paper aims to
15 explore the direct impact of HRM on radical innovation with a content approach and a process
16 approach. It will also examine the mediating effect that learning through an exploration
17 process has on HRM and radical innovation. Using data from 200 medium-sized Spanish
18 industrial firms, our results demonstrate that Strategic Human Resource Management
19 (SHRM) has a positive and direct effect on radical innovation. We also find that an HRM
20 system directed toward change and creativity and SHRM positively support the process of
21 exploration learning, and that competence exploration has a favourable impact on radical
22 innovation. These results indicate that competence exploration mediates the effect HRM
23 systems and SHRM have on radical innovation.
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45 **Keywords:** Radical innovation; Human Resource Management (HRM) system; Strategic
46 Human Resource Management (SHRM); Content approach; Process approach; Competence
47 exploration.
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55 **INTRODUCTION**
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4 In today's increasingly uncertain, changing and complex markets, firms have to possess
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6 critical factors that enable them to create value and obtain a competitive edge (Bhatnagar,
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8 2012; Hecker and Ganter, 2013). This idea has gained support in recent years due to the
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10 global economic crisis and consequent recession (Hausman and Johnston, 2014).

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13 As key factors in the competitiveness of firms, innovativeness (Caia et al., 2017; Cegarra-
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15 Navarro, et al., 2016; Khosravi et al., 2019; Volberda et al., 2013; Zhang et al., 2016) and
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17 human capital (Collins and Clark, 2003; Jiang et al., 2012; Renkema et al., 2017; Sozen et al.,
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19 2015) stand out.
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23 Innovativeness refers to firms' capacity to innovate; that is, the capacity to create new
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25 products, services, markets or processes and/or to improve existing ones (Wang and Ahmed,
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27 2004). Innovation includes any new practice added to firms, including equipment, products,
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29 processes, policies and projects (Damanpour, 1991). Human capital also bestows value on a
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31 firm and includes a series of characteristics which make it valuable, scarce, difficult to imitate
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33 and impossible to substitute; all of which mean that it has a strategic role to play within the
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35 organisation according to the resource-based view (RBV) (Barney, 1991; Huselid, 1995;
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37 Jiang et al., 2012; Renkema et al., 2017).
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43 Due to the great importance of innovativeness and human capital, special attention has been
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45 given to the impact that HRM can have on firms' innovative performance (Ardito et al., 2015).
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47 In the studies that relate human capital and innovation, it is assumed that employees play a
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49 key role in innovation since workers' learning processes are essential in order to acquire the
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51 knowledge, skills and experience necessary for innovation to occur (Collins and Clark, 2003;
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53 Gebauer et al., 2012; Wright et al., 2001). One way to stimulate learning is through HRM
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4 because it plays a central role in orientating the behaviour of employees and can boost
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6 positive attitudes toward learning (Kang and Snell, 2009; Lopez-Cabrales et al., 2011).
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9 Research on the effect of HRM on innovation has usually focused on innovation according to
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11 its nature, differentiating among product, process, organisational or marketing innovation
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13 (Damanpour, 1991) and has generally analysed isolated HRM practices (Chen and Huang,
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15 2009; De Saá-Pérez and Díaz-Díaz, 2010; De Winne and Sels, 2010). There are few papers
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17 that have studied the relationship between HRM systems and innovation (Laursen and Foss,
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19 2003; Chiang et al., 2014) or have addressed the effect of HRM on incremental and radical,
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21 green, open or hidden innovation (Ben Arfi et al., 2018; Lennerts et al., 2020; Murphy et al.,
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23 2016). Therefore, the role of HRM in enhancing radical innovation is still a rather unexplored
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25 area of research, and this paper seeks to shed some light on the relationship between both
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27 variables. We deal with radical innovation because this kind of innovation demands greater
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29 efforts on the part of the company and has important learning implications for employees.
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31 Radical innovation has been less frequently analysed and linked to personnel issues, but it is
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33 essential for the success and competitiveness of firms in the current dynamic business
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35 environment. Therefore, one particular research gap that remains unclear is the direct impact
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37 of an HRM system on radical innovation addressed from a configurational perspective (it is
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39 assumed that a coherent HRM system has a greater effect on firm innovation than the sum of
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41 the isolated effects of each practice alone). A second gap in the literature concerns the direct
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43 effect of SHRM on radical innovation. This dual perspective of HRM; focusing on content
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45 (HRM practices consistent with each other), and process (fit between HRM and firm
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47 strategy), is essential in order to know whether human resource managers should concentrate
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49 on one or both perspectives and to explain why these managers should be involved in a
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4 company's strategic direction. The third gap that this study aims to analyse is the role that
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6 learning plays in the relationship between HRM and radical innovation, taking into account
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8 that learning processes can nurture the development of product innovation (Lennerts et al.,
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10 2020), and that HRM can favour learning.
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13 Combining ideas from the HRM and innovation literature, the present paper raises hypotheses
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15 and tests them on a sample of Spanish companies. Results reveal that SHRM and competence
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17 exploration have a positive and direct impact on radical innovation. The findings also confirm
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19 that an HRM system directed toward change and creativity and SHRM favourably affect the
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21 exploration learning process. It has also been found that competence exploration plays a
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23 mediating role between HRM systems and radical innovation and between SHRM and radical
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25 innovation. Therefore, this article contributes to the literature on HRM and innovation by
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27 detecting various gaps in the research and by empirically analysing a less frequently studied
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29 area; namely, the influence of HRM on radical innovation from a dual HRM perspective
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31 (content and process approaches) and the mediating effect of competence exploration on the
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33 relationship between HRM and radical innovation.
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40 In order to achieve all these objectives, the paper is organised into various sections. The first
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42 outlines the importance of radical innovation for firms. The second, taking as references the
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44 RBV and social exchange theory, justifies the importance of HRM as a strategic factor for
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46 company success, distinguishing between HRM content and process approaches. The content
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48 approach analyses the effect of an HRM system on radical innovation from a configurational
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50 perspective. The impact of SHRM on radical innovation is studied in the process approach.
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53 Next, the importance of learning in innovation and the role that HRM plays as a facilitator of
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55 organisational learning is explored. Then, we describe the methodology and give the results of
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4 the empirical study. Finally, we comment on the most relevant results and summarise key
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6 conclusions, implications and limitations of the work.
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10 **REVIEW OF THE LITERATURE**

11 **Radical innovation**

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14 Since the first works presented by Schumpeter (1934), innovation has been recognised as a
15
16 key element of competition and dynamic efficiency in markets. Innovation is a way of
17
18 facilitating a firm's response to external changes, pressure from competition, changes in
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20 customers' demands and the constant requirement for new and better products and services
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22 (Jansen et al., 2006; Prajogo, 2006). Through innovating, firms can enjoy greater brand
23
24 loyalty and less price-consciousness from buyers as a consequence of customers valuing the
25
26 uniqueness of the innovation (Lieberman & Montgomery, 1988). Nowadays, innovation is an
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28 imperative for organisations (Khosrovi et al., 2019).
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32 Traditionally, innovation has been understood as the adoption of a system, policy,
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34 programme, process, product or service that is new for the organisation (Damanpour, 1991).
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36 Nonetheless, within the concept of innovation there are different types with different
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38 implications and aims (Volberda et al., 2013). Schumpeter (1934) distinguished five kinds of
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40 innovation: new products, new production methods, new markets, new supply sources and
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42 new forms of business organisation. According to Damanpour (1991), the most widespread
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44 innovation types are those that use the nature of the innovation or its radicalism as their
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46 criterion. As for the nature of innovation, according to the classification made by the Oslo
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48 Manual (OECD, 2005), one can distinguish among product, process, organisational and
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50 marketing innovations. Among all these types, product innovation has been the most widely
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4 studied because of its direct effect on performance (Ardito and Petruzzelli, 2017; Mansury
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6 and Love, 2008; Prajogo, 2006).

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9 Looking at how radical, or how novel and risky an innovation is, we can talk about
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11 incremental or radical innovation. Incremental innovation is a series of lesser changes in
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13 existing products, processes or services, based on strengthening current capacities (Henderson
14
15 and Clark, 1990). Incremental innovation produces small changes in a firm's products and
16
17 services (Baum et al., 2000; Chen et al., 2019) through small technological improvements to
18
19 respond to customers' needs (McDermott and O'Connor, 2002). These innovations are easily
20
21 accepted by customers since the changes with respect to the previous product are minor.
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23 These products are also less costly to develop (Brown and Eisenhardt, 1995; Dewar and
24
25 Dutton, 1986) and entail fewer risks (Brown and Eisenhardt, 1995). In addition, they require
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27 less time to develop and reach the customer sooner, thus favouring their dissemination
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29 (McDermott and O'Connor, 2002; Shaikh and O'Connor, 2020). Incremental innovation is
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31 fundamental to the growth of market share (Dewar and Dutton 1986), and managers tend to
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33 invest more in incremental than in radical innovation because they think that proximate
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35 adaptations of a technology will preserve their existing monopolistic position (Shaikh and
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37 O'Connor, 2020).

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39 Radical innovation, on the other hand, is defined as fundamental changes in a firm's
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41 technology which give rise to new products, services or production processes for new
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43 customers or emerging markets (Chen et al., 2019; Flor et al., 2018; Xie et al., 2018). This
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45 often implies the appearance of new competitors, distribution channels and sales methods and
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47 offers the customer substantial new benefits (Garcia and Calantone, 2002; Lennerts et al.,
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49 2020).

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4 Radical innovation implies important changes and novelty in the products developed (Garcia
5 and Calantone, 2002). This is clearly riskier (Henderson and Clark, 1990) and demands
6
7 important investment in research, but the strategic rewards it offers are also greater when
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9 applied successfully (Danneels, 2002; Dewar and Dutton, 1986). Radical innovation enables
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11 firms to reach a more favourable position, or even a monopoly, creating new markets and
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13 acquiring new alternatives (Dewar and Dutton, 1986). Notwithstanding, it also requires
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15 substantial investment (Brown and Eisenhardt, 1995) and longer product development time.
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20 While incremental innovation is based on existing organisational knowledge, radical
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22 innovation requires very different technological knowledge and the creation of newer
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24 capabilities, routines, and processes (Shaikh and O'Connor, 2020). Therefore, radical
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26 innovation must explore new activities and produce new concepts in order to develop new
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28 knowledge (Flor et al., 2018; Schnellbacher et al., 2019).
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32 In our study, we analyse product innovation with the aim of delving into one of the most
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34 relevant types of innovation for the success of a company. However, we focus on radical
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36 innovation because it has been less frequently studied, and the literature states that radical
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38 innovation is the key to financial performance and firm competitiveness (Sorescu et al., 2003;
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40 Tellis et al., 2009).
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45 46 47 **HRM and innovation**

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49 Growing acceptance of internal resources as sources of competitive advantage derived from
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51 the RBV (Barney, 1991) reinforces the idea that human capital is a fundamental strategic
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53 factor for an organisation's success (Collins, 2020; Wright et al., 2001). Human capital, which
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55 is a rare, valuable, inimitable and non-substitutable resource, can provide a source of
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4 sustainable competitive advantage. This strategic focus can be applied in two ways. First,
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6 certain HRM practices produce a unique set of responses from employees (Jiang et al., 2012).
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8 Therefore, it is necessary to develop these practices to achieve a pool of human capital that
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10 has higher levels of skill (Collins, 2020). Second, certain firm strategies demand particular
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12 behaviour from workers (Huselid, 1995), and it is necessary to achieve a better fit between the
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14 skills existing in the firm and those required by its strategic intent. Thus, we propose that the
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16 RBV provides theoretical support to explain why HRM practices, with SHRM which
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18 integrates HRM into the company's strategy, might have a positive effect on radical
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20 innovation. The former proposal examines the HRM *content approach*, while the latter
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22 studies the *process approach* (Wei et al., 2008). According to Ngo et al. (2008), HRM
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24 practices refer to how employees are managed, and SHRM focuses on what an organisation
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26 does with its workers.
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33 According to the theory of social exchange (Blau, 1964), HRM implementation is a social
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35 process that depends on relationships of social exchange among HRM actors. The interactions
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37 among these actors generate reciprocal obligations among the parties involved. For this
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39 reason, if employees perceive HRM practices as investments in their own development, they
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41 may feel committed to adopting the attitudes and behaviour that the organisation expects from
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43 them (Chen et al., 2019; Farndale et al., 2011; Whitener, 2001). According to Chen et al.
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45 (2019), employees are willing to accept an increased number of HRM practices when they
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47 have a good relationship with their line managers, and line managers, in turn, will reciprocate
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49 the support from the HR department by showing greater enthusiasm in applying these
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51 practices. The theory of social exchange considers that workers feel obliged to repay the
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4 *content* of HRM practices through their commitment to the company, and, thus, they also
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6 reward the *process* of HRM implementation.
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11 *The content approach: HRM practices and innovation*
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13 The *content* approach aims at improving firm performance through HRM practices. Delery
14 and Doty (1996) distinguish three perspectives: universalistic, contingent and configurational.
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16 The universalistic perspective states that there are a series of human resource management
17 practices called “best practices”, which have a positive impact on organisations, whatever
18 their characteristics. The contingent perspective underlines that “best practices” in human
19 resources do not exist, and that these should be consistent with other aspects of an
20 organisation, especially with its strategy (Akhtar et al., 2008). Finally, the configurational
21 perspective upholds the importance of implementing a coherent system of practices, rather
22 than isolated practices, in order to influence results (Wright et al., 2001). Moreover, Lado and
23 Wilson (1994) noted that HRM systems, with all the complementary elements and
24 interdependencies among their practices, can be unique, causally ambiguous and synergistic
25 in how they enhance firm competencies, and thus could be impossible to imitate, in contrast
26 to individual practices.
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45 Based on these arguments, we propose exploring the impact of HRM practices on innovation
46 from a configurational perspective. The basic assumption in this relation is that innovation in
47 a firm is, first and foremost, a human issue (Ardito and Petruzzelli, 2017; Kianto et al., 2017).
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50 The development of the new knowledge necessary for the creation of new products or
51 processes depends on the existence of prior knowledge, so the skills and experience of
52 employees are of great importance for radical innovation (Jiménez-Jiménez and Sanz-Valle,
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4 2008; Kianto et al., 2017; López-Cabrales et al., 2009; De Wine and Sels, 2010). Taking into
5
6 account the human nature of innovation, HRM practices could increase an organisation's
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8 capability to innovate. In short, HRM practices play a key role in creating a suitable working
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10 environment which stimulates organisational innovation, and HRM practices will affect
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12 innovation more if applied jointly rather than separately (Ceylan, 2013; Jiménez-Jiménez and
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14 Sanz-Valle, 2005; Laursen and Foss, 2003; Mazzei et al., 2016).
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18 The empirical studies that have addressed this issue find, in general, that individual HRM
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20 practices have an influence on product innovation (Zhou et al., 2011; Zoghi et al., 2010),
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22 process innovation (De Saá-Pérez and Díaz-Díaz, 2010), or administrative and technical
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24 innovation (Chen and Huang, 2009). However, most research examines the effect of HRM
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26 practices on innovation classified according to its nature. Indeed, only a few studies analyse
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28 the effects of these practices on radical innovation (Beugelsdijk, 2008; Gil-Marques and
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30 Moreno-Luzon, 2013).
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35 In line with the configurational perspective, some researchers examine the connection
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37 between HRM systems and firm performance, and there is evidence that this relationship
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39 exists (Huselid, 1995; Lepak et al., 2006). Strong HRM systems should contribute to
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41 organisational outcomes by facilitating relationships among HRM practices, employees'
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43 attitudes and individual performance (Chen et al., 2019). However, there are only a few
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45 studies that analyse the relationship between HRM systems and innovation (Arvanitis, 2005;
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47 Ceylan, 2013; Chiang et al., 2014; De Saá-Pérez and Díaz-Díaz, 2010; Jiménez-Jiménez and
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49 Sanz-Valle, 2008; Laursen and Foss, 2003).
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54 Although HRM systems, rather than isolated practices, are what really affect individual and
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56 organisational performance, according to Lepak et al. (2006), there is a lack of agreement on
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4 what these systems are, which HRM practices they include, how they operate, or how they
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6 should be studied.

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9 Regarding which practices should comprise these systems, previous research has emphasised
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11 that HRM systems should involve empowerment, rigorous selection processes, extensive
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13 training and development, merit-based performance appraisal and competitive compensation
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15 (Collins and Smith, 2006). These practices are considered key to promoting employee
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17 creativity and to involving workers in a firm's innovative activity (Chiang et al., 2014).

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21 Empowerment is defined as the delegation of power and responsibility from higher levels in
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23 the organisational hierarchy to lower-level employees (Baird and Wang, 2010), and it is often
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25 identified as one of the main triggers of employee creativity (Mazzei et al., 2016). A high
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27 level of independence in the performance of their jobs encourages employees to contribute
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29 new ideas and share knowledge, which can increase innovation (Beugelsdijk, 2008; Jiménez-
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31 Jiménez and Sanz-Valle, 2005; Popa et al., 2017; Mohan et al., 2017). Giving employees
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33 more freedom and power of self-regulation may make them more willing to contribute ideas
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35 (Damanpour, 1991; Poskela and Martinsuo, 2009). Some studies provide empirical evidence
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37 of a significant and positive influence of employee empowerment on innovation (Breunig et
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39 al., 2014; Çakar and Ertürk, 2010; De Spiegelaere et al., 2014; Siyamtinah, 2016).

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43 In order to boost innovation in a firm, it is necessary to have creative, flexible workers who
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45 are able to assume risks. Thus, the selection process should be designed to seek out these
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47 characteristics among candidates (De Winne and Sels, 2010; Song et al., 2003). If the process
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49 used places value on candidates' creative and innovative characteristics, there is more
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51 likelihood of attracting workers with a greater range of ideas and more innovative behaviour
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53 (Brockbank, 1999; Mazzei et al., 2016). Successful firms use recruitment and selection
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4 networks that systematically seek out new talent to create a pool of creative workers (Jiang et
5
6 al., 2012). The selection of workers with the appropriate skills means the firm can integrate
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8 knowledge from various sources and thus stimulate the generation of ideas (Collins and
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10 Smith, 2006; Scarbrough, 2003).
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13 If a firm provides its workers with extensive training in acquiring and developing new
14
15 knowledge, skills and attitudes to perform tasks, it may well be increasing its capacity to
16
17 innovate (De Winne and Sels, 2010; Kuratko et al., 2014). This training should be designed to
18
19 expose employees to new ideas and different experiences so that they question the firm's
20
21 established modus operandi (De Saá-Pérez and Díaz-Díaz, 2010). According to Argote et al.
22
23 (2003), training should stimulate employees to apply what they have learned to their jobs and
24
25 give them a new vision of their tasks that will lead them on toward innovative behaviour. In
26
27 general, the most innovative companies implement training programmes to a greater extent
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29 and with more continuity than less innovative firms (Guisado-González et al., 2016).
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33 If a firm wants to increase innovation, it must give it the importance and organisational
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35 priority it deserves. According to Collins and Clark (2003), performance appraisal and
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37 compensation are the main HRM practices that firms can use to influence employee behaviour
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39 and involve workers in the firm's aims. This can be done by establishing performance
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41 assessment mechanisms that measure whether employees exhibit innovative behaviour and
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43 produce results (Brockbank, 1999). Employees feel motivated when there is a positive
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45 impulse toward change and creativity. Thus, performance appraisal can increase workers'
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47 commitment to innovation (Jiménez-Jiménez and Sanz-Valle, 2005). Creativity may be
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49 enhanced even more if feedback is included in performance assessments, serving as a
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51 stimulus for workers (Jiang et al., 2012).
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4 Finally, as commented on earlier, compensation also plays a key role in innovation. It is
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6 useful for rewarding creativity, risk taking and an innovative attitude since monetary
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8 incentives encourage these types of behaviours (Ardito et al., 2015; Argote et al., 2003).
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10 According to the literature, flexible rewards are the most suitable way to foster innovation.
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12 (Laursen and Foss, 2003). This recognition gives workers the necessary encouragement to
13
14 foster creativity and generate new ideas, which leads to new products, processes or systems
15
16 (Chen and Huang, 2009). Ederer and Manso (2013) show that incentive schemes that tolerate
17
18 early failure and reward long-term success drive improved innovation results, and Chang et al.
19
20 (2015) show the positive effect of non-executive employee stock options on firm innovation.
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22 In an HRM system, a rigorous selection process and extensive training contributes to a high
23
24 level of collective human capital for the workforce. In addition, providing competitive
25
26 compensation and extensive benefits for workers makes it possible to recruit highly skilled
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28 employees. Finally, an HRM system that emphasises empowerment helps people to be
29
30 creative and learn new skills (Huselid, 1995; Takeuchi et al., 2007).
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38 On the basis of the arguments above, we propose our first hypothesis:
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40 *H₁: An HRM system directed toward change and creativity has a positive and direct*
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42 *effect on radical innovation.*
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48 *The process approach: SHRM and innovation*

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50 The process approach aims at improving firm performance through SHRM. Huselid (1995)
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52 holds that SHRM is the emphasis that each firm places on aligning its HRM with its
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54 competitive strategy. SHRM assumes that a firm relates HRM to its organisational strategy by
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56 mobilising the skills and actions of its employees toward its objectives. With this process
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4 approach, human resource managers participate in the designing of corporate strategy. As a
5
6 consequence, organisational strategy and HRM are closely linked (Lengnick-Hall et al.,
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8 2012). The degree of fit between HRM and strategy determines whether human capital is
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10 adding value to the firm. Successful firms have usually ceased to see their human resource
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12 department as a department with its own budget, staff and tasks, but rather as an organisation
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14 with resources, customers and services to deliver (Chauhan and Chauhan, 2002).
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18 The integration of SHRM into a firm's strategy means that human resource managers
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20 collaborate in the implementation of a strategic plan to gain a competitive edge. The role of
21
22 human capital is thus maximised, which in turn helps to maximise the firm's profitability
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24 (Collins and Clark, 2003). When HRM is consistent with a firm's strategic objectives, this
25
26 increases organisational efficiency and results (Huselid, 1995).
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30 According to Bae and Lawler (2000), if HRM is integrated into a company's strategy, it
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32 contributes to the development of a group of workers who add value to the firm, and who
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34 therefore improve results. Macaleer and Shannon (2003), for their part, state that the head of
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36 human resources should proactively assume the role of strategic partner in order to guarantee
37
38 an effective fit between a firm's overall aims and human resource initiatives. Steven et al.
39
40 (1999) state that the human resource department should be considered an essential part of
41
42 management so that it can influence organisational performance. In this way it will be able to
43
44 help the firm to gain a competitive edge through the application of HRM. This means
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46 designing a set of activities, such as hiring strategies, development programs or remuneration
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48 systems, that fit with the needs of the firm and help it to achieve its long-term objectives
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55 (Loshali and Krishnan, 2013).
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4 Although there are studies that analyse how the way HRM is aligned to a firm's strategy
5 affects results (Huselid, 1995), there is hardly any **research** that focuses on how this
6 influences innovation. According to Bowen and Ostroff (2004), this perspective has been
7 overlooked by researchers. Among the **studies** which consider this aspect, Beugelsdijk (2008)
8 **analyses** the effect of SHRM on generating product innovations, and Estrada et al. (2013)
9 state that the alignment of HRM with firm strategy facilitates the creation of a favourable
10 innovative climate.

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21 Taking into account the arguments presented, we propose our second hypothesis:

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23 *H₂: SHRM has a positive and direct effect on radical innovation.*
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28 **Competence exploration as a mediator between HRM and radical innovation**

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30 One of the topics that has raised **much** interest in recent decades has been the study of
31 tensions between exploitation and exploration in companies (Lennerts et al., 2020;
32 **Schnellbacher et al., 2019; van Assen, 2020**). While exploitation pursues more efficient
33 management of a company's existing resources and capacities, exploration strives to foster the
34 creation of new business opportunities. Exploitation refers to the use of existing knowledge
35 and technology and the modification of previous products. It is associated with a short-term
36 perspective, more routine procedures and more probable but smaller benefits. Exploration is
37 related to the search for new knowledge, the use of unfamiliar technologies and the creation
38 of new products. It implies a long-term perspective and is related to external knowledge with
39 uncertain but greater benefits (Santiago and Alcorta, 2012; Lennerts et al., 2020; March,
40 1991; van Assen, 2020). Although researchers have studied the topic of exploration and
41 exploitation from different points of view, for example as two different strategic activities
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4 (Lubatkin et al., 2006), in this study exploration and exploitation have been understood as two
5
6 different learning processes (March, 1991) that facilitate the generation of competences.
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9 Both processes are essential for organisations and can favour the development of innovation.

10
11 According to Khosravi et al. (2019), organisational learning is a driver of innovation and
12
13 plays an essential role in enabling firms to achieve flexibility within the innovation process.
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15
16 In general, studies find that exploitation is beneficial for incremental innovation and
17
18 exploration for radical innovation. In addition, most research points out that exploration is
19
20 also favourable for incremental innovation, but exploitation is detrimental to radical
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22 innovation (Lennerts et al., 2020; Molina-Castillo et al., 2011; Yalcinkaya et al., 2007). Some
23
24 studies even suggest that the simultaneous use of exploration and exploitation (organisational
25
26 ambidexterity) reinforces the effects of learning (Schnellbacher et al., 2019). However, the
27
28 tensions arising from the concurrent pursuit of exploitative and exploratory activities are
29
30 paradoxical, and their joint use generates competition for scarce resources and increases risk
31
32 in investment decisions (March, 1991; Santiago and Alcorta, 2012; van Assen, 2020).
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38 The ability of a firm to generate radical innovation depends on its access to new knowledge
39
40 since the development of new products or services requires new insight that is distant from a
41
42 firm's existing knowledge (Subramaniam and Youndt, 2005). To fill the gap between an
43
44 organisation's internal knowledge and the knowledge needed to innovate, the acquisition of
45
46 external knowledge and the search for new technologies are fundamental (Flor et al., 2018;
47
48 Xie et al., 2018). Therefore, exploration, which provides unknown knowledge and cutting-
49
50 edge technology, becomes crucial to develop breakthrough products (March, 1991; Molina-
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52 Castillo et al., 2011; van Assen, 2020).
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4 Taking into account the importance of learning in innovation, it is necessary to study what
5
6 variables can facilitate learning. The literature indicates that one of the possible facilitators is
7
8 HRM. This is because organisational learning is based on employees' individual learning, and
9
10 HRM influences the capacity of a firm to generate new knowledge and stimulate this learning.
11
12 HRM also enhances the likelihood of new ideas being generated and of new products and
13
14 processes being developed (Kang and Snell, 2009; Lopez-Cabrales et al., 2011). Certain HRM
15
16 practices could enhance learning. For example, training and development for job-related
17
18 skills, behavioural performance appraisal and job-based pay should encourage exploitative
19
20 learning, while training and development for future skills, developmental performance
21
22 appraisal and skill-based pay should encourage exploratory learning (Diaz-Fernandez et al.,
23
24 2017; Kang and Snell, 2009; Lepak and Snell, 2002). Furthermore, SHRM, by aligning the
25
26 interests of an organisation with those of its workers, can develop a talented and committed
27
28 workforce, creating an organisation capable of learning (Wright et al, 2001).

29
30 Therefore, in our study we also propose an indirect effect of HRM on radical innovation.
31
32 Other research, such as that of Chen and Huang (2009) and López-Cabrales et al. (2009),
33
34 finds such indirect relationships and suggests that knowledge mediates the relation between
35
36 some HRM practices and product innovation.
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40 Based on the arguments presented above, our third hypothesis is

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42 *H₃: HRM has a positive and indirect effect on radical innovation.*

43
44 *H_{3a}: Competence exploration mediates the relationship between an HRM system and
45
46 radical innovation.*

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48 *H_{3b}: Competence exploration mediates the relationship between SHRM and radical
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50 innovation.*

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4 INSERT FIGURE 1 ABOUT HERE
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6 **METHODOLOGY**

7 **Population and Sample**

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10 The study population comprised 3,685 Spanish industrial firms with between 50 and 500
11 employees, according to the SABI (Sistema de Análisis de Balances Ibéricos) database. The
12 study covers a variety of sectors, which facilitates the extrapolation of its findings. The
13 Spanish economy has grown in recent years at a faster rate than the euro area as a whole. In
14 2019 the Spanish Ministry of Economy and Business expects a 2.1% growth in the Spanish
15 economy (Ministerio de Economía y Empresa, 2019). However, Spain occupies the 29th
16 position in the Global innovation index (GII, 2019). Therefore, there is great interest in the
17 development of policies aimed at continuing the growth and development of R&D and
18 innovation programs.
19
20

21 Data were collected via a structured questionnaire on a specially designed website. An expert
22 firm managed the survey process. It initially contacted an executive from each firm to explain
23 the survey and how to access it. However, several informants were used from each firm to
24 avoid the common bias caused by information coming from a single source. This should
25 improve the validity of the results. Thus, two managers from the same firm were selected: the
26 marketing manager (for responses on innovation and results), and the human resource
27 manager (for aspects related to the function of personnel). We randomly contacted 871
28 companies to obtain 200 valid questionnaires (which were answered by 2 managers from each
29 of the 200 organisations). The confidence level of the sample is 95% with a sampling error of
30 $\pm 6.74\%$.
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4 The activities of the information collection process were monitored at all times, especially as
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6 regards the protocol for contacting companies and obtaining data. Once the database was
7
8 obtained, the quality of the data was checked by randomly contacting respondents again, with
9
10 some companies surveyed to verify the quality of the data. No problems were found. The
11
12 characteristics of the sample can be seen in Table 1.
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16 INSERT TABLE 1 ABOUT HERE
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19 A routine check for industry bias indicated no significant differences in the mean responses in
20
21 any construct across firms from different industries. In addition, the Chi-square distribution
22
23 analysis revealed no significant differences between the sample and the population in terms of
24
25 industry distribution, the number of employees and sales volume.
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27

28 29 30 **Measures**

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32 Variables were measured with scales tested in the literature. 5-point Likert scales were used.
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35 HRM was measured in two ways: through an *HRM system* and by studying *SHRM*. The
36
37 specific scales used were:
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41 *HRM system*: We evaluated whether the HRM practices of each firm corresponded to an
42
43 HRM system directed toward change and creativity. The interviewees were asked to indicate
44
45 the extent to which their firm had adopted the 15 HRM practices that the literature has
46
47 identified as likely to have a significant impact on innovation. The practices cover the most
48
49 important areas (3 indicators per area) of HRM items from the studies by Lepak and Snell
50
51 (2002) and Chen and Huang (2009): Empowerment, Selection, Training, Performance
52
53 Appraisal and Compensation. The items used appear in the Appendix. One item of training
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55 was eliminated in the scale refinement process. Following this, a second order reflective
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4 construct was created to measure HRM systems starting from each of the practices mentioned
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6 above.

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9 *SHRM*: This was studied by incorporating a scale of a reflective nature with four final items
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11 that had been tested in previous studies (Ngo et al., 2008; Wei et al., 2008). In this case, the
12
13 aim was to ascertain whether the staff practices used were in line with the future strategic
14
15 aims of the firm.

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18 *Competence exploration*: This refers to the tendency of a firm to invest resources to acquire
19
20 entirely new knowledge, skills and processes. It was operationalised using six items taken
21
22 from the scales employed by Atuahene-Gima (2005). This construct measures whether the
23
24 organisation has learned or acquired new organisational skills that are important for managing
25
26 new technologies or processes which were not previously available.

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30 *Radical innovation*: This was measured using seven indicators based on the rate of adoption
31
32 compared to what was done by the competition. The items selected from Jansen et al. (2006)
33
34 for measuring radical innovation are associated with the development and creation of new
35
36 products, markets and distribution channels and the search for new customers.

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40 According to Henseler et al. (2016b), there are three types of measurement models that can be
41
42 used in structural equations: common factor models, causal indicator models and composite
43
44 models. The nature of the measurements for the variables in this study are modelled as
45
46 composites since they are design constructs or artefacts that are the result of theoretical
47
48 thinking (Henseler, 2017), such as innovation, competence exploration or HRM practices
49
50 (Henseler et al., 2016b). Specifically, Mode A composites have been used for their
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52 operationalisation.
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Analysis

The methodology used was structural equations with PLS (Partial Least Squares), a variance-based structural equation modelling technique (Henseler et al., 2016a). PLS-SEM allows us to build a research model that represents a certain theory by simply converting the theoretical concepts into unobservable (latent) variables and the empirical concepts into indicators, which are linked by a series of hypotheses (Cepeda-Carrión et al., 2016).

According to Rigdon (2016), PLS-SEM is acceptable when (a) the research model has reflective variables that are used to define a state where perceived variables are equally dependent upon another variable which is not itself observed, (b) the study utilises an exploratory analysis, and (c) the data are non-normal. Finally, SmartPLS 3 software (Ringle et al., 2015) was used to assess the measurement model and to estimate the structural model using bivariate correlations between each indicator and the construct (Sarstedt, et al., 2016).

Using PLS-SEM involves following a two-stage approach. The first step requires the assessment of the measurement model. This allows the relationships between the observable variables and theoretical concepts to be specified. This analysis is performed in relation to the attributes of individual item reliability, construct reliability, average variance extracted (AVE) and the discriminant validity of the indicators of latent variables. For the second step, the structural model is evaluated. The objective of this is to confirm the extent to which the causal relationships specified in the proposed model are consistent with the available data.

Measurement model

The various criteria for guaranteeing the quality of the study have been checked. The reliability of the measuring scales was verified through the Cronbach alpha coefficient, and a

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4 value greater than 0.7 was returned in all cases, which is considered acceptable in the
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6 literature. The composite reliability index ranged from 0.819 to 0.950, above the
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8 recommended 0.7 threshold (Nunnally, 1978). The average variance extracted (AVE)
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10 revealed that all the reflective constructs exceeded the 0.50 limit (Fornell and Larcker, 1981).
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12 Elsewhere, the R^2 value for the endogenous constructs surpassed the minimum recommended
13
14 value of 0.1, showing that the model is suitable for testing the hypotheses (Table 2). We then
15
16 evaluated the discriminant validity of the measures. As suggested by Fornell and Larcker
17
18 (1981), the average variance extracted for each construct is greater than the corresponding
19
20 correlations (see Table 2). Discriminant validity was also assessed following the heterotrait-
21
22 monotrait (HTMT) criterion (Henseler et al., 2015). All diagonal values are lower than 0.85,
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24 indicating discriminant validity. Consequently, all the variables exhibited suitable
25
26 discriminant validity. In short, the model has good convergent validity, reliability and
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28 discriminant validity.

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INSERT TABLE 2 ABOUT HERE

Structural model

In order to test our hypotheses, we used SmartPLS with bootstrapping resampling (Chin, 1998). According to Podsakoff and Organ (1986), PLS-SEM avoids many of the supposed underlying constraints of maximum likelihood methods. In addition, PLS-SEM models both reflective and formative constructs, as is the case in this study. Finally, as Reinartz et al. (2009) point out, PLS-SEM is recommended for studies where there are fewer than 250 observations.

The analysis of the estimated model confirms the model (SRMR =0.068; d_{ULS} =0.973; d_G =0.360). Moreover, the value of the variance inflation factor (VIF) generated for the

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4 exogenous latent variables in the model is <1.5, which means that there was no collinearity
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6 problem between the predictor variables.
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10 **RESULTS**

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12 As Table 3 and Figure 2 show, the results confirm most of the **studied** relationships. PLS-
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14 SEM calculates the amount of explained variance of the construct of the predictive variables,
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16 as well as the structural relations of the coefficients and their statistical significance.
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18 Bootstrapping resampling with 5,000 subsamples is used to analyse the significance of the
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20 effects of interaction (Chin, 1998). A one-tailed test is used assuming that the coefficient has a
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22 positive sign according to the corresponding hypothesis that predicts the association (Kock,
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24 2015).
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31 INSERT TABLE 3 ABOUT HERE

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33 INSERT FIGURE 2 ABOUT HERE

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35 The results support many of the relations hypothesised. The first hypothesis deals with the
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37 effect of HRM systems on radical innovation. In this case, we do not find positive evidence
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39 that supports H₁ ($\beta = 0.078$, $t = 0.894$, $p > 0.05$). The lack of evidence in this relationship
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41 contradicts what is argued by the literature on innovation. It is true that most of this literature
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43 does not contemplate the degree of the innovation. Therefore, these HR practices may only be
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45 valid for the development of incremental innovation. On the other hand, perhaps the effect of
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47 HR practices does not have such a direct effect on radical innovation and requires the
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49 development of certain innovative behaviour that ultimately results in the generation of
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51 innovations.
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4 Secondly, we analysed whether SHRM might help to improve radical innovation. As in the
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6 above hypothesis, SHRM has a positive effect on radical innovation ($\beta = 0.170$, $t = 2.004$, $p <$
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8 0.05). This reinforces the idea that fixing a global strategy for firms that approaches issues
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10 from an employee standpoint, as well as the contrasting concept which considers a firm's
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12 strategic aims in order to determine the HRM policies to follow, are vital elements in gaining
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14 a competitive edge and improving overall results, fostering the development of radical
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16 innovation at the same time.
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21 In order to test H_3 , we analyse the mediating role of competence exploration in the
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23 relationship between both HRM systems and SHRM, and radical innovation. First, as Table 3
24
25 shows, HRM systems ($\beta = 0.173$, $t = 2.002$, $p < 0.05$) and SHRM ($\beta = 0.261$, $t = 3.303$, $p <$
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27 0.001) positively explain the competence exploration construct. According to our review,
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29 HRM could contribute to the generation of new knowledge and essential competences, which
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31 suggests the importance of this function in creating new organisational competency. Second,
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33 competence exploration has a positive effect on radical innovation ($\beta = 0.466$, $t = 6.027$, $p <$
34
35 0.001). This result is also broadly sustained by previous literature since radical innovation
36
37 demands new abilities to generate new knowledge and innovations. Finally, we identify that
38
39 competence exploration mediates the effect of both HRM systems (H_{3a} : $\beta = 0.080$, $t = 1.957$,
40
41 $p < 0.05$) and SHRM (H_{3b} : $\beta = 0.123$, $t = 2.717$, $p = 0.001$) on radical innovation. However,
42
43 according to the results of previous hypotheses, competence exploration would have a total
44
45 mediating effect in the case of HRM systems but only a partial mediating effect on SHRM.
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47 This could imply that the influence of HRM systems on innovation is only due to the creation
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49 of new competences. SHRM encourages learning, but it could also directly influence radical
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51 innovation, perhaps thanks to the fact that it contributes to the definition of a better
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4 organisational strategy and an innovation process that contemplates the limitations and
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6 strengths of company personnel.
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10 **DISCUSSION AND CONCLUSIONS**

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13 A firm's success depends on its ability to respond quickly and flexibly to changes in its
14
15 environment. Innovativeness and human capital are therefore held to be critical for generating
16
17 a sustainable competitive advantage. Literature suggests that innovativeness and human
18
19 capital are interconnected as determining factors in favouring innovation at work
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21 (Beugelsdijk, 2008; Liu, 2017; López-Cabrales et al., 2009). This is especially important for
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23 those companies that make more intense efforts to innovate with the objective of developing
24
25 more radical innovation that can improve the competitive position of the company.
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31 Despite the important role that literature attributes to HRM in the development of business
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33 innovation, some researchers state that it is necessary to understand the effect of strategic
34
35 personnel management in greater depth (Takeuchi et al., 2007). It is assumed that a group of
36
37 HRM practices, such as empowerment, strict selection processes, comprehensive training and
38
39 performance evaluations, all of which emphasise the development of human capital, and
40
41 compensation practices based on individual and team work performance, would have parallel
42
43 and simultaneous influences on workers and would play a fundamental role in driving new
44
45 product development in companies (Collins and Smith, 2006). From a configurational
46
47 perspective, it is often argued that a coherent system of HRM practices should have a greater
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49 effect on the performance of a company than the sum of the individual effects of each HRM
50
51 practice alone (Delery and Doty, 1996; Ichinowski et al., 1997). These results could be
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53 extrapolated to other areas such as the field of innovation. However, the empirical works that
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4 analyse the relationship between HRM and innovation are few, especially from a
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6 configurational perspective (Laursen and Foss, 2003), and even fewer in the case of radical
7
8 innovation (Ceylan, 2013).
9

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11 On the other hand, other authors understand the influence of trying to fit HRM to a
12
13 company's strategy. This would involve analysing personnel practices with the strategic
14
15 objectives that the firm intends to pursue. However, the incidence of this alignment between
16
17 both areas on obtaining radical innovation has not been previously studied.
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21 In consequence, from a theoretical perspective, our results suggest three important
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23 implications. First, this study contributes to the radical innovation literature with a specific
24
25 focus on how HRM improves radical innovation. This is relevant because previous literature
26
27 on this topic has usually focused on innovation according to its nature (Chen and Huang,
28
29 2009; Chiang et al., 2014; Ardito and Petruzzelli, 2017). Therefore, additional research is
30
31 required to understand the organisational antecedents of radical innovation. Second, this paper
32
33 is one of the first attempts to provide empirical evidence of the relationship between HRM
34
35 and radical innovation with a dual approach: a content approach and a process approach. In
36
37 the content approach, the contribution of this article is the consideration of the effect of an
38
39 HRM system, whereas prior research has mainly studied isolated HRM practices (De Saá-
40
41 Pérez and Diaz-Diaz, 2010; De Winne and Sels, 2010; Khosravi et al., 2019). The third
42
43 contribution is based on organisational learning and responds to the demands of the literature
44
45 that indicate the need to generate new knowledge in order to innovate (Khosravi et al., 2019).
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47 For this, HRM practices and SRHM to promote learning are necessary. Some authors have
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49 analysed the relationship between knowledge, HRM and product innovation (Chen and
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4 Huang, 2009; Lopez Cabrales et al., 2009), but our study goes deeper and investigates the idea
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6 of the mediating role of competence exploration in HRM and radical innovation.
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9 The findings of this research show that an HRM system directed toward change and creativity
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11 does not have a direct effect on radical innovation. This result is similar to the study carried
12
13 out by Beugelsdijk (2008). This author states that radical innovation is more difficult to
14
15 achieve because a firm's ability to organise and manage radical innovation is much more
16
17 limited. According to Gil-Marques and Moreno-Luzon (2013), the literature about HRM
18
19 practices and innovation reflects certain agreement on the idea that HRM practices have a
20
21 positive impact on incremental innovation, but their effect on radical innovation is not clear.
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23

24
25 The HRM system that we propose intends to strengthen the autonomy of workers, select
26
27 employees based on their skills and ability to learn, promote training and boost teamwork and
28
29 cooperation. Perhaps, however, these practices are not sufficient in order to directly generate
30
31 revolutionary changes in a company's new products, but rather in an indirect way through
32
33 other organisational variables. Therefore, this study, based on the relationship that literature
34
35 has established between learning and innovation (Lennerts et al., 2020; March, 1991 Molina-
36
37 Castillo et al., 2011; Yalcinkaya et al., 2007), supports the idea that competence exploration
38
39 acts as a mediator in the relationship between HRM and innovation. Radical innovation needs
40
41 new knowledge to facilitate the development of completely new products. In order for this
42
43 development to take place, companies must explore, learn new skills and acquire completely
44
45 new technologies. In addition, radical innovation requires individualistic workers who are
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47 able to face high levels of conflict and competition. Radical innovation could also require
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49 some HRM practices that encourage individual behaviour, such as risk-taking, tolerance to
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4 failure, creativity, flexibility in the face of change or high tolerance to ambiguity. These
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6 behaviours are more aligned with exploratory innovation than with exploitative innovation.

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9 This study also finds that SHRM, i.e., a system in which HRM helps to design a firm's
10
11 strategy, has a positive and direct effect on radical innovation. This result is similar to that
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13 reported in previous research, which generally found that the fit between HRM and
14
15 organisational strategy had a favourable effect on results (Huselid, 1995; MacDuffie, 1995).
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18 In addition, our conclusions show the importance of HRM participation in the establishment
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20 of company strategy, not only its adaptation to that which exists.
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24 Finally, the findings regarding the indirect effect of HRM on radical innovation indicate that,
25
26 firstly, HRM systems and SHRM positively affect competence exploration and, secondly, this
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28 exploration has a favourable impact on radical innovation. These results coincide with those
29
30 of previous studies that demonstrate that HRM stimulates learning (Diaz-Fernandez et al.,
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32 2017; Kang and Snell, 2009; Lopez-Cabrales et al., 2011) and with those works that indicate
33
34 that competence exploration is beneficial for radical innovation (Flor et al., 2018; Lennerts et
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36 al., 2020; Molina-Castillo et al., 2011; Xie et al., 2018). Therefore, competence exploration
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38 mediates the relationship among both HRM systems and SHRM, and radical innovation.
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43 In conclusion, our results show that an HRM system (content approach) does not have a direct
44
45 effect on radical innovation, but SHRM (process approach) has a favourable and direct impact
46
47 on radical innovation. Also, we find that competence exploration mediates the effect of both
48
49 HRM systems and SHRM on radical innovation. Specifically, this exploration performs a
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51 total mediating effect between HRM systems and radical innovation and only has a partial
52
53 mediating effect in the case of SHRM.
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4 The implications of these results for managers are clear. Managers must be aware that HRM
5
6 is of great importance in the development of radical innovation and must pay attention to both
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8 the content and the process of HRM. Although an HRM system directed toward change and
9
10 creativity does not have a direct effect on radical innovation, it has a indirect influence
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12 through competence exploration. Therefore, managers should allow employees more freedom
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14 and independence when performing their tasks. They should select new members of the
15
16 organisation according to their technical skills and problem-solving capabilities. Sufficient
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18 attention should be paid to staff training, with the aim of making workers more flexible by
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20 providing them with a wide variety of competences. Managers should evaluate staff
21
22 performance regularly and use this to improve and develop employees. Likewise, when
23
24 determining remuneration, the value of an employee's contribution should be considered
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26 above the post occupied. Increases in salary should be in accordance with the personal
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28 development and training of the employee. All of these HRM practices will positively
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30 influence competence exploration and indirectly contribute to developing radical innovation.
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38 Top management must also recognise the importance of SHRM and take it into account when
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40 establishing the firm's strategy. They should effectively communicate business goals and
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42 strategies to employees. For their part, human resource managers should involve themselves
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44 in the general workings of the organisation and aim to support the overall objectives of the
45
46 firm through their decisions. Among other activities, they should change their compensation
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48 systems to encourage managers to achieve long-term strategic objectives, design staffing
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50 plans to help implement business strategies, assess key personnel based on their potential to
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52 implement strategic goals and conduct staff development programmes designed to support
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54 strategic changes.
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4 However, managers must be warned that changes in HRM to achieve innovation might
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6 compromise the existing efficiency of the organisation. When companies want to increase
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8 innovation, they need creative employees and HRM that increases autonomy, flexibility,
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10 tolerance of uncertainty and employee ambiguity (Chen and Huang, 2009). These desirable
11
12 characteristics for the future often lead to new costs in the present and changes in employee
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14 behaviour that may affect the current operation of the company. Therefore, managers should
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16 evaluate these changes not only in terms of benefits but also in terms of costs. This will allow
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18 them to find the best models and invest in those policies that contribute positively to radical
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20 innovation, while also increasing the firm's global performance.
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26 This research expands on the literature about the HRM - radical innovation relationship by
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28 considering how a dual (content and process) perspective of HRM influences radical
29
30 innovation. However, this study has some limitations that need to be considered. First of all,
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32 in this study we have focused only on medium-sized businesses from the industrial sector.
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34 Further research could examine whether similar relationships occur in large companies with
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36 different locations and subsidiaries, as well as examining companies of a smaller size in
37
38 which the personnel function is less developed, and the proactive role of this function is more
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40 difficult to achieve. In addition, this study should be extended to the service sector, which
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42 generates a large part of a region's wealth, analysing the peculiarities that differentiate it from
43
44 the industrial sector. Furthermore, the effect of company size could determine how radical
45
46 innovations are likely to be. Therefore, our findings should not be extended to small or large
47
48 businesses or to other contexts with a different sector structure, without a considerable degree
49
50 of caution. Another limitation is the cross-sectional design of this research. Finally, subjective
51
52 measures of performance have been used. Therefore, the inclusion of external quantitative
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4 data could strengthen its conclusions. However, although different informants have been used
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7 in each company to measure different concepts, we do not have two answers for the same
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9 construct from different sources in this study.

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11 To conclude, it is interesting to look at future lines of research that are capable of overcoming
12
13 the main limitations of this study. Considering that both innovativeness and HRM tend to
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15 improve results, but not immediately since time is required for the consequences to be
16
17 appreciated, we propose that longitudinal research could take this time lapse into account.

18
19 Another interesting point would be to analyse the synergistic effect of HRM systems and
20
21 compare it with the individual effect of isolated practices in order to understand their
22
23 complementary aspects and internal consistency. Another interesting future line would be to
24
25 incorporate the concept of democracy in the workplace. This considers how a variety of
26
27 interpersonal and structural arrangements link organisational decision making with the
28
29 interests and influence of employees at various levels. This can affect the type of HRM that
30
31 the company implements. Another aspect that could be considered in more detail is the
32
33 moderating effect of size on the relationships proposed. It would be interesting to identify
34
35 which practices small firms could apply in order to be more efficient in this function,
36
37 considering their reduced resources, or how the institutional structure of large companies
38
39 could influence this strategic vision. Another necessary aspect is to determine the influence of
40
41 organisational structures on HRM practices and the strategic approach of this function,
42
43 especially in cases where there is no defined human resource structure. Finally, it might be
44
45 appropriate to include social capital as a determinant to understanding both employment
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47 practices and innovation results (Sozen et al., 2015) since it represents the connections that
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4 exist between people and their shared values and behavioural norms. These enable and
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6 encourage social cooperation and the generation of new knowledge for innovative processes.
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4 **Appendix:**
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6 Human Resource Management System:

7 Empowerment:

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 - Employees have jobs whose contents vary frequently.
 - Employees can decide how to carry out their work.
 - Employees have enough control about what occurs in their departments.

10 Selection:

- 11
 - Different selection methods are used to select the best candidate.
 - Selection is based on technical abilities and capacity to solve problems.
 - Selection is oriented to identifying employees with learning abilities.

12 Training:

- 13
 - Training is oriented to procuring a variety of competences and polyvalence.
 - Training has a team and problem-solving orientation.

14 Performance appraisals:

- 15
 - Performance appraisals are used for the improvement and development of employees.
 - The organisation carries out formal performance appraisals frequently.
 - Performance appraisals are based on group or organisational performance.

16 Compensation:

- 17
 - To establish compensation, the contribution of the employee is more highly valued than the position that he/she occupies.
 - Salary increases are based on the personal development and training of employees.
 - Salary incentives are fixed according to teamwork performance.

18 Strategic Human Resource Management:

- 19
 - Staffing plans are designed to help implement business or corporate strategies.
 - Key personnel are evaluated based on their potential to implement strategic goals.
 - Job analysis is conducted based on what the job may entail in the future.
 - Staff development programmes are designed to support strategic changes.

20 Competence exploration

- 21
 - Manufacturing technologies and skills entirely new to the firm have been acquired.
 - Product development skills and processes entirely new to the industry have been learned.
 - Entirely new managerial and organisational skills that are important for innovation have been acquired.
 - New skills in areas such as funding new technology, staffing R&D functions, training and development of R&D and engineering personnel for the first time have been learned.
 - Innovation skills in areas where there had been no prior experience have been strengthened.

22 Radical innovation:

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- Our unit accepts demands that go beyond existing products
- We invent new products.
- We experiment with new products in our local market.
- We commercialise products that are completely new to our unit.
- We frequently utilise new opportunities in new markets.
- Our unit regularly uses new distribution channels.

Table 1. Sample Characteristics

| Manufacturing Sectors | |
|---|--------|
| Textiles | 4.98% |
| Leather and related products | 17.41% |
| Paper and paper products | 1.00% |
| Printing and reproduction of recorded media | 3.48% |
| Chemicals and chemical products | 3.98% |
| Basic pharmaceutical products and pharmaceutical preparations | 1.49% |
| Rubber and plastic products | 9.45% |
| Metal mechanics | 19.40% |
| Electrical equipment | 4.48% |
| Furniture | 27.86% |
| Other manufacturing | 6.47% |
| Sales Volume (mill. €) | |
| <10 | 31.0% |
| 10 - 50 | 43.5% |
| 50 - 100 | 14.0% |
| >100 | 11.5% |
| Number of employees | |
| 55 - 99 | 45.0% |
| 100 - 250 | 30.5% |
| 250 - 500 | 24.5% |
| Total: 200 | |

Table 2. Properties and correlations of the constructs

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 1. Empowerment | 0.894 | 0.376 | 0.342 | 0.503 | 0.238 | 0.224 | 0.283 | 0.569 |
| 2. Selection | 0.310 | 0.814 | 0.639 | 0.657 | 0.353 | 0.240 | 0.209 | 0.524 |
| 3. Training | 0.307 | 0.526 | 0.951 | 0.850 | 0.397 | 0.252 | 0.227 | 0.399 |
| 4. Performance Appraisal | 0.432 | 0.516 | 0.724 | 0.867 | 0.607 | 0.316 | 0.345 | 0.574 |
| 5. Compensation | 0.206 | 0.313 | 0.417 | 0.576 | 0.779 | 0.168 | 0.083 | 0.271 |
| 6. SHRM | 0.210 | 0.208 | 0.234 | 0.291 | 0.210 | 0.874 | 0.588 | 0.377 |
| 7. Competence exploration | 0.263 | 0.175 | 0.208 | 0.306 | 0.049 | 0.545 | 0.821 | 0.413 |
| 8. Radical innovation | 0.498 | 0.413 | 0.349 | 0.483 | 0.264 | 0.352 | 0.371 | 0.840 |
| Notes: Diagonal elements (bold figures) are the square root of the variance shared between the constructs and their measures. Below diagonal elements are the correlations between constructs. Above diagonal elements are the Heterotrait-Monotrait Ratio (HTMT) values. | | | | | | | | |
| <i>Mean</i> | 3.038 | 3.660 | 3.796 | 3.711 | 2.791 | 3.735 | 4.198 | 3.679 |
| <i>Standard deviation</i> | 0.881 | 0.590 | 0.723 | 0.669 | 1.095 | 0.509 | 0.718 | 0.751 |
| <i>Average variance extracted</i> | 0.799 | 0.663 | 0.904 | 0.753 | 0.608 | 0.763 | 0.674 | 0.705 |
| <i>Composite reliability</i> | 0.923 | 0.855 | 0.950 | 0.901 | 0.819 | 0.941 | 0.925 | 0.905 |
| <i>Cronbach alpha</i> | 0.876 | 0.749 | 0.895 | 0.837 | 0.804 | 0.922 | 0.903 | 0.861 |
| <i>R²</i> | - | - | - | - | - | - | 0.133 | 0.328 |

Table 3. Results of the structural model

| Paths | Standardised coefficient | Standard Deviation | Confidence interval | |
|--|--------------------------|--------------------|---------------------|-------|
| | | | LL | UL |
| H ₁ : HRM system → Radical innovation | 0.078 | 0.078 | -0.049 | 0.209 |
| H ₂ : SHRM → Radical innovation | 0.170* | 0.085 | 0.029 | 0.308 |
| HRM system → Competence exploration | 0.173* | 0.081 | 0.039 | 0.305 |
| SHRM → Competence exploration | 0.261*** | 0.080 | 0.129 | 0.392 |
| Competence exploration → Radical innovation | 0.466*** | 0.077 | 0.332 | 0.588 |
| <i>Indirect effects</i> | | | | |
| H _{3a} : HRM system → Competence exploration → Radical innovation | 0.080* | 0.038 | 0.019 | 0.145 |
| H _{3b} : SHRM → Competence exploration → Radical innovation | 0.123** | 0.045 | 0.054 | 0.200 |
| <i>Second order relationships</i> | | | | |
| HRM system → Empowerment | 0.632*** | 0.075 | 0.503 | 0.745 |
| HRM system → Selection | 0.691*** | 0.064 | 0.577 | 0.778 |
| HRM system → Training | 0.803*** | 0.042 | 0.732 | 0.859 |
| HRM system → Performance Appraisal | 0.894*** | 0.023 | 0.856 | 0.922 |
| HRM system → Compensation | 0.593*** | 0.087 | 0.439 | 0.718 |

Note: ***p<0.001 **p<0.01 *p<0.05 based on a Student's t(4999) distribution with one tail [t(0.05, 4999) = 1.645, t(0.01, 4999) = 2.327, t(0.001, 4999) = 3.092]. Bootstrapping based on n = 5.000 subsamples; LL=Lower bias corrected bootstrap 95% confidence interval; UL= Upper bias corrected bootstrap 95% confidence interval.

Figure 1. Research model

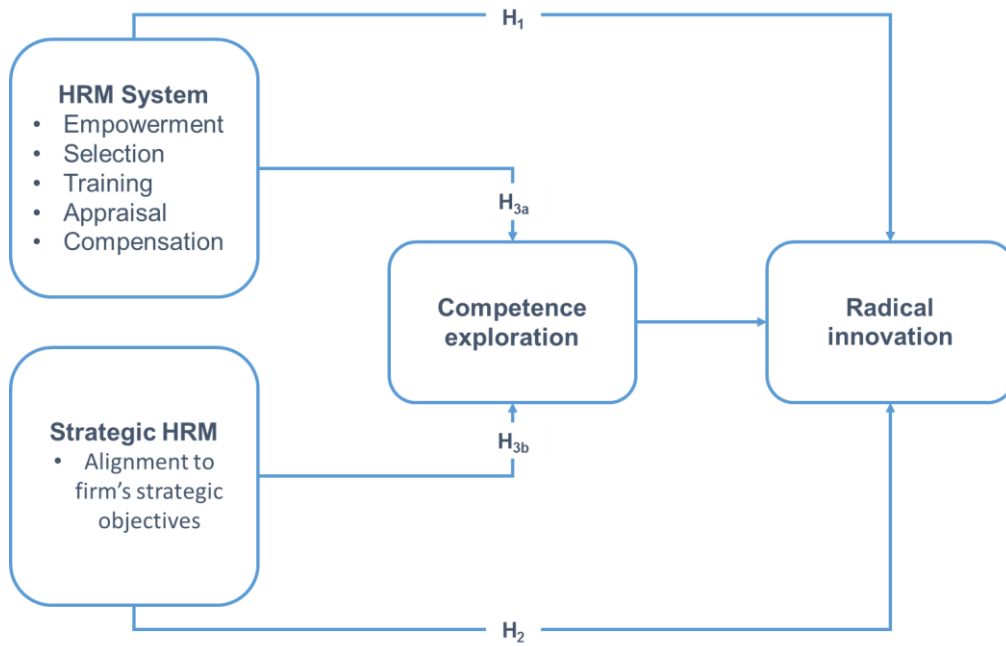


Figure 2. Results of PLS-SEM

