Influence of human resource information systems and technology on firm performance: a qualitative comparative analysis

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Abstract: The application of information systems and technologies is a very important challenge for all areas of the company, causing changes in their work processes. Today, the literature has not reached a consensus on the impact that the digitisation of the human resources area has on the results of the company. Therefore, the Fuzzy Set Qualitative Comparative Analysis (fsQCA) has been used in a study with a sample of 42 technology companies from the Valencian Community to identify the conditions that affect the firm performance as an outcome. Two traditional contingent factors (company ownership and the CEO's educational background) are considered, as is the use of information systems and technology for Human Resource Management (HRM). The fsQCA reveals that investment in tools for human resource optimisation and obsolete device replacement positively affect firm performance. Absence of profit growth is linked to a lack of investment in human resource optimisation technology. The distribution of capital amongst different owners, regardless of the technology's current or former availability also hampers firm performance.

Keywords: HRM; human resource management; business performance; information systems; company ownership; fsQCA; fuzzy-set qualitative comparative analysis.

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This paper is a revised and expanded version of a paper entitled 'Using a configurational approach to understand information and technologies in human resources management' presented at 'International Conference on Technology and Entrepreneurship-Virtual (ICTE-V)', 2020.

1 Introduction

A consequence of the growth in market competitiveness is the need for differentiation for companies that wish to remain in the future (Millar et al, 2016). Human capital is the main asset of an organisation and therefore, the proper management of this area becomes a determining factor for the success of organizstions (Schultz, 1961; Barney, 1986). Indeed, several authors argue that HRM practices may encourage the discovery of new sources of sustained competitive advantage, especially when aligned with the firm's competitive strategy (Cappelli and Singh, 1992; Pauli et al., 2019).

Likewise, the digital transformation and the application of information systems and technologies has caused changes in the work processes of the different functional areas (Schwab, 2016; Sheng et al., 2019). The intraorganisational transmission of information constitutes one of the most valuable entrepreneurial resources (Ribeiro-Soriano and Kraus, 2018; Baier-Fuentes et al., 2019; Barnett et al., 2019; Sá and dee Pinho, 2019). Information and Communication Technologies (ICTs) facilitate this transmission (Gururajan and Fink, 2010; Ribeiro-Soriano et al., 2014; Adamuthe and Thampi, 2019).

Qualitative comparative methods are increasingly used in management and international business to analyse the results of studies in this area (Kornelakis, 2018; Torre et al., 2019). Since, Berg-Schlosser and Quenter (1996) reported that this technique had its primary applications in political science and historical sociology studies, much progress has been made in terms of the publication of studies using this technique by high-impact management and social science journals (Roig-Tierno et al., 2017). According to Cambré et al. (2013); Feurer et al. (2016) and Park and El Sawy (2013), Qualitative Comparative Analysis (QCA) and Fuzzy-Set Qualitative Comparative Analysis (fsQCA) are more suitable than quantitative regression analysis in today's turbulent environments. The main reason for the suitability of these techniques is that values no longer remain constant when analysing dependent variables. In fsQCA, the concepts of dependent and independent variables are referred to in different terms. They are known as *outcomes* and *conditions,* respectively. In regression analysis, the impact of variables is quantified, but no indication is given regarding which variables are necessary or sufficient. Necessity and sufficiency can only be analysed by studying the complexity of the configurational relationships proposed by fsQCA. Furthermore, fsQCA enables the study of the presence or absence of the conditions or causes of an outcome, which cannot be analysed in quantitative studies (Ragin, 2000).

Digitalisation is one of the most important challenges for the area of human resources. The use of new technologies help developing the transition to a strategic HRM, in which the general objectives of the company can be addressed with a more strategic view (Poba-Nzaou et al., 2020; Panayotopoulou et al., 2007). However, there is no consensus on concrete practices that contribute to the improvement of business results. Some previous studies argue that the use of new technologies on HRM digitalisation can have a relevant impact on the improvement of firm performance (Zhou et al., 2020; Emeagwal and Ogbonmwan, 2018). However, other studies did not find significance evidence to prove that digitalisation on HRM helps reducing costs (Reddick, 2009). In the light of the previous aforementioned gap in the literature, we propose this study with the aim of filling it. After conducting a review in terms of digitalisation of the HRM, we contribute to the current literature by defining different conditions associated to the enhancement of digital technologies in the business HRM system. The theoretical contribution of this work consists in the study of the information systems and the technology that is being applied in the field of human resources. In this way, the impact of these tools on certain outcome variables is studied.

With respect to the methodological contribution, we apply the fsQCA to identify the potential combinations of causal conditions associated with two contingent (company ownership and CEO educational background) as well as the influence of information and human resource technology on firm performance (in terms of profit growth) (Hussain et al., 2019).

The goal of this paper is thus to study the effect of three crucial factors on organisational performance: the distribution of a company's property, the employees' level of education, and the use of new information and communication technologies in HRM. Our study not only contributes to the literature in terms on explaining the consequences of digitalisation on HRM, but also proposes different possible combinations of conditions that lead to the desired outcome. This allows to understand which are the determinants of the application of digitalisation tools on the financial performance of the company.

Consequently, the following research questions were tackled: Does the distribution of company property influence firm performance? Does the overall level of employee education affect performance? Does the use of new information and communication technologies for HRM boost performance?

This paper is structured as follows. After this introduction, a literature review is provided on the role of the distribution of company property, the significance of the staff's educational level and the impact of information technologies and big data on HRM. Next, the research questions addressed by this study are presented in detail. Subsequent sections then present the method, sample, variables and analysis procedure. The main results of the study are discussed in the fourth section. Finally, conclusions are presented, along with contributions, limitations and potential guidelines for future research.

2 Literature review

Proper management of human resources practices can become the main source of sustained competitive advantage, especially if it is aligned with the company's competitive strategy (Capelli and Singh, 1992; Bharadwaj et al., 2013). Some authors argue that this long-term competitive advantage arises through generating organisational knowledge (Barney, 1992; Lado and Wilson, 1994). Nonaka (1994) argued that knowledge is more difficult to imitate by competitors when it is tacitly within the organisation. In addition, if it is transferred throughout the structure, it is even more difficult to move to other organisations. The transmission of information in an organisation is very valuable. For this, information and communication technologies facilitate this transmission of knowledge throughout the organisation (Ribeiro-Soriano et al., 2014; Gururajan and Fink, 2010). The existing literature advocates the use of mediating variables to explain the impact of knowledge transmission technologies on firm performance (Chung and Tseng, 2019; Nobari et al., 2019). On the other hand, digital tools are 'significant economic drivers' (Mancha and Shankaranarayanan, 2020), as well as a relevant source of new entrepreneurial activities. Innovation, which is consider one of the main cornerstones of entrepreneurial orientation, together with proactivity and risk aversion represents an antecedent in developing new information and technology tools (Shane and Venkataraman, 2000).

In the light of these arguments, the following proposition is presented:

- *Proposition 1: Specialised information and technology tools used to optimise the exploitation of human resource data influence firm performance.*

As mentioned in the previous proposal, the development of new forms in HRM, based on technology, help companies to strengthen their competitive advantage over other players in the market, while promoting a more comprehensive vision company strategy (Poba-Nzaou et al., 2020). However, it should be noted that the current environment responds to the acronym for VUCA (volatile, uncertain, complex and ambiguous) (Horstmeyer, 2020). This means that the technologies are not static, but on the contrary, they continually respond to disruptive changes, which companies must know how to manage and act quickly before them (Vial, 2019). Here the concept of ubiquitous computing appears, in which it is argued that technology undergoes a process of constant evolution, and that therefore the physical environment must be integrated at all times into

technological means, being aware of the constant advances that are occurring. In this way, the quality of the tools used in the area of eHRM will be at all times as effective as possible. Therefore, the objective is to avoid obsolescence at all costs to achieve higher levels of ubiquitous computing, in which the integration of people within the technological environment of the organisation is always the maximum (Monaghan et al., 2020). Therefore, the following proposition is derived in our study:

- *Proposition 2: The replacement of devices in the area of human resources avoids their obsolescence and influences firm performance.*

According to some authors, the future belongs to organisations that are able to analyse and assess big data efficiently (Sedkaoui, 2018; Angrave et al., 2016; Zapotocny, 2015). The key is to discover how to use big data analysis to maintain the value of data related to human capital and in what direction should the software programs evolve the impact on the performance of the organisation (Boudreau and Lawler, 2015). In the new digital era it is very important not only agility but also cost reduction. Therefore, the new paradigm of the new technology applied to human resources is known as 'ubiquitous computing' and refers to the adequacy of the physical environment with the electronic space (McFarlan and Austin, 2001; Cash et al., 1994; Tansley et al., 2014). The goal of human resources management is to adapt the physical environment to the changes and developments that the technological world presents (Holtgrave et al., 2019). The availability of information and management tools in the area of human resources shows that they are used in order to achieve a more efficient and productive management (Iqbal et al., 2019; Kose and Sakata, 2019). Several studies ensure that electronic human resources management simplifies processes and improves the efficiency of employees in the area (Bondarouk et al., 2017; Bondarouk and Ruël, 2013; Gardner et al., 2003; Olivas-Lujan et al., 2007). Considering this, many studies ensure that human resources management can have a positive effect on firm performance (Combs et al., 2006; Jiang et al., 2012).

Based on the previous literature, the following proposition is formulated:

- *Proposition 3: Investment in tools that optimise work processes related to human resources influences firm performance.*

2.1 Contingent factors: company ownership and CEO's educational background

Different stakeholders defend their position regarding human resources practices (Guerci and Shani, 2013; Jackson et al., 2014). The interest of the owners is to achieve a greater return on investments and improve the corporate reputation (Järlström et al., 2018). According to Yeung and Berman (1997), the interests of employees, customers and all stakeholders are very connected. Employee practices affect the level of customer satisfaction who decide with their consumption practices to be faithful to the organisation. Shareholder satisfaction is positively affected, due to the increase in sales. This positive satisfaction has a direct impact on employees that is transferred not only in economic terms (bonuses, monetary rewards and higher salaries), but also on non-economic circumstances such as more flexibility and more investment in employee training and professional development (Yeung and Berman, 1997). On the other hand, the owner of the company sets the organisational and culture principles spread out the

whole institution (Bouncken and Barwinski, 2020). If the owner promotes the use of technological tools, HRM will adapt as well to these conditions, fostering the transition to a more digitalised people management. In this line, the CEO will determine the influence and role that the Chief Information Officer (CIO) and Chief Digital Officer (CDO) will adapt towards the company (Locoro and Ravarini, 2018). In the light of the aforementioned arguments, we propose the following proposition:

- *Proposition 4: Company ownership influences firm performance when the use of information and technology in human resources is analysed.*

The CEO is the person responsible for a strategic change in an organisation (Jaw and Lin, 2009; Dalton and Kesner, 1983). Some studies state that the level of education of the CEO explains their strategic choices and the consequent changes (Hambrick and Mason, 1984). Those members who belong to the top management team, and who have higher levels of study, are more able to process high levels of information quickly and effectively. According to their area of specialisation, they focus on studies related to social sciences and have easier guidelines, processes and management that characterise the area of human resources (Frear et al., 2012). The CEOs trained in this area will have a greater propensity to use technological means in the area of human resources (Rey-Marti et al., 2016; Heyden et al., 2017; Dutton and Jackson, 1987). The CEO's educational background is also correlated to his entrepreneurial orientation and innovation spirit (Mancha and Shankaranarayanan, 2020). Nowadays, soft skills focused on digital competences, proactivity and innovation, among others, are gradually being integrated in both MBAs and undergraduates in order to increase their employability and successful rate. According to the previous literature, we develop the following proposition:

- *Proposition 5: A CEO's educational background influences company performance when the use of information and technology in human resources is analysed.*

3 Method

3.1 Sample

The sample for this study includes technology-based companies based in the Valencian Community that are considered innovative according to the definition of innovation proposed by the Valencian Institute of Competitiveness (IVACE). The data was collected by sending the survey through a link, to the professional email of key informants. With respect to the profile of the respondents, all were CEOs or held a managerial position in the company. The suitability of this method has been corroborated by Kreiser et al. (2002), who used a similar approach in a previous study.

Two companies were previously surveyed to ensure that the questionnaire was clear. The survey led to adjustments in the final questionnaire. A procedure proposed by Kumar et al. (1993) was applied to avoid key informant bias (Rong and Wilkinson, 2011). Data were collected during the month of September 2019.

Emails were sent to 60 companies obtaining a response rate of 80%. Finally, 42 reliable responses were considered after tabulation because respondents had completed all the items in the questionnaire. 8 questionnaires were not considered valid.

With respect to the questionnaire, it was composed of 10 items destined to ask about the company's ownership, CEO's education, the information systems available in the company and the technology applied. Likewise, to ask the respondents about the growth of the company, an item about the average sales was included, since, unlike other measures, it was considered to be a data available for all respondents. For all items, a Likert scale of 1 to 5 was used.

The abbreviations used in this study are presented below in Table 1.

Table 1   Abbreviations

Abbreviations	Definition
Heres	Specialised tools
Susdis	Device replacement
Inhe	Investment in tools
Prop	Company ownership
Form	CEO's educational background
Rto	Performance (profit growth)

The results of the descriptive analysis are shown in Table 2.

Table 2   Descriptive statistics for the dependent variable (outcome in fsQCA) and independent variables (conditions in fsQCA)

Abbreviation	Mean	Median	Standard deviation	Minimum	Maximum
Heres	3.429	4	1.532	1	5
Susdis	2.667	3	1.3	1	5
Inhe	3.69	4	1.137	1	5
Prop	0.667	1	0.477	0	1
Form	3.286	3	0.708	2	4
Rto	3.714	4	1.235	1	5

3.2   Data analysis

QCA is used to study causal conditions and combinations of these conditions to reach relevant conclusions about the data (Ragin and Fiss, 2008). QCA is concerned with the structural configurations that produce a given outcome (Fiss, 2007). These configurations are subject to equifinality, which means that different solutions can cause the same outcome (Ganter and Hecker, 2014; Bouncken and Fredrich, 2016; Bouncken et al., 2016). The combinations of the conditions or the lack of them are applicable to business relations (Fiss, 2011; Sjödin et al., 2016). Our analysis consists of an asymmetric study of the causal conditions that are necessary and/or sufficient for the outcome of interest to occur (Greckhamer et al., 2008; Honig and Lamoureux, 1997; Ketchen et al., 1993). In this study, the outcome is profit growth.

This method is suitable when dealing with small samples (e.g. a small number of companies, individuals or observations; Ragin, 2008). However, large samples may also be used with QCA (Lijphart, 1971; Ragin, 1987, 2006c). Indeed, Berg-Schlosser and De Meur (2009, pp.27–28) explained that 'analysing 4 to 7 conditions, and between 10 and 40 cases are a good number of conditions and shows for the use of this technique'. In

contrast, for Ragin (2008), the number of conditions should be between three and eight. Finally, Crilly (2011) reported that the ideal limit is seven conditions per study.

3.2.1 Process

The fs/QCA 3.0 software package, available at www.fsQCA.com (Ragin and Davey, 2016), was used for this study. This method is based on the Quine-McCluskey algorithm (Quine, 1952, 1955) and Boolean algebra. Using Boolean algebra can reveal causal structural configurations that are sufficient to produce the outcome of interest.

The first step was calibration, which is quite a distinct process from calculating probabilities (Woodside, 2012). Through this process, variables (conditions and outcomes) are transformed into values between 0 and 1 (Woodside et al., 2012). *A priori*, these transformations should be carried out on the grounds of both academic experience and similar prior studies (Ragin, 2000). Three specific cut-offs are used: 'completely inside', 'completely outside' and 'point of ambiguity' (Wu et al., 2014).

In the second stage, a data matrix or truth table is built (Fiss, 2011; Schneider et al., 2010; Schneider and Wagemann, 2012). From this table, configurations for which there is at least one observable event matching the established criteria are retained. Ragin (2006a) recommends a minimum consistency value of 0.75. There are three types of solutions: complex, parsimonious and intermediate (Crilly et al., 2012; Fiss, 2011). The complex solution is the most conservative, offering less detail than the best solutions (Ragin, 2008).

The researchers must then choose between the plausible configurations using coverage and consistency. Woodside (2013a, 2013b) likened coverage to the coefficient of determination in quantitative methodology and consistency to correlation in quantitative analysis. Ragin (2008, p.44) affirmed that coverage is 'the degree to which the causal condition or the combination of causal conditions leads to the result' and that consistency is 'the degree to which the result is explained by necessity of the causal conditions'. Consistency ranges from 0 to 1 (Ragin, 2006b). Ragin (2008) recommends a minimum consistency value of 0.8 (preferably 0.85 for macro-level data).

3.3 Measures

3.3.1 Outcome: company performance

Company performance was measured using the previous year's average annual sales growth (see Wiklund and Sheperd, 2003).

3.3.2 Causal conditions: entrepreneurial orientation

We considered two traditional contingent factors: company ownership and the CEO's educational background. We also analysed the information systems and technology applied in human resources, considering three factors: specialised tools to optimise human resources, anti-obsolescence device replacement for increased human resource efficiency, and investment in tools for the optimisation of human resource work processes. The previous items were measured on a 5-point Likert scale.

4 Results

Table 3 shows how each causal condition was calibrated and the related results using Ragin's proposed method (2008). We used percentile-based calibration, which has been commonly used in similar prior studies (e.g. Khedhaouria and Thurik, 2017). In terms of causal conditions, the 90th percentile was equivalent to scores of 5 points for specialised tools, 4 for device replacement, 5 for investment in tools and 4 for CEO's education. The 10th percentile was equivalent to scores of 2, 1, 2 and 2 points for each of the aforementioned factors, respectively. To collect information from as many cases as possible, we adjusted some of the breakpoints (or points of maximum ambiguity) established at the 50th percentile scores, which were originally equivalent to 3, 3, 4 and 3, respectively. These breakpoints are given in Table 3. Output calibration, the thresholds for which are also shown in Table 3, was based on a similar reasoning. The suitability of this procedure has been confirmed by Kraus et al. (2018), who also calibrated conditions using the scores corresponding to the same percentiles (90th, 50th and 10th).

Table 3 Calibration of outcome and causal conditions

Abbreviation	Condition or outcome	Description	fsQCA threshold
Heres	Condition	The company uses specialised tools (e.g. Haddop, MongoDB and Elasticsearch) for data exploitation.	5 → 0.95 2.9 → 0.5 2 → 0.05
Susdis	Condition	The company replaces its devices (e.g. tablets, PDAs, PCs and mobiles) periodically to avoid obsolescence.	4 → 0.95 2.9 → 0.5 1 → 0.05
Inhe	Condition	The company invests in tools (e.g. AGILE methodologies, PARET diagrams and SIPOC diagrams) that optimise work processes.	5 → 0.95 3.9 → 0.5 2 → 0.05
Form	Condition	CEO's educational background	4 → 0.95 3.1 → 0.5 2 → 0.05
Rto	Outcome	Performance (profit growth)	4 → 0.95 3.9 → 0.5 1 → 0.05

4.1 Necessary conditions

The analysis of necessary conditions is useful to identify which causal conditions must occur to produce a specific outcome (see Table 4). When considered individually, no causal condition met the criteria to be considered necessary for the outcome. Necessity can be established only if the consistency score exceeds 0.9 (Schneider et al., 2010). The symbol '~' denotes the absence of a given condition.

Table 4   Analysis of necessary conditions

PRESENCE: fs_Performance		
	Consistency	*Coverage*
fzHERES	0.595976	0.658258
~fzHERES	0.497553	0.685393
fzSUSDIS	0.528548	0.642432
~fzSUSDIS	0.593801	0.734365
fzINHE	0.526917	0.704215
~fzINHE	0.590538	0.668719
Prop	0.695486	0.639500
~Prop	0.304513	0.560000
fzFORM	0.679173	0.683260
~fzFORM	0.410005	0.643345
ABSENCE: fs_Performance		
	Consistency	*Coverage*
fzHERES	0.638243	0.445045
~fzHERES	0.509905	0.443446
fzSUSDIS	0.659776	0.506279
~fzSUSDIS	0.534022	0.416947
fzINHE	0.536606	0.452762
~fzINHE	0.649440	0.464286
Prop	0.621016	0.360500
~Prop	0.378984	0.440000
fzFORM	0.639966	0.406455
~fzFORM	0.501292	0.496587

4.2 Sufficient conditions

A condition is considered sufficient if its consistency is 0.75 or greater (Schneider et al., 2010). Table 5 displays sufficient conditions for both profit growth and the absence of profit growth. The existence of at least one case matching the criterion of being observable in a minimum of one company was assumed. As shown in the truth table, the cut-off for consistency was established at 0.81 for the outcome of presence of profit growth and at 0.83 for the outcome of absence of profit growth. These results are consistent with Rihoux and Ragin's (2009) assertions stressing the need for consistency scores over 0.75.

Table 5   Sufficient conditions for profit growth and absence of profit growth

Configuration number	*Profit growth*			*Absence of profit growth*			
	1	*2*	*3*	*4*	*5*	*6*	*7*
Heres		○	●	●	●	○	●
Susdis	●	○	●	●	●	○	○
Inhe	●		●	○	●	○	○
Prop	●	●		●	●	○	○
Form	○	●	○	○	●	○	●
Raw coverage	0.2268	0.1892	0.1784	0.1163	0.0965	0.1723	0.2257
Unique coverage	0.1479	0.0277	0.0533	0.1163	0.0577	0.0784	0.1318
Consistency	0.9542	0.8447	0.9036	0.0775	0.8296	0.8403	0.8344
Solution coverage	0.390430			0.478036			
Solution consistency	0.876405			0.819858			

Notes: Based on Ragin and Fiss (2008) and Fiss (2011), the solutions are grouped by their 'core' structures, where: ● black circles indicate the presence of the condition; ○ white circles indicate the absence of the condition; ●○Large circles indicate a core condition (i.e. it appears in both the parsimonious solution and the intermediate solution); ●○Small circles indicate that the condition only appears in the intermediate solution; Blank spaces indicate that this condition may be present or absent (i.e. it is not relevant).

In terms of profit growth, consistency was 0.876405 for the model of sufficiency, which accounts for 39.04% of the cases (companies) included in the study. All three configurations appear to be comparable because they exceed our considered minimum threshold of 0.8 for success (Ragin, 2008). We subsequently determined which configuration has the highest case coverage, allowing us to account for the largest possible number of cases in our study. Based on this criterion, Configuration 1 is chosen, covering 22.68% of the cases under study. This configuration indicates that there is profit growth when three conditions are met: first, companies must invest in technology for human resource optimisation; second, companies must replace obsolete devices and third, CEOs must have a low educational level. This conclusion is confirmed with a consistency coefficient of 0.9542.

Regarding the absence of profit growth, consistency was set at 0.819858 for the model, which covered 47.80% of the cases (companies) considered. Here, Configuration 4 was discarded because, as per Ragin's indications (2008), the consistency coefficient must be greater than 0.8. Of the three remaining configurations, the one with the highest coverage was identified. This configuration explains the largest number of cases in the study. Configuration 7 covers 22.57% of the cases. This configuration indicates that there is an absence of profit growth when the company fails to invest in tools to optimise human resources and has or has had such tools, and the ownership of the company does not need to be concentrated.

5   Discussion and conclusions

The main motivation of our paper was to identify how the digitisation of the human resources area impacts on firm performance. The literature reviewed in the theoretical framework pointed out that the transmission of information in the organisation is highly valued and in turn facilitates the transmission of knowledge (Ribeiro-Soriano et al., 2014; Chung and Tseng, 2019; Nobari et al., 2019). However, the use of technology had not been directly related to the firm's performance. Vial (2019) stressed that technology is not static and that its evolution is important to adapt to constant advances. Iqbal et al. (2019); Kose and Sakata (2019) highlighted the need for the availability of information and management tools in the area of human resources to achieve more efficient and productive management. Owing the lack of consensus about the combination of factors that must be given in the company to ensure the improvement of its performance, the authors of this work carried out a study with 42 technology companies.

In methodological terms, this study contributes to the research on HRM by employing the fsQCA approach. Applying this technique shows that none of the variables considered *per se* leads to the outcome of interest. Instead, different combinations of factors are capable of producing the outcome. FsQCA was deployed to identify all potential combinations of causal conditions associated with two traditional contingent factors (company ownership and the CEO's educational level).

Regarding the sample size or the number of cases that should be considered for research purposes, Pratt (2009, p.856) affirmed that 'there is no 'magic' number of interviews, or specific statistic frequency accurately quantifying the sufficient amount of data required to support qualitative research. This depends on the questions a researcher is seeking to answer'. The findings show that profit growth results from the combination of the following conditions: company investment in tools to optimise human resources, replacement of obsolete devices and a CEO without a high level of education. Conversely, the absence of profit growth happens when a company decides not to invest in technology to optimise human resources, didn't have available the appropriate tools, and the ownership does not need to be concentrated. These findings advance in the theoretical understanding of the effect of applying new information systems and technology in the human resources area, which at the same time have a positive impact on firm performance. The combination of a higher level of education and the use of tools that optimise the processes of human resources are key to advance in the company's performance. For this reason, this study advances not only in determining how important are the investments in optimising tools in human resources, but also in assuring that the CEO educational background plays an important role. Therefore, positive synergies can derive from the implementation of technology and high level of education. This phenomenon has practical implications, since the influence that the level of education of the CEO has on the firm performance is high. Moreover, companies should consider the implementation of new tools, replacement of devices and data exploitation in order to understand clearer the employees' needs and satisfy them accordingly.

Like all research, this study has some limitations. The sample is limited in terms of the economic sectors it covers and its size. The fact that the analysis covered a relatively short period and was based on cross-sectional data is also a limitation of our research. Although this study offers considerable insight into a fairly new field, the application of fsQCA to human resources still represents a great opportunity for further research. Likewise, these limitations offer a path to future lines of research. Replicating our study

in other sectors or in other geographic area could prove valuable. Finally, the study of other contingent factors and their impact on the firm performance would also be of interest to the field of human resources.

References

Adamuthe, A.C. and Thampi, G.T. (2019) 'Technology forecasting: a case study of computational technologies', *Technological Forecasting and Social Change*, Vol. 143, pp.181–189.

Angrave, D., Charlwood, A., Kirkpatrick, I., Lawrence, M. and Stuart, M. (2016) 'HR and analytics: why HR is set to fail the big data challenge', *Human Resource Management Journal*, Vol. 26, No. 1, pp.1–11.

Baier-Fuentes, H., Hormiga, E., Miravitlles, P. and Blanco-Mesa, F. (2019) 'International entrepreneurship: a critical review of the research field', *European Journal of International Management*, Vol. 13, No. 3, pp.381–412.

Barnett, W.A., Hu, M. and Wang, X. (2019) 'Does the utilization of information communication technology promote entrepreneurship: evidence from rural China', *Technological Forecasting and Social Change*, Vol. 141, pp.12–21.

Barney, J.B. (1986) 'Strategic factor markets: expectations, luck, and business strategy', *Management Science*, Vol. 32, No. 10, pp.1231–1241.

Barney, J.B. (1992) 'Integrating organizational behavior and strategy formulation research: a resource based analysis', in Shrivastiva, P., Huff, A. and Dutton, J. (Eds): *Advances in Strategic Management*, JAI Press, Vol. 8, pp.39–62.

Berg-Schlosser, D. and De Meur, G. (2009) 'Comparative research design: case and variable selection', in Rihoux, B. and Ragin, C.C. (Eds): *Configurational Comparative Methods*, Sage, Thousand Oaks, CA, pp.19–32.

Berg-Schlosser, D. and Quenter, S. (1996) 'Macro-quantitative vs. macro qualitative methods in political science – advantages and disadvantages of comparative procedures using the welfare-state theory as an example', *Historical Social Research*, Vol. 21, No. 1, pp.3–25.

Bharadwaj, A., El Sawy, O.A., Pavlou, P.A. and Venkatraman, N. (2013) 'Digital business strategy: toward a next generation of insights', *MIS Quarterly*, pp.471–482.

Bondarouk, T., Harms, R. and Lepak, D. (2017) 'Does e-HRM lead to better HRM service?', *International Journal of Human Resource Management*, Vol. 28, No. 9, pp.1332–1362.

Bondarouk, T.V. and Ruël, H. (2009) 'Electronic human resource management: challenges in the digital era', *The International Journal of Human Resource Management*, Vol. 20, pp.505–514.

Boudreau, J. and Lawler, E. (2015) *Talent Analytics Measurement and Reporting: Building a Decision Science or Merely Tracking Activity*, Working paper, Centre for Effective Organisations, University of Southern California.

Bouncken, R. and Barwinski, R. (2020) 'Shared digital identity and rich knowledge ties in global 3D printing – a drizzle in the clouds?', *Global Strategy Journal*.

Bouncken, R.B. and Fredrich, V. (2016) 'Business model innovation in alliances: successful configurations', *Journal of Business Research*, Vol. 69, No. 9, pp.3584–3590.

Bouncken, R.B., Fredrich, V. and Pesch, R. (2016) 'Configurational answer to the ongoing riddle of formal and/or emergent planning practices', *Journal of Business Research*, Vol. 69, No. 9, pp.3609–3615.

Cambré, B., Fiss, P.C. and Marx, A. (2013) 'Conclusion: the path forward', in Fiss, P.C., Cambré, B. and Marx, A. (Eds): *Configurational Theory and Methods in Organization Research*, pp.311–319.

Cappelli, P. and Singh, H. (1992) 'Integrating strategic human resources and strategic management', *Research Frontiers in Industrial Relations*, Industrial Relations Research Association, Madison, WI, pp.165–192.

Cash, J.I., Nohria, N. and Eccles, R. (1994) *Building The Information-Age Organization: Structure Control and Information Technologies*, McGraw-Hill Professional.

Chung, T.A. and Tseng, C.Y. (2019) 'The knowledge intensity and the economic performance in Taiwan's knowledge intensity business services', *Economic Research-Ekonomska Istraživanja*, Vol. 32, No. 1, pp.797–811.

Combs, J., Liu, Y., Hall, A. and Ketchen, D. (2006) 'How much do high-performance work practices matter? A meta-analysis of their effects on organizational performance', *Personnel Psychology*, Vol. 59, No. 3, pp.501–528.

Crilly, D. (2011) 'Predicting stakeholder orientation in the multinational enterprise: a mid-range theory', *Journal of International Business Studies*, Vol. 42, No. 5, pp.694–717.

Crilly, D., Zollo, M. and Hansen, M.T. (2012) 'Faking it or muddling through? Understanding decoupling in response to stakeholder pressures', *Academy of Management Journal*, Vol. 55, No. 6, pp.1429–1448.

Dalton, D. and Kesner, I. (1983) 'Inside/outside succession and organizational size: the pragmatics of executive succession,' *Academy of Management Journal*, Vol. 26, pp.736–742.

Dutton, J.E. and Jackson, S.E. (1987) 'Categorizing strategic issues: links to organizational action', *Academy of Management Review*, Vol. 12, pp.76–90.

Emeagwal, L. and Ogbonmwan, K.O. (2018) 'Mapping the perceived role of strategic human resource management practices in sustainable competitive advantage', *Academy of Strategic Management Journal*, Vol. 17, No. 2.

Feurer, S., Baumbach, E. and Woodside, A.G. (2016) 'Applying configurational theory to build a typology of ethnocentric consumers', *International Marketing Review*, Vol. 33, No. 3, pp.351–375.

Fiss, P.C. (2007) 'A set-theoretic approach to organizational configurations', *Academy of Management Review*, Vol. 32, No. 4, pp.1180–1198.

Fiss, P.C. (2011) 'Building better causal theories: a fuzzy set approach to typologies in organization research', *Academy of Management Journal*, Vol. 54, No. 2, pp.393–420.

Frear, K.A., Cao, Y. and Zhao, W. (2012) 'CEO background and the adoption of Western style human resource practices in China', *The International Journal of Human Resource Management*, Vol. 23, No. 19, pp.4009–4024.

Ganter, A. and Hecker, A. (2014) 'Configurational paths to organizational innovation: qualitative comparative analyses of antecedents and contingencies', *Journal of Business Research*, Vol. 67, No. 6, pp.1285–1292.

Gardner, S.D., Lepak, D.P. and Bartol, K.M. (2003) 'Virtual HR: the impact of information technology on the human resource professional', *Journal of Vocational Behavior*, Vol. 63, No. 2, pp.159–179.

Greckhamer, T., Misangyi, V., Elms, H. and Lacey, R. (2008) 'Using qualitative comparative analysis in strategic management research: an examination of combinations of industry, corporate, and business-unit effects', *Organizational Research Methods*, Vol. 11, No. 4, pp.695–726.

Guerci, M. and Shani, A.B. (2013) 'Moving toward stakeholder-based HRM: a perspective of Italian HR managers', *The International Journal of Human Resource Management*, Vol. 24, No. 6, pp.1130–1150.

Gururajan, V. and Fink, D. (2010) 'Attitudes towards knowledge transfer in an environment to perform', *Journal of Knowledge Management*, Vol. 14, No. 6, pp.828–840.

Hambrick, D.C. and Mason, P.A. (1984) 'Upper echelons: the organization as a reflection of its top managers', *Academy of Management Review*, Vol. 9, No. 2, pp.193–206.

Heyden, M.L., Reimer, M. and Van Doorn, S. (2017) 'Innovating beyond the horizon: CEO career horizon, top management composition, and R&D intensity', *Human Resource Management*, Vol. 56, No. 2, pp.205–224.

Holtgrave, M., Nayir, D.Z., Nienaber, A.M. and Schewe, G. (2019) 'Knowledge comes but wisdom lingers! Learning orientation as the decisive factor for translating social capital into organisational innovativeness and performance in Turkey', *European Journal of International Management*, Vol. 13, No. 2, pp.127–158.

Honig, H. and Lamoureux, S. (1997) 'Organizational configurations and performance: a meta-analysis', *Academy of Management Journal*, Vol. 40, No. 1, pp.223–240.

Horstmeyer, A. (2020) 'The generative role of curiosity in soft skills development for contemporary VUCA environments', *Journal of Organizational Change Management*, Vol. 33, No. 5, pp.737–751.

Hussain, S., Qazi, S., Ahmed, R.R., Vveinhardt, J. and Streimikiene, D. (2019) 'Innovative user engagement and playfulness on adoption intentions of technological products: evidence from SEM-based multivariate approach', *Economic Research-Ekonomska Istraživanja*, Vol. 32, No. 1, pp.555–577.

Iqbal, N., Ahmad, M., Raziq, M.M. and Mendes-Borini, F. (2019) 'Linking E-HRM practices and organizational outcomes: empirical analysis of line manager's perception', *Revista Brasileira de Gestão de Negócios*, Vol. 21, No. 1.

Jackson, S.E., Schuler, R.S. and Jiang, K. (2014) 'An aspirational framework for strategic human resource management', *The Academy of Management Annals*, Vol. 8, No. 1, pp.1–56.

Järlström, M., Saru, E. and Vanhala, S. (2018) 'Sustainable human resource management with salience of stakeholders: a top management perspective', *Journal of Business Ethics*, Vol. 152, No. 3, pp.703–724.

Jaw, Y.L. and Lin, W.T. (2009) 'Corporate elite characteristics and firm's internationalization: CEO-level and TMT-level roles', *The International Journal of Human Resource Management*, Vol. 20, No. 1, pp.220–233.

Jiang, K., Lepak, D.P., Hu, J. and Baer, J.C. (2012) 'How does human resource management influence organizational outcomes? A meta-analytic investigation of mediating mechanisms', *Academy of Management Journal*, Vol. 55, No. 6, pp.1264–1294.

Ketchen, D.J., Thomas, J.B. and Snow, C.C. (1993) 'Organizationalconfigurations and performance: a comparison of theoretical approaches', *Academy of Management Journal*, Vol. 36, pp.1278–1313.

Khedhaouria, A. and Thurik, R. (2017) 'Configurational conditions of national innovation capability: a fuzzy set analysis approach', *Technological Forecasting and Social Change*, Vol. 120, pp.48–58.

Kornelakis, A. (2018) 'The comparative method and comparative management: uneasy bedfellows or natural partners?', *European Journal of International Management*, Vol. 12, Nos. 5/6, pp.642–654.

Kose, T. and Sakata, I. (2019) 'Identifying technology convergence in the field of robotics research', *Technological Forecasting and Social Change*, Vol. 146, pp.751–766.

Kraus, S., Ribeiro-Soriano, D. and Schüssler, M. (2018) 'Fuzzy-set qualitative comparative analysis (fsQCA) in entrepreneurship and innovation research – the rise of a method', *International Entrepreneurship and Management Journal*, Vol. 14, No. 1, pp.15–33.

Kreiser, P.M., Marino, L.D. and Weaver, K.M. (2002) 'Assessing the psychometric properties of the entrepreneurial orientation scale: a multi-country analysis', *Entrepreneurship Theory and Practice*, Vol. 26, No. 4, pp.71–93.

Kumar, N., Stern, L.W. and Anderson, J.C. (1993) 'Conducting interorganizational research using key informants', *Academy of Management Journal*, Vol. 36, No. 6, pp.1633–1651.

Lado, A.A. and Wilson, M.C. (1994) 'Human resource systems and sustained competitive advantage: a competency-based perspective', *Academy of Management Review*, Vol. 19, No. 4, pp.699–727.

Lijphart, A. (1971) 'Comparative politics and comparative method', *American Political Science Review*, Vol. 65, No. 3, pp.682–693.

Locoro, A. and Ravarini, A. (2019) 'The CIO and CDO socio-technical roles in the age of digital business transformation: an interpretive study', *Organizing for the Digital World*, Springer, Cham, pp.235–245.

Mancha, R. and Shankaranarayanan, G. (2020) 'Making a digital innovator: antecedents of innovativeness with digital technologies', *Information Technology and People*, pp.318–335

McFarlan, F.W. and Austin, R.D. (2001) *Creating Business Advantage in the Information Age*, McGraw-Hill Higher Education.

Millar, C., Groth, O. and Roos, J. (2016) 'Management Innovation in an uncertain world', *California Management Review*.

Monaghan, S., Tippmann, E. and Coviello, N. (2020) 'Born digitals: thoughts on their internationalization and a research agenda', *Journal of International Business Studies*, Vol. 51, No. 1, pp.11–22.

Nobari, S.M., Yousefi, V., Mehrabanfar, E., Jahanikia, A.H. and Khadivi, A.M. (2019) 'Development of a complementary fuzzy decision support system for employees' performance evaluation', *Economic Research-Ekonomska Istraživanja*, Vol. 32, No. 1, pp.492–509.

Nonaka, I. (1994) 'A dynamic theory of organizational knowledge creation', *Organization Science*, Vol. 5, No. 1, pp.14–37.

Olivas-Lujan, M.R., Ramirez, J. and Zapata-Cantu, L. (2007) 'e-HRM in Mexico: adapting innovations for global competitiveness', *International Journal of Manpower*, Vol. 28, pp.418–434.

Panayotopoulou, L., Vakola, M. and Galanaki, E. (2007) 'E-HR adoption and the role of HRM: evidence from Greece', *Personnel Review*, Vol. 36, No. 2, pp.277–294.

Park, Y.K. and El Sawy, O.A. (2013) 'The value of configurational approaches for studying digital business strategy', in Fiss, P.C., Cambré, B. and Marx, A. (Eds): *Configurational Theory and Methods in Organizational Research (Research in the Sociology of Organizations*, Vol. 38, Chapter 9, Emerald, Wagon Lane, Bingley.

Pauli, U., Buchelt, B. and Pocztowski, A. (2019) 'Self-employment: a promising agenda for IHRM research', *European Journal of International Management*, Vol. 13, No. 1, pp.111–125.

Poba-Nzaou, P., Uwizeyemunugu, S. and Laberge, M. (2020) 'Taxonomy of business value underlying motivations for e-HRM adoption', *Business Process Management Journal*, pp.1661–1685.

Pratt, M.G. (2009) 'For the lack of a boilerplate: tips on writing up (and reviewing) qualitative research', *Academy of Management Journal*, Vol. 52, No. 5, pp.856–862.

Quine W.V. (1952) 'The problem of simplifying truth functions', *The American Mathematical Monthly*, Vol. 59, No. 8, pp.521–531.

Quine W.V. (1955) 'A way to simplify truth functions', *The American Mathematical Monthly*, Vol. 62, No. 9, pp.627–631.

Ragin, C.C. (1987) *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies*, University of California Press, Berkeley.

Ragin, C.C. (2000) *Fuzzy-Set Social Science*, University of Chicago Press, Chicago.

Ragin, C.C. (2006a) *User's guide to fuzzy-set/qualitative comparative analysis 2.0*, University of Arizona Department of Sociology, Tucson, AZ.

Ragin, C.C. (2006b) 'Set relations in social research: evaluating their consistency and coverage', *Political Analysis*, Vol. 14, No. 3, pp.291–310.

Ragin, C.C. (2006c) 'How to lure analytic social science out of the doldrums: Some lessons from comparative research', *International Sociology*, Vol. 21, No. 5, pp.633–646.

Ragin, C.C. (2008) *Redesigning Social Inquiry: Fuzzy Sets and Beyond*, University of Chicago Press, Chicago.

Ragin, C.C. and Davey, S. (2016) *Fuzzy-Set/Qualitative Comparative Analysis 3.0.*, Department of Sociology, University of California, Irvine, California.

Ragin, C.C. and Fiss, P.C. (2008) 'Net effects versus configurations: an empirical demonstration', Ragin, C.C (Ed.): *Redesigning Social Inquiry: Fuzzy Sets and Beyond*, University of Chicago Press, Chicago, pp.190–212.

Reddick, C.G. (2009) 'Human resources information systems in Texas city governments: scope and perception of its effectiveness', *Public Personnel Management*, Vol. 38, No. 4, pp.19–34.

Rey-Marti, A., Ribeiro-Soriano, D. and Palacios-Marques, D. (2016) 'Entrepreneurial attributes of human capital and contingency factors in the culinary tourism', *International Entrepreneurship and Management Journal*, Vol. 12, No. 1, pp.67–85.

Ribeiro-Soriano, D. and Kraus, S. (2018) 'An overview of entrepreneurship, innovation and sensemaking for improving decisions', *Group Decision and Negotiation*, Vol. 27, No. 3, pp.1–8.

Ribeiro-Soriano, D., Palacios-Marqués, D., Devece-Carañana, C.A. and Peris-Ortíz, M. (2014) 'How to create international business competences and their impact on firm performance', *European Journal of International Management*, Vol. 8, No. 3, pp.279–292.

Rihoux B. and Ragin, C.C. (2009) *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*, Sage, Thousand Oaks, CA.

Roig-Tierno, N., González-Cruz, T.F. and Llopis-Martínez, J. (2017) 'An overview of qualitative comparative analysis: a bibliometric analysis', *Journal of Innovation and Knowledge*, Vol. 2, No. 1, pp.15–23.

Rong, B. and Wilkinson, I.F. (2011) 'What do managers' survey responses mean and what affects them? The case of market orientation and firm performance', *Australasian Marketing Journal*, Vol. 19, No. 3, pp.137–147.

Sá, E.S. and de Pinho, J.C.M. (2019) 'Effect of entrepreneurial framework conditions on R&D transfer to new and growing firms: the case of European Union innovation-driven countries', *Technological Forecasting and Social Change*, Vol. 141, pp.47–58.

Schneider, C.Q. and Wagemann, C. (2012) *Set-Theoretic Methods for the Social Sciences: A Guide to Qualitative Comparative Analysis*, Cambridge University Press, Cambridge.

Schneider, M.R., Schulze-Bentrop, C. and Paunescu, M. (2010) 'Mapping the institutional capital of high-tech firms: a fuzzy-set analysis of capitalist variety and export performance', *Journal of International Business Studies*, Vol. 41, No. 2, pp.246–266.

Schultz, T.W. (1961) 'Investment in human capital', *The American Economic Review*, Vol. 51, No. 1, pp.1–17.

Schwab, K. (2016) *La Cuarta Revolución Industrial*, Debate.

Sedkaoui, S. (2018) 'How data analytics is changing entrepreneurial opportunities?', *International Journal of Innovation Science*, Vol. 10, No. 2, pp.274–294.

Shane, S. and Venkataraman, S. (2000) 'The promise of entrepreneurship as a field of research', *Academy of Management Review*, Vol. 25, No. 1, pp.217–226.

Sheng, J., Amankwah-Amoah, J. and Wang, X. (2019) 'Technology in the 21st century: new challenges and opportunities', *Technological Forecasting and Social Change*, Vol. 143, pp.321–335.

Sjödin, D.R., Parida, V. and Kohtamäki, M. (2016) 'Capability configurations for advanced service offerings in manufacturing firms: using fuzzy set qualitative comparative analysis', *Journal of Business Research*, Vol. 69, No. 11, pp.5330–5335.

Tansley, C., Kirk, S., Williams, H. and Barton, H. (2014) 'Tipping the scales: ambidexterity practices on e-HRM projects', *Employee Relations*, Vol. 36, No. 4, pp.398–414.

Torre, R.D.L., Alcaide-Muñoz, C. and Ollo-Lopez, A. (2019) 'A review of intellectual property management practices using qualitative comparative analysis', *International Journal of Intellectual Property Management*, Vol. 9, Nos. 3/4, pp.264–286.

Vial, G. (2019) 'Understanding digital transformation: a review and a research agenda', *The Journal of Strategic Information Systems*, Vol. 28, No. 2, pp.118–144.

Wiklund, J. and Shepherd, D. (2003) 'Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses', *Strategic Management Journal*, Vol. 24, No. 13, pp.1307–1314.

Woodside, A.G. (2012) 'Incompetency training: theory, practice, and remedies', *Journal of Business Research*, Vol. 65, No. 3, pp.279–293.

Woodside, A.G. (2013a) 'Moving beyond multiple regression analysis to algorithms: calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory', *Journal of Business Research*, Vol. 66, No. 4, pp.463–472.

Woodside, A.G. (2013b) 'Proposing a new logic for data analysis in marketing and consumer behavior: case study research of large-N survey data for estimating algorithms that accurately profile X (extremely high-use) consumers', *Journal of Global Scholars of Marketing Science*, Vol. 22, No. 4, pp.277–289.

Woodside, A.G., Ko, E. and Huan, T.C. (2012) 'The new logic in building isomorphic theory of management decision realities', *Management Decision*, Vol. 50, No. 5, pp.765–777.

Wu, P-L., Yeh, S-S., Huan, T-C. and Woodside, A.G. (2014) 'Applying complexity theory to deepen service dominant logic: configural analysis of customer experience-and-outcome assessments of professional services for personal transformations', *Journal of Business Research*, Vol. 67, No. 8, pp.1647–1670.

Yeung, A.K. and Berman, B. (1997) 'Adding value through human resources: reorienting human resource measurement to drive business performance', *Special Issue: Measuring Human Resource Effectiveness and Impact*, Vol. 36, No. 3, pp.321–335.

Zapotocny, M. (2015) 'Human resource information systems: the current problems and future challenges', *Innov Vis 2020 from reg dev sustain to glob econ: Growth I*, pp.2606–2614.

Zhou, Y., Liu, G., Chang, X. and Wang, L. (2020) 'The impact of HRM digitalization on firm performance: investigating three-way interactions', *Asia Pacific Journal of Human Resources*, Doi: 10.1111/1744-7941.12258.