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Leadership characteristics and digital transformation

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ABSTRACT

Digital transformation (DT) is essential for all companies and industries, depending crucially on systems, IT, strategy, and people. In this research, we analyse how firms' characteristics, associated with management characteristics, promote DT in Portuguese companies. The model considers the relationship between digital strategy and corporate and business strategy, according to firm and management characteristics. We use a multilevel analysis, applying fsQCA to data obtained from 47 Portuguese firms. The results represent an important step forward in the knowledge of the conditions to promote higher stages of DT, especially regarding leadership and management associated with certain firms' characteristics. The conclusions support the crucial role of leadership and especially the importance of managers' coherence towards companies' mission to promote more advanced stages of DT. At the same time, it contributes to develop knowledge about the best possible combination of firms' and management characteristics to promote DT.

1. Introduction

Digital transformation (DT) applies to all aspects of human society (Kaplan, Truex, WasteII, Wood-Harper, & DeGross, 2004). DT forces companies and industries into organizational changes and critical business adaptations if they want to survive and prosper.

More than one-third of the top 10 incumbents in each industry will be displaced by digital disruption in the next five years (Bradley, Loucks, Macaulay, Noronha, & Wade, 2015; Yokoi, Shan, Wade, & Macaulay, 2019). In the digital economy and society index (DESI) 2020 of the EU, Portugal ranks 19th out of the 28 EU member states. It is one of the weakest compared to the EU average (European Commission, 2020), which gives an idea of the existing gap.

While there is a broad consensus on the importance and influence of leadership for the conduct of DT processes (Yokoi et al., 2019), approaches to DT usually remain partial and not very structured, usually missing the analysis of the influence of other companies' characteristics and management's characteristics, such as the coherence of managers towards the company's mission, and its related influence on the efficacy of the company's strategic management.

To support the analysis of the influence of these drivers for DT, we apply the principles of strategic management linked to the theory of leadership (Avolio & Gardner, 2005; Porter & McLaughlin, 2006). We use the fsQCA methodology applied to a sample of 47 Portuguese companies. In view of the objectives of the study, the type of field work carried out, and the sample size, it is considered that fsQCA is the methodology that best suits the performance of this qualitative analysis.

We consider that digital strategy is a synergetic sum of information technology (IT) and information systems (IS) strategic initiatives, driven by managers' decisions deciding to exploit these available infrastructures. For that, they use software and other equipment that supports the companies' operations (production, commercial, financial, etc.) and the development of people within the organization, by executing a strategy aligned with its purpose and mission, to exploit the potential of new (more) digital business models, and achieve more sustainability and success (Wirtz, 2019). These actions prevent the company from falling into the trap of so-called "digital Darwinism" (Goodwin, 2018).

The purpose of this study is to improve knowledge of the DT processes that are taking place in companies. We depart from the following research question: What are the leadership and management characteristics that, accordingly to the firm's characteristics, will contribute to a more advanced DT stage of companies?

The results obtained are important for the development of leadership profiles and specific management attitudes, for the promotion of DT processes, and for alignment of digital strategies with corporate and

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business strategies, to reach more advanced stages of DT.

The main conclusions highlight the importance of specific types of leadership and management attributes, and the strategic management capacities, according to specific firm's profiles, to promote more advanced DT strategies. This research represents an important advance on the knowledge regarding the process of DT in Portuguese companies. The results contribute to a better alignment between digital strategies and corporate and business strategies having in mind the proper characteristics of the firm.

In the next section, we present the theoretical framework. Section 3 presents the method, and develops the research model and propositions, constructs and variables, and data and sample. Section 4 presents the results, followed by the discussion of results in Section 5, and the conclusions and contributions in Section 6. The paper ends with the presentation of the limitations and future research prospects.

2. Theoretical framework and propositions

2.1. Strategy in DT

The increased use of digital technologies by society and industries is pushing the so-called DT (Kaplan et al., 2004), as a pillar of the continuous search for innovation and competitiveness by organizations (Wirtz, 2019; Yokoi et al., 2019). Nowadays, IT is driving organizational activities, in a symbiotic process that usually implies a strategy redefinition (Morabito, 2016) given its crucial implications in terms of the reorientation of business models (Hess, Matt, Benlian, & Wiesboeck, 2016). This is making DT into the main driver of the present change in organizations' value creation processes.

DT occurs simultaneously to respond to changes taking place in organizations' environment, and as a result of the increased use of digital technologies by companies, aiming to improve their competitiveness through market differentiation (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Wirtz, 2019). DT is simultaneously an endogenous phenomenon, where actions aim to respond to opportunities generated by digital technologies (Galindo-Martín, Castaño-Martínez, & Méndez-Picazo, 2019; Kumar, Ramachandran, & Kumar, in press; Sklyar, Kowalkowski, Tronvoll, & Sörhammar, 2019; Tan, Pan, Lu, & Huang, 2015), and an exogenous phenomenon that may threat the organization's development (Li, Su, Zhang, & Mao, 2018; Lucas & Goh, 2009; Sia, Soh, & Weill, 2016). DT is a complex and multidimensional phenomenon which holistically tends to embrace all the domains of the firm.

When DT is supported by adequate implementation of a company-wide digital strategy, it assumes an integrated form of addressing the company's opportunities and risks, and may influence the development of the company, especially when it involves deep changes in the company's overall market positioning (Li, Wang, Cao, & Wang, in press; Singh & Hess, 2017; Wirtz, 2019).

The concept of digital business strategy is associated with the organization's exploitation of its digital resources to develop market differentiation (Bharadwaj et al., 2013), or to improve its operational efficiency (Matt, Hess, & Benlian, 2015), usually resulting in a transformation of the firm's business model (Hess et al., 2016; Wirtz, 2019). DT is a disruptive movement (Bradley et al., 2015; Yokoi et al., 2019). The use of DT tends to transform the status quo and usually demands a continuous process of alignment within the firm (Wade, Noronha, Macaulay, & Barbier, 2017). Given its permanence for long periods of time, DT must be considered a 'journey' rather than a project (Gray, El Sawy, Asper, & Thordarson, 2013).

DT strategy as a holistic concept comprises the different parts of the business and affects at least four dimensions of the company (Matt et al., 2015): i) the strategic use of IT and future technological ambition; ii) the process of value creation and the firm's core business; iii) the firm's organizational setup in terms of implementation of digital activities; and, iv) the financial aspects concerning core business changes.

The development of agility, digital options and a variety of competitive actions, concerns a strategic process of 'coevolutionary adaptation' in which firms learn through experience and over time (Sambamurthy, Bharadwaj, & Grover, 2003), and it is dependent on the company's strategic management capabilities and potential regarding DT strategy (Svahn, Mathiassen, & Lindgren, 2017; Wulf, Mettler, & Brenner, 2017).

The company's opportunities and risks can be addressed in an integrated way through the implementation of a firm-wide DT strategy (Li et al., in press; Singh & Hess, 2017). The efficacy of the strategic management process is related to specific stages of the strategic process or to the effective impact of IT and IS on the company's performance compared to its potential (Bakos & Treacy, 1986; Tilles, 1963). Strategic management principles (Feldman, 2020) indicate that existing resources and the company's emergent digital strategy need a continuous alignment process inherent to a DT 'journey' (Gray et al., 2013), to assess capacity readiness for the digital consumer (Svahn et al., 2017; Wulf et al., 2017) and to a 'coevolutionary adaptation for leveraging information technologies (Sambamurthy et al., 2003). The importance of the efficacy of strategic management is also highlighted in a study conducted by Weill and Woerner (2018). These authors concluded that different paths on DT are influenced by customer experience and operational efficiency, which will result in new digital business models (Weill & Woerner, 2015, 2018). Based on this reasoning, we formulate the following proposition:

P3 – Higher perception on the efficacy of the company's strategic management is present or absent in solutions showing more advanced stages of DT.

Mission, as a means to reach the company's purpose, is usually what supports the company's strategy (Goodwin, 2018; Pearce & David, 1987). The coherence between the mission and managers' behaviour is another crucial element, that may involve a change in the market positioning (Bharadwaj et al., 2013; Li et al., 2019; Singh & Hess, 2017), which results frequently in a transformation of the company's business model (Hess et al., 2016), and which, in turn, needs clarification of core business deviations and structural changes in organizational setup (Matt et al., 2015), with possible implications for the company's mission. We formulate the following proposition:

P2 – Higher perception of coherence of managers' actions towards the company's mission is present or absent in companies that tend to show more advanced stages of DT.

2.2. Leadership in DT

Leadership has also a critical role in engaging information system leaders and business leaders in the digital transformation of respective organizations (Hansen, Kraemmergaard, & Mathiassen, 2011).

Successful DT involves digital strategies to guide leaders' efforts and generate new value propositions, combining SMACIT technologies (social, mobile, analytics, cloud and internet of things) with the existing capabilities of companies (Sebastian et al., 2017; Yokoi et al., 2019).

Leaders lead the organization, especially the managers involved in DT, conducting them to participate in business unit meetings on strategic IT issues. This involvement usually results in greater strategic business knowledge and a greater level of freedom in making strategic decisions (Grover, Cheon, & Teng, 1994; Hansen et al., 2011).

DT can be viewed as the conduction of a digital orchestra (Wade et al., 2017) and the person in charge, its leader, as a maestro. The leadership roles involving IT have different impacts on firms, accordingly to their contribution to organizational performance, leadership skills development, level of freedom in strategic IT's decision making, strategic business knowledge, and interpersonal skills (Preston, Leidner, & Chen, 2008).

The Chief Digital Officer (CDO) may assume three main roles within DT processes of firms (Singh & Hess, 2017): i) entrepreneur; ii) digital evangelist; and iii) coordinator. The entrepreneur CDO promotes the use

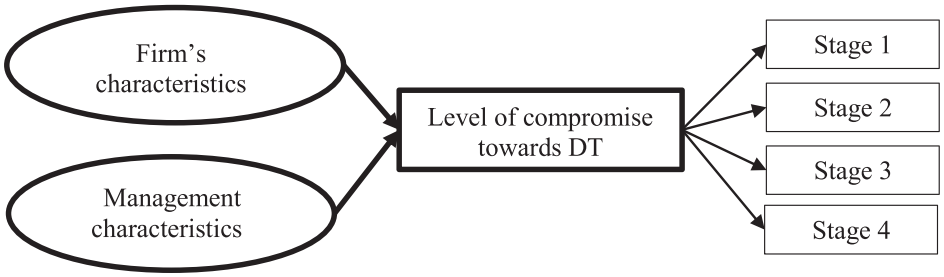

Fig. 1. Research Model.

of new technologies to innovate having a strong customer focus, and sometimes point the way to adapt whole business models. The digital evangelist CDO inspires people to a shift across all hierarchy levels and departments in organization's culture and communicate its DT strategy so that the entire firm embark in the digital 'journey'. Finally, the coordinator CDO has a broader role, initiating and designing the organizational shift, and promoting cross-functional cooperation towards the development of the IT and IS strategy and infrastructure (Singh & Hess, 2017).

DT must involve a strong coordination and effective collaboration between the Chief Information Officers (CIO) and the Chief Executive Officer (CEO) (Benlian & Haffke, 2016) and consider the idiosyncrasies of all other employees, needing to go further down in the firm's hierarchy and mobilizing most of its staff, concerning changes arising from DT (Benlian & Haffke, 2016).

Leadership characteristics given by autonomy of staff and democracy of the decision-making process by managers, influences the level of compromise with DT. A more decentralized process in strategic IT decision-making is usually the result of a higher involvement of managers in the discussion of issues regarding strategic IT. A coordination CDO promotes cross-functional cooperation for organizational strategic shifts (Singh & Hess, 2017) which implies a more democratic leadership style. We formulate the following proposition:

P1 – Increased staff autonomy and more decentralized decision-making processes, associated with more democratic leadership styles, are present or absent in solutions that show more advanced stages of DT.

2.3. Firms' characteristics and DT

Firms' characteristics like size, the digital mindset of the workforce, and the perspective of top management and reporting relationships of the CDO will also have an influence on DT processes (Singh & Hess, 2017). Additionally, coordination complexity of digital transformation is influenced by company size, degree of decentralized structure, and by the amount of dependencies between processes, products and IT systems (Singh & Hess, 2017).

Ownership of capital, being a family-owned business (FoB) or not, also influences the characteristics of the DT processes (Hess et al., 2016; Sebastian et al., 2017). These authors concluded that IT was the main driver of innovation of these companies' digital business units.

Companies' dimension, in terms of business volume, is another source of differences regarding DT. Li et al. (2018) showed that entrepreneurs develop their managerial capabilities by building up social networks and through learning and reflection. Platform utilization capabilities and business development capabilities allow SMEs to grow their business, to maintain durable customer relationships and to respond to platform and market changes. Moreover, business team building shows the potential to bridge SMEs' transformation and entrepreneurs' self-transformation, proving that managers' autonomy, adequate business planning, and efficacy of strategic management are important issues to promote DT. We formulate the following proposition:

P4 – Firm' characteristics are present or absent in solutions where companies show a higher level of compromise with DT.

3. Method

3.1. Research model

The research model explores possible solutions for the different stages of a company's DT process indicating the level of compromise towards DT. Solutions result from the combination of firm's characteristics, explained by three variables, and management characteristics, explained by three variables (Fig. 1).

Table 1
Variables and description.

Type	Variables	Description	Calibration	Observations
Independent variables	family	Family-owned business (FoB)	1 = Yes 0 = No	
	size	Business volume	1 = > 50 Million€ 0 = less or equal to 50 Million €	
	intern	Internationalization given by the percentage of business volume abroad	1 = 21% or more 0 = 0 to 20%	
	fs_leader	Leadership characteristics, given by autonomy of workers and democracy of the decision-making	Score of 9 or 10 = fully in	Range of answers between 1 and 10, where:
	fs_cohemiss	Perceived level of coherence between the Mission and managers' behaviour	>5 = maximum ambiguity	10 = Totally agree;
	fs_stratplan	Staff's perception on the efficacy of the strategic process (capacity to provide adequate means to prevent negative impacts and profit from external challenges)	<3 = fully out	1 = Totally disagree
Dependent variables	fs_digstrat1	Relevance of digital strategy to corporate strategy		
	fs_digstrat2	Relevance of digital strategy to business strategy		
	fs_ digstrat 3	Perceived level of innovations derived from digital strategy		
	fs_ digstrat 4	Relevance of investments in digital strategy		

3.2. Constructs and variables

The construct firm's characteristics include the following variables: 1) the type of capital ownership (FoB or non-FoB (family); 2) the dimension of companies defined by their business volume (size); and 3) the internationalization level, given by the percentage of sales abroad (intern) (Table 1).

The construct management characteristics includes: 1) leadership styles characterized by the perception of the autonomy given to employees (fs_leader); 2) the perceived coherence of managers' actions towards the company's mission (fs_cohemiss; and 3) the perceived efficacy of the company's strategic management process (fs_stratplan).

Digital strategy is incorporated within corporate and business strategy of a firm to promote DT, resulting in stronger competitive positioning of the company usually through the development and implementation of new business models that leverage the company's digital potential and result and innovations, supported by increased investment levels.

Outcome variables are related to the level of compromise towards digital technologies. DT is related to the corporate and digital strategy, the different business strategies of the firm, the process and product innovations, and the level of investment within the company. They comprehend four possible stages of DT. Stage 1: Relevance of digital strategy on corporate strategy; Stage 2: Relevance of digital strategy for business strategy; Stage 3: Perceived level of innovations derived from digital strategy; Stage 4: Relevance of investments on digital strategy.

In this sense, our research considers the possibility of different stages of a company's DT process, related to the sequential deepening of its DT involvement. A proposal of a framework regarding the possible different stages of DT (Table 2).

3.3. Data and sample

This study is based on a survey sent by email, between March and July 2019 to about 1000 Portuguese companies. Of the total of 122 replies received, 47 were valid. Below are descriptive statistics (Tables 3 and 4).

To analyse the data, we conduct a fuzzy-set qualitative comparative analysis (fsQCA) (Fiss, 2011; Kraus, Richter, Brem, Cheng, & Chang, 2016; Roig-Tierno, Gonzalez-Cruz, & Llopis-Martinez, 2017; Schneider & Wagemann, 2012; Woodside, 2013).

4. Results and analysis

With fsQCA, it is possible to devise some patterns that result in different perceived levels of compromise with DT. We use intermediate solutions (Fiss, 2011). According to the research model proposed (Fig. 1), the level of compromise towards DT is translated into four main stages. Results for stage 1 of DT provide eight possible solutions when considering the presence of the outcome, that is, companies fulfilling the requirements of this first stage of DT (Table 5), and just two solutions, when considering the absence of such an outcome.

Solutions, ordered by level of raw coverage, are as follows:

Solution 2: Non-FoB with decentralized leadership styles when there is a higher perception of coherence of managers towards the firm's mission, and the efficacy of strategic management process;
Solution 3: Higher dimension and non-FoB characterized by decentralized leadership styles, and a higher perception of coherence between managers' actions and the firm's mission;
Solution 5: Smaller and less internationalized businesses, with decentralized leadership styles, when there is a higher perception of coherence between the managers' actions and the firm's mission, as well as about the efficacy of strategic management process;
Solution 1: Less internationalized non-FoB, characterized by democratic leadership, and a good level of coherence of managers' actions towards the firm's mission;
Solution 4: Smaller and less internationalized non-FoB, characterized by a higher perception of coherence of managers' actions towards the firm's mission, and about the efficacy of strategic management process;

Table 2
Conceptual stages of DT.

Stage of DT	Brief description of conditions to be observed	Notes
Stage 1	Relevance of digital strategy to corporate strategy	The first and most basic stage of DT corresponds to a broader recognition of the need, and a basic conceptualization of DT, for the firm's development. Some isolated initiatives are taken in that regard. First actions and basic investments are considered to prepare the company for digital challenges at a corporate level. Investment amounts for IT and IS systems are planned. Some decisions like the definition of a digital strategy, or the hiring of a CDO or a CIO, may be considered to put together isolated actions towards DT. At this stage, level of investment in DT is still basic, considering that the firm is yet at the level of conceptualization of its digital initiatives. This scenario may occur independently from the situations where the company already has a web site, a presence on social media or even operates with certain levels of ecommerce, just representing a small percentage of its sales.
Stage 2	Relevance of digital strategy for corporate and business strategy	In the second stage of DT firms are more concrete about DT. Corporate initiatives for DT are transformed in business actions, usually for specific commercial initiatives although most of the changes are as yet still internal. A concrete digital business strategy (Bharadwaj et al., 2013) starts to be applied to transform the way business operates and will relate with its main stakeholders in the future. Investments in IT and IS, linked to the usual corporate and business strategy,y start to grow in a coordinated way, following some concrete plan that usually tends to congregate the different initiatives towards DT. However, they are still residual, compared to the overall level of the company's budget. IS and IT are usually the priority and the basis for the future change and innovation that characterizes the next step of DT
Stage 3	Perceived level of innovations derived from digital strategy	The third stage of DT consists of the translation of corporate and digital business strategy into concrete visible business and or process innovations by exploiting IT and IS potential. The company truly starts to change the way it operates and delivers their products/services. A digital culture starts to flourish, related to the way people socialize, communicate, and operate within and outside the firm's boundaries. At this stage, it is normal to see a redefinition of the company's business model and the development of new Value Propositions and/or product/service offers resulting from DT. A smooth balance shift between the level of sales from e-business when compared to the traditional commercial physical (bricks-and-mortar) channels starts to occur.
Stage 4	Relevance of investments in digital strategy	In the last stage of DT, digital strategy oriented by a dominant digital culture becomes predominant and embraces both corporate and business strategy. The level of innovations coming from DT become very relevant, and investments are also very significant, even predominant. Some previously bricks-and-mortar businesses start to be offered solely virtually, the physical business tends to be in the minority, and this clearly translates into the levels of income from DT initiatives.

Table 3
Firm's characteristics – number of observations (*).

Constructs	Variables	Yes	No	Total
Firm's characteristics	Family-owned Business (family)	11	36	47
	Business Volume > 50 M (size)	19	28	47
	Internationalization > 20% (intern)	20	27	47

Table 4
Management characteristics and outcomes – number of observations.

Constructs	Variables	>8	>5	<3	<6	N
Management characteristics	Staff autonomy and decentralized decision making (fs_leader)	19	39	4	8	47
	Coherence of mission (fs_cohemiss)	18	39	5	8	47
	Efficacy of strategic planning (fs_stratplan)	12	38	2	9	47
Outcomes	fs_digstrat1	24	35	2	12	47
	fs_digstrat2	13	37	2	10	47
	fs_digstrat3	10	35	5	12	47
	fs_digstrat4	13	33	5	14	47

Notes:
(a) Relevance of digital strategy to corporate strategy.
(b) Relevance of digital strategy to business strategy.
(c) Perceived level of innovation derived from digital strategy.
(d) Relevance of investments in digital strategy.

Table 5
Conditions that support solutions in the stage 1.

	S1	S2	S3	S4	S5	S6	S7	S8
family	○	○	○	○		○		●
size			●	○	○	●	●	○
intern	○			○	○	●	●	●
fs_leader	●	●	●		●		●	○
fs_cohemiss	●	●	●	●	●	●	●	○
fs_stratplan		●		●	●	●	●	●
Raw coverage	0.28	0.53	0.33	0.16	0.29	0.18	0.17	0.02
Unique coverage	0.00	0.12	0.03	0.04	0.17	0.03	0.02	0.02
Consistency	0.86	0.90	0.92	0.86	0.84	0.89	0.88	1.00
Solution Consistency	0.89							
Solution Coverage	0.86							

Note: ● = causal condition present; ○ = causal condition absent.

Solution 6: Bigger and more internationalized non-FoB, characterized by a higher perception of coherence of managers' actions towards the firm's mission, and about the efficacy of strategic management process;
Solution 7: Bigger and more internationalized businesses, characterized by decentralized management styles, a higher perception of coherence of managers' actions towards the firm's mission, and a good efficacy of strategic management process;
Solution 8: Smaller and internationalized FoB, characterized by a higher perceived level of efficacy of strategic management process, but with less democratic leadership processes, and a low perceived coherence level of managers towards the company's mission.

Concerning the situation where respondents have not identified a strong relevance of digital strategy on corporate strategy, just two solutions were obtained (Table 6), as follows:

Solution 1: Highly internationalized non-FoB, characterized by non-democratic leadership styles, and with low perceptions concerning coherence of managers towards the firm's mission, and low efficacy of strategic management;
Solution 2: Smaller, but highly internationalized non-FoB, with prevalent democratic leadership styles, but lower perception concerning the efficacy of strategic management, and the coherence between the firm's mission and managers' actions.

Stage 2 of compromise with DT is related to the relevance of digital strategy for both corporate and business strategy of the firm. Solutions rendered nine possible combinations for this stage (Table 7), as per below:

Solutions, ordered by level of raw coverage, are as follows:

Solution 1: Non-FoB showing more democratic leadership styles, and higher levels of perceived coherence of managers' actions towards the firm's mission, as well as a higher perceived efficacy of their strategic management process;
Solution 4: Higher dimension and non-FoB, characterized by more democratic leadership styles, having higher levels of coherence of managers towards the firm's mission, and higher perceived efficacy for their strategic management process;
Solution 6: Higher dimension and more internationalized non-FoB, with higher levels of perceived coherence towards their mission, and of perceived efficacy of their strategic management process;
Solution 7: Bigger and more internationalized non-FoB, characterized by more democratic leadership styles and higher levels of perceived coherence between managers' actions and the firm's mission;
Solution 8: Bigger and more internationalized businesses, showing more democratic leadership styles, and higher levels of perceived coherence of managers towards the firm's mission and a higher perceived efficacy of their strategic management process;
Solution 2: Smaller and less internationalized non-FoB, with higher levels of perceived coherence of managers towards the firm's mission, as well as the perceived level of efficacy of strategic management;
Solution 3: Non-FoB, having higher democratic leadership styles, and higher levels of perceived coherence of managers towards the mission;
Solution 5: Smaller and more internationalized non-FoB, with more democratic leadership styles, as well as a higher perceived efficacy of their strategic management process;
Solution 9: Smaller and more internationalized FoB, characterized by less democratic leadership styles, and a lower coherence between managers' actions and the firm's mission, also showing a strong perceived efficacy of its strategic management process.

Conversely, situations where respondents consider that there is an absence of the conditions to include the company in stage 2 of DT rendered three possible solutions (Table 8).

Table 6
Absence of conditions that support the inclusion in the stage 1.

	S1	S2
Family	○	○
Size		●
Intern	●	○
fs_leader	○	●
fs_cohemiss	○	○
fs_stratplan	○	○
Raw coverage	0.17	0.14
Unique coverage	0.17	0.14
Consistency	0.87	0.98
Solution Consistency	0.92	
Solution Coverage	0.31	

Note: ● = causal condition present; ○ = causal condition absent.

Table 7
Presence of conditions that support solutions in the stage 2.

	S1	S2	S3	S4	S5	S6	S7	S8	S9
family	○	○	○	○	○	○	○		●
size		○	○	○	○	●	●	●	○
intern		○	○		●	●	●	●	●
fs_leader	●		●	●	●		●	●	○
fs_cohemiss	●	●	●	●		●	●	●	○
fs_stratplan	●	●		●	●	●		●	●
Raw coverage	0.56	0.18	0.14	0.31	0.14	0.20	0.19	0.19	0.02
Unique coverage	0.13	0.04	0.00	0.18	0.02	0.03	0.02	0.02	0.02
Consistency	0.93	0.92	0.79	0.88	0.85	0.96	0.90	0.96	1.00
Solution Consistency					0.89				
Solution Coverage					0.89				

Note: ● = causal condition present; ○ = causal condition absent.

Solutions obtained that show the absence of conditions that support the inclusion of the companies in the second stage of DT delivered the following patterns:

Solution 2: Bigger and less internationalized non-FoB, with more democratic leadership styles, and without a strong perceived value of strategic management;
Solution 1: More internationalized non-FoB, with less democratic leadership styles, lower coherence towards the mission, and a weaker perceived value of strategic planning;
Solution 3: Smaller and less internationalized FoB, with less democratic leadership styles, lower coherence towards the mission, and a lower perceived efficacy of strategic management process.

Stage 3 of involvement in DT concerns the effective adoption of innovative business solutions deriving from the consideration of the potential of digital strategy. Results obtained concerning the presence of this outcome (Table 9).

Solutions, ordered by level of raw coverage, that support the inclusion of companies in stage 3 of DT, occur mostly in the following six situations:

Solution 2: Non-FoB, having more democratic leadership and coherent management styles, where there is a strong perception on the efficacy of strategic management process;
Solution 3: More international and non-FoB, with more democratic leadership styles, and higher coherence of management towards the firm's mission;
Solution 1: Less internationalized non-FoB, having more democratic leadership styles and more coherent management styles towards the firm's mission;
Solution 5: Higher dimension and more internationalized non-FoB, presenting more coherent management styles towards the firm's mission, and a stronger perception on the efficacy of strategic management process;

Table 8
Absence of conditions that support the inclusion of company in the stage 2.

	S1	S2	S3
Family	○	○	●
Size		●	○
Intern	●	○	○
fs_leader	○	●	○
fs_cohemiss	○		○
fs_stratplan	○	○	○
Raw coverage	0.17	0.19	0.13
Unique coverage	0.17	0.19	0.13
Consistency	0.97	0.93	0.81
Solution Consistency	0.91		
Solution Coverage	0.49		

Note: ● = causal condition present; ○ = causal condition absent.

Table 9
Presence of conditions that support solutions in the stage 3.

	S1	S2	S3	S4	S5	S6
family	○	○	○	○	○	
size			●	○	●	●
intern	○			○	●	●
fs_leader	●	●	●			●
fs_cohemiss	●	●	●	●	●	●
fs_stratplan		●		●	●	●
Raw coverage	0.30	0.58	0.35	0.18	0.20	0.20
Unique coverage	0.00	0.13	0.02	0.04	0.02	0.02
Consistency	0.82	0.89	0.89	0.83	0.85	0.90
Solution Consistency	0.84					
Solution Coverage	0.71					

Note: ● = causal condition present; ○ = causal condition absent.

Solution 6: Bigger and more internationalized businesses, with more democratic leadership and coherent management styles, associated with a strong perception on the efficacy of strategic management process;
Solution 4: Smaller and less internationalized non-FoB, having more coherent management styles, and a strong perception on the efficacy of strategic management process;

The situations where there is the absence of conditions to support the inclusion of the company in the third stage of DT are presented in Table 10.

Results for this outcome indicate five solutions, as follows:

Solution 1: More internationalized non-FoB, with less democratic leadership styles, and a lower perceived coherence of managers' actions towards the firm's mission, and with a weaker perceived value of strategic management;
Solution 2: Smaller and less internationalized FoB, having less democratic leadership styles, lower coherence of managers towards the company's mission, and a weaker perceived value of strategic management;
Solution 3: Bigger and less internationalized non-FoB, showing more democratic leadership styles, lower coherence of managers towards the company's mission, and a weaker perceived value of strategic management;
Solution 4: Smaller and more internationalized non-FoB, showing more democratic leadership styles, lower coherence of managers towards the company's mission, and a weaker perceived value regarding the efficacy of strategic management;
Solution 5: Smaller and more internationalized FoB, with less democratic leadership styles, and lower coherence of managers towards the company's mission, but a stronger perceived value of the efficacy of strategic planning.

Finally, stage 4 of compromise of the firm towards DT, expressing an

Table 10
Absence of conditions that support the inclusion of company in the stage 3.

	S1	S2	S3	S4	S5
family	○	●	○	○	●
size		○	●	○	○
intern	●	○	○	●	●
fs_leader	○	○	●	●	○
fs_cohemiss	○	○	○	○	○
fs_stratplan	○	○	○	●	●
Raw coverage	0.14	0.11	0.09	0.09	0.04
Unique coverage	0.12	0.11	0.09	0.06	0.04
Consistency	0.97	0.81	0.87	0.90	0.78
Solution Consistency	0.87				
Solution Coverage	0.44				

Note: ● = causal condition present; ○ = causal condition absent.

almost full commitment of the company towards the DT imperative, occurs when there is a strong investment in the digital strategy, which is considered as a requisite to implement proper business strategy, crucial to answer adequately persistent market and customer demand (Table 11).

Six solutions provide the patterns that show the inclusion of companies in stage 4 of DT:

Solution 2: Non-FoB, having more democratic leadership styles, and showing a higher coherence of managers towards the firm's mission, and a stronger perception of the efficacy of strategic management process;
Solution 3: Higher dimension non-FoB, characterized by more democratic leadership styles, and higher coherence of managers towards the company's mission;
Solution 1: Less internationalized non-FoB, with more democratic leadership styles, and higher coherence of managers towards the firm's mission;
Solution 5: Bigger and more internationalized non-FoB, characterized by higher coherence of managers towards the company's mission, and a strong perception of the efficacy of strategic management;
Solution 6: Bigger and more internationalized businesses, characterized by more democratic leadership styles, and a higher coherence of managers towards the company's mission, as well as a strong perception on the efficacy of strategic management.
Solution 4: Smaller and less internationalized non-FoB, having higher coherence of managers towards the company's mission, and a strong perception of the efficacy of strategic management;

Conversely, the absence of this stronger commitment is revealed by the absence of adequate investment by the company in supporting IT and IS strategies and infrastructures to support business strategy and innovation towards DT.

Absence of this commitment is prevalent in four patterns (Table 12).

Solutions that reveal this absence of commitment concerning stage 4 of DT are as follows:

Solution 1: Less internationalized non-FoB, having less democratic leadership styles, and lower coherence of managers towards the company's mission, and where there is a weaker perception of the efficacy of strategic management;
Solution 2: Bigger but less internationalized non-FoB, having democratic leadership styles, but lower coherence of managers towards the company's mission and a weaker perception of the efficacy of strategic management;
Solution 3: Smaller and more internationalized non-FoB, characterized by more democratic leadership, lower coherence of managers towards the company's mission but a strong perception on the efficacy of strategic management;
Solution 4: Smaller and more internationalized FoB, characterized by less democratic leadership styles and lower coherence of managers towards the company's mission, as well as a weaker perception of the efficacy of strategic management.

5. Discussion

This study analyzes how firms' characteristics, associated with management characteristics, promote DT in Portuguese companies. Based on the overall perception regarding the leadership and decision-making style, the coherence of managers' actions towards the firm's mission and the efficacy of strategic management process, we verified the capacity to develop different stages of DT according to characteristics of the firm (dimension, level of internationalization, and type of capital ownership). Stages considered gradually characterize the deepening of DT processes in companies analyzed. Moreover, we have confirmed that there are certain firms', as well as management characteristics, that facilitate the development of DT or make it difficult.

We confirm propositions 1, 2, and 3. More democratic leadership styles, more coherent managers' actions towards the firm's mission, and more efficient strategic management processes, are characteristics that favour the development of DT processes. These conditions are observed in almost all the combinations that characterize the companies' involvement in the different stages of DT, and these results are reinforced in the more advanced stages of DT development.

As for proposition 4, we confirmed the importance of the firm's characteristics to explain the capacity of a firm to engage in different DT stages. Internationalization is possibly the most important characteristic in this regard.

The literature confirms that the impact of digital transformation (DT) on business organizations is technology-enabled (Hanna, 2016), but that it is always led by managers, and oriented for people (Goodwin, 2018). Managers decide which technologies to adopt, when change must be made, the pace of adoption, and what will be the organizational, productive, and business processes to be covered by those technologies. To

Table 11
Presence of conditions that support solutions in the stage 4.

	S1	S2	S3	S4	S5	S6
family	○	○	○	○	○	
size			●	○	●	●
intern	○			○	●	●
fs_leader	●	●	●			●
fs_cohemiss	●	●	●	●	●	●
fs_stratplan		●		●	●	●
Raw coverage	0.28	0.57	0.34	0.18	0.19	0.19
Unique coverage	0.00	0.14	0.02	0.04	0.02	0.02
Consistency	0.79	0.88	0.85	0.86	0.82	0.87
Solution Consistency	0.85					
Solution Coverage	0.71					

Note: ● = causal condition present; ○ = causal condition absent.

Table 12
Absence of conditions that support the inclusion of company in the stage 4.

	S1	S2	S3	S4
Family	○	○	○	●
size		●	○	○
intern	●	○	●	●
fs_leader	○	●	●	○
fs_cohemiss	○	○	○	○
fs_stratplan	○	○	●	●
Raw coverage	0.14	0.09	0.08	0.04
Unique coverage	0.12	0.09	0.06	0.04
Consistency	0.95	0.83	0.82	0.78
Solution Consistency	0.88			
Solution Coverage	0.33			

Note: ● = causal condition present; ○ = causal condition absent.

improve efficiency on organizational, productive and business levels, and to promote DT, the mission and the company's strategy must consider DT (Aral, Dellarocas, & Godes, 2013; Hanna, 2016; Oestreicher-Singer & Zalmanson, 2013). The main characteristics determining the pace of DT are related to the size of the company, its internationalization level, and the ownership of capital. The push of the strategic moves and the pull of the markets, technology, and societal changes are the main drivers of DT (Motoyama & Malizia, 2017).

Configurations obtained show that management characteristics are prevalent, when compared to firms' characteristics, to explain the beginning of a DT process.

More democratic leadership associated with managers' coherence towards the firm's mission and the efficacy of strategic planning, are the triggers that explain the occurrence of this first stage of DT. In this cases, firms' characteristics provide ambiguous results for the outcome.

Regarding firms' characteristics it is important to highlight that just one in nine possible configurations considered the case of family-owned business (FoB) present in the first stage of DT, whereas in five out of nine possible solutions, the condition of not being FoB is relevant.

Results obtained for the absence of conditions for the inclusion of companies in the first stage of DT reaffirm the difficulty of FoB to go digital, and are especially associated with a low coherence of managers towards the firm's mission, and lower efficacy of the strategic management. Conversely, higher levels of internationalization are also important for companies to start implementing DT processes.

Concerning the second stage of DT, both the firms and the management characteristics become more relevant to explain DT. Notwithstanding, it continues to show a prevalence of management characteristics. Moreover, there is a confirmation of the apparent difficulties of FoB to develop DT. Just one out of nine possible solutions consider the fact of being FoB, while not being FoB is a causal condition, registered in seven out of nine possible solutions.

Internationalization of business also confirms its importance to explain the development of this second stage of DT: five out of nine solutions showed this as a causal condition for this outcome. This occurs mostly when internationalization is combined with higher dimension of the businesses.

Conversely, the fact of being a smaller and less internationalized FoB, having less democratic leadership style, with lower coherence of managers towards the firm's mission, as well as lower efficacy of strategic management, is the combination that causes absence of firms from the second stage of DT. This confirms the empirical ideas already referred to in the literature review on this subject.

The analysis of the solutions regarding the occurrence of the third and fourth stages of DT reinforces the previous trends already identified, that is: the difficulties of FoB to promote more advanced stages of DT (there are no combinations for the third and fourth stages with FoB) and the paramount importance of management characteristics to justify the deepening of DT.

Concerning the firms' characteristics, the analysis tends to reinforce the idea that not being FoB, being more internationalized, and being bigger are important characteristics to be able to develop these more advanced stages of DT.

Regarding management characteristics, a special reference must be made to the coherence of managers towards the company's mission. This condition is present in all six solutions for the third and fourth stages of DT. This is also in line with the cases showing more democratic leadership styles, and higher perceived efficacy of strategic management.

The analysis of solutions concerning the absence of these outcomes (third and fourth stages of DT) tend to confirm the ambiguity of the firms' characteristics to explain DT, and also the need to develop more democratic leadership and more coherent management styles, as well as more effective strategic management processes in companies in order to create the conditions to develop DT.

Sousa and Rocha (2018) state that the ability to manage disruptive businesses, coming out from DT processes of companies, requires the development of certain leadership, management, and strategic innovation skills.

Results indicate that more agile and democratic decision-making processes associated with more democratic leadership styles are features that promote the development of DT in Portuguese companies. Also, the capacity of managers to develop principles of coherence towards the company's mission is a condition that can promote the development of higher stages of DT. Finally, the innovation competencies may relate to the efficacy of strategic management processes, which ultimately will develop the firm's capacities to sustain competitive advantages from the DT process.

Weiner, Balijepally, and Tanniru (2015) confirm that there are certain conditions to promote the achievement of operational goals related namely to IT developments and to better prepare the future of the company. Those are related with the capacity to promote more democratic leadership styles and also the higher coherence of managers towards the firm's mission, and the perception of the efficacy of strategic management,.

Although not conclusive, we may assert that the condition of being FoB does not favour the firm to improve its DT stage. Villegas, Jiménez, and Hernández (2018) state that this might happen mostly because the majority of FoB do not have, simultaneously, all the management characteristics that could favour the development of the different stages of DT. However, also in the case of FoB, we notice that there are certain combinations of firms' characteristics, such as their bigger dimension, and their increased internationalization, that may counter-balance these pitfalls coming from management characteristics, and push higher stages of DT.

In this context, Vogelgesang, Clapp-Smith, and Osland (2014) indicate that international businesses tend to show a bigger dimension and their leaders tend to develop competencies to use ICT and to promote more democratic decision-making processes with their team members. At the same time, leaders of bigger companies tend to develop management mechanisms and to implement management practices more in line with those that were considered as important to the development of more advanced stages of DT.

6. Conclusions and contributions

The capacity to develop more advanced stages of DT is more related to management characteristics than to firms' characteristics.

Within firms' characteristics, conclusions support that higher levels of internationalization and/or bigger dimensions of businesses are important conditions to promote more advanced stages of DT, although they need to occur in combination with certain management characteristics.

Regarding management characteristics, more democratic leadership styles, higher levels of coherence towards the firm's mission, and higher efficacy of the strategic management processes are relevant conditions to explain more advanced stages of DT. These conditions can even counter-balance certain firms' characteristics that tend to hinder the development of DT.

The coherence of managers towards the company's mission emerged as a crucial condition to promote DT. This condition is present in almost every solution and especially in more advanced stages of DT. Effective leadership, characterized by the capacity to live authentically the firm's mission, and share that mission with the remaining staff and employees, seems to be crucial to mobilize actions towards DT, and may even offset some other pitfalls that may exist to promote DT, regarding both management or firms' characteristics.

Overall, family-owned businesses (FoB) tend to show more difficulties to promote more advanced stages of DT. This happens mostly due to their difficulties to develop some management characteristics that are important to this end. However, higher internationalization levels or the bigger dimension of FoB may balance the usual pitfalls of FoB to develop DT and can even work as push-triggers for the DT of FoB.

Knowledge obtained will favour the development of DT through the search of the best possible combinations between the firm's characteristics and the needed management characteristics.

7. Limitations and future research

The main limitations of this study derive from the sample used, which is not representative of Portuguese companies in general.

Future research may confirm the proposed research model to be a representative sample and conduct additional analyses, while also exploring the issue on the importance of the company's mission and its role in the reinforcement of the strategic positioning of the company, as well on the further mobilization of people to the development of DT.

Another suggestion for future research consists in using the model here proposed to develop a longitudinal study within a set of firms, and enhance the results obtained.

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