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Big data and risk management in business processes: implications for corporate real estate

This is the author's manuscript

Original Citation:

Availability:

This version is available http://hdl.handle.net/2318/1715171 since 2019-11-08T10:55:50Z

Published version:

DOI:10.1108/BPMJ-03-2019-0125

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08 November 2026

Big Data and Risk Management in Business Processes: Implications for Corporate Real Estate

Abstract

Purpose – The aim of this paper is to improve understanding of the integration between big data (BD) and risk management (RM) in business processes (BPs), with special reference to corporate real estate (CRE).

Design/methodology/approach – This conceptual study follows, methodologically, the structuring inter-textual coherence process – specifically, the synthesised coherence tactical approach. It draws heavily on theoretical evidence published, mainly, in the corporate finance and business management literature.

Findings – A new conceptual framework is presented for CRE, to proactively develop insights into the potential benefits of using BD as a business strategy/instrument. The approach was found to strengthen decision-making processes and encourage better RM – with significant consequences, in particular, for BP management. Specifically, by recognising the potential uses of BD it is possible to redefine the processes also with advantages in terms of RM.

Originality/value – This study contributes to the literature in the fields of real estate, RM, BP management and digital transformation. To the authors' knowledge, although the literature has examined the concepts of BD, RM and BP, no prior studies have comprehensively examined these three elements and their conjoint contribution to corporate real estate. In particular, the study highlights how the automation of data-intensive activities and the analysis of such data (in both structured and unstructured forms), as a means of supporting decision-making, can lead to better efficiency in risk management and optimisation of processes.

Keywords – Big Data; Risk Management; Corporate Real Estate; Digital transformation; Business process; Business process management

Paper type – Conceptual paper

1 - Introduction

In the era of digitisation and automation, the real estate sector is going through a phase of deep change fueled by a strong discontinuity from its traditional cultural, social and demographic frameworks (Deloite, 2017). The redevelopment, modernisation and safeguarding of the existing real estate sector as well the corporate real estate (CRE) are topics currently receiving broadscale attention and interest (Battisti, 2018; Jylhä *et al*., 2019). In this scenario, it is increasingly necessary to ask: what will be the role of technology and digital transformation in real estate development and, further, what impact will these developments have on business processes involved in this field?

In general, business processes (BPs) go hand in hand with digital transformation - driven by new technological platforms, tools and paradigms such as the Internet of Things (e.g. Bresciani *et al*., 2018; Carayannis et al., 2018; Del Giudice, 2016; Metallo *et al.,* 2018; Santoro *et al.,* 2018; Scuotto *et al*., 2016, 2017) and big data deployment (Ferraris *et al.,* 2018; Wamba *et al.,* 2017) - allowing to connect actors, processes and obtain resources to develop business processes. Technology, in this regard, plays the role of accelerator of change (Bresciani, 2017), often leading to 'revolution', not 'evolution'. Furthermore, the gathering, analysis and application of large amounts of data have the potential to transform the entire BP (Wamba and Mishra, 2017), altering firms' decision-making processes by enabling improved visibility of their operations (McAfee and Brynjolfsson, 2012; Wamba *et al.,* 2015). In particular, the integration of technology in the real estate sector and, specifically, the development of digital real estate technologies – often referred to as PropTech (property technology; Pyle *et al*., 2017) – are destined to change the entire industry (Baum, 2017; Shaw, 2018). Altogether, the field is undergoing a transformation that will affect all related activities, from the management of properties, to the search for a new house – all the way to complete domestic digitisation. The current processes and procedures used will be entirely questioned and combined with the most modern approaches and solutions.

In general, technological innovation can support the organizations in different sectors (e.g. Bresciani, 2016; Flammini et al., 2017; Trivelli et al., 2019) but, in real estate, it has not yet realized its full potential. Historically, the sector presents as an 'early adopter' and the industry as a whole has tended to be conservative, characterised by only very gradual evolution. In the current context, while demographic and cultural changes will increasingly lead to an evolution of the organisational and operational models of real estate companies, the nature of these developments will still reflect more traditional, longstanding structural, strategic and operational features of the industry.

In this context, it becomes essential to implement a technology infrastructure capable of supporting the processes (*business process*) and that, through the collection of large amounts of data (*big data*), can allow a better *risk management*.

The notions of big data (BD), risk management (RM) and business process (BP) have all received attention from researchers and practitioners over the past few decades; indeed, research interest in these areas has been steadily increasing in recent years. To the authors' knowledge, however, although the relevant literature examines individually the concepts of BD, RM and BP or does so jointly – BD and BP (Vera-Baquero *et al.,* 2014); BD and RM (Frankel, 2012); RM and BP (Suriadi *et al*., 2014) – no studies consider these three elements together within the real estate sector; further, nothing is known about what encompasses these three concepts in CRE. Based on these considerations, the aim of this paper is to improve understanding of the integration between BD and RM in BPs, with special reference to CRE.

To accomplish this, a structuring intertextual coherence process has been followed; specifically, a synthesised coherence tactical approach (Locke and Golden-Biddle, 1997) has been used. The approach draws heavily on theoretical evidence (Baccarani and Bonfanti, 2015) published mainly in the corporate finance and business management literature.

This research fills the above-identified gap in knowledge. In particular, the contribution of this conceptual paper is twofold. First, the work extends the literature in the fields of real estate, BP management, digital transformation and risk management. Second, the authors highlight how, in CRE, the automation of data-intensive activities and the analysis of data, structured and unstructured, can support decision-making (thereby leading to greater efficiency in RM and optimisation of such processes).
The remainder of the paper is organised as follows. First, a theoretical framework for conceptualising and defining risks/RM, BD and BP in real estate/corporate real estate is provided. Second, the methodological approach is explained. Third, a new conceptual framework of analysis is presented and discussed. Finally, the work ends with some conclusions, implications for research-practice and direction for future research.

2 – Theoretical framework

2.1 – Risks and Risk Management in Real Estate/Corporate Real Estate

As for any organisations, from a strategic and financial perspective, there are some risks in real estate and, specifically, in corporate real estate (e.g. Cacciamani, 2012; Cafferata *et al*., 2011; Ciaramella, 2016; Gibson and Louargand, 2002) that can substantially impact value creation (Tardivo *et al*., 2015; Battisti, 2018). In general terms, risks are among the important issues to be evaluated in ensuring the best performance of any type of organisation (Campanella *et al*., 2017; 2019). They are a critical factor as well in real estate, particularly given the fluctuations and uncertainties that typically characterise this sector. Risk, indeed, is a central topic to be considered in investing in real estate; further, it can present itself in various forms, making it complex to recognise. In the relevant literature (e.g. Cacciamani, 2012; Joseph, 2004; Khumpaisal, 2011), there are numerous risks that have been identified, that pertain to such expenditures. Some of these risks are common to all processes (e.g. market risk, counterparty risk, compliance risk), while others are typical of a real estate investment or a real estate management or real estate disinvestment. All the risks must be managed to ensure that they are compensated for with a proportionate return. In this sense, risk management is a '*methodological approach to continuous identification, analysis, treatment and monitoring of risks by proactively using adequate processes, methods and tools'* (Sienou *et al*., 2006). In particular, the goal of the value creation (Miglietta *et al*., 2017: Battisti et al., 2019) previously introduced is thus influenced by the ability of an organisation to manage potential risks to guarantee that optimal decisions are made (e.g. Hubbard, 2009; Tardivo *et al*., 2015).
Specifically, in the literature there are several studies (Bartelink *et al*., 2015; CBRE, 2012; Gibson and Louargand; 2002; Huffman, 2003; Rasila and Nenonen, 2008; Simons, 1999) that have directly/indirectly investigated the risks associated with CRE – also in terms of corporate real estate risk management (CRERM), In particular, the most recent contribution on corporate real estate risks is that of Bartelink *et al*. (2015) which identifies six main risk categories:

- development risks,
- financial risk policy,
- operational and business policy risks,
- location (physical) risks,
- appearance (design/reputational) risks, and
- external and regulation risks.

The first category pertains to risks connected with the development or renovation of real estate (Huffman, 2003; Bartelink *et al*., 2015). The second concerns risks resulting from the company's financial corporate real estate policy, as might affect the shareholder (Bartelink *et*

al., 2015; CBRE, 2012; Gibson and Louargand, 2002; Huffman, 2003; Rasila and Nenonen, 2008). The third refers to risks that arise from decisions about the operations of the business itself (Bartelink *et al*., 2015; CBRE, 2012; Gibson and Louargand, 2002; Huffman, 2003; Rasila and Nenonen, 2008; Simons, 1999). The fourth concerns risks related to the possibility of income loss due to the following factors:

- counterparty risks for the solvency of tenants and/or for the risk of default;
- risk of concentration of tenants, due to a high concentration of the latter in the same economic activity;
- default risk of rental situations for the expiration dates of leases that are not renewed (see Bartelink *et al*., 2015; CBRE, 2012; Huffman, 2003; Rasila and Nenonen, 2008; Simons, 1999).

The fifth risk factor, also defined as 'reputational risk' or 'design risk', concerns the possibility that the appearance of the CRE may have a negative impact on shareholder value (Bartelink *et al*., 2015; CBRE, 2012; Huffman, 2003; Simons, 1999). The last factor concerns all those risks that could actually influence the shareholder value, as may be caused by external factors or are connected to some change in relevant regulations (Bartelink *et al*., 2015; CBRE, 2012; Gibson and Louargand, 2002; Huffman, 2003; Simons, 1999).
The following table summarises the main risks in CRE, as covered by the different authors/institution.

Table 1 – Risks in CRE

Risks	*Simons (1999)*	*Gibson and Louargand (2002)*	*Huffman (2003)*	*Rasila and Nenonen (2008)*	*CBRE (2012)*	*Bartelink et al. (2015)*
Development Risks			X			X
Financial Risk Policy		X	X	X	X	X
Operational and Business Policy Risks	X	X	X	X	X	X
Location (Physical) Risks	X		X	X	X	X
Appearance (Design/Reputational) Risks	X		X		X	X
External and Regulation Risks	X	X	X		X	X

For organisations that operate in the real estate sector, the implementation of appropriate CRE risk management strategies are essential for attaining and sustaining competitive advantage (Park and Glascock, 2010). As a result, and given the risks analysed above, some general CRE RM strategies have been elaborated (Huffman, 2003). These range from due diligence to insurance practices, all the way to avoidance, hedging and diversification. In particular, Adler *et al*. (1999), Peltier (2004), and Hajmohammad and Vachon (2016) identified four main strategies generally utilised in the RM process:

- acceptance/assumption: consists of adapting to risks when they become a significant problem;
- avoidance: eliminating a specific risk before it occurs;
- mitigation: reducing the probability of the impact of a given risk; and
- transfer: transferring a certain risk from one subject to another.

The following table provides a short overview of the four main risk management strategies studied by different scholars through the years.

Table 2 – Risk management strategies in CRE

Risk management strategies	*Adler et al, (1999)*	*Peltier (2004)*	*Hajmohammad and Vachon (2016)*
Assumption/Acceptance	X	X	X
Avoidance	X	X	X
Mitigation	X	X	X
Transfer	X	X	-

As evidenced from the table, two main findings can be highlighted. First, it emerges that, in CRE and the like, both active (Avoidance and Mitigation) and passive (Assumption/Acceptance) strategies are adopted in response to the related trigger event, related needs and related business policy. Second, it appears that the Transfer strategy seems to have received less interest over the years.
However, despite the precise categorisation of these various risks, it is useful to remember that risk is inherently subjective (Slovic and Weber, 2002); it is not just attributable to chance. Rather, differences in risk perception can be the result of variability across priorities, primary processes and cognitive biases. For this reason, risk (or more generally uncertainty) must be dealt with using a flexible approach, seeking feedback not only early in the process through stakeholder interactions (Sarasvathy, 2001; Shams, 2016a, 2016b; Wiltbank *et al*., 2006) but processing the relevant data as it becomes available.

2.2 – Big Data in Real Estate/Corporate Real Estate

The term 'big data' refers to a vast corpus of data that, in general, requires advanced technologies to be processed and analysed (and thereby put into a form that can be extracted, read and applied for business purposes) (e.g. Frisk and Bannister, 2017; Rothberg and Scott Erickson, 2017). In the literature, there are many definitions of BD (e.g. Ardito *et al.,* 2018; Diebold, 2018; Laney, 2001; Madden, 2012; Manyika *et al*., 2011); finding one that is unambiguously accepted is therefore difficult. In particular, BD definitions have developed rapidly which, itself, has raised some confusion (Gandomi and Haider, 2014). However, one of the most widely used definitions is that one of Gartner, Inc.: '*Big data is high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making*' (Gartner IT Glossary, n.d.).
Some scholars (e.g. De Mauro *et al*., 2015; Gandomi and Haider, 2014; Hashem *et al*., 2014; Laney, 2001; Madden, 2012; McAfee and Brynjolfsson, 2012; Schroeck *et al*., 2012; White, 2012), instead of providing a classic definition, have tried to describe the term BD through their main key characteristics. The first author who defined the term based on its characteristics was Laney (2001), who suggested that *volume, variety* and *velocity* (or the Three V's) are the three key dimensions of challenge in data management. As a result, the Three V's have developed as a common framework for defining BD (e.g. Chen *et al*., 2012; McAfee and Brynjolfsson, 2012). In addition to the traditional Three V's, other dimensions of BD have also been applied by scholars in recent years as a means of defining it (e.g. Chen *et al*., 2014; Ferraris *et al*., 2018; Gandomi and Haider, 2014; Intezari and Gressel, 2017; Lugmayr *et al.,* 2017; Moorthy *et al*., 2015). These include *veracity, value, variability, validity, venue, vocabulary* and *vagueness.*
The following table shows the features and definitions used to describe BD by the various authors.

Table 3 - Characteristics of Big Data

Features	Authors	Definitions
Volume	De Mauro *et al*., 2015; Ferraris *et al*., 2018; Gandomi and Haider, 2014; Gartner, 2012; Hashem *et al*., 2014; Laney, 2001; Madden, 2012; McAfee and Brynjolfsson, 2012; Moorthy *et al*. 2015; Schroeck *et al*. 2012; White, 2012.	Exponential quantities of data that are continuously expanding.
Variety	De Mauro *et al*., 2015; Ferraris *et al*., 2018; Gandomi and Haider, 2014; Gartner, 2012; Hashem *et al*., 2014; Laney, 2001; Madden, 2012; McAfee and Brynjolfsson, 2012; Moorthy *et al*. 2015; Schroeck *et al*. 2012; White, 2012.	Heterogeneity of data: it is possible to have both a large number of data and a vastness of sources from which to find information and numerous platforms from which they derive.
Velocity	De Mauro *et al*., 2015; Ferraris *et al*., 2018; Gandomi and Haider, 2014; Gartner, 2012; Hashem *et al*., 2014; Laney, 2001; Madden, 2012; McAfee and Brynjolfsson, 2012; Moorthy *et al*. 2015; Schroeck *et al*. 2012; White, 2012.	Velocity is the speed at which data is created exponentially and the speed of transfer.
Veracity	Ferraris *et al*., 2018; Gandomi and Haider, 2014; Moorthy *et al*. 2015; Schroeck *et al*. 2012; White, 2012.	This term indicates the reliability of the data and understands those that are not correct or reliable compared to those not reliable.
Value	De Mauro *et al*., 2015; Ferraris *et al*., 2018; Gandomi and Haider, 2014; Hashem *et al*., 2014; Moorthy *et al*. 2015; White, 2012.	The volume of data can express more important information than those taken individually.
Variability	Gandomi and Haider, 2014; Moorthly *et al*. 2015.	Variation of data flows that derive from different sources while being connected to each other.
Validity	Moorthy *et al*., 2015.	Degree of reliability of the data.
Venue	Moorthy *et al*., 2015.	Difference in platforms and inequality of formats.
Vocabulary	Moorthy *et al*., 2015.	Appearance of new notions and terms, descriptions that did not exist before.
Vagueness	Moorthy *et al*., 2015.	Confusion, uncertainty and inaccuracy in reading data.

Technology and innovation always go hand in hand; indeed, today – more than ever – innovation itself goes through BD. These changes are due to the union between the tangible world and the virtual world, implemented through the internet, and making connections between everyday objects (IoT) (e.g. Uden and He, 2017). Also central to this process is Cloud Computing, a common term for everything that includes delivering hosted services over the Internet (e.g. Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS)). The rapid development of Internet of Things and Cloud Computing has led to the explosive growth of data in industry and business arena (e.g. Jin *et al*., 2015; Kumar *et al*., 2018; Trequattrini *et al*., 2016). These transformations have involved several sectors such as:

- banking and finance,
- production,
- public administration and healthcare,
- distribution,
- utilities,
- food and beverage,
- telecommunication and media,

- insurance, and
- real estate.

In particular, nowadays IT technologies are changing the structure of the real estate market into one that is predominantly data driven. Specifically, in real estate, BD comprises a range of databases involving:

- structured data such as historical series of transactions or evaluation results;
- structured data relating to micro- and macro-economic and demographic variables;
- unstructured data relating to web, social networks, topographic information, etc.;
- geo-referencing on homogeneous micro zones.

Buyers, sellers, financial institutions, realtors and other stakeholders need access to such data to make informed decisions about real property because, for example, pricing and valuation in the corporate real estate industry are difficult to quantify.

BD has endless potential for both entrepreneurs and consumers in real estate. For the entrepreneurs, it can be used in marketing to create personalised offerings or to recognise the most suitable areas for building one or more property. For the end users, BD can be applied to evaluate different properties agreeing to various parameters in order to identify the most suitable and/or potentially profitable one.

Therefore, given their widespread presence in many sectors, BD allows organisations to look differently at the decision-making in BP.

2.3 – Business process in Real Estate/Corporate Real Estate

In the literature, there historically are numerous BP definitions (e.g. Davenport, 1993; Hammer and Champy, 1993; Rummler and Brache, 1995). One of the most used definitions is that of Johansson *et al*. (1993) who define a BP as '*a set of linked activities that take an input and transform it to create an output. Ideally, the transformation that occurs in the process should add value to the input and create an output that is more useful and effective to the recipient either upstream or downstream*'.

Generally, firms require numerous processes, from the acquisition of raw materials to the sale of the product or service. The three main areas of the BP, as presented by Hull and Motahari Nezhad (2016), are:

- 'Transaction-Intensive Processing': involves less complex but routine tasks, characterised by the repetition of tasks and more subject to repetition.
- 'Judgement-Intensive Processes': characterised by a higher degree of difficulty than the first and involving, for example, the search for new customers and new sales relationships.
- 'Design and Strategy Support Processes': concerns extraordinary operations; therefore, it is not possible to have an automation degree, but it is necessary to study new practices in order to find the solution for these extraordinary events.

In the current context, for many companies, the ability to digitise, automate and, at the same time increase, the efficiency of their BPs is a distinctive element.

Technology is changing many scenarios and even BPs through automation. Increasingly, it can be expected to be a constant in the workplace, enabling better understanding of the business climate and, as well, making predictive decisions in real time based on the need and behavior of the people. Consequently, BP automation is driving companies in a range of sectors to new scenarios. Real estate industry and corporate real estate are also benefitting from these developments. The core business activities for selling properties, finding qualified leads for properties, managing projects, and portfolio and asset management can be vastly simplified a great with automation. Improved service delivery, communications, time to market and new avenues for growth are factors driving real estate businesses to adopt technology such as BD as a means of optimising their competitive position. For example, in

the real estate sector it will be possible to analyse the customer experience more thoroughly and in detail and, based on the data, automate actions both internally and externally. In this sense, business process management (BPM) represents an important business area within the industry (Del Giudice *et al*., 2018). It is a set of activities that apply process optimisation to improve performance and business results and thereby minimise risks (Lehnert *et al*., 2016; Miglietta *et al*., 2018).

3 – Methodological approach

In order to construct our contribution and presenting a new conceptual framework for CRE, this study is based on a structuring inter-textual coherence process (Alvesson and Sandberg, 2011; Lock and Golden-Biddle, 1997; Sandberg and Alvesson, 2011). In structuring an inter-textual field, the scholars try organise existing studies and knowledge into a context for contribution that reflects the consensus of previous work (Barrett and Walsham, 2014), by using a range of textual strategies (Alvesson and Sandberg, 2013).

In the literature, there are three textual strategies for connecting current studies into a context for contribution: synthesised coherence, progressive coherence and non-coherence (Lock and Golden-Biddle, 1997). In our study, we used a synthesised coherence tactical approach (Dittrich *et al*., 2015) in order to '*cite and draw connections between works and investigative streams not typically cited together to suggest the existence of undeveloped research areas'* (Lock and Golden-Biddle, 1997, p. 1030). In particular, the approach is based on theoretical evidence published mainly in the corporate finance and business management literature. Further conceptual aspects are based on experiences obtained during different public speaking opportunities such as giving university lectures, seminars and presenting contributions at conferences (Baccarani and Bonfanti, 2015).

4 – A new conceptual framework for Corporate Real Estate

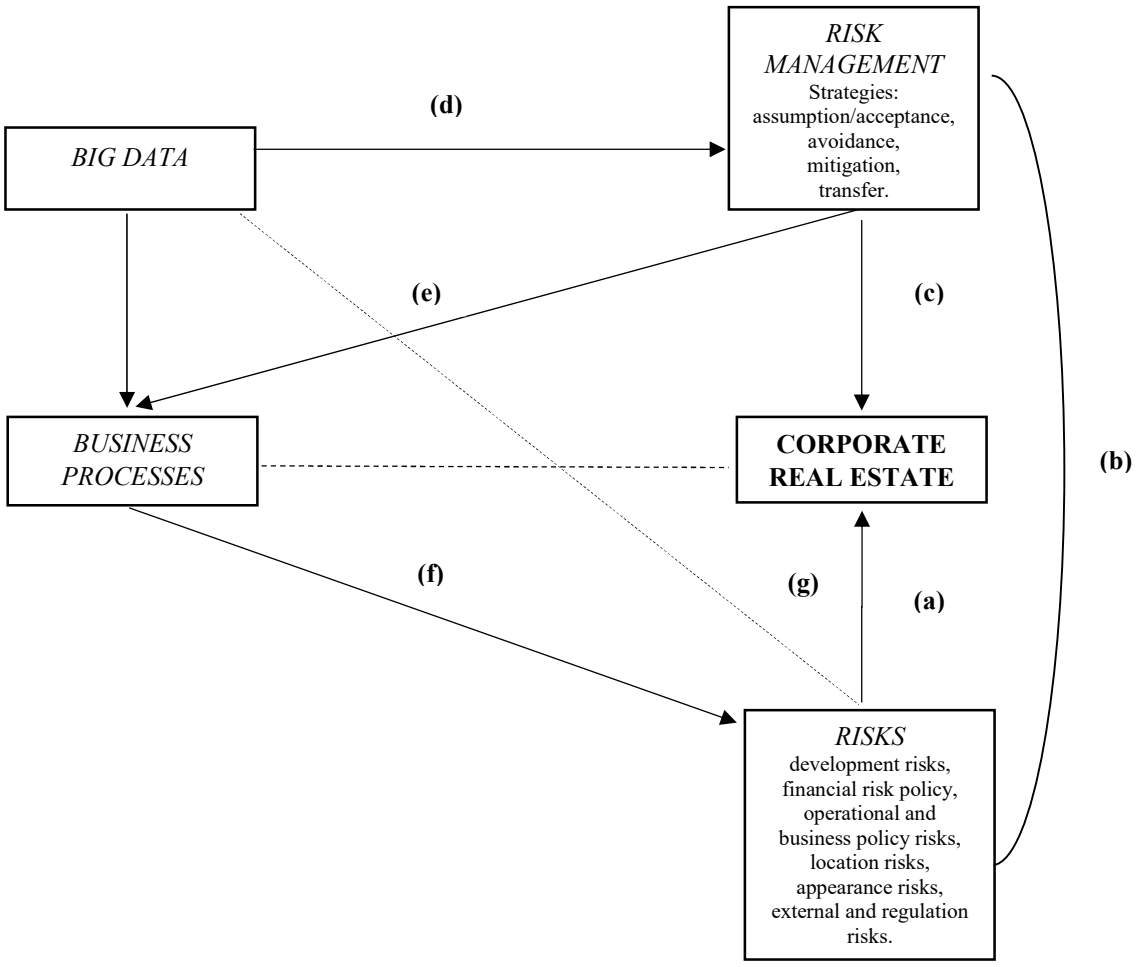
The real estate sector in general, and specifically CRE, are going through a phase of rapid evolution linked to the changes that are taking place in the ways of working, living, consuming. An important professionalisation process of the sector is underway to meet the needs of the client. While traditionally a sector with a strong 'handmade' professional quality, it is currently moving towards a dimensional growth of companies which – both for internal decisions and regulatory constraints – also means greater transparency and compliance.

Over the past few years, in the real estate sector, the use of technology has mainly been used to improve the efficiency of old consolidated processes. However, there are ways in which technology such as BD can influence the real estate market far beyond pure efficiency improvements (with a disruptive effect also on the nature of property, remodelling, and the way in which real estate is bought, sold and managed). Automation, BD and the Internet of Things are now a common heritage of both the industrial world and consumers. In the age of 'on-demand', the state of the art of technology and the availability of capital suggest that, in the future, buildings will increasingly be sold to, and purchased from, companies.

However, as previously analysed, there are some *risks* associated with CRE (a) that must be managed (b) through the implementation of appropriate *strategies* (c). Also, the risk management faces innovative challenges and data technologies present new opportunities to address these challenges. In fact, massive, comprehensive and near real-time data sets have the potential to increase monitoring of risk (Veldhoen and De Pris, 2014). Therefore, risk management/mitigation is a central element in the way BD is changing the real estate sector itself and, as well, its business *strategies*. The opening of large amounts of data (*big data*) through the use of the internet and the process of collecting and analysing that content to

extract hidden information (*big data analytics*) can strengthen decision-making processes and encourage better *risk management* (d), with significant effects in the *BPs* (e), and consequently on risks (f), with positive effects on CRE (g).
The following graph summarises a new conceptual framework for corporate real estate.

Figure 1 – A new conceptual framework for CRE



As previously analysed, among the various technologies that are revolutionising the real estate sector (e.g. PropTech, Internet of Things), BD can favour, on one hand, a minimisation of risks (thereby improving efficiency and facilitating cost reduction) and, on the other, an optimisation of the BPs. In the real world, real estate companies are obliged to make strategic choices based on quality information regarding the relevant market(s) and, in real time, keep their current and prospective exposure under control with respect to the various types of risk involved.
The four risk management strategies identified by Adler *et al*. (1999), Hajmohammad and Vachon (2016) and Peltier (2004) might be adopted in any kind of BP in order to reduce potential risk factors such as inability to react to designated changes, inadequate information, absence of resource/skill, inability to use resource/skill, absence/inaccurate or unclear strategic definition and misusage of technology (zur Muehlen and Ho, 2005). In fact, if not adequately mitigated, these risks may imply a loss of resources as well as loss of earnings (Clemons, 1995; Towers, 1994). Continuous risk assessment is therefore needed throughout the implementation of process such risk management.

Given their versatility, Acceptance/Assumption, Avoidance, Mitigation and Transfer may also be applied to CRE. For example, in the case of management of real estate assets necessary for the activity and, in particular, the management of industrial, tertiary and commercial spaces used by companies, the Avoidance and Mitigation strategies are of particular importance because they might find an application in the lease of an existing structure and/or industrial or commercial establishment. In fact, when the CRE venture includes development activities such as construction financing, permit approvals, environmental issues, design requirements, location analyses, taking use of an existing building via leasing could reduce their related uncertainties (Huffman, 2003). Before a company decides to purchase or lease a property, it might consider how the real estate transaction fits into its overall real estate portfolio strategy. If the decision to purchase or lease matches the real estate portfolio strategy, then there are no problems related to risk management (or rather, considering that risk is an intrinsic element of the corporate system, the problems concerning risk management are minimal). On the contrary, if this decision is not in line with the corporate's portfolio, the previous strategies listed above (Avoidance and Mitigation) might not be applicable; in that case, an alternative may be to adopt a passive risk management strategy: Acceptance/Assumption. The latter, for instance, consists of adapting to the relative risks derived from its own purchase choice in favor of the choice of leasing.

Use of BD technologies might improve the four risk management strategies briefly described above. In particular, referring to the first strategy (Acceptance/Assumption), BD may help the organisation adapt to regulatory regulations and mandates.

With regard to the second strategy (Avoidance), since corporations spend too much time analysing existing processes (Hammer and Champy, 1993, Grover *et al*., 1995), BD technologies could help improve or redesign a process by eliminating (or at the least, better managing) a specific risk.

BD technologies applied to the third strategy (Mitigation) might accelerate standardised process routing. Finally, concerning the last strategy (Transfer), BD technologies could improve process outsourcing.

It is important to emphasise that the use of BD technologies must be anticipated by an improvement of the database infrastructure capabilities (Davenport, 1993; Grover *et al*., 1995).

5 – Concluding Remarks, Implications and Future Lines of Research

To the authors' knowledge, this is the first pioneer conceptual work based on the integration between big data and risk management in BPs, with special reference to the corporate real estate, and it is based methodologically on the structuring inter-textual coherence process and, specifically, on the synthesised coherence tactical approach.

This study highlights a new conceptual framework for the real estate sector, specifically for CRE, in order to develop insights on the benefits connected to the use of BD as a strategy/instrument to strengthen decision-making processes and encourage better RM management with significant consequences on BPM. Specifically, by recognising the potential uses of BD it is possible to redefine the processes also with advantages in terms of RM. For example, using predictive analytics, firms can examine the condition of different types of properties, obtaining detailed recommendations and information.

In particular, the contribution of this paper is twofold. First, we have extended the literature in the fields of real estate, digital transformation, BP management and RM. Although the literature has examined the concepts of BD, RM and BP, no prior studies have jointly considered these three elements in CRE. Second, we have highlighted how the automation of data-intensive activities and the analysis of BP, both structured and unstructured, to support

business decisions, can lead to better efficiency in RM and optimisation of decision-making processes.

The insights of this study offer implications for both research and practice in corporate finance and in the BPM field.

Concerning the theoretical implications of our investigation, this study associates BD and RM with BP. In the literature, as previously noted, several studies have investigated the three issues separately, but there are no clear references to research that has analysed the three topics together. Specifically, the new conceptual framework for CRE may help academics to identify new research questions, gain an overview of existing research, and position and align their own works.

Concerning the practical implications, this research is useful for the different stakeholders and people involved in the real estate market (e.g. investors, sellers and buyers) because BD, if adequately used, can make markets more secure (since they are based on empirically-derived figures and facts). In particular, BD offers important opportunities in most area of risk, with effects on RM itself and on decision-making processes. The common benefits offered by BD stem from its massive volume and variety. However, BD can be strategically applied to reduce and manage different types of risk (e.g. credit risk, market risk, operational risk and compliance risk). Specifically, optimal RM can only have a positive impact on company processes, with positive effects on the real estate sector. This research can also be useful for companies that produce, distribute or sell solutions for BD (software, databases, analytics and infrastructure) because they can offer a huge and complex amount of data within the real estate sector with impacts on BPs. They also can make these data available to various stakeholders (including banks, funds, developers and asset managers).

Future research can be carried out to extend the findings of the present study. In particular, our research could be extended in several directions. First, it would be interesting to see whether our conceptual framework can be tested on case studies. Second, it might be interesting to understand how major real estate companies are evolving in response to recent technological advances, with particular focus both on the attention they are giving to the theme of digital transformation, as may be driven by new technological platforms, tools and paradigms and, as well, how they are using these to improve their own business practices.

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