Ambidextrous Organization and Agility in Big Data Era: The Role of Business Process Management Systems

Riccardo Rialti, Giacomo Marzi, Mario Silic, Cristiano Ciappei

Abstract

Purpose: *The aim of this research is to explore the effect of Big Data Analytics capable Business Process Management Systems (BDA capable BPMS) on ambidextrous organizations' agility. The ways in which the functionalities of BDA capable BPMS may improve organizational dynamism and reactiveness will be explored.*

Design: *A theoretical analysis of the potential of BDA capable BPMS in increasing organizational agility, with particular attention to the ambidextrous organizations, has been performed. A conceptual framework was subsequently developed.*

Findings: *The research proposes a framework highlighting the importance of BDA capable BPMS in increasing ambidextrous organizations' agility. Moreover, the authors apply the framework to the cases of consumer-goods companies that have included BDA in their processes management.*

Research limitations: *The principal limitations are linked to the need to validate quantitatively the proposed framework.*

Practical implications: *The value of the proposed framework can be found in its ability to help managers to fully understand and exploit the potentiality of BDA capable BPMS. Moreover, the implications show some guidelines to ease the implementation of such systems within ambidextrous organizations.*

Originality: *The research offers a model to interpret the effects of BDA capable BPMS on ambidextrous organizations' agility. In this way, the research addresses a significant gap by exploring the importance of information systems for ambidextrous organizations' agility.*

Keywords: Ambidextrous Organization; Ambidexterity; Big Data; Business Process Management Systems; Big Data Analytics; Information Systems.

Paper Type: Conceptual Paper

1. Introduction

For decades, scholars have proposed theories to explain organizations' inability to make steady improvements to existing businesses, to adopt innovations, or to adapt to the changing environment (Raisch *et al.*, 2009; Del Giudice and Della Peruta, 2016; Marzi *et al.*, 2017). They have largely concluded that improvements or adaptations were not possible as the companies in question lacked agility (O'Reilly and Tushman, 2008). Numerous solutions, however, have been proposed in order to motivate companies to improve their agility and performance by using cross-functional teams or a dynamic capabilities approach (O'Reilly and Tushman, 2013). Based on the poor results achieved by companies which tried to improve their agility, O'Reilly and Tushman (2008) brought attention back to companies which successfully survived in the present competitive environment by separating their units into explorative and exploitative units. Such organizations have been identified by scholars as ambidextrous organizations – characterized by their decentralized structure, common culture and vision, and separated explorative and exploitative units (Tushman and O'Reilly, 1996). Scholars have subsequently sought to hypothesise the ways in which these organizations have managed to successfully strive in a constantly changing environment (O'Reilly and Tushman, 2008). Ambidexterity, in fact, has been deemed related to both increases in organization agility and performance (Vrontis *et al.*, 2017). Previous literature has moreover stressed out how ambidextrous organizations, which are characterized by higher degrees of agility, are more able to adapt to evolving situations (Lee *et al.*, 2015; Bresciani *et al.*, 2017).

Approaching from this perspective, information systems scholars too have observed that adequate information systems could potentially help an organization to fully exploit the benefits arising from ambidexterity (Gothelf, 2014; Lee *et al.*, 2015). It has been highlighted that such systems may have a crucial role in business processes management and, in turn, may improve consumer satisfaction, allowing for rapid answers to market changes and fostering intra-organizational collaboration - all traits relating to ambidextrous organizations' agility (Gao, 2013; Scuotto *et al.*, 2016; 2017; Marzi *et al.*, 2017). In the current digital era, traditional information systems for business process management may however prove to be insufficient to enable organizations to harvest the opportunities arising from the complex digitalized environment surrounding them (Del Giudice and Straub, 2011; Bresciani *et al.*, 2017). As a result of this, current information systems for business process management need Big Data Analytics (BDA) capabilities in order to fully explore and exploit opportunities hidden within the increasing amount of unstructured data (Lopez-Nicolas and Soto-Acosta, 2010; Sivarajah *et al.*, 2017).

Several studies have hypothesized the ways in which information systems may have a crucial role for ambidextrous organizations (Roberts and Grover, 2012; Bresciani *et al.*, 2017), however the majority of literature has not considered how the emergence of big data has revolutionized the characteristics and capabilities of information systems (Yin and Kainak, 2015). At present, BDA capable BPMS can constantly monitor processes and provide information to the right actor involved in process management (Gao, 2013). There is thus a subsequent need to investigate how such systems may increase ambidextrous organizations' agility (Lee *et al.*, 2015). The capabilities of such systems in improving exploration and exploitation capabilities of those organizations will also be explored (Wamba and Mishra, 2017). In this vein, the research aims at exploring the role of BDA capable BPMS in fostering ambidextrous organizations' agility. Throughout this, the authors theorize a conceptual framework emerging from pertinent literature on the integration of BDA in business processes (Mishra et al., 2017; Wamba e Mishra, 2017). Hence, an interpretation of the importance of BDA capable BPMS will be provided. Moreover, to ground our findings, the framework has been applied to the cases of ambidextrous consumer-goods companies that have recently integrated BPMS with BDA.

The principal results of this paper relate to exploring the effects of BDA capable BPMS on ambidextrous organizations' agility by identifying the touchpoints between those two streams of literature. The proposed framework, which has been enriched with insights from the application of

the framework in a real-world context, also provides commentary along with several potential implications for practitioners.

In this paper, firstly, we present the theoretical foundations of ambidexterity and the importance of BDA capable BPMS. The insights of existing literature have been presented in next section in order to create a conceptual framework explaining the phenomenon. Next, the framework has been applied to the case of ambidextrous consumer-goods companies. Finally, managerial implications have been discussed.

2. Theoretical Background

2.1 Ambidextrous Organizations and Agility

The notion of ambidextrous organization was first theorized by Duncan (1976) as a response to the switch from a static to a dynamic competitive environment experienced by organizations in the 70s. During the years, the concept of ambidexterity in organizational studies has undergone numerous contributions that enriched it with both theoretical and empirical evidences (Gibson and Birkinshaw, 2004; Raisch *et al.*, 2009). Several scholars have demonstrated that the organizational ability to pursue two dissimilar things at the same time -i.e. manufacturing efficiency and flexibility (Raisch *et al.*, 2009); differentiation and low-cost strategic positioning (Porter, 1980); global integration and local responsiveness (Junni *et al.*, 2013)- seems a determinant of organizations' survival and performance (Zollo *et al.*, 2015; Zollo *et al.*, 2016; Marzi et al., 2017c). Consequently, an ambidextrous organization is thus identifiable as an organization capable of simultaneously exploring its environment and exploiting emerging opportunities or, in other words, an organization capable of pursuing current processes while continuously adapting to the changing competitive environment (Junni *et al.*, 2013). Exploration includes the ability of an organization to search, take risks, discover, and innovate in order to prepare the field for the exploitation task. Exploitation, instead, involves the ability of an organization to implement innovation, produce, optimize, and execute tasks (Duncan, 1976).

According to Lu and Ramamurthy (2011), ambidexterity naturally encompasses the concept of agility. Zain *et al.* identify how an organization aiming for agility has "to be quick in assemble [sic] its technology, employees, and management with communication infrastructure in responding to changing consumer demands in a market environment of continuous and unanticipated change" (2005, p.831). There are several studies that show evidences of ambidextrous organizations' agility. According to Lubatkin *et al.* (2006), an ambidextrous organization could rapidly respond to market changes whilst focusing on maintaining the satisfaction levels of their existing consumers, which assesses how happy consumers are with the organizations' offerings (Rialti *et al.*, 2016). The organizational and technical flexibility, or the organizations' capability of conveniently adapting to change, has emerged then as a fundamental competitive characteristic of agility in an ambidextrous organization (O'Reilly and Tushman, 2013; Vrontis *et al.*, 2017). Ambidextrous organizations characterized by agility require dynamic BPMS in order to increase dynamism and improve processes monitoring and, consequently, improve performance (Kortmann *et al.*, 2014; Vrontis *et al.*, 2017). Such evidences of agility within ambidextrous organizations and their importance are listed in the following table (see Table 1).

Table 1 Here

The six evidences illustrated in the above table (Table 1), retrace what Lu and Ramamurthy (2011) empirically found in organizations which were deliberately pursuing organizational agility. The authors identified two types of outcome related to pursuing organizational agility: market capitalizing and operational adjustment agility. The first refers to the ability to quickly respond to and exploit changes by uninterruptedly monitoring and speedily improving products/services to address

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consumers' needs. The latter refers to the organization's ability to successfully and rapidly cope with market or demand changes. The six evidences in Figure 1 respectively converge the two sides of organizational agility as descriptive traits of market capitalizing agility and operational adjustment agility, as suggested by Sambamurthy *et al.* (2003).

Figure 1 Here

Therefore, the more the environmental dynamism increases, the more an ambidextrous organization is likely to benefit from the dual capacity of exploration and exploitation (Lee *et al.*, 2015). Hence, market capitalizing and operational adjustment agility are two fundamental outcomes of the pursuit of agility, and may be considered paramount in fully taking advantage of exploration and exploitation functions simultaneously and effectively (Lu and Ramamurthy, 2011; Vrontis *et al.*, 2017).

However, several studies highlight the crucial role that information systems play in enabling the information workflow needed to fully foster agility in the whole organization (Ferraris *et al.*, 2017; Bresciani *et al.*, 2017). As a result, it is not possible to separate an ambidextrous organization characterized by a high degree of agility from an efficient and flexible information system (Tallon and Pinsonneault, 2011). This is particularly true in the current digital era, which is characterized by the need to proficiently collect and exploit huge quantities of data. Considering this perspective, the next section will explore the importance of BDA capable BPMS (Gao, 2013) with regard to ambidextrous organizations' agility.

2.2 Big Data, Business Process Management Systems, and Ambidextrous Organizations' Agility

Recently, the expression 'big data' has been used to describe datasets so complex that they cannot be managed or analysed using traditional data analysis software (De Mauro *et al.*, 2017). Despite the abundant information such datasets contain, big data are usually large, heterogeneous, and unstructured datasets that cannot be explored by following usual approaches (Yin and Kaynak, 2015). Big data differs from traditional massive or large datasets in terms of *volume*, *velocity*, *variety*, *veracity*, and *value* - labelled as the five V's of big data (Wamba *et al.*, 2017). The 'volume' of big data is related to dimensions where it exceeds a terabyte (McAfee and Brynjolfsson, 2012). Indeed, large organizations collect several terabytes or petabytes of data daily from their interactions with consumers, from internal processes, or from the internet (Del Giudice, 2016; Santoro *et al.*, 2017). The 'velocity' of big data is defined as the "rate at which data are generated and the speed at which it should be analysed and acted upon" (Gandomi and Haider, 2015, p.138). Specifically, to fully exploit big data, organizations should be capable of analysing it in real-time (IBM, 2012). The 'variety' of big data refers to the heterogeneous sources of big data (i.e. sensors embedded in machines, consumers' activities on social media, B2C or B2B digital interactions, etc.) and the consequent heterogeneous formats that the files composing big data may assume (Wamba *et al.*, 2015). 'Veracity' is related to the trustworthiness of the majority of data sources (Mishra *et al.*, 2017) and, finally, 'value' highlights the economic value of insights extracted from big data. Large datasets that don't contain meaningful information may therefore not be considered big data (Yin and Kainak, 2015). In addition to these characteristics, there are other potential V's that characterize big data in literature. SAS has suggested that 'variability', i.e. the variation in data flow rate (2016), may be an additional trait of big data (Mishra, *et al.*, 2017). Similarly, 'visualization', the possibility to visualize digitally the insights from big data, has been considered a big data characteristic (Lugmayr *et al.*, 2017). This has expanded the number of V's to 7, namely: *volume*, *velocity*, *variety*, *veracity*, *value*, *variability* and *visualization* (Mishra *et al.*, 2017).

Because of several successful implementations of BDA systems within organizations, McAfee and Brynjolfsson seminally identified big data as the next revolution in management (2012). Big data analytics allow managers "to measure and know radically more about their business and to directly

translate that knowledge into decision making and performance" (McAfee and Brynjolfsson, 2012, p.4). Managers may take decisions on the basis of BDA systems, enabling more effective decision making (Del Giudice *et al.*, 2016). On the one hand, big data allow the streamlining of internal processes by reducing bottlenecks, thereby increasing efficiency (Davenport, 2014). On the other hand, managers may identify consumers' common behavioural patterns and tailor their offerings and the prices according to consumers' preferences based on insights coming from consumer-originated big data (Hofacker *et al.*, 2016). The BDA capable BPMS adoption within the business may thus lead to increased consumer-centricity, operational optimization, improved risk management, better workforce utilization, and even new business models (Motamarri *et al.*, 2017).

In order to unleash the potential of big data, information systems scholars and practitioners have stressed the importance of integrating BDA capabilities into business process management systems (BPMS) (Gao, 2013; Wamba and Mishra, 2017). BDA capable BPMS have been identified as information systems spanning the whole organization, capable of collecting huge quantities of data arising from business processes, analysing data in real time, and communicating the results of this analysis to all the actors involved in the process (Wamba and Mishra, 2017). BDA capable BPMS shares many characteristics with traditional BPM systems, i.e. they aim towards promoting efficiency, effectiveness, and innovation, but it they differs in a fundamental aspect from traditional ones. Embedding BDA in BPMS may give "process participants better real-time situational awareness and the ability to tailor their responses appropriately" (Gao, 2013, p.4). According to Vossen (2013) and Vera-Baquero *et al.* (2015), BDA capable BPMS need to be *analytical*, *automatic*, *adaptive*, and *agile* to leverage big data (Hill and Schulte, 2011; Gao, 2013) and this makes the system capable of advanced analysis while automatically processing data from several different business processes (Wamba and Mishra, 2017). Additionally, when applied to two or more related organizations, these systems may foster inter-organizational information exchange (Vera-Baquero *et al.*, 2015). Moreover, if such BPMS are adaptive, they may adapt to changing situations and to the evolving of more complex data.

BDA capable BPMS show potential in fostering organizational flexibility, agility, and dynamism. Specifically, on the one hand, such systems may lead to better performance in satisfying costumers' needs, allowing for rapid responses to market changes, and improving intra-organizational collaboration (Wamba and Mishra, 2017; Scuotto *et al.*, 2017). Their implementation is therefore related to organization market capitalization agility. On the other hand, it is possible to observe the ways in which they are related to operational adjustment agility (Lu and Ramamurthy, 2011). BDA capable BPMS may simultaneously analyse data originating from several internal business processes and, consequently, allow managers to improve the efficiency of internal business processes. BDA capable BPMS, therefore, may also potentially improve organizations' exploration and exploitation capabilities (Sivarajah *et al.*, 2017).

Although there has been significant research on the importance of information systems in ambidextrous organizations (Bresciani *et al.*, 2017), systems of relevant importance, like BDA capable BPMS, have not been studied extensively. In fact, due to their characteristics, BDA capable BPMS may be instrumental in increasing ambidextrous organizations pursuit of agility. Moreover, such systems may also affect market capitalizing and operational adjustment agility.

3. Big Data Analytics Capable Business Process Management Systems and Ambidextrous Organization's Agility. Conceptual Framework's Development and Application

In this section, we will discuss why BDA capable BPMS are fundamental for ambidextrous organizations pursuing agility and the outcomes of these systems' implementation. Specifically, the authors have attempted to tie-up existing findings on the outcomes of BDA capable BMPS' implementation with pertinent literature on ambidextrous organizations' agility. Then, some propositions have been developed and positioned within the hypothesized conceptual framework. Next, some corroborations about the veracity of the framework have been provided by applying it to a real-world context. This approach correlates with previous research on emerging managerial

phenomenon involving technological advances (see Kim and Ramkaran, 2004; Niehaves and Plattfaut 2011; Caputo *et al.*, 2016). Indeed, researches analysing the impact of contemporary technological advances on managerial practices may provide stronger evidence by using cases from leading organizations (Caputo *et al.*, 216). In this sense, because the adoption of BDA capable BPMS may have a disrupting impact on organizations, an approach not exclusively focused on a theoretical perspective may represent a suitable solution (Gandomi and Haider, 2015). Therefore, some implications of BDA capable BPMS adoption from leading ambidextrous organizations could be useful to refine the proposed framework.

3.1 From Big Data to Ambidextrous Organizations' Agility
Big data has dramatically changed the competitive landscape in which organizations operate (McAfee *et al.*, 2012). In order to gain a competitive edge, actually, organizations should adopt information systems capable of extracting meaningful information from unstructured datasets. BDA capable BPMS emerge as fundamental (Gao, 2013) as they can collect data from several different business processes, analyse them, and provide the right information to the right actors involved in business process management (Vossen, 2013). Firstly, by adopting BDA capable BPMS, organizations can better manage their data as BPMS, indeed, can collect data from consumers, allowing organizations to monitor existing consumers' activities and interactions on firm-initiated online platforms (Gunasekaran *et al.*, 2017). In particular, BDA capable BPMS could simultaneously track and analyse consumers' behavioural pattern, gather feedback on products and, additionally, communicate information simultaneously to marketing department (Hofacker *et al.*, 2016; Rialti *et al.*, 2016). BDA capable BPMS can then increase consumers' satisfaction by offering consumers' tailored offerings, both with regard to product characteristics and pricing (Gunasekaran *et al.*, 2017). Consequently, these systems have a crucial role in increasing organizations' reactiveness to market changes (Sivarajah *et al.*, 2017). Likewise, in terms of stakeholder management, these systems can improve processes involving external stakeholders by monitoring interactions and allowing organizations to analyse data in real time (Hahn *et al.*, 2016). Additionally, BDA capable BPMS may be useful for improving relationships with partners (Gao, 2013), as such systems can ensure the necessary information flow between involved parts (Bresciani *et al.*, 2017). Shared analytical architectures based on cloud computing may indeed allow two partners to work contemporaneously on the same dataset, thus allowing the exchange of insights and of results (Scuotto *et al.*, 2017). In a similar fashion, BDA capable BPMS can improve the collaboration between two different business units within the same organization (Hahn, *et al.*, 2016; Sivarajah *et al.*, 2017). Finally, because of their analytical capabilities, by adopting an internal processes management perspective, BDA capable BPMS could identify bottlenecks in internal processes such as production processes or information sharing processes (Wamba and Mishra, 2017). Therefore, these systems may increase the speed of the decision process, increase organizations' dynamism, and foster ambidextrous organizations pursue for agility, which is related to the notion of velocity in decision making and consequent actions (Zain *et al.*, 2015). They could thus subsequently foster real-time operational adjustment and increase efficiency (Roberts and Grover, 2012). Hence:

(1) BDA capable BPMS could foster ambidextrous organizations' agility as they allow for the monitoring of both consumers' behavioural pattern and internal processes while simultaneously proving an information flow to the actor involved in process management. Hence, they may increase the velocity of the decision-making process, which is coherent with ambidextrous organizations' pursuit of agility.

According to Lu and Ramamurthy (2011), organizations' attention toward consumers' satisfaction level, the capability to act promptly in response to market change, the possibility to ensure consumers' satisfaction, and the existence of an effective mechanism to collaborate directly with partners are related with ambidextrous organizations' pursuit of agility. The ability to better identify and capitalize markets' emerging opportunities has been deemed fundamental for ambidextrous organizations

aiming to reach market capitalization agility (Roberts and Grover, 2012). Similarly, ambidextrous organizations characterized by a high degree of agility may potentially achieve operational adjustment agility. Organizations deeply committed to embracing dynamic business process management and achieving technical and organizational flexibility may be capable of identifying eventual inefficiencies in internal processes and may be able to adjust production quantity according to the need (Wei *et al.*, 2014). Such organizations also tend to show higher production efficiency levels (Lu and Ramamurthy, 2011). The market capitalizing and operational adjustment agility are potentially two outcomes of ambidextrous organizations' pursuit of agility (Gothelf, 2014; Lee *et al.*, 2015). Identifying opportunities in the market and predicting the possibility of reaping the benefits are consequences of the agility of ambidextrous organizations which, in turn, is connected with ambidextrous organizations' exploration and exploitation capabilities (Junni *et al.*, 2013). Hence:

(2) Ambidextrous organizations pursuing agility may achieve market capitalizing agility.
(3) Ambidextrous organizations pursuing agility may achieve operational adjustment agility.

Information systems such as BDA capable BPMS may have a crucial role and may act as facilitators in ambidextrous organizations pursuing organizational agility (Tallon and Pinsonneault, 2011). They allow organizations to collect and analyse, simultaneously, information from external and internal sources (Overby *et al.*, 2006; Nazir and Pinsonneault, 2012). Consequently, BDA capable BPMS are fundamental in speeding up decision making and in consequently harvesting the benefits arising from pursuing agility (Davenport, 2014).

Therefore, ambidextrous organizations characterized by high levels of agility may achieve market capitalization agility and operational adjustment agility (Lu and Ramamurthy, 2011). Firstly, BDA capable BPMS can indeed enable ambidextrous organizations to better identify market trends, opportunities, and emerging niches before competitors (Overby *et al.*, 2006; Gunasekaran *et al.*, 2017). Secondly, BDA capable BPMS may allow ambidextrous organizations to reduce the wasting of productive factors (Dubey et al., 2017) and to regulate the flow of production, thus reducing stock inventories too (Sivarajah et al., 2017). Consequently, they could facilitate organizations simultaneous exploration and exploitation functions (Gao, 2013; Santoro *et al.*, 2017). This is particularly true in the current environment, where data analytics capabilities are vital (Chen *et al.*, 2014). Hence:

(4) BDA capable BPMS may act as facilitators for ambidextrous organizations, characterized by high degree of agility, to achieve market capitalizing and operational adjustment agility. Indeed, such BPMS allow both to better identify market opportunities and to exploit those latter efficiently.

Additionally, seeing as organizations that have achieved operational adjustment agility are more prone to embrace dynamic business process management and adopt innovative information systems (Wei *et al.*, 2014), we hypothesize that ambidextrous organizations characterized by high level of agility may be more likely to adopt innovative BPMS or to improve existing ones (Leonhardt *et al.*, 2017; Santoro *et al.*, 2017). Actually, ambidexterity tied-up with ad hoc information systems may foster the knowledge absorption and sharing capabilities of the organization (Vrontis *et al.*, 2017), which is vital for technology adoption (Santoro *et al.*, 2017). In the particular case of BDA capable BPMS, their adoption may be grounds for the adoption of new systems thanks to the training received by the workforce (Ferraris *et al.*, 2017). Moreover, seeing as they facilitate the diffusion of information within the organization, it is quite feasible that these systems are invaluable in the adoption of innovations as they allow all actors to receive the necessary information (Zain *et al.*, 2005). Hence:

(5) Organizations that have achieved operational adjustment agility are more likely to innovate current process management systems or to adopt more innovative ones.

The Five propositions have been used to develop the following conceptual framework in order to explain how BDA capable BPMS may be fundamental in fostering ambidextrous organizations'

agility (Figure 2). The framework reassumes the underlying mechanisms that relate the adoption of BDA capable BPMS to market capitalizing and organizational adjustment agility. In particular, we have highlighted how, thanks to faster decision-making processes and a smoother flow of information, an organization may be able to better identify and exploit market opportunities while contemporaneously increasing internal efficiency.

Figure 2 Here

3.2 Refining the Conceptual Framework: Some evidence from an Application to Consumer-Goods Companies

To corroborate the initial proposed framework, we apply the proposed model to one specific typology of organization: consumer-goods companies. Consumer-goods companies are one of the principal typologies of large organizations (Porter, 1980). They frequently operate in different markets, with regard to both products and geographical context and, moreover, the majority of consumer-goods companies trace their origins back through the 20th century (Porter, 1974). This notwithstanding, consumer-goods companies have traditionally focused on innovating products and services to strive in a competitive arena (Barras, 1986). Indeed, according to Chui and Fleming (2011), consumer-goods companies are leading the big data revolution together with banks, retailers, and social media. Interestingly, consumer-good companies' have applied BDA also on production side cannot, hence, it is possible to observe how BDA capable BPMS could affect production efficiency. In addition to this, because consumer-goods companies are frequently characterized by different units delegated to exploration and exploitation, they frequently share some traits of ambidextrous organizations (Tushman and O'Reilly, 1996; O'Reilly and Tushman, 2013). Thus, consumer-goods companies represent a suitable opportunity to apply our framework to a real-world context. Moving from these considerations, the authors have consulted both practitioner-oriented literature and three senior and junior data analysts from large US based consumer-goods companies. This enabled the authors to refine the framework, gather some insights from practice, and ground the framework in the identified setting.

With this in mind, adopting a production-side based point of view, the integration of BDA within BPMS has been identified by practitioners as vital in increasing consumer-goods companies' productivity. Specifically, it may lead to the prevention of potential disruptive machinery-related issues, which has been stressed as the greatest potential of BDA capable BPMS on production-side. The possibility of BDA to estimate machinery-related failure rates may predict potential emerging problems (Chui and Fleming, 2011). Machine-learning based algorithms, moreover, have been deemed capable to suggest to workers potential ways of acting more precisely amidst technical problems (Caputo *et al.*, 2016). BDA capable BPMS can therefore increase the efficiency of production processes, which is coherent with the operational and technical flexibility that ambidextrous organizations may reach as a consequence of implementing this kind of BPMS system. Consumer-goods companies may consequently aim towards achieving fully data-driven production-side business processes management.

Despite this, the greatest impact of BDA capable BPMS concerns organization market capitalizing agility. As a consequence of BDA capable BPMS adoption, consumer-goods companies can identify previously neglected niches of consumers, which may prove to be extremely profitable. In fact, traditional marketing analysis systems have been deemed unreliable as they are not always capable of properly identifying smaller niches due to their limited analytical capabilities (Hofacker *et al.*, 2016). Moreover, through confrontation with practitioners, it has emerged that the analytical power of BDA capable BPMS are fundamental for consumers' life-time value predictions in consumer-goods companies. BDA capable BPMS applied to consumer-goods companies are capable of predicting which consumers will purchase company products again and which ones will not. Therefore, they allow for the improvisation of sales-revenue management by providing marketers

with relevant insights on which consumers are not as profitable. This is fundamental in consumer-goods companies, which usually sell low-margin products. Finally, automatic BDA capable BPMS are relevant for developing online customized marketing campaigns, which have been linked to consumer satisfaction (Rialti *et al.*, 2017). For this reason, the implementation of BDA capable BPMS is linked to market capitalizing agility.

Concerning the production side, such BPMS can plan production according to predicted sales volumes (Deloitte, 2017). Similarly, BDA capable BPMS offer consumer-goods companies the possibility to share data with their B2B partners (Sivarajah *et al.*, 2017). Hence, consumer-goods companies may constantly monitor partners stocks and predict when a partner may need more supplies (Chui and Fleming, 2011).

Concerning ambidextrous consumer-goods companies, moreover, from a practitioner's point of view, BDA capable BPMS can tie-up the explorative and exploitative units. In particular, they can ensure the information flows from the explorative unit to the exploitative one. An example of this can be found in the possibility of uncovering unexpected niches and in targeting them properly. BDA capable BPMS, then, because they could identify and exploit opportunities, can increase the speed of decision-making processes and, overall, ambidextrous consumer-goods companies may better achieve agility and technical flexibility.

Moving from these insights, a framework specifically concerning ambidextrous consumer-goods companies has been developed (see Figure 3). The new framework illustrates in greater detail the possible outcomes on production and marketing of the implementation of BDA capable BPMS in ambidextrous consumer-goods companies (De Mauro *et al.*, 2017). Moreover, it also stresses how BDA capable BPMS have the potential to improve relationships with partners.

Figure 3 Here
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4. Implications of the research
4.1 Theoretical Implications
The research provides some preliminary insights on the perspective importance of implementing BDA capable BPMS within ambidextrous organizations. In particular, it has been hypothesized that systems capable to collect unstructured data and to analyse this data in real-time may present a competitive advantage for ambidextrous organizations looking to increase their flexibility (Vossen, 2013). Such BPMS, in fact, may extract meaningful information from complex big data and simultaneously inform the actors involved in BPM (Mishra *et al.*, 2017). The informative potential of big data may be unleashed by BDA capable BPMS (Gao, 2013). Subsequently the manager may receive immediate information concerning changes occurring at consumer, partner, and internal levels (Wamba and Mishra, 2017). As a consequence of the constant flow of information, therefore, managers and actors involved in processed management may act promptly to implement strategies in response to environmental changes, all to the organization's benefit (Ferraris *et al.*, 2017). This relates with the findings from the application of the framework, which provides some insight on the ways in which BDA capable BPMS may be able to identify new opportunities and exploit them properly without wasting resources.

Due to their characteristics, moreover, BDA capable BPMS can be technically capable of increasing ambidextrous organizations dynamism. Indeed, the information flow from such systems allows the manager to know, better than ever, their business and competitors, as previously assessed by McAfee and Brynjolfsson (2012). Such systems can prospectively allow managers to better known consumers, collaborate with partners, and embrace a constant internal and external BPM (Roberts and Grover, 2012; Lee *et al.*, 2015; Bresciani *et al.*, 2017). Such BPMS may thus increase ambidextrous organizations' agility and, in turn, foster the achievement of so-called market capitalization and operational agility (Lu and Ramamurthy, 2011). Since a firm capable to achieve market capitalization and operational agility may identify opportunities in the market and adjust internal production

capacity to follow the demand, BDA capable BPMS may therefore increase ambidextrous organizations' exploration and exploitation capabilities (Nazir and Pinsonneault, 2012).

In this way, this research contributes to the stream of literature on BPMS (Wamba and Mishra, 2017) by providing insight into the outcomes of integrating BDA within BPMS. Moreover, it additionally contributes to the stream of literature on ambidextrous organizations' agility (O'Reilly and Tushman, 2013). Specifically, the principal contribution to this first stream of literature concerns better identifying the characteristics and the potential of BDA capable BPMS, which are both topics that have been rather neglected in existing literature on BPMS, with a few exceptions (Mishra *et al.*, 2017; Motamarri *et al.*, 2017). Instead, this research has enriched literature on ambidextrous organizations' agility by providing further insights on the importance of BDA capable BPMS in increasing dynamism and achieving market capitalization and operational adjustment agility (Lu and Ramamurthy, 2011). Thus, such BPMS may increase exploration and exploitation capabilities of ambidextrous organizations (Gao, 2013; Leonhardt *et al.*, 2017).

4.2 Implications for Practitioners: Implementing BDA Capable BPMS in Ambidextrous Organizations

In spite of the potential of BDA capable BPMS in increasing ambidextrous organizations agility, some challenges may emerge during the implementation of such BPMS. It is therefore first necessary to comment on the technical challenges associated with BDA capable BPMS in order to better appreciate the importance of coupling ambidextrous organizations' agility with BDA capable BPMS. It is crucial, indeed, to have a full understanding of where the big data comes from in order to focalize information systems' role in today's organizations.

In case of big data, the analytical architecture, underlying data processes, procedures, tools, and methods are different when compared to small data (going from a data warehouse to *data lake* for big data) (LaValle *et al.*, 2011). For example, we speak of the Not Only SQL (NoSQL) data model, schema-less data retrieval real-time data action, and horizontally scaled data system architecture for big data, as opposed to relational data model, schema data retrieval, data-at-rest, and monolithic systems with vertical scaling for small data (Vossen, 2013). With all these differences, it is a significant challenge to manage big data (IBM, 2012). One of the mistakes that many organizations make when adopting BDA capable BPMS to pursue agility is to consider BDA as an architectural design, wherein the database is seen as a static repository and schemas are usually fixed and unable to bring any dynamic dimension (Yin and Kainak, 2015). To find the best possible architectural approach, first we have to understand how the big data is deployed. Usually, it starts with implementing an engine for big data processing (e.g., Hadoop, Apache Spark, etc.) with the necessary physical infrastructure, which includes the complex configuration of servers, storage, and other components necessary to run and process the big data centre. With more data, more resources (e.g., hardware) will be needed, meaning that organizations will have to go through another iterative process of buying more hardware, and this process takes time. In order to speed up this process, we are witnessing a trend where organizations are turning to cloud providers (e.g., Amazon AWS) which give them an agile infrastructure in which resources are pulled in or out based on the demand (Lu and Ramamurthy, 2011). This approach is sufficient when it comes to bringing agility to organizations from an infrastructure standpoint.

Thus, ambidextrous organization's agility, in order to be successfully integrated with big data, has to deliver on several other premises. The debate on this relationship between architectural design and agility is still ongoing (Chen *et al.*, 2016). As outlined above, the BDA infrastructure's build processes represent an "up-front" approach where everything must be ready before the data is analysed, which rather contradicts the meaning of agility itself (Bellomo *et al.*, 2015). Gao (2013) and Chen *et al.* (2016) demonstrated the alignment between the two worlds: Agility, actually, supports the iterative nature of big data. One possible way in implementing and following this iterative nature is to build systems that can be easily iterated, modified, adapted, or replaced and this is coherent with the adaptability of the majority of BDA capable BPMS. A cultural shift is an important consideration,

as organizations looking to combine agility with the big data will need to look beyond their existing state of mind, and aim for exploration and change. This will bring flexibility related to agility, which means temporal and financial savings for the organization.

We can speak of "big data culture" where the entire organization has to work on adapting their employees' mind set to the new approach (Tallon and Pinsonneault, 2011). For example, for a bank to remain competitive and launch new services and products, it is necessary to adopt new models of working by implementing and launching digital initiatives before the competition. The only way to be faster than the traditional implementation is to implement the new technology infrastructure with a data lake containing structured and unstructured data (e.g., Twitter data) (Davenport *et al.*, 2012; Caputo *et al.*, 2016; Santoro *et al.*, 2017). The business alignment between the IT department and the business team is vital in creating systems that respond to specific user requests and needs (Gao, 2013; Ferraris *et al.*, 2017), and the entire process has to be iterative enough so time is not lost between different implementations and trials.

In spite of such difficulties, however, an ambidextrous organization would be able to implement such systems, subsequently providing managers with a real-time snapshot of consumer's (internal or external) data, giving a clear competitive advantage to agile organizations as it enables them to get real-time information about any service, product, or procedure an organization wants to improve or implement. This is coherent with the expected outcomes hypothesized (namely market capitalization and operational adjustment agility) (Lu and Ramamurthy, 2011; Zollo *et al.*, 2016; Wamba and Mishra, 2017). Hence, well designed, projected, and implemented BDA capable BPMS may allow ambidextrous organizations to increase their agility and to achieve market capitalization and operational adjustment agility. This is possible due to their dynamic capability to extract information from such systems (Chen *et al.*, 2014).

Briefly, then, the marriage between ambidextrous organization and BDA capable BPMS will be successful as long as organizations allow for cultural shifts and conduct appropriate implementation steps that will provide dynamic capabilities of big data (Tallon and Pinsonneault, 2011; Wamba and Mishra, 2017).

5. Conclusions, Limitations, and Suggestions for Future Research

The aim of the present research was to identify the effect of BDA capable BPMS on ambidextrous organizations' agility. The results highlight the role of such systems in increasing dynamism and reactiveness to the environmental changes of organizations and, consequently, organizational agility (Zain et al., 2005). Moreover, the achievement of market capitalization and operational adjustment agility have emerged as the principal results of the implementation of such BPM systems (Lu and Ramamurthy, 2011). Increased exploration and exploitation capabilities may also be considered related to implementing BDA capable BPMS within ambidextrous organizations.

Thus, the proposed conceptual framework was applied to consumer-goods companies in order to test its validity and robustness. The qualitative results suggested that the theory and practice are aligned and, therefore, we can consider the prosed model valid and applicable to a wider set of organizations. In this vein, the present research has contributed to both theory and practice.

Regarding the first, this paper can be seen to expand academic literature on ambidextrous organizations and business process management (Wamba and Mishra, 2017). In particular, we have merged the principle of organizational agility with ambidextrous organization literature, showing the ways in which an ambidextrous organization needs to be agile in the era of big data.

With regard to practical implications, this research shows the importance of keeping an organization agile, especially for companies which are constantly dealing with a large amount of data. Moreover, we have provided a framework for managers which is suitable for diagnosing organizational agility issues within a company and its connection with data related issues.

However, this research is limited in some aspects. In particular, its main limitation relates to the fact that the conceptual framework has been developed on findings from existing studies coming from a

different set of industries. We tried to overcome this critical aspect by adding empirical validation to our findings, but still a wider testing of the present framework is need.

In fact, we would advise future researchers to better examine the phenomenon with in depth case studies from exemplary organizations, comparing different industries and different markets. Moreover, a quantitative analysis is needed to provide information on the importance of the implication of BDA in BPM, and to try to quantify the outcomes in terms of effectiveness or efficiency. In particular, a clear connection between organizational agility, ambidextrous organization, and performance should be established.

Finally, we wish to stress that the theoretical development of this present stream of research will benefit from continuous updating due to the ever-changing environment generated by the big data era.

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Tables

Evidences of agility within ambidextrous organizations	
E1 - Constant customers' satisfaction focus	An ambidextrous behaviour lead to better performance in satisfying costumers' needs (Lubatkin *et al.*, 2006; Jasman *et al.*, 2012)
E2 – Capability to rapidly response to market changes	Combined market exploration and market exploitation has complementary interaction effects on organizations' ability to adapt to market changes (O'Reilly and Tushman, 2008; Voss and Voss, 2013)
E3 – Pursue organizational flexibility	Organizational ambidexterity permit to be environmentally aligned and efficient, fostering the relationship between contextual structures and organizations' performance (Gibson *et al.*, 2004; Raisch, *et al.*, 2009)
E4 - Achieve and maintain technical flexibility	Operational ambidexterity positively affects the organizations' response to environmental uncertainty fostering manufacturing flexibility and organizations' performance (Patel *et al.*, 2012; Kortmann *et al.*, 2014)
E5 - Embrace dynamic business process management	Coordination flexibility and resources flexibility have a positive effect on organizations' processes performance (Wei *et al.*, 2014; Kortmann *et al.*, 2014)
E6 – Pursue effective strategic collaboration with partners	Ambidextrous organizations create better strategic alliances with partner and effectively integrate their knowledge in shared project (Lin *et al.*, 2007; Tiwana, 2008)

Table 1 - Evidences o agility within ambidextrous organization paradigm

| Characteristics of Big Data	Definition
V1 - Volume	Volume is related to the dimensions of big data. Big data usually exceed the terabyte in term of dimensions (McAfee and Brynjolfsson, 2012; Yin and Kaynak, 2015; Wamba *et al.*, 2017).
V2 – Velocity	Velocity of Big Data regards the "rate at which data are generated and the speed at which it should be analysed and acted upon" (Gandomi and Haider, 2015, p.138).
V3 – Variety	Variety of big data refers to the heterogeneity of sources of big data (Wamba *et al.*, 2015), i.e. text and messages, tweets, posts, e and photos shared online have all been deemed potential components of a big data dataset (Davenport *et al.*, 2012; Erevelles *et al.*, 2016).
V4 - Veracity	Veracity refers to the trustworthiness of data sources (Power, 2014; Mishra et al., 2017). In fact, only data coming from identifiable sources should be considered for being analysed using big data analysis techniques (IBM, 2012).
V5 - Value	Value highlights the economic value that insights extracted from big data may generate (Yin and Kaynak, 2015).
V6 – Variability	Variability refers to the variation in data flows rate (SAS, 2016). In particular, such characteristics has been deemed important since the flow of data composing a big data dataset isn't frequently homogeneous over time (Mishra, *et al.*, 2017).
V7 - Visualization	Visualization regards the possibility to visualize digitally the insights from big data (Lugmayr *et al.*, 2017).

Table 2 - Big Data's 7Vs

List of Figures
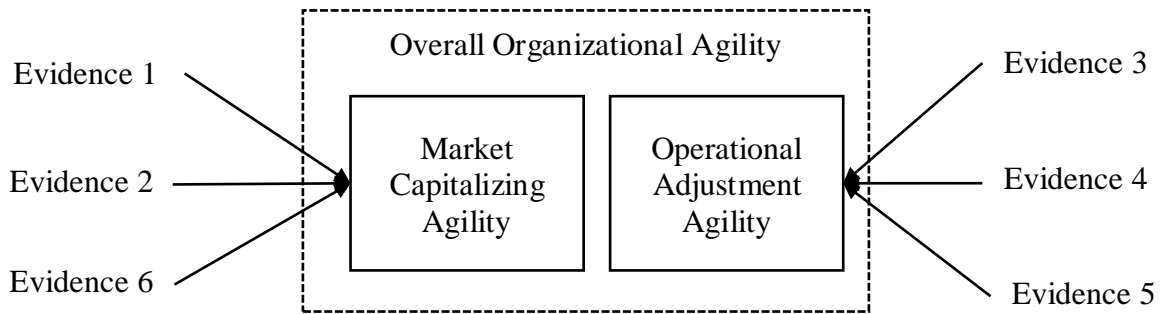
Figure 1- Organizational agilities' evidences within market capitalizing and operational adjustment agility.
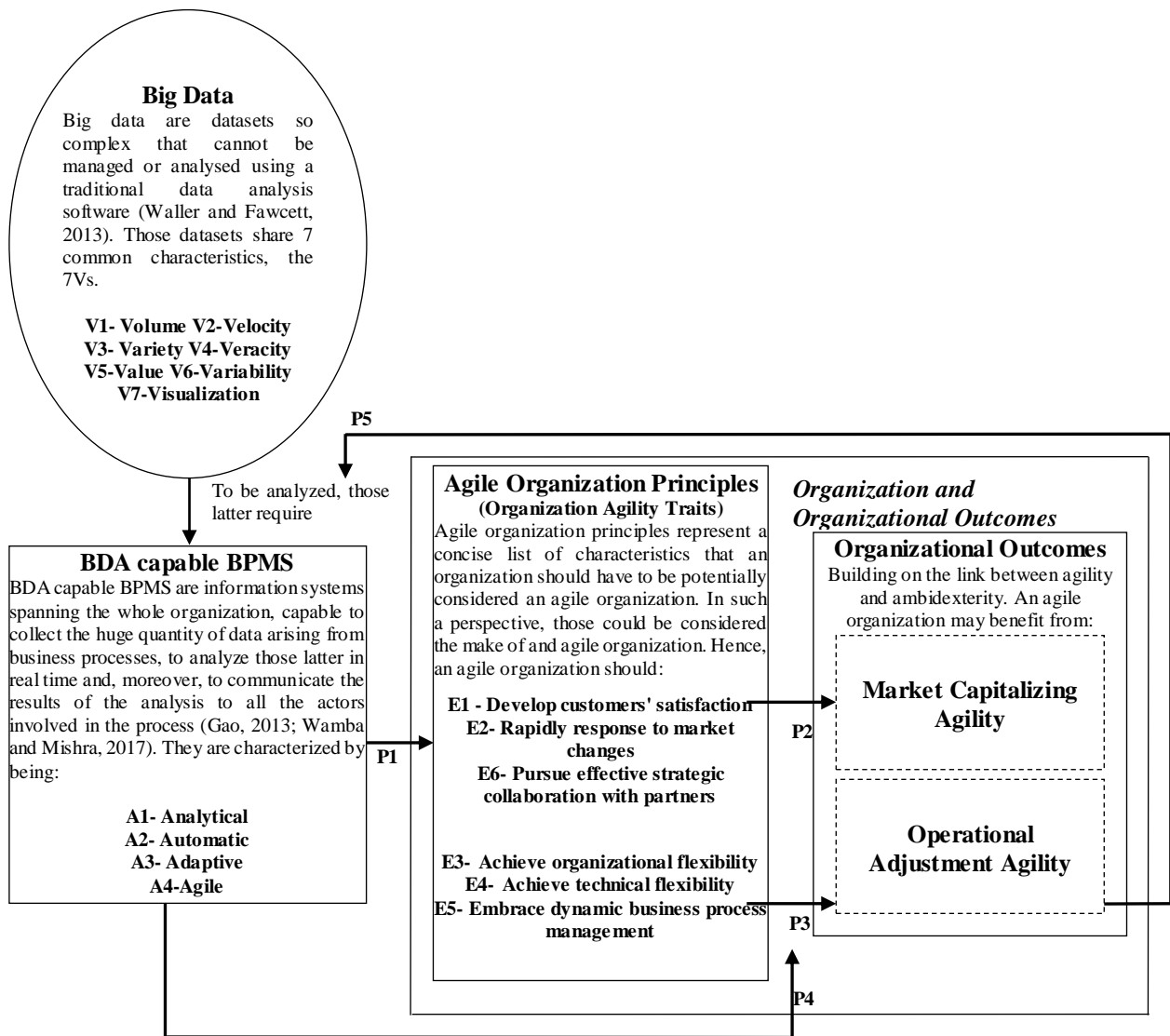

Figure 2- The importance of BDA capable BPMS for Agile Organization