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IMPLEMENTATION OF THE BIG DATA CONCEPT IN PROPERTY MANAGEMENT BY USING BUSINESS INTELLIGENCE APPLICATION- A MINI REVIEW

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ABSTRACT

This paper reports a preliminary study on the implementation of the big data concept in property management by using a business intelligence application. Property management seeks to maximise value by optimising operational efficiency that requires a high degree of technological literacy in managing properties and assets. Property management requires techniques, technologies, systems, practices, methodologies and applications that analyse critical business data to help stakeholders in better understanding the business and most importantly the maintenance aspects of the property. This is especially important for governments in managing its real estate assets and properties. Poor utilisation of properties and assets is a pernicious budget problem. The sudden rise of big data has left property players unprepared to use it effectively, therefore most properties and assets are not well maintained. Property management needs to manage large amounts of complex data in terms of rental, inventory, assets, people, operational, geographies, pricing etc. It is therefore vital for property managers to have a platform to handle more complex and unstructured data. The transformation from samples to the overall data, the change from the pursuit of exactness to acceptance uncertainty and the correlativity instead of causality are indispensable for preparation for the age of big data. With improved analytics, organisations can better predict their future portfolio utilisation, moderating operating costs and potentially defer or eliminate costly capital projects.

Keywords: Big data, business intelligence, property management

1.0 INTRODUCTION

The concept of property management has developed throughout the years and nowadays it covers a vast area of managements [1]. As time travels, the need for high efficiency of property management is vital to ensure the smoothness of organisation's businesses. Mainly it is aimed to boost the efficiency and suitability of the property management and ensure the organisation's aims are achievable in terms of efficiency, cost and quality [1]. According to [2], property management is required for attaining the financial objective; that is to maximise investment returns. At the same time property management seeks to maximise value to optimise operational efficiency. Well maintained property assets are essential as they will improve a working environment of an organisation [3]. Eventually property management will contribute to the efficient operation of the organisation itself. Globalisation and shifting information and communication technology [4] will require property management players to re-orient themselves [5]. This re-orientation is required to manage all the information related to property management to ensure all the aims of the organisation are achievable, both the short-term and long-term aims.

The Malaysian Government is particularly serious in establishing a systematic management of its properties and assets as it owns various types of properties: operational real estate (hospitals, schools), public real estate and commercial real estate. This has prompted the government to manage all the properties in a systematic and effective manner [6], which is in line with its vision in becoming a developed country with first class infrastructure [3]. Excellent maintenance of assets could salvage a country from mayhem of infrastructural deterioration [7]. However, due to a lack of maintenance culture [1, 3], many public assets and government-owned facilities are not well maintained and are in poor condition [3, 8].

As property management handle large sets of complex data, it is necessary for this field to have a platform that could handle more complex and unstructured data. One of the technologies discussed in terms of data handling is business intelligence, also known as business analytics. Traditionally, business intelligence has been used by most companies in allocating considerable time and resources to generating statistical reports, which are then demonstrated on spreadsheets and noted by analysts [9]. More powerful implementation of technological insights has generated analytical tools that enable firms to make more informed business decisions.

Innovation is the word that is often heard in business nowadays. Every single participant in business needs to respond to innovation. Failing to respond will place the business in jeopardy by its inability to adapt. The digital age has transformed the property business with new processes that need players to be more efficient. These processes reduce long term costs and increase competitive advantage in the real estate market. The property industry seems very slow to adapt to the idea of technology but eventually it will evolve when the market forces it to do so. For example, the establishment of Wired Score assesses the connectivity of a building and provides transparency to occupiers on the quality of digital infrastructure. Furthermore, in Malaysia the rental trend has changed to become multi-home property management, therefore innovation is required in order to keep up with the demand. Communication between tenants and property managers needs to be streamlined in terms of rent payment, issue reporting, lease negotiations and more. For example, maintenance work needs human intervention, however by using a business intelligence system (especially when the management office is closed) could save everyone time, trouble and cost. Other instances include record keeping, rental records, security and complaints.

The transformation of acceptance uncertainty and the correlativity instead of causality are indispensable to prepare for the age of big data. With improved analytics, organisations can better predict their future portfolio utilisation, moderating operating costs and potentially defer or eliminate costly capital projects.

2.0 BIG DATA

There is extensive availability of data in every sector [10]. Computer scientists, physicists, economists, mathematicians, political scientists, bio-informaticists, sociologists, and other scholars are all trying to get their hands on the massive data produced by and about people, things and their interactions [11]. The data had evolved into large sets of data for traditional data-processing systems therefore new technology is needed [11]. This is what is known as big data. Big data has become the buzzword and has been applied in various sectors across the world. Despite the unrecognisable true value of big data [11, 12] observers have noted that big data solutions have been promoted as the way to focus on public issues [12].

There is no actual definition of big data [11, 13]. It is hard to define this term [14, 15]. Conventionally, big data is often referred to as the Vs: Volume of data, Velocity of data and Variety of data [12, 13, 15]. First of all, the data must be big [12], in that a typical database software tool does not fulfil the requirements on capturing, storing, managing and analysing the data [14]. By definition, the volume of big data has also been defined as the sheer size of the dataset itself: number of data and disk data usage [13]. The velocity of big data refers to the pace of data being constructed and stored, and its rate to retrieve it back [16]. It means that data is continuously and constantly being added [13]. There is no definite benchmark that could really be used to consider the volume and velocity of the data as big data [12]. The data complexity is defined by the variety of the Vs: Volume of data, Velocity of data and Variety of data. Big data shall have a multiple data source that is often being integrated [13]. Hence the data could be varied in its forms; including text, images and videos [12].

Utilisation of big data will help in many areas, ranging from efficiency of operations to decision making processes [17]. Data evolving pushes every player to take the initiative of researching big data. Big data is known as a powerful tool to manage the evolving needs in managing data. Big data has the capacity to collect and analyse the data with unprecedented breadth and depth [18]. According to Boyd and Crawford, there are arguments on the benefits and threats of the application of big data; either it will become a tool to address various problems or it will it become an intrusion of privacy [11]. Nevertheless, big data has plenty of advantages in each field for which it is applied; making data analysis simpler, faster, more accurate and minimises risk [19]. Big data also ensures the possibility of powerful computing, always a step ahead in time [20]. The introduction of big data makes the accessibility of data at your fingertips [11].

3.0 BIG DATA FRAMEWORK

To establish big data framework (especially for the government), needs to combine several components of management and information technology. The Industrial Revolution 4.0 (IR 4.0) has been in the mainstream of many countries, therefore the use of technology is inevitable. Big data needs to combine with mobility, cloud computing and social media to derive a digital transformation of government management, in particular of properties and assets. Transformation is changing the way in which technology has been viewed and the impact on human lives. Big data technology has seen a new generation of technologies and architecture designed to extract value economically from very large volumes of a wide variety of data by enabling high-velocity capture, discovery and analysis [21]. It encompasses hardware and software which integrate, organise, manage, analyse and present data that is able to produce useful functions to users, which are as follows:

i. Volume – large and increasing quantities of data.
ii. Variety - Multiple types of data whether structured, semi-structured or unstructured or combinations of these types of data.
iii. Velocity - The speed of which data arrives and the speed of analysis, ranging from batch to streaming data.
iv. Value - Increasing business value from big data analytics and technology prices.

Volume

Big data alludes to massive volumes of data which require millions and billions of records that need to be considered. This includes emails, websites visited, search engines and complaints. Email usually contains the best record of pending and current business, but it needs to be sorted and noted to find out what it contains. Another example is building design, assets and infrastructures where the public may evaluate varieties of virtual prototypes to zero in on the best selection of properties and assets to be used.

Variety

Variety in big data is a combination from a variety of data sources and formats. The function is to determine whether the application can be considered as big data. Big data applications combine data from a variety of data sources from both internal and external to an organisation from different types whether it is structured, semi-structured or unstructured. The variety of big data will also have an impact from a technical point of view, for example, the use of social media for commenting on government assets and facilities. What is the relative importance of comments in social media versus customer records? How can departments combine a large number of changing public records with published facilities and asset research data to find the best solution for a particular case? An example of this may be the mash up of the internal operational data with the semi-structured data from web log files that identifies customers' online behaviour, with sentiment analysis of unstructured text from customer comments.

Velocity

The velocity in big data refers to the moving data through the system of an organisation which varies from batch integration and loading of data at predetermined intervals to real time streaming data. The use of search engines, data processing, text analytics and search, inferencing, machine learning and event-based architecture can help in processing big data. The key in the velocity of big data is to understand the nature of the business and the requirement of the end user. For instance, property managers need to identify and understand emerging property business trends immediately to make a difference. Other applications can be used such as real time assets and facilities' recognition for maintenance purposes. Web search engines must also be able to process and mine billions of queries to determine the accuracy of algorithms. In other words, velocity in big data is capable of processing the right information at the right time with the right degree of accuracy for what is needed [21]. The need for specialised software is not always necessary to meet high-performance demands. The combination of high-availability clustering, scale-out file systems, multi-CPUs and multicore processors means that the performance that can be delivered levering common off-the-shelf (COTS) components is likely to be sufficient in government organisations. Data can utilise the use of the cloud system, making consideration of the hardware unnecessary. Nevertheless, the use of high performance computing will sometimes be needed if the project is pushing the boundaries.

Value

From the big data point of view value refers to both the cost of technology and the value derived from the use of big data. The cost is important because it is the key defining factor of what is new with the big data. Governments can be considered as large data warehouses which have existed for a long time. Real time data management in government services has existed for years. Unstructured content analysis in the form of text mining has existed in government agencies for years. Big data will change the system to be more affordable and available to the public in the broader market. A combination of open source software and decreasing hardware prices has made these technologies more affordable. Value also refers to the benefits derived from big data projects. These benefits can be broadly classified as:

i. Capital cost reduction. A reduction in software and other infrastructure costs.
ii. Operational efficiency. A reduction in labour costs to more efficient methods for data integration, management, analysis and delivery.
iii. Business process enhancement. An increase in revenue or profit due to new or better ways of conducting business, including improvement to commercial transactions, sustainable management of communities and appropriate distribution of social and government services.

4.0 BIG DATA APPLICATION IN PROPERTY MANAGEMENT

The importance of big data uses should not be excluded in the property management field. There is no doubt that an application of big data had gained excellent decision making capacity and boundless economic benefits through beneficial information produced by data mining [22]. Hence, property management shall take full advantage of big data because real estate is a pillar industry of the national economy [22]. This is due to the fact that property management has high correlation in the real estate industry which has contributed significantly to the Malaysian economy. An application of big data in property management will change the way of complex

data handling and at the same time will produce more precise predictions of results [23]. Eventually it will help maximise the companies' profit as a result of the systematic and efficient property management. Furthermore, the growth in rental trends which involve big amounts of investment requires strong demand for property management services. However, property management continues to be fraught with inefficiencies and the industry has generally behind the times in terms of technology [24].

There are many complex datasets involved in property management. Namely the data of rental, inventory, assets, people, operational, geographies, pricing etc., therefore it is vital for property managers to have a better platform to handle more complex and unstructured data. The enormous size of data with variations and complexities bring new revenue models and vast spaces for the development of big data in property management [22]. There are areas where business intelligence is able to enhance the efficiency in property management activities, such as:

i. Analytics in building automation systems.
ii. Automation in property management job functions.
iii. Machine learning in real estate marketplaces.

In Malaysia, property management requires technique, technologies, systems, practices, methodologies and applications that analyse critical business data to help stakeholders better understands its business and most importantly well-maintained data. An application of big data in the property field has several advantages, namely ensuring a quick decision making process, developing an accurate decision which produces actionable results and ensuring each of those decisions are tailored according to individual customers [25]. An efficient management of data could help in cutting down cost and develop a chance in business expansion [25].

Moreover, most decision making processes in property management rely on data analysis. The application of big data in property management help in forming an accurate prediction of market trends of client needs and requirements [19]. With the application of algorithm calculations in big data, it ensures generated results are accurate and reliable [19]. By having these applications, it ensures that players in the property field are always one step ahead [20].

In applying big data into the property management field, it is necessary to classify all data related. It is crucial to find a method to create a standard to classify data that can meet diverse purposes; to reduce data noise and to remove data redundancy [26]. By doing so, it helps excavate deeper data in big data. A classification of data includes a process of data mining and data analysis. In the financial field, the complex data is classified according to the industry standard. A classification of data in property management for an application of big data it is yet to be decided.

5.0 BUSINESS INTELLIGENCE

Business intelligence holds an important role in extracting information and manipulates the information to discover hidden trends of data [27]. Business intelligence is the use of technology to collect and translate information to improve business effectiveness [27, 28]. According to [29, 30] business intelligence is defined as the right to access the right data at the right time to make the right business decision. But this does not limit to warehouse data only but the online data [31]. Business intelligence has also been defined as the process of information collection, treatment and its diffusion to reduce uncertainty in decision making [32]. Basically, business intelligence helps organisations process information and data to help in the business decision making process.

The fast growing competency of data generation and collection has generated vital obligations for an application of business intelligence tools. Business intelligence tools help to intelligently and automatically transform the processed data into helpful information and knowledge [27] [9]. The informative data could be transformed into a beneficial guidance via visual reports, trend-reviewing and key-performance indicators [9].

The main purpose of business intelligence is to direct players' knowledge with the valuable information gathered to make the best decisions to ensure achieving organisational objectives [9]. Business intelligence helps organisations to understand and administer their business in order to gain a top position in the market [27, 33]. The ultimate purpose of business intelligence is to improve timelines and information quality [33]. Business intelligence tools have vast benefits including: business issues could easily be solved by employees, the identification of most profitable among the list of clients, improve e-commerce strategies, reduce risk of information exposure to outsiders, determination of the best combination of products and service line customers [33].

6.0 BUSINESS INTELLIGENCE INTEGRATION IN PROPERTY MANAGEMENT

An integration of business intelligence in property management will have a great impact and benefit all players in this field. Data involved in property management varies from structured to unstructured data, thus by applying business intelligence technologies will improve the performance of organisations. Business intelligence technologies and tools could group all datasets involved in property management for easy access and easy analysis for a precise decision making process.

An example of business intelligence research application in real estate is by CBRE Asia, which applied business intelligence in their corporate real estate field. In corporate real estate, there is demand in derivation of exceptional performance, cost savings and operational efficiencies [9]. An application of business intelligence will uncover the efficiencies of the operation and showcase savings opportunities. Business intelligence also enables users to explore up to the minute metrics of portfolios [9].

Hence similar applications of business intelligence in property management will help maximise the profits of organisations by ensuring efficiencies of operation and help in making the best decisions. In other words, the outlook for big data application through business intelligence is very promising for the future. The implementation of business intelligence in property management job functions can improve the following job applications:

i. Improving residents' property quality of living:
Business intelligence improves residents' experience living in the property. For example, residents can use an online mobile system to pay rent or extend a lease. In advanced applications, residents are also able to regulate their energy and water use.

ii. Efficient management in terms of time and money:
Business intelligence is able to save property managers' time and money. For example, property owners could handle typical management tasks anywhere because the online system will provide recommendations on maintenance and management issues, the physical condition and value of their property without worrying about understaffing problems.

iii. Systematic management for property managers:
Business intelligence is able to reduce property managers' burden. For example, companies could utilise the online system or applications to find new residents and cost-efficient vendors. Managers could also be efficiently notified of current or potential issues with the property in order to be resolved in sufficient time.

Definitions of big data volumes are relative and vary by factors, such as time and the types of data. What may be deemed big data today may not meet the threshold in the future because storage capacities will increase, allowing even bigger datasets to be captured. In addition, the type of data, discussed under variety, defines what is meant by 'big'. Two datasets of the same size may require different data management technologies based on their type, e.g., tabular versus video data. Thus, definitions of big data also depend upon the industry. These considerations therefore make it impractical to define a specific threshold for big data volumes.

Table 1 Sources of big data [34]

SOURCES OF BIG DATA	DESCRIPTION
PUBLIC DATA	• Typically held by government, government organisations and local communities that can be harnessed for wide ranging business and management applications. • Examples of such data include transportation, energy use, and healthcare that can be accessed under certain restrictions to guard individual privacy.
PRIVATE DATA	• Data held by private firms, non-profit organisations and individuals that reflect private information that cannot be readily imputed from public sources. • For example, private data includes consumer transactions, organisational supply chains using RFID tags, movement of company goods and resources, website browsing, and mobile phone usage among several others.
DATA EXHAUST	• Ambient data that is passively collected non-core data with limited or zero value to the original data collection partner.

	• The data is collected for a different purpose but can be recombined with other data sources to create new sources of value. • When individuals adopt and use new technologies (e.g., mobile phones), they generate ambient data as by-products of their everyday activities. • Individuals may also be passively emitting information as they go about their daily lives (e.g., when they make purchases, even at informal markets; when they access basic health care; or when they interact with others). • Another source of data exhaust is information-seeking behaviour, which can be used to infer people's needs, desires, or intentions. This includes internet searches, telephone hotlines, or other types of private call centres.
COMMUNITY DATA	• Community data is a distillation of unstructured data especially text into dynamic network that captures social trends. • Typical community data includes consumer reviews on products, voting and Twitter feeds, among many others.
SELF-QUANTIFICATION	• Types of data that is revealed by the individual by quantifying personal actions and behaviours. • For example, a common form of self-quantification is through the wrist bands that monitor exercise and movement which is then uploaded to a mobile phone application which can then be tracked and aggregated. • In psychology, individuals have 'stated preferences' of what they would like to do versus 'revealed preferences' where the preference for an action or behaviour is inferred. • For example, an individual might buy energy efficient bulbs with the goal of saving electricity but instead keep lights on longer because it is now using less energy. Such self-quantification data helps bridge the connection between psychology and behaviour. Social science scholars from diverse areas such as psychology, marketing, or public policy could benefit from stated and implicit preference data for their research.

Table 2 Specific big data projects underway around the world [35]

City examples	Impact on city and real estate values
SANTA CLARA, CA, USA	

• The drought in California prompted Santa Clara to retrofit its municipal irrigation system with sensors to more efficiently manage limited water supplies. The system is expected to save 180 million gallons of water	• Remove inefficient amenities and save money. • Avoid long-term decline in values.
LONDON, UK • Transport for London (TFL) uses ticketing data to build travel patterns across its rail and bus networks. This information helps in improving the network and assessing the impact of closures and diversions.	• Better transit flow. • May raise values on city periphery.
YINCHUAN, CHINA • Yinchuan is a smart city pilot project in China, with features such as facial recognition on buses, grocery delivery via apps and an online portal connecting doctors with patients.	• Increased productivity in city. • Makes the city more attractive and spurs on residential demand.
RIO DE JANEIRO, BRAZIL • IBM has designed for the city an operations centre that integrates data from 30 different agencies. These provide a foundation for valuable public safety services, including an early warning and evacuation system for Rio's favelas.	• Improved public services and safety net. • Long-term positive impact on poor neighbourhoods.
SPAIN • Spain's tax agency analysed data from unmanned drones surveying 4000 municipalities. It discovered 1.69 properties paying insufficient taxes on new construction, expansion and pools. The initiative brought in 1.2billion euros in additional taxes.	• More efficient municipal taxation. • Better local services.

CONCLUSION

In today's business world - a highly competitive world - no business field shall be excluded from an application of business intelligence. With the use of developing technology in data handling, it ensures the organisation makes the best decisions, thus puts them in the top place among others. A better understanding of big data in property management and an integration of business intelligence will eventually improve the poor utilisation of property management portfolio optimisation. Property management like so many other industries currently desires innovation in job functions by utilising technological innovation. One of the most powerful innovative new technologies transforming property management today is by using big data applications through business intelligence. Big data applications are being used more frequently in all aspects of the property management industry, but its use in property management allows all stakeholders effective ways to control expenses, increase return, and manage risk using automated systems based on data applications. Data analysis and forecasts are able to improve outcomes in property optimisation. Opportunities are emerging to use information about customers' preferences to provide better services at lower costs.

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