AWARENESS OF BIG DATA CONCEPT IN THE DOMINICAN REPUBLIC CONSTRUCTION INDUSTRY: AN EMPIRICAL STUDY

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ABSTRACT: The construction industry, being one of the main characters in the ever-demanding need for technology developments, sometimes falls short of other industries in terms of implementation. The adoption of Big Data (BD) in industries like health and retail has had positive impacts in aspects such as decision-making processes and forecasting trends that allow planning some future business movements in advance. Hence, the question of whether these results can be recreated in construction industry. Therefore, this paper addresses the level of awareness identified as the first step towards implementation of the BD Concept within the construction industry of Dominican Republic (DR). Since little to no information exist on the subject the selected approach to perform this research was qualitative, twenty-one semi-structured interviews were studied using content analysis. Four levels of awareness is developed based on the Endsley situation awareness model. The results showed that nearly ninety-five percent of the interviewees had either no knowledge or a very basic awareness of the BD requirements or intermediate awareness but only five percent had actually applied BD in the construction industry. This paper provides the level of awareness of BD in the DR construction industry and provides evidence for the need to provide continuous professional development programmes for construction professionals and a need for an update of curriculum in construction-related education.

KEYWORDS: Awareness, Big Data, Construction, Dominican Republic, Technology, volume, and velocity.

1. INTRODUCTION

Big Data is one of the emerging terms with more presence in today’s technological society, several authors such as (Rabhi, Falih, Afraites, & Bouikhalene, 2019), (Wang, Wang, Yang, Zhu, & Liu, 2020), and (Tamminia et al., 2020), have reported applications in various areas of science and engineering. The adoption of Big Data (BD) analysis in business and human resources management has had positive impacts in terms of improvement of the decision-making processes (Rabhi et al., 2019). Big Data works as a solution for the “what to do” with the ever-growing volume of information that is produced every second, and it has applications across business sectors.

After financial services, the construction industry generates the largest amount of data of any sector. A key challenge for the profession is how we use this data to improve what we deliver. Despite the promise of artificial intelligence (AI) and the Internet of Things industry, estimates suggest that up to 95% of construction industry data is not used but wasted (RICS, 2020). (Khan, 2008; RICS, 2020; Sitsabo Diamini, 2012) noted that the construction industry plays an important part in the economic growth of the countries. It is indeed one of the main characters in resources consumption and thus the ever-demanding need for technology developments. Being that the case, it sometimes falls short of other industries in terms of implementation of technological developments. Construction methods have barely changed through the history of the industry, while access to resources and materials has varied significantly in recent years creating the need for change in the management and use of these resources. Technologies such as BIM that promote a more digitally integrated project management system, have gained popularity recently since they allow us to visualize and plan the development of construction projects more efficiently (Kamunda Renukappa S. Suresh S. and Jallow H., 2020; Sarkar & Modi, 2015). (RICS, 2018) published an insight paper in conjunction with Oxford University on Big data, smart cities, intelligent buildings, surveying in a digital world – to equip construction professionals with the insights and tools to be able to consider these issues carefully and act with integrity in an increasingly data-driven world.

Some industries possess a higher success rate in adopting technological developments than others, e.g. the construction industry, which requires more time to make the changes that allow them to keep up with the latest technologies (Silverio-Fernandez, Renukappa, & Suresh, 2019). In the same way, many industries have proven the benefits of adopting Big Data, hence the question arises as to whether these positive results can be replicated in the construction industry. (Ngo, Hwang, & Zhang, 2020), explains that the adoption of BD in construction could produce a great value, but there are no tools to assess the adoption capacity of construction companies.
2. THEORETICAL BACKGROUND

The first documented use of the term Big Data (BD) goes back to mid-1990s (Li et al., 2016). Big Data is used to define the big amount of information contained in a database, which due to its heterogeneous characteristics makes it difficult to manage with traditional data analysis tools (Liu, 2015). In recent years the term has regained popularity as a result of increased production and transmission rate of information that is collected and handled thus gaining the attention of many disciplines and industries to take advantage of the benefits of its implementation (Tamiminia et al., 2020). Many studies (Caesarius & Hohenthal, 2018; Pigni Piccoli G. & Watson R., 2016; The Economist, 2012) agree that the adoption of BD results in positive outcomes such as improved financial performance, business optimization and innovation. (Raguseo, 2018) work highlights the “high revenue” promise as a main driver.

The emerging tools, software’s and gadgets related to different disciplines promotes the adoption of new technologies (Wang et al., 2020). In some countries, adoption of technological developments such as BD occurs more naturally than others. Hence dividing these tendencies in two groups. The first group in most cases adopt the new technology due to government support or incentives or due to industry initiatives, and that as a result exposing the benefits and challenges of adoption. The second group which adopt the new technology after adopting the “wait and see policy” identifying the best practices and lesson learnt from the first group are in a pursuit of the achieving same or more benefits. Still, in both cases, it can be found that some industries are more prone to change than others, and some technological developments can be more easily adopted in some areas than others. The ease with which an industry or discipline adopts a new technology is primarily given by the type of companies that make-up of that industry. In this particular case, industries were most of its companies are data-driven or carried out their operations digitally are more likely to embrace the adoption of new technologies (Caesarius & Hohenthal, 2018; RICS, 2020).

2.1. Big Data Industries Applications

The technological development and exponential grow of information has created the perfect environment for the proliferation of tools that, similar to Big Data, allow to extract useful insights from this data, becoming a determining factor in the decision-making process (Wang et al., 2020).

Figure 1: Big Data applications in different industries

As shown in Figure 1, fields such as Healthcare, Public Sector Administration, Business, Manufacturing, among others have taken advantage of the Big Data development wave present in the last couple of years (Rabhi et al., 2019; Tabesh, Mousavidin, & Hasani, 2019; You & Wu, 2019). Many fields have adopted Big Data to substitute their out-dated systems for data management in order to provide a better management and analysis of the high volumes of data that they now produce and possess (Boyd et al., 2020). (Tamiminia et al., 2020), agrees by confirming that the massive volumes of existing geospatial data, its variety of origins and formats, and growing diversity and accessibility, demonstrating how very different fields are motivated by the same aspects in terms of BD adoption. For instance, (You & Wu, 2019) states that the increasing amount of patient data in healthcare formed by information assets with high volume, velocity, value, and diversity through healthcare data resources. The BD
Based healthcare information system has been growing rapidly in recent years and is being adapted to derive important health trends and support timely preventive care. Mainly, because the increasing amount of patient data can no longer be handled by the traditional approaches. (You & Wu, 2019), noted that Electronic healthcare records (EHRs), which use big data analytics for major evaluations of diseases and performance of epidemiological analyses. Finally, the decision-making aspect plays a major role in the healthcare industry, therefore the data that propels this process need to be manage with an appropriate tool such as BD.

Other areas such as business and management rely in subjective judgement for decision-making. However, according to (Rabhi et al., 2019) increasingly important decisions are on hard data, which can be obtained through big data analytics. Also, in Human Resources Management, the rate of adoption of Big Data are due to the need of manage large volume of employees, customers, and transactional data in organisations, with the purpose of helping companies to “make decisions and create bigger benefits” (Wang et al., 2020) acknowledges that, BD application in the manufacturing industrial field is still in its infancy but at the same time, mentions its application in several fields such as natural resource management, industrial automatization and maintenance and Product Lifecycle Management, which are already being developed and applied. Another series of most common applications are presented by (Tabesh et al., 2019), in their study of BD implementation strategies from the administrative point of view (Error! Reference source not found.).

![Figure 2](image)

**Figure 2:** Extract from table "An overview of important big data analytics algorithms and applications"

Source: Tabesh, et. al., 2019.

Big Data has garnered an incredible amount of attention in recent years, this topic has become the focus of conferences and scientific publications all around the world, thus becoming a major innovation source for the academia, causing even a widespread proliferation of research around this topic (Li et al., 2016). Contrary to popular belief that BD is a technology oriented to private industry, the public sector has also started to benefit from its adoption. (Khurshid et al., 2019) indicate that public bodies are one of the producers of data in large quantities such as geo-spatial maps, public records of transfers, appointments, financial statements, census data, and environment datasets. Governments have been actively making available to the public large amounts of data without restrictions creating Big Open Data (BOD) a subcategory of BD that shares its same basic characteristics. Among the applications of this BOD businesses can use this data for commercial purposes, it can allow public to make more informed decisions and the most important thing is that it will provide real-time data for policymaking to deal with intricate situations. Also, the cyclic process of BD analysis (Figure 3) (Rabhi et al., 2019), makes it an ideal tool to follow up on the implementation of those public policies. (Khurshid et al., 2019), also highlight the fact there has been an increase of government uses, for example Pakistan has adopted the use of BOD, based on the need for transparency, follow up of the recent technological developments and development of social and commercial value, among others.

![Figure 3](image)

**Figure 3:** Big Data Analysis Process
2.2. Big Data in Construction

Little is known about the adoption of BD in the construction, since the developments that make possible its use in this industry are still in the early stages (Ngo et al., 2020). Still there is evidence indicating that its adoption within the industry would produce similar results to those obtained in other disciplines. For instance, (Wood, 2018) indicates that the 75% of construction companies already uses cloud storage, which complies with one of the basic aspects of BD which is the creation of the dataset, in the same way, (Burguer, 2019) states that construction related BD exist based on the records that have been kept of all the buildings that have ever been built and that are now digitally storage. Also, these databases continue to grow continuously thanks to the contribution of the digitization of old projects and from sources such as machines, computers, people and others data-generating device from new and current construction projects.

In the same way, (Neilson, Indratno, Daniel, & Tjandra, 2019), indicated that traffic data complies with all requirements needed to be considered as BD, the information from monitoring equipment and wireless sensors that have been installed to promote safety and traffic monitoring is already being used to gain insights that promotes a more efficient traffic management environment. It also highlights that the projected future of transportation which is the case of autonomous vehicles will depend on real-time traffic data that BD could help to deliver in a more effective way. In the same line, (Chen, Lin, & Wu, 2020), also consider transport as a potential beneficiary of big data adoption, as well as other aspects directly and indirectly related to construction such as monitoring of critical infrastructures and geospatial fields which are used to better locate construction projects (Filipović, Lukić, & Lukić, 2020).

Authors such as (Bilal, M., Oyedele, L.O., Qadir, J., Munir, K., Ajayi, S.O., Akinade, O.O., Owolabi, H.A., Alaka, H.A., Pasha, 2016; Oudjehane Moeini S., 2017), have identified the source of the data available within the construction industry to be considered BD in the form of project schedules, reports, drawings, site images and sensor data as well as information and designs coming from the use of BIM and the use of sensors and technologies related to IOT. In a more recent study, (Ngo et al., 2020) listed the applications of BD in relationship to the project life cycle (Error! Reference source not found.). also mentioning the general characteristic of supporting the decision-making processes, which is considered as a general characteristic through of all fields.

![Figure 4: Applications of Big Data in the Construction Project Lifecycle](image)

In accordance with the applications presented above (Burguer, 2019) also indicates that the use of BD in early stages such as design can contribute to a better determination of what and where to build by using not only the modeling and design of the building but also environmental data, stakeholder inputs, social media discussions and historical data which can be used to determine risk probability. An example of this is Brown University in the United States, who used this technology to determine the location of their new building, considering both the benefit of the university and the students. In the same way, traffic, weather and the activity from the surrounding businesses and community can contribute towards the design of the project phasing. During construction, the management of idle time, replenishment of materials and equipment rental and maintenance can be improved.
together with the ability to reduce material waste which represents approximately 25% of the project cost (Carlstrom, 2020). Finally, during the operation stage, the analysis of information coming from the use of sensor on buildings and some infrastructures such as bridges can contribute to the monitoring and managing in the way of energy consumption, operating regulations, detection of uncommon events (Burguer, 2019).

Trends like the “Construction 4.0” which promotes a “connected building site” (Berger, 2016), and technologies currently being implemented such as BIM will allow a better transition to a wide adoption of BD, since it has contributed since its inception to the creation and growth of the construction database through the digitization of designs and processes as well as the incorporation of sensors that generate and transmit construction related data, also the insights extracted from the BD analysis can be used as an input to schedule maintenance in the operating stage of infrastructures for instance. The BIM files of one construction project can easily reach the 100 GB (1024 Bytes) in size (Garyev & Garyaeva, 2019), and only in the UK, 69% of construction companies were using BIM in their projects according to the National BIM Report (NBS, 2019), which gives an idea of roughly how much data is being generated only by the use of BIM in the construction projects.

### 2.3. Construction Industry of the Dominican Republic

Just as in the rest of the world, the construction industry plays an important role within Dominican Republic’s economy, contributing 12.2% of the Gross Domestic Product in the form of job and income generation, according to the (Central Bank of the Dominican Republic, 2020) in 2019. The natural phenomena such as earthquakes and the cyclonic season to which the island is subjected during the year requires that the infrastructure be able to withstand the effects of these phenomena placing a special level of responsibility on the Dominican construction industry. The execution of both public and private construction projects with the view to meeting needs in areas such as housing, tourism, and rural development, make this industry one of the main players in the Dominican economy (Silverio-Fernandez et al., 2019).

The construction industry is intimately linked to the economic development of the Dominican Republic, from the generation of jobs to the infrastructural development of the nation, such as the improvement of the quality of life through low-cost housing, infrastructure linked to basic necessity services and other factors exposed in the national development strategy (MEPYD, 2017).

In 2019 the Economic Commission for Latin America and the Caribbean (CEPAL), ranked the Dominican Republic with the highest economic growth compared to 2018 in the region (UN, 2019), which suggests that any study carried out in this country could be replicated in others assuming similar conditions in the industry. Consequently, the data collected in this research about the knowledge that the Dominican Decision-makers have about the concept of BD can serve to draw similar conclusions not only in DR but also in other countries of the region and the world.

This document as an extract of a wider investigation about Big Data Implementation in the Dominican Republic’s Construction Industry could help to identify and understand the main challenges faced by the adoption of the BD technology or any other technology that in the same way requires a change in the culture and in the way the industry develops its projects, shifting from the traditional delivery methods to more technological oriented ones driven by the sustainable development of today’s society which demands of lest waste, more efficient use of resources and the consideration of social and environmental aspects.

### 2.4. Measurement of Awareness

In order to “measure” the awareness of BD in DR, Endsley’s “Theory of Situation Awareness” was adopted for this study. This because it is the most generally accepted interpretation of situation awareness, is defined as the “… perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future” (M R Endsley, 1995). Based on this model, Situation Awareness Global Assessment technique, which is according to (Dishman, Fallacaro, Damico, & Wright, 2020), considered “the only direct and objective situation awareness measurement tool”. Situational awareness in Endsley’s model has three (3) levels (Error! Reference source not found.): perception,
comprehension, and projection (Mica R Endsley & Connors, 2014). For the purpose of this study an adaptation of the Endsley Model was created (Error! Reference source not found.). Level zero (0) of “No Awareness” was added.

Figure 5: Endsley original model of Situation Awareness

![Figure 6: Endsley's Model Adaptation](image)

The concept of Situation awareness (SA) was initially used in military and aviation applications (M R Endsley, 1995). Over the years the application of the SA can be seen across several industries to provide an awareness classification, for instance, disciplines such as health have used Endsley’s model of SA in mental health (Moura et al., 2020). Also, for: thoracic surgery, obstetrics, nursing and anaesthesia (Dishman et al., 2020). Likewise, the program evaluation field used SA to help improve the decision-making skills of program evaluators (Mason, 2020). Manufacturing has also used SA analysis to reduce the incidence of accidents related to forklift driving (Choi, Ahn, & Seo, 2020). However, there is no evidence of this model been applied to Big Data and in particular to the construction industry.

3. RESEARCH SCOPE AND GAP

The first step in understanding the factors that enables the adoption of Big Data in construction is to identify the state of knowledge that is possessed on the subject, which is the scope of this study. It comprises only the general knowledge aspects of the investigation. Representatives from medium and large construction companies in the Dominican Republic were interviewed to assess their level of awareness with questions that explore their understanding about BD using topics related to the Big Data Concept, its characteristics, benefits, data handling and commitment with productivity. This study is limited to analysing concepts related to general knowledge about big data, leaving other aspects also important for implementation such as barriers, challenges, key drivers, etc., for future research.

3.1. Research Gap

Even when there is literature that supports the implementation of Big Data in construction, it recognizes that it is still in its initial stages and that a clear path to adoption has not yet been documented (Ngo et al., 2020). No relevant results were found of the Dominican Republic’s strategies to implement new technologies in apart from (Silverio-Fernandez et al., 2019) but the studies are with respect to smart devices. Therefore, this study seeks to explore the research question: What is the level of awareness about Big Data within the Dominican Republic’s construction industry?

This study will provide an insight into likeminded countries within the region that similar to the Dominican Republic lack documented literature of the adoption of new technologies such as BD. The Dominican Republic plays a major role in the Latin American and Caribbean region with one of the strongest economic growth according to (The World Bank, 2020), reason why any study carried out there could identify a path for other countries in the region to follow.

4. RESEARCH METHODOLOGY

The methodology adopted for this investigation was dictated by data availability (Kumar, 2015), since little to no information exist on the subject, the selected approach to perform this research was qualitative. Semi-structured interviews which are a reliable source of comparable data and let the participants to freely share their points of
view (Cohen D, 2006) was selected as the data collection method. Twenty-one (21) semi-structure interviews were carried out to explore different areas concerning Big Data in the DR Construction industry.

The interviews were directed at large and medium-sized companies with undeniable presence within the productive market and whose representatives (interviewees) were top-level executives involved in their decision-making process.

<table>
<thead>
<tr>
<th>Position</th>
<th>Number of Interviewees</th>
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<tbody>
<tr>
<td>Chief Executive Officer (CEO)</td>
<td>1</td>
</tr>
<tr>
<td>Vice-President of Operations</td>
<td>1</td>
</tr>
<tr>
<td>Superintendents</td>
<td>2</td>
</tr>
<tr>
<td>Seniors</td>
<td>4</td>
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<tr>
<td>Managers</td>
<td>10</td>
</tr>
<tr>
<td>Coordinators</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
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</table>

The literature showed that the size of the company influences their ability to implement new technologies such as BD, where the bigger the company the most likely it is able to possess the investment capability and accumulate the amount of data necessary to implement a successful BD analysis (Ngo et al., 2020), this factor determined the sampling technique as non-probabilistic, providing a group of characteristics that both companies and participants should meet to be considered suitable for this study. The size of the company and the position/experience of the interviewee were the factors considered when establishing the sample. The national taxpayer registry of the Dominican Republic was used to identify the construction companies with potential to participate in this research.

The participating construction companies were selected following to the classification according to size provided by the laws of the Dominican Republic (National Congress of the Dominican Republic, 2008), this indicates that the organizations will be classified as:

- Micro: with 1–15 employees, less than RD$3,000,000.00 in active capital or less than RD$6,000,000.00 in annual revenue.
- Small: between 16–60 employees, between RD$3,000,000.01–12,000,000.00 in active capital or between RD$6,000,000.01–40,000,000.00 in annual revenue.
- Medium: between 61–200 employees, between RD$12,000,000.01–40,000,000.00 in active capital or between RD$40,000,000.01–150,000,000.00 in annual revenue.
- Large: with more than 200, more that RD$40,000,000.00 in active capital or more than RD$150,000,000.00 in annual revenue.

A total of seventy-eight (78) companies were contacted and asked whether they would be willing to participate in the investigation, a primary response rate of forty-eight-point seven percent (48.7%) was obtained. The results (Table 2) represents the pre-interview process which can be divided in four (4) stages from the moment of the first contact to the interview. Stage I, represents the total of contacted companies, from which thirty eight (38) answers were received Stage II, represents the type of answer received about willingness to participate, nineteen (19) companies responded with definite willingness to participate, fifteen (15) responded with non-definitive interest and the remaining four (4) companies expressed no willingness in participating in the study. Stage III represents the companies to whom all the information related to the study was sent and where another confirmation was requested to schedule the interview appointment. From which twenty-six (26) companies responded with an affirmative answer, one (1) with maybe and other seven (7) decided not to participate. Finally, Stage IV represents, the scheduled interviews, of which twenty-one (21) were conducted from nineteen (19) companies.

<table>
<thead>
<tr>
<th>Stage</th>
<th>78</th>
<th>Companies Contacted</th>
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<tbody>
<tr>
<td>Stage I</td>
<td>78</td>
<td>Companies Contacted</td>
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To determine the number of interviews that would be used for the investigation, the saturation phenomenon was employed. Saturation is a well established method to determine how many interviews are enough in a qualitative study. This term is used to identify the phenomenon where the interviews do not contribute any new or additional information to the investigation (Latham, 2020). (Guest Bunce A. & Johnson L., 2006), in their study reached saturation point in the twelfth interview. In this study, the final sample consisted of twenty-one (21) interviews, from 19 companies. (Crouch & McKenzie H., 2006) states that less than 20 participants in qualitative research helps establish a close relationship and consequently a more reliable exchange of information, identifying the ideal number is between fifteen and twenty (15-20) participants.

Another aspect considered is data generalisation from which conclusions can be drawn from particular situations (Polit & Beck, 2010). As explained earlier in section 3.1 where it is described that due to the economic growth of the Dominican Republic within the Latin America and Caribbean region, it is in an advantageous position and could possibly serve as an example regarding the implementation of new technologies such as BD.

The data collection process lasted from October 2019 to March 2020 and were held in Santo Domingo, Dominican Republic. The interviews were capture using voice recordings and the duration was between nine (9) and twenty-two (22) minutes approximately. Each interview was transcribed and then translated into English from Spanish, which is the official language of the Dominican Republic, except one was in English language with the prior approval of the interviewee.

4.1. Data Analysis

The analysis method adopted is thematic analysis. This study aims to explore the awareness and understanding of the participants about BD. An assessment of the level of awareness was performed covering key aspects such as concept, characteristics, benefits, data handling and commitment with productivity related to adoption of new technologies.
In preparation for the data analysis part of a process described by Creswell in its “Guide for Qualitative Data Analysis” (Figure 7) was considered. As (Creswell, 2013) describes five steps that were used to prepare the interviews for the analysis process. The three (3) first steps were applied to the data collected as preparation for the analysis.

The data analysis process of coding and generation of themes was performed using the program Microsoft Excel, each code was placed in a cell, thus creating a grid containing a classification according to the coding assigned to each question and each interview (Caulfield, 2019). This classification represents the levels of awareness about the Big Data within the Endsley model (Figure 6). Furthermore, the individual results according to each question are presented to visualize awareness in each specific area represented by the questions.

5. FINDINGS

In this study, during face-to-face interviews, in order to capture the level of awareness on the concept of “Big Data”, a question was raised, i.e. what is your level of awareness of “Big Data” concept? Overall, interviewee’s awareness on the BD concept were distributed between various levels of the situational awareness in the modified Endsley’s model. Of the interviewees, 33% (7 of the 21) noted that ‘no awareness’ or never heard of the Big Data concept and its relationship within the construction industry. This reflects on the no awareness Level 0 of the Endsley’s model. For instance, interviewee I3 highlighted that:

“No, I had not really heard the term until this moment”.

It is evident from the above statement that, the DR construction organisations lacks basic understanding of the concept of Big Data. Therefore, to improve the DR construction industry competitiveness, decision makers have to recognise and understand the concept of Big Data. It is worthwhile to consider a holistic impact of Big Data concepts to improve the project delivery processes of the DR construction industry.

33% (7 of the 21) of the interviewees had ‘basic awareness’ on the concept of Big Data and are at Level 1. This reflects on the basic awareness Level 1 of the Endsley’s model. For instance, interviewee I20 highlighted that:

“Very generally, a big database that can be used to identify trends and to manage information”.

Similarly, I12, stated that:

“I’ve heard of the term applies to statistics and economy, but I never hear of any relationship of BD and Construction”.

From the above, it is evident that there is a basic awareness of what BD is but not in relation to the construction industry. Therefore, there is a need to raise awareness of Big Data concepts and applications in the context of construction industry. It is evident that 66% of the interviewees (14 of the 21) lacks the basic understanding of the concept of BD and its relevance to the construction industry. Therefore, there is a need to develop a continuous professional development programme for the benefit of present construction professional in the DR.

Of the interviewees, 29% (6 of the 21) noted that they have an ‘intermediate awareness’ on the concept of Big Data. This reflects on the intermediate awareness Level 2 of the Endsley’s model. For example: I4 and I11 noted that

“BD in relation with the construction industry is about the amount of data created in a construction project”. – I4

“From what I understand is that this technology allows you to extract insights of data from past projects in order to make better decisions in the management of the future projects” – I11

It is evident that there is an intermediate level of awareness in terms of the applications of BD in the construction industry, but the interviewees were not involved in the implementation of the BD concept. Therefore, it is important to document and provide BD leadership awareness programmes that include the holistic approach for implementing BD in construction industry.
Whereas just 5% (1 of the 21) interviewees noted that they have an ‘advanced awareness’. This reflects on the advanced awareness Level 3 of the Endsley’s model. The interviewee I, noted that:

“I knew the term Big Data, actually last year because I used a software for data analytics as it is a big corporation, they have like two departments, one for construction and one that’s like a supplier. The operation manager used information for the statistics of the sales which quarter of the year make the most xxx, in comparisons with this year and the last year. As well as the construction department saw how they used the information. As a big corporation, more data is gathered on a continuous basis. Therefore, I had to learn what Big Data is and how to manage Big Data and apply it to provide trend analysis and enhance decision making”.

6. DISCUSSION

The need to manage increasing data volumes that has been produced today is the major key driver for many industries that have already been making inroads in the adoption of Big Data and data management technology for years (Tamiminia et al., 2020; You & Wu, 2019), phenomenon that undoubtedly also occurs within the construction industry. Plenty of literature exist reflecting on the positive results of adoption BD in other disciplines (Caesarius & Hohenthal, 2018; Pigni Piccoli G. & Watson R., 2016; Raguseo, 2018; Tamiminia et al., 2020; The Economist, 2012), while limited sources exists about Big Data adoption within the construction industry indicating the presence of a gap. Still, areas such as project waste management, energy efficiency, project planning are already benefiting from BD implementation, driven by the use of technologies and trends such as BIM and Construction 4.0, which also contribute to the growth of BD datasets through the promotion of cloud storage and the use of data generating equipment in construction (Berger, 2016; Burguer, 2019; Wood, 2018).

This study represents the first step towards the adoption of Big Data within construction and was carried out by assessing the level of awareness that main characters, on which a future BD implementation in construction will depend, possess of the topic. The results revealed the awareness state of the industry when it comes to Big Data, showing overall, that there is a basic level of awareness prevailing within this field, meaning that an in-depth and industry-wide adoption of the subject is required to ensure a homogeneous implementation of the technology.

Surprisingly, the results demonstrated that the concept of big data, is generally known in the Dominican Republic’s industry, which agrees with much of the literature indicating that in recent years there has been an exponential increase in the use of both the term and the technology (Wang et al., 2020). But at the same time there is a lack of understanding about the possible connection between BD and construction, identifying this as the main challenge. Since most of the participants that did know about the technology were unaware of its applications in the industry. On the other hand, the literature shows that the basic elements for data accumulation and transmission in the form of cloud storage and data-generating and transmitting devices, are already widely used in the world industry being Dominican Republic no exception (Burguer, 2019; Wood, 2018) even when they haven’t been recognised as such or put in place for BD purposes.

The accumulation of large volumes of data is the main driver for the implementation of BD in most industries (Boyd et al., 2020), the industry-wide adoption of BIM, which contribute more than 100GB of data in each project, represents a great input to the creation of BD databases that can be used for analysis and the extraction of insights that can improve decision-making and the generation of necessary feedback processes (Garyaev & Garyaeva, 2019). In contrast, the inherent resilience of the construction industry to implement new technologies that do not have a high and proven success factor plays against any move towards implementation (Ngo et al., 2020). Thus, indicating that overcoming this is a primary aspect to develop for a successful adoption of Big Data and any new technology.

The findings of this research will allow researchers and managers to be aware, and at the same time, understand that at this moment the main barrier for the adoption of Big Data is the lack of concept generalization, as well as the lack of understanding about the tools necessary to manage the data. This could potentially help to react accordingly, in order to minimize those obstacles at the time of implementation. Also, this study could serve as a base of knowledge and a drive to a better awareness of the technology and its benefits together with the understanding of what is being done and what is still needed to adopt BD as part of the construction industry culture of project deliverance, at the end, the benefits of transparency, efficiency, better decision-making are the main assets required to meet the needs of today’s society.
7. CONCLUSION

The adoption of Big Data has become a primary goal for most industries across the world, driven by the exponential increase in data generation and the proliferation of data generating elements that seek to facilitate the management of operations both within companies and in daily life. In the same way it has been shown that the construction industry on many occasions lags in the adoption of new technological developments such as BD. While the creation of large volumes of data that have led to the expansion of this technology through different industries will continue to grow along with technological developments, thus it is necessary that industries like construction take advantage of the opportunities offered by this type of tools.

The use of Big Data Analysis has proven to offer a wide variety of benefits such as improvement of decision-making, process efficiency, and improvements in transparency and communication within the industries in which it has been implemented. For the construction industry it could help with the reduction of project waste hence lowering costs, managing the sustainability requirements of projects, improve planning and project deliverance to mention a few.

As a first step towards the adoption of BD in construction, this study sought to determine the level of awareness about BD that representatives within the decision-making level of construction companies possess, with the purpose of identifying the challenges and barriers that needed to be overcome to could facilitate a future implementation of the technology across the whole sector. Situation awareness was selected since it is a main element of the decision-making process. The assessment of the level of awareness of BD served to identify the strategies that could facilitate path for an industry-wide implementation.

The data analysis was carried out applying a modification of the Endsley model, which served to qualify the answers obtained in the semi-structured interview. Four levels of awareness were identified ranging from level 0 or no awareness, to level 3 or advance awareness. The results showed that although there is a relatively high level of knowledge about the BD concept, there is also a high level of ignorance about the basic steps of data management and BD applications in relation with the construction industry. The first is important because it is the foundation of the dataset creation necessary to promote a BD analysis, and the latter because it could boost the interest of investors and start an industry-wide implementation of the BD technology.

This paper provides a richer insight into the understanding of awareness and how it could be used to explore topics related to the implementation of new technologies. This study contributes towards the understanding of what are the first steps towards Big Data adoption and to provide a source that can be used to inform current and future professionals about a technology that will certainly be relevant in the near future of the construction industry.

This study could be further extended by exploring other barriers, challenges, key motivators and opportunities presented by big data adoption, taking other industries as an example. Future studies could also explore the level of awareness in other settings like more developed countries in order to determine if this factor influences the adoption of new technologies. In the same way, a study of the financial performances of companies that have implemented BD across all industries to demonstrate if the BD benefits vary depending on the type of organisation.

This study is limited to analysing concepts related to general knowledge about big data, and its results apply within the framework of the construction industry of the Dominican Republic, although the results may be applicable to other countries with similar conditions. Other key aspects for implementation as well as exploration within the framework of other countries can be used as the objectives of future research.

Finally, the implications of this study are to the professional involved in the digital process and decision-makers in the construction industry. Also, to the construction-oriented education sector to provide didactic tools to better prepare future professionals, similarly to provide continuous improvement training to achieve a standardised level of awareness of BD for the current construction professionals.

8. REFERENCES


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