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The behavior of managers handling digital business transformations: theoretical issues and preliminary evidence from firms in the manufacturing industry

Behavior of
managers
handling DBTs

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Abstract

Purpose – Organizational culture plays a central role when dealing with the issue of digital business transformation (DBT). Managers handling a DBT and involved in digital strategizing are expected to modify the organizational culture of firms to make it more fitting with the paradigm of digital economy and having more chance of success. Thus, it is noteworthy to inspect the role they can have over DBTs. Accordingly, the purpose of this paper is to investigate the behavior that managers assume when they approach DBTs by investigating whether they act as mentors/facilitators or entrepreneurs/innovators, as coordinators or decision makers.

Design/methodology/approach – To achieve the above purpose, ten case studies about manufacturing firms have been selected. Case studies, retrieved by the Digital Innovation Observatories of the School of Management of the Politecnico di Milano, are studied and analyzed by means of a qualitative content analysis on textual data. This allows getting specific insights into organizational culture before and after DBT and about the role played by managers.

Findings – Achieved results disclose that managers need to modify the organizational culture of their firms to handle a successful DBT. However, firms can assume different organizational culture and thus the role assumed by managers handling a DBT can change as well.

Originality/value – To the authors knowledge, this paper is among the first that aim to investigate the role that managers assume when handling DBTs. In particular, originality lies in the fact that assumed roles are rebuilt in reference to their ability to modify organizational culture.

Keywords Digital business transformation, Organizational culture, Leadership, Manufacturing industry, Content analysis, Case studies

Paper type Research paper

1. Introduction

Before defining and implementing firms' strategies (generally meant), managers need to analyze the external context, from which opportunities or threats can derive, and evaluate internal factors, which can determine strengths or weaknesses (Dosher *et al.*, 1960; Pickton and Wright, 1998). Also in reference to digital strategizing – the act of planning and defining strategies in the paradigm of digital economy (Correani *et al.*, 2020; Matricano, 2020) – managers need to identify and analyze exogenous and endogenous factors that can influence strategic choices by firms (Baiyere *et al.*, 2020).

As for external factors, several classifications have been proposed in recent years (Denecken, 2014; European Commission, 2015, 2017; Boston Consulting Group, 2015; Ross *et al.*, 2016; Sebastian *et al.*, 2017; Beliaeva *et al.*, 2019). All of them, despite different nomenclatures, underline the relevance of information and communication technologies (ICTs) and of information and communication infrastructures (ICIs). These factors are



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relevant to all the digital strategies but they have a specific impact according to each firm. As such, generalizations are difficult to carry out. As a consequence, emphasis needs to be based on endogenous factors.

From an extensive literature review, the origins of relevance of endogenous factors can be dated back to the 1990s, thanks to the affirmation of two theoretical frameworks: the resource-based view (RBV) of firms – originally proposed by [Penrose \(1959\)](#) and lately supported by [Rumelt \(1982\)](#), [Wernerfelt \(1984, 1995\)](#), [Barney \(1986, 1991\)](#), [Dierickx and Cool \(1989\)](#) and [Grant \(1991\)](#) – and the knowledge-based view (KBV) of firms ([Conner and Prahalad, 1996](#); [Grant, 1996](#); [Spender, 1996](#)).

While the first theoretical framework emphasizes the importance of all the resources available to firms (especially tangible ones), the second one attributes a leading role to intangible resources, especially knowledge. According to KBV, in fact, tangible resources (although rare, of value, imperfectly imitable and difficult to transfer) are static and so – in the long term – they are destined to lose their relevance. To obtain a competitive advantage, and to make it sustainable over time, it is therefore advisable for firms to direct their interest toward intangible assets. These, by definition, are dynamic (i.e., they are more easily adaptable to unstable economic contexts, indecipherable and characterized by continuous changes) and, therefore, are more suitable for achieving a lasting competitive advantage.

Since the 1990s, KBV has assumed an increasing importance among scholars and this has led to important changes in the management of resources ([Castaldi, 2007](#)). Without sacrificing the role of tangible resources (which are still necessary for the production of goods and services), firms have paid greater attention to knowledge and – above all – to the processes through which it is created and exploited ([Dagnino, 2005](#)). As underlined by prominent scholars ([Nonaka, 1994](#); [Nonaka and Takeuchi, 1995, 1997](#); [Nonaka et al., 2000](#)), knowledge processes can be successful or not. Reasons of success/failure can be sought in the economic context that is unstable, indecipherable and characterized by continuous changes. However, the main reasons of success/failure of these processes can be found inside firms. In this vein, some endogenous factors – such as organizational culture and leadership – have assumed a relevant role as they can foster or prevent the sharing of old knowledge and the creation of new one.

In the wave of changes occurred since the 1990s (and driving to the affirmation of KBV of firms), organizational culture and leadership have confirmed their relevance also in reference to digital economy even if it is not clear yet how they combine with each other. In particular, from an extended literature review, it seems that scholars have just started focusing attention on the behavior that managers assume when they approach digital strategizing and handle a digital business transformation (DBT) ([Olsson and Bernhard, 2020](#); [Matricano, 2020](#)). Managers, in fact, are expected to modify the organizational culture of firms, to make it more fitting with the paradigm of digital economy, but it is not renowned if they act as mentors/facilitators or entrepreneurs/innovators, as coordinators or decision makers. This is the research gap that this paper aims to fill in.

To deal with this issue, this paper is structured as follows. In [Section 2](#), we conduct an extended literature review. This aims to classify the different organizational cultures that firms can embrace and the different roles that managers can assume, which is a prerequisite for the analysis of firm evolution in the context of a digital business transformation (DBT). [Section 3](#) describes the theoretical framework, analyzing the dimensions thought to affect the development of successful DBTs. In [Section 4](#), the case study analysis (carried out on ten selected cases retrieved by the Digital Innovation Observatories of the School of Management of the Politecnico di Milano) is illustrated. Follows sample description in [Section 5](#). Achieved results are presented in [Section 6](#) and discussed in [Section 7](#). Eventually, in [Section 8](#), we draw the main concluding remarks of the paper.

2. Literature review

Digital transformation has a deep impact on strategy formulation and implementation (Castaldi, 2020; Caputo *et al.*, 2021; Pappas *et al.*, 2021). In the aim of digital strategizing – that is, the act of planning and defining strategies in the paradigm of digital economy – specific attention needs to be addressed toward organizational culture (Leidner and Kayworth, 2006; Shih and Huang, 2010; Müller and Nielsen, 2013; Lee and Berente, 2012; Yoo *et al.*, 2012; Parida *et al.*, 2019; Ruthi-hinda, 2019). It is organizational culture, defined by entrepreneurs/top managers and shared with human resources (Schein, 1991), that represents the most important premise for the success, or failure, of DBTs (Solberg *et al.*, 2020).

2.1 Organizational culture

To catalogue organizational cultures in a proper way, scholars increasingly refer to the competing value framework (CVF; Quinn and Rohrbaugh, 1983; Quinn and McGrath, 1985; Quinn, 1988; Cameron and Quinn, 2006) that is based on two parameters: stability/flexibility and internal/external focus. On the basis of the stability/flexibility parameter, it is analyzed the level of control exercised by top managers over the human resources working in the company (stability) or the discretion that is granted to them (flexibility). On the basis of the internal/external focus, instead, it is assessed whether human resources present in the company have reached a good level of integration (internal focus) or whether they are oriented externally, emphasizing the differentiation of their activities (external focus). By combining the two factors it is possible to obtain four archetypes of organizational culture (Table 1).

In the first quadrant of Table 1, there is the clan, an archetype that is characterized by flexibility and internal focus. As pointed out by the scholars who proposed the framework (Quinn and Rohrbaugh, 1983; Quinn and McGrath, 1985; Quinn, 1988; Cameron and Quinn, 2006), the clan-inspired organizational culture is based on cohesion, participation and sharing (there is an internal focus). In this case, there is considerable organizational flexibility, but everyone's attention is mainly focused on the company. Always based on flexibility, but oriented toward the outside, it is the archetype of adhocracy (second quadrant). In this case, organizational flexibility is instrumental to adapt to external changes. In the third quadrant, there is the archetype of the hierarchy. In this case, organizational culture is oriented toward stability (with rules and roles to be respected) and looks mainly within the company. The archetype of the market is placed in the last quadrant, the fourth one. Also in this case the organizational culture is oriented toward stability (with rules and roles to be respected), but an external focus prevails (attention is directed to all events that may occur outside the company).

Based on the parameters used (Quinn and Rohrbaugh, 1983; Quinn and McGrath, 1985; Quinn, 1988; Cameron and Quinn, 2006), the proposed classification allows us to identify what is – or should be – the organizational culture that companies should develop to start and manage a DBT. Surely companies should aim to develop and spread an organizational culture with an external focus (thus reducing the choice between two alternatives, adhocracy

	Internal focus	External focus
Flexibility	Clan 1	Adhocracy 2
Stability	3 Hierarchy	4 Market

Source(s): Matricano (2020), p. 34

Table 1.
Archetypes of
organizational culture

or the market) and, obviously, they should favor flexibility. This could make the final choice fall on adhocracy. However, excluding hierarchical culture, clan and market-oriented cultures also seem to be a valid way to start a DBT. These organizational cultures, in fact, have some merits (flexibility and/or external focus) that can create a valid promise for a successful DBT. Thus, it is important for businesses to find the right balance between stability/flexibility and internal/external focus and not to aim only to adhocracy.

To develop and spread an organizational culture oriented toward adhocracy, clan or market, it is important to consider another aspect (Rutihinda, 2019). The creation and dissemination of corporate culture (whatever the archetype to which one refers) depends on the leadership exercised in the company (Wilson *et al.*, 2004; McKee and Massimilian, 2006; Uhl-Bien *et al.*, 2007; Li *et al.*, 2016; Kane *et al.*, 2019; Larson and DeChurch, 2020; Solberg *et al.*, 2020).

2.2 The role of leaders

Depending on the role assumed by top managers and their entrepreneurial behavior, organizational culture is directed toward one archetype rather than another. In fact, from the contribution authored by Rutihinda (2019), it is possible to infer that if the top managers take on the role of mentor, facilitator or even of a relative, then the organizational culture is directed toward the clan (archetype characterized by flexibility and internal focus). If the top managers take on the role of entrepreneur or innovator (Ammirato *et al.*, 2019), by assuming taking on the risk, then the organizational culture moves toward the archetype of adhocracy (characterized by flexibility and external focus). Again, if top managers take on the role of coordinator, supervisor, then the organizational culture tends toward the archetype of the hierarchy (characterized by stability and internal focus). Finally, if top managers take on a role of decision maker, oriented toward the achievement of objectives, then the archetype of the organizational culture is that of the market. The different roles covered by top managers with reference to the different types of corporate culture are shown in Table 2.

For top managers who are already involved in firms and who, according to established practices, have already assumed a certain role – linked, of course, to the organizational culture already in place in the company – it is not easy to change their role. In order for a subject to be able to act as a leader in view of a DBT – some scholars define these subjects as digileaders (Jakubik and Berazhny, 2017; April and Dalwai, 2019; Promsri, 2019) – and to direct the organizational culture towards the adhocracy, the clan or the market it is necessary for this subject to report different individual characteristics (Jakubik and Berazhny, 2017) such as social intelligence, passion, empathy, an open mind, creativity, critical thinking, the ability to carry out a virtual teamwork, cocreation, the ability to collaborate, communication, sharing, collaborative learning, knowing how to delegate power, ability to empower others, the ability to anticipate the future, to have a clear vision and to establish ex ante objectives to be achieved. Over time, therefore, some scholars have formalized the figure of digileaders assigning them – in a more appropriate way – the role of Chief Digital Officer (CDO; Dumeresque, 2014; El Sawy *et al.*, 2016; Singh and Hess, 2017; Tumbas *et al.*, 2018;

	Internal focus	External focus
Flexibility	Mentors/facilitators	Entrepreneurs/innovators
	1	2
Stability	3	4
	Coordinator	Decision maker

Table 2.
Roles assumed by
managers in reference
to archetypes of
organizational culture

Source(s): Matricano (2020), p. 37

Berman *et al.*, 2020; Kunisch *et al.*, 2020). This subject, like other subjects operating at top management level and having specific skills, is responsible for planning and guiding the DBT because of his digital mindset (Solberg *et al.*, 2020). In particular, according to Larjovuori *et al.* (2018), CDOs should: define the strategic vision of DBT and plan the actions necessary to put it into practice. In particular, the CDOs must act in the light of two objectives. On the one hand, they must have a clear idea of what the future of the company could be; on the other hand, they must be actively involved in achieving these objectives; and guide the change in organizational culture. CDOs must work on the mindset, on the organizational culture already in place, on learning to fail to guide the company toward change; allow/facilitate change. With reference to this goal, it is essential that CDOs act as coaches, encouraging human resources to question what is being done and how it is done (Solberg *et al.*, 2020). At the same time, the CDOs must be able to promote an active, proactive participation of human resources, and lead networks. In particular, the attention of CDOs must be directed toward customers (who are always at the center of a DBT) and toward collaborations and partnerships from which new opportunities can arise. Obviously, it should be noted that leadership oriented toward a DBT alone does not guarantee any success. In fact, it is clearly emphasized that only if human resources share leadership, then it is possible to change the organizational culture. However, empirical evidences confirm that involvement of human resources in the aim of a DBT is not a simple task (Georgalis *et al.*, 2015; Schwertner, 2017; Weill and Woerner, 2018; Fenech *et al.*, 2019). According to some scholars (Higgs and Rowland, 2005; Ford *et al.*, 2008; Jacobs *et al.*, 2013; Price and Whiteley, 2014; Burnes, 2015), in fact, the main difficulty consists in convincing human resources of the need for a change that – at least in the first instance – assigns considerable importance to technologies and reduces the value of human resources themselves (Hill, 1988). In this vein, scholars' attention (Safar *et al.*, 2006; Gupta, 2018; Viki, 2018; Fenech *et al.*, 2019) is mainly focused on barriers to change such as inertia, doubt and cynicism (Viki, 2018). These barriers can nullify any push for change by digileaders, reducing the importance of their individual characteristics and invalidating their long-term strategic vision.

Putting aside the involvement of human resources, this paper aims to focus on the organizational culture of firms conducting a successful DBT and investigate the roles assumed by managers in such a process.

3. Theoretical framework

Based on previous literature review, we can assume that the characteristics of firms' organizational culture and the roles assumed by leaders are fundamental for a successful DBT.

As shown in Figure 1, we propose a multidimensional framework for the investigation of the relationship between the characteristics of organizational culture and the success of conducted DBT. Moreover, we suggest that the impact of organizational culture on the efficacy of DBTs is mediated by the role assumed by the process leaders.

Based on previous arguments, we elaborate the following propositions.

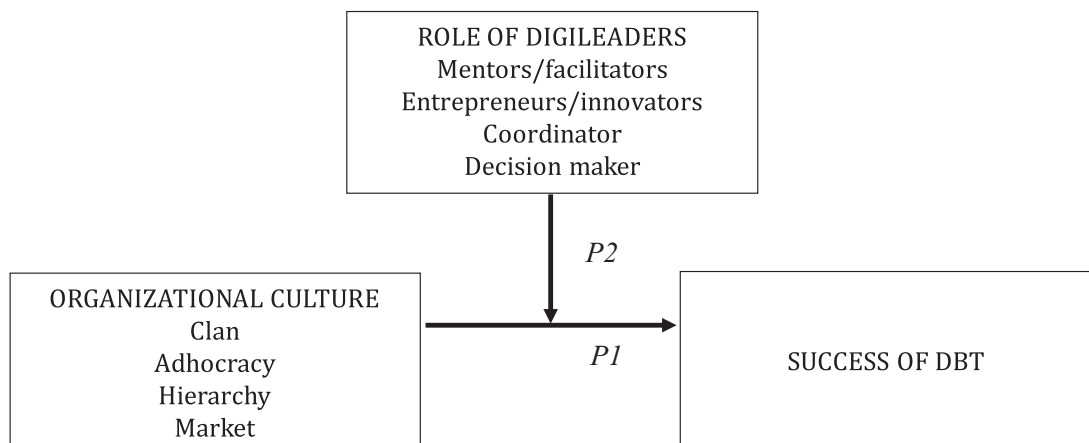
Proposition 1. Adhocracy, clan and market-oriented cultures represent a good starting point to conduct a successful DBT, the better being represented by adhocracy.

Nonetheless, the creation and dissemination of corporate culture depends on the leadership exercised in the company by process leaders.

DBT requires to be guided by managers able to act as a leader for the aim of this complex organizational evolution (so called "digileader" as previously seen in Section 2.2).

For these arguments, we could also offer the following proposition.

Figure 1.
Theoretical
framework: the
antecedents of
successful DBTs



Proposition 2. The leadership characteristics of the managers guiding the process are likely to affect the impact organizational culture on the efficacy of a DBT.

4. Case study analysis

4.1 Research methodology

With the aforementioned aim to investigate the antecedents of successful DBTs, that is, the characteristics of organizational cultures and the behavior assumed by managers handling the process, we carried out a content analysis on ten business case studies.

We opted for qualitative research as it allows the investigation of a complex, fluid, evolutionary and multifaceted phenomenon such as the one digital transformation, enabling to go deeper into a field that has not been sufficiently analyzed yet (Morse, 1991; Creswell and Creswell, 2018).

Indeed, case studies allow to gain insights into individual settings, supporting an in-depth analysis of specific features of the investigate phenomenon (Eisenhardt, 1989; Swanborn, 2010).

By means of case studies, we aim to analyze the presumed links among identified dimensions in real-life interventions, verifying the causal relationships between organizational culture and leadership roles on the one hand and the success of DBTs on the other (Yin, 1981, 2009).

This way we aim at advancing the existing knowledge-based and provide evidence-based insight into the investigated phenomenon, thus also providing useful indications for the successful implementation of digital transformation initiatives by firms.

4.2 Case selection

For the aim of the work, we selected ten case studies. All of them pertain DBTs launched by firms operating in the manufacturing industry, representing our unit of analysis. We limited our analysis to one only industry to improve comparability. We choose manufacturing as it has been deeply impacted by new digital technologies; indeed, it is characterized by a consistent IoT spending, strong concern with the industrial internet of things (IIoT), and implementation of artificial intelligence (AI) and big data analytics (www.forbes.com, www.gartner.com; www.i-scoop.eu). In addition, DBT is strongly affecting large manufacturing firms' organizational structure (Bilgeri et al., 2017). These were traditionally characterized by a mindset of stability, incremental changes, hierarchical structures and definite responsibilities, all of which are now severely challenged by DBT (Bilgeri et al., 2017).

Case studies were retrieved by Osservatori.net, a multimedia and interactive platform set up by the Digital Innovation Observatories of the School of Management of the Politecnico di Milano, created in 1999 with the aim of raising cultural awareness in all the main areas of digital innovation and representing a point of reference in Italy for digital innovation, performing research, communication and continuous update activities.

4.3 Content analysis (data collection and analysis)

The decision to adopt a content analysis was due to the characteristics of the selected unit of analysis; it is a research technique that allows to draw meaning from textual data, to analyze documents and describe a phenomenon in a systematic and objective manner (Krippendorff, 1980).

It can be applied both to qualitative and quantitative data, in an inductive or deductive way, permitting the reduction of a phenomenon into defined categories, in order to improve analysis and interpretation (Berelson, 1952; Elo and Kyngäs, 2008; Delli Paoli and Addeo, 2011). As Elo and Kyngäs (2008, p. 107) write: “Inductive content analysis is used in cases where there are no previous studies dealing with the phenomenon or when it is fragmented. A deductive approach is useful if the general aim was to test a previous theory in a different situation or to compare categories at different time periods.”

By means of a content analysis, we aimed at detecting not only the manifest but also the latent meaning of selected documents/case studies (Berelson, 1952; Lasswell, 1968). By searching for specific elements and keywords in the case studies, we investigated the role played by organizational culture and leadership in the context of successful digital transformation experiences. Our approach went beyond the mere count of selected keywords but considered the contextual meaning of the text, thus leading to a subjective interpretation. This approach does not limit to the linguistic meaning of the text, focusing on the messages transmitted as a whole, based on the understanding of the cognitive patterns of other people (Duriau *et al.*, 2007; Losito, 1996).

The analysis started from a systematic classification process of coding. For the aim of the investigation, we created a coding scheme adopting a hybrid approach based on both deductive and inductive analysis processes to derive the concepts from the data. We started from a deductive coding, operationalizing the structure of the analysis on the basis of previous knowledge and the theoretical framework presented in Section 3 (this way allowing to test previous theory). The theoretical propositions guided data collection, acting as a guide for the analysis and helping to direct the activity and to delimit the variables under investigation. This led to a first draft of the coding scheme. Then we moved to an inductive approach for the choice and identification of the terms and elements characterizing each category, based on data about selected case studies and thus stemming from concrete application.

It was a progressive and iterative process, leading to a coding scheme composed by three variables, two of them being organizational culture before and after DBT, each made up of four categories (flexibility, stability, internal focus, external focus) and the third, the role assumed by managers handling the DBT, made up of two categories (related to the culture before DBT and after the DBT) (Table 3).

Just like a questionnaire, the above form (coding scheme) was used, to “interview” the text of selected business case studies.

5. Sample description

As anticipated, we retrieved from Osservatori.net, all the ten available case studies pertaining firms operating in the manufacturing industry.

As to enterprise size, the sample is heterogeneous. In fact, 90% of sample firms are big corporations. Fifty percentage of sample have their headquarters in Italy, 20% in the USA, and the remaining 30% in the UK, Japan and Germany.

Going to the content of the DBT, as expected for manufacturing firms, all business case studies pertain the transition to Industry 4.0 processes. The types of digital technologies adopted by firms in the process of digital transformation range from 1 to 4 and they are the following: IoT/IIoT, advanced automation, advanced human machine interface, industrial analytics, additive manufacturing and cloud manufacturing. As shown in [Table 4](#), the most cited is IoT/IIoT (33%), followed by advanced automation (19%) and advanced human machine interaction (19%).

Digital transformation usually involves more than one organizational function and process. These often consist in the production and maintenance activities (respectively, 22% and 21%), followed by logistics (15%), education and training (12%), planning, prototyping/new product development and quality assurance (9% each), and finally assembly (3%) ([Table 5](#)).

At this stage, after presenting the main info about the sample used for the present research, it is possible to proceed with the empirical part and so it is possible to present the results of the “interview” to the text of selected business case studies.

6. Results

The qualitative content analysis adopted for the investigation of organizational culture and leadership behavior related to DBT launched and managed by manufacturing firms has taken to the results as shown in [Table 6](#). This table recalls [Table 3](#) (the coding scheme adopted for the present research). In particular, the roles assumed by the managers handling the process before and after the DBT are inferred ([Galanakis and Giourka, 2017](#)).

From [Table 6](#), very interesting results derive. Out of ten firms, four of them did not modify their organizational culture before and after DBT. In one firm, managers assumed and maintained the role of decision makers. Organizational culture was (both before and after DBT) oriented toward market. In three firms, instead, managers assumed and maintained the role of entrepreneurs/innovators. In this case, organizational culture was (both before and

Firm demography

Headquarters location
Industry
Firm Size
Digital technologies adopted
Involved organizational functions/processes

Organizational culture before DBT

Flexibility
Stability
Internal focus
External focus

Organizational culture after DBT

Flexibility
Stability
Internal focus
External focus

Role assumed by managers handling the DBT

Related to the culture before DBT
Related to the culture after DBT

Source(s): Authors' own elaboration

Table 3.
Coding scheme

after DBT) oriented toward adhocracy. At the same time, out of ten firms, six of them modified their organizational culture and the role assumed by managers handling DBT, appearing relevant and of great interest for this study.

The six companies that have modified their organizational culture followed different paths. Three of them moved from hierarchy to adhocracy. Before DBT, culture was characterized by stability and internal focus. But, to launch and implement the DBT, managers realized the importance of turning it into a culture based on flexibility and external focus. Thus, they acted as entrepreneurs/innovators. Two firms, instead, passed from hierarchy to market. This means that their culture was characterized by stability and internal focus before DBT but also that – to realize DBT – cultural changes were needed. In this case, stability was kept, but the focus of the firm changed, passing from internal to external. Accordingly, managers acted as decision makers. Eventually, one firm moved from hierarchy to clan. In this case, before DBT culture was characterized by stability and internal focus. Changes needed to implement the DBT also required a partial change about organizational culture. The internal focus was kept but flexibility replaced stability. A synthesis of the results described above is depicted in [Figure 2](#).

7. Discussion

From the synthesis of results depicted in [Figure 2](#), three main observations come out. The first one concerns the different organizational cultures that are widespread inside firms before starting a DBT. From the above analysis, in fact, it clearly results that before DBT six firms shared an organizational culture oriented towards hierarchy. This kind of culture is characterized by stability and internal focus and – as such – it does not disclose the best premises to start a DBT. Instead, from the analysis, it results that one firm embraced an organizational culture oriented toward market (stability and external focus) and that three

Adopted technology	%
Iot/IIoT	33%
Advanced automation	19%
Advanced human machine interface	19%
Industrial analytics	14%
Additive manufacturing	10%
Cloud manufacturing	5%
Total	100%

Source(s): Authors' own elaboration

Table 4.
Adopted digital technologies

Involved functions/processes	%
Production	22%
M&R	21%
Logistics	15%
Education and training	12%
Planning	9%
Prototyping/NPD	9%
Quality assurance	9%
Assembly	3%
Total	100%

Source(s): Authors' own elaboration

Table 5.
Involved organizational functions/processes

Table 6.
Results achieved through qualitative content analysis

Cases	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Firm 9	Firm 10
<i>Firm demography</i>										
Headquarters location	Italy	Germany	USA	Italy	USA	Italy	Italy	Japan	Italy	UK
Industry	Engineering	Automotive	Chemical	Engineering	Automotive	Assembly machinery	Hydraulics	Engineering	Hydraulics	Capital goods
Firm Size	SME	Big	Big	Big	Big	Big	Big	Big	Big	Big
Digital technologies adopted	IoT	Advanced automation and industrial analytics	Advanced human machine interface (augmented reality)	Industrial IoT, advanced automation	Industrial IoT	Industrial IoT; analytics, advanced human machine interface, advanced automation	IoT, industrial analytics, cloud manufacturing, additive manufacturing	Advanced human machine interface	Industrial IoT, advanced automation, advanced human machine interface, additive manufacturing	Industrial IoT
Involved organizational functions/ processes	Production	Production and logistics	Maintenance and repair	Planning, production, assembly, logistics, quality assurance, maintenance	Production, maintenance, logistics, quality assurance	Prototyping, planning, production, maintenance, education	Prototyping (NPD), production, maintenance, logistics, planning, training	Education and training	Production, maintenance, quality assurance, NPD, education and training	Production, logistics, maintenance
<i>Organizational culture before DBT</i>										
Flexibility		X		X	X	X	X	X	X	X
Stability	X		X							
Internal focus	X		X		X	X		X	X	
External focus		X		X			X			X
<i>Organizational culture after DBT</i>										
Flexibility										
Digital mentality and philosophy										
Innovation must be done where it can help										
Anyone can propose new projects as long as they aim to respond to emerging needs										
Participation in the change process involves everyone (top managers and operators)										
Steering committee										
Automation refers to several projects										
Seeking for professionals who respond to new needs										

(continued)

Cases	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8	Firm 9	Firm 10
Stability			Nothing has changed in reference to the management of DTB						Committee for projects' evaluation	There is a responsible for "digital 4.0" projects
Internal focus					Learn Lean from the Source					
External focus	Opportunities offered by the National Plan Industry 4.0	Environmental sustainability, energy and work efficiency	Partnership with start-ups	The company already managed collaborations with external partners	Opportunities offered by the National Plan Industry 4.0	Collaborations with external stakeholders	Organizational culture focused on several stimuli		Only suppliers are involved to offer suggestions and/or alternatives	Involvement of right actors, as long as they share the same digital culture
Role assumed by managers handling the DBT	FROM... Coordinators	Entrepreneurs /innovators	Coordinators	Entrepreneurs/innovators	Coordinators	Coordinators	Entrepreneurs/innovators	Coordinators	Coordinators	Decision makers
TO... (related to the culture after DBT)	Entrepreneur/innovators	Entrepreneurs/innovators	Decision makers	Entrepreneurs /innovators	Entrepreneur/innovators	Entrepreneurs /innovators	Entrepreneurs/innovators	Mentors/ facilitators	Decision makers	Decision makers
Source(s): Authors' own elaboration										

Behavior of managers handling DBTs

Table 6.

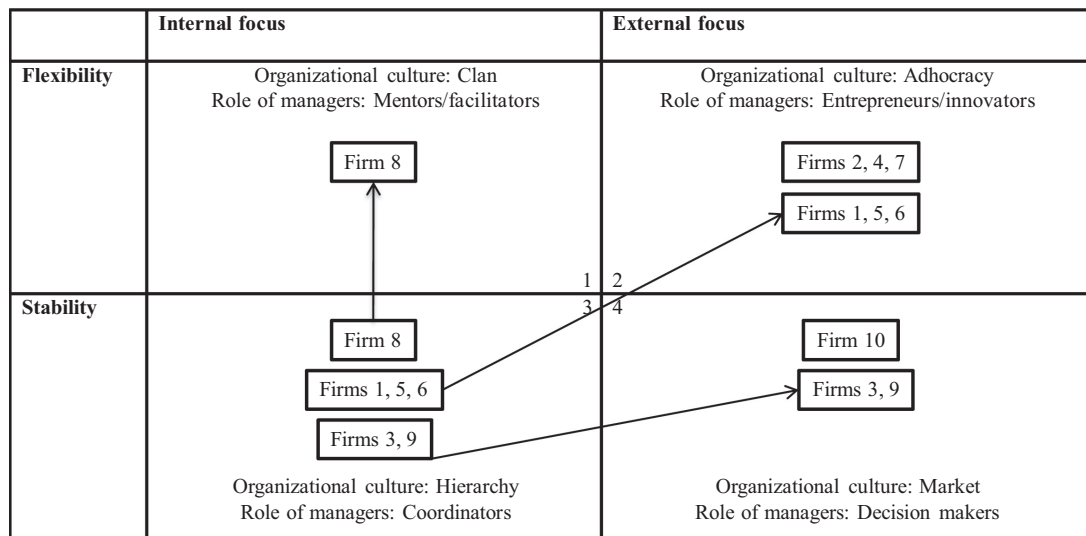


Figure 2.
Culture evolution and
management roles in
the context of DBTs

firms embraced an organizational culture oriented toward adhocracy (flexibility and external focus) before DBT. Thus, it is possible to argue that in most of the sample firms, managers did not perceive the need to change and so their firms did not disclose the right premises to launch and implement a DBT (six were totally prevented from this). In the remaining cases, instead, it seems that managers had already perceived the need to change and somehow their firms were almost ready or at least incline to face a DBT.

The second consideration deals with the rejection of an organizational culture oriented toward hierarchy when approaching a DBT. As it can be noticed from Figure 2, all the firms embracing a hierarchical organizational culture before DBT moved toward clan, adhocracy and market archetypes of organizational culture. Thus, positively, it can be noticed that firms became aware of limitations due to a hierarchical organizational culture. Stability and internal focus cannot suitably sustain DBTs.

The third and last comment pertains to the new organizational culture that firms embrace and share after DBT. Most of the firms (but not all of them) convey toward adhocracy. However, other firms embrace an organizational culture oriented toward clan or market. This result generates interesting reflections about the organizational culture and the role of managers over DBT. On the one hand, it is possible to hypothesize that managers try to act like entrepreneurs/innovators – driving organizational culture toward adhocracy – but human resources inside firms might be reluctant to this. Resistance, opposition to changes by human resources might be a limit to the modification of organizational culture. On the other hand, managers handling a DBT might not be necessarily oriented toward adhocracy. In this vein, they might opt for a different organizational culture. From available sources it is not possible to infer what really happened inside firms. Anyway, for sure we know that all the above cases represent successful cases of DBT. The lesson learned consists in being aware that organizational culture needs to be changed (it is important to refuse the hierarchical model and embrace an organizational culture oriented toward clan, adhocracy or market) and – above all – that managers need to assume different roles (depending on the organizational culture embraced ex ante and ex post) to implement and manage a successful DBT.

8. Conclusions

The present has investigated the role of organizational culture as shaped by managers guiding successful DBTs. By means of a content analysis, the paths addressed by ten firms have been rebuilt and the roles assumed by managers have been figured out.

Although case studies cannot claim to be representative, they reveal that many of the knowledge concerns discussed in the theoretical part of the paper are reasonable and concrete.

As the aim of the case studies was theory testing and refinement, it is useful to discuss findings in relation to our two propositions.

In Proposition 1, we assumed that adhocracy, clan and market-oriented cultures represent a good starting point to conduct a successful DBT, the better being represented by adhocracy. Coherently, on this point, findings of the case studies show that most, though not all, sample firms conducting successful DBTs have conveyed toward adhocracy, the remaining assuming to clan and market-oriented cultures.

In Proposition 2, then, we assumed that the role of the managers guiding the process are likely to affect the impact organizational culture on the efficacy of a DBT, due to the consideration that the creation and dissemination of corporate culture depends on their leadership. Once again finding appears in line with this assumption, as in sample firms, the managers guiding the process assume roles that support the adoption/evolution of organizational cultures coherent with the DBT effort.

Despite achieved results, the paper has some limitations that need to be pointed out. Mainly, these deal with number of cases considered and research methodology. Ten cases can be used to the act in the aim of theory building (Dubin, 1978; Eisenhardt, 1989; Bygrave, 1993; Doty and Glick, 1994; Zahra, 2007; Corley and Gioia, 2011) but they can be not enough. For sure they allow getting insights about an emerging phenomenon, still *in fieri* but – at the same time – additional studies are necessary. Our results may thus provide an indication of the dimensions of the investigated phenomenon to be considered in future quantitative replication studies.

Beyond this, the main limitation seems to lie in the reference to textual data that are not a primary source since other experts in the field have transcribed them. Textual data might be influenced by previous transcriptions and this might modify achieved results. Overall, this risk is typical of all the studies based on second-hand data textual sources. Again, the work is based on Italian firms, thus the Italian culture and degree of digitalization. As a consequence, future research would benefit from replicating our study in other countries to provide definite evidence for previous assumptions.

As an additional extension for future research, as our results do not give information about the reaction of human resources employed in firms to the cultural evolution required by DBTs' leaders, further research is needed to investigate this aspect.

The above limitations, however, do not prevent from getting intriguing results that have major implications for managers and scholars.

As for managers, they should be aware of the organizational culture embraced in their firms, they should have clear in mind the aim of their efforts (a DBT) and they should plan their behavior to make successful changes. In the meanwhile, they should also be aware of resistance/opposition to changes by human resources already in the firms. DBTs are processes based on digital strategizing and so it is important to act according to management principles even when talking of digital transformations (Baiyere *et al.*, 2020; Correani *et al.*, 2020; Matricano, 2020). In this light, it is appropriate to underline that DBTs are business-driven and technology-enabled processes.

As for scholars, this paper has significant implications too. It is not appropriate to investigate DBTs just as technological change. Efforts aiming to understand if and how new technologies are used offer a myopic view of DBT. Thus, scholars are strongly evoked to investigate DBTs from a wider perspective to offer new theoretical issues and empirical evidences about them.

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