PILOT STUDY ON THE USE OF BIG DATA FOR WASTE CONCRETE MANAGEMENT IN SRI LANKA

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ABSTRACT: *The construction wastage is one of the greatest barriers for the sustainable development of any country. This topic has gained wide attention in many developed countries. Further, in a developing country like Sri Lanka, this should be a topic of greater attention. However, in contrary, only few of the researches have been undertaken in this regard. This particular paper has reviewed the application of big data in various other industries and forwards it as a feasible solution for the Waste Concrete Management in Sri Lanka.*

Keywords: Waste Concrete Management, Big Data, Sustainable Building

1. INTRODUCTION

"Sustainable Development can be envisioned as a unique approach that meets the needs of the present without compromising the ability of future generations to meet their own needs" (IISD, 2018). However, construction Industry has been consistently affected by the wastages. As reported by Hobbs (2001), construction industry consumes 25% of virgin wood and 40% of the raw stone, gravel, and sand. On the other hand, nearly 40% of waste generated globally are from construction and demolition of buildings (Roach, 2001). Construction and demolition waste has taken a major portion of the solid waste discarded in landfills around the world. These wastages hamper the economy of a country while polluting the environment for a very long term.

In Sri Lanka, as concluded by Rameezdeen, Kulatunga & Amaratunga (2001), a significant amount of money is wasted on the wastages in the specific industry and it is beyond acceptable limits. With the construction industry moving in the same pace as above, it would definitely lead to unavailability of resources for the future need. Although, this has created a huge amount of losses, only few of the researches have been undertaken on this topic Rameezdeen et al. (2001).

Table 1 provides the details of concrete and its wastages with respect to an ongoing project in Sri Lanka for a period of 02 months (October and November, 2017).

Table 1. Amount of Concrete Used and Respective Wastages in Krrish Square Development Project, Colombo 01.

Grade of Concrete (Mpa)	Total Volume Poured for 02 months	No. of Test Cubes Required (Minimum)	No. of Cubes taken at once (Cubes / Take)	Total No. of Cubes Taken	No. of Times Concrete Taken in Wheelbarrow	Volume of Concrete Required for a Test Cube (m^3)	Volume of Concrete for Testing (m^3)	Volume of Concrete wasted during Testing (m^3)
C15	1029	9/ 100 m^3	3	62	36	0.2093	3.600	3.391
C35	3065.1	9/ 100 m^3	3	511	117	1.7246	11.700	9.975
C40	5225.5	9/ 100 m^3	3	871	139	2.9396	13.900	10.960
C50	40.5	12/ 100 m^3	2	12	6	0.0405	0.600	0.560
C65	472	1/ Truck	1	99	99	0.3341	9.900	9.566
C70	636	1/ Truck	1	106	106	0.3578	10.600	10.242
Total	**10468.1**			**1661**	**503**	**5.606**	**50.300**	**44.694**

From the above table, it could be derived that for a period of 2 months, nearly 40 m^3 of concrete is wasted in one site which accounts to nearly 240 m^3 per year. It could be estimated that for a year, nearly 2400 m^3 of concrete would be wasted in such 10 projects. The amount of wastages is relatively high and it is an issue that needs to be addressed.

The present world is highly influenced by the advanced technologies and the data in huge volume is consistently being exploded giving rise to a term called “Big Data”. Big data is a field that has influenced many industries around the world by means of providing several potential solutions to the many identified issues in a specific industry, thus converting them as a smart operating system. (Ismail, Bandi & Maaz, 2018). As predicted by Waal-Montgomery (2015), the volume of global data will have a steady rise at a rate of approximately 40% per year. Further, it will proceed to intensify fifty times from the current volume by the year 2020.

The recent technological advancement in the construction industry has allowed the construction managers to have a close watch over the processes thus, the availability of the data related to any construction is relatively higher than in the past. It is notable that the particular industry is known to deal with enormous amount of data that reflects the 3Vs of the Big Data and the proper utilization of such data could pave better ways for the development in the construction industry.

2. LITERATURE REVIEW

2.1 Big Data

Big data can be defined as an extremely large amount of data sets that could be analyzed computationally to reveal patterns, associations and trends, especially with respect to human behavior and interactions (Oxford English Dictionary). The term is often characterized with 3Vs namely (i) Volume – amount of the data itself, (ii) Velocity – the speed where the data is generated and (iii) Variety – the diversity and complexity of data sources. (Ismail et al., 2018). Other V’s that were suggested by few other researchers include, but are not limited to, value, veracity, visualization or visibility, and variability (Ylijoki & Porras 2016)

MGI (2012) has suggested that the big data can be incorporated in any organization to create value for such an organization. The ways in which big data can add value according to MGI (2012) are as follows:

1. To build transparency
2. To provide a platform for experimentation to discover needs, expose variability, and enhance performance
3. To Segment populations to customize the actions
4. To use automated algorithms as a replacement or to support human decision making
5. To innovate new business models, products, and services

2.2 Current Big Data application in other sectors

Currently, the term big data has entered into almost all the spheres of the industries and it plays a very important role in major industries. (Gaitho, 2017). As a result, many organizations have taken steps to incorporate the use of big data for the effective undertaking of the organization (Akbar, 2017). A survey made by Gartner in 2015 proved that companies have incrementally increased their investment in big data to 75% from 58%, the value recorded by the same survey in the year 2012. The extensive scope of big data has provided a massive scale of potential and value that can be generated across different sectors such as retail sector, manufacturing as well as the upstream industry.

2.2.1 Retail Sector

Retail sector is among the pioneers to identify the potentials of big data. This follows from the upsurge of e-commerce during the big data 1.0 era (Laney, 2001). The retail businesses were influenced by the power of basic internet technologies that could establish a strong web presence and their capacity to process a large set of data. This in turn, helped to improve their efficiency (Provost & Fawcett, 2013). The capability of big data was further used in analysis of the vast amount of data as to support decision making to expand businesses, to improve cost efficiency and also to forecast revenue (Meneer, 2015).

2.2.2 Oil and Gas Industry

The oil and gas industry sector has also been influenced greatly by big data. Mathew (2016) reported that the data collected particularly in the operational process is used mainly for detection and control purposes in this industry. Advanced analytics of the big data helped in decision making while their insights were used to plan for predictive maintenance. With the use of big data, the technology has managed to bring the maintenance cost down to about 13% (Choudhry, Mohammad, Tan & Ward, 2016). Error detection on equipment before they are entirely damaged and their maintenance were possible through digital monitoring and predictive maintenance. In this way, big data

provided potential solutions to enhance the production and to address the financial impacts before it occurs.

2.2.3 Manufacturing Sector

Manufacturing is yet another leading sector which made use of the big data techniques and technologies for the enhancement of product quality while reducing the operational costs (Oracle, 2015). The combined advantage from the external data from social networks, data from suppliers and the sensitive data from sensors and machines has been utilized to gain valuable insights to the existing information. Decision making has been improved by the use of big data as it captures the overall data and map them together. Beside this, big data technologies help in improving the product quality and reducing the overall cost by means of production and quality data analysis.

3. BIG DATA AND THE CONSTRUCTION INDUSTRY

The construction industry is often acknowledged as one of the indicator for economic wellbeing, productivity and efficiency of any country. However, according to Harenberg (2017) who compared from 1993, mentioned that it is all –time low in 2017. Castagnino, Rothballer & Gerbert (2016) have forwarded that the adoption of new technologies in this industry is very slow and this could be the principal reason for the low level performance of this industry. The particular fact has also been supported by the digitization index of MGI which has listed construction sector as one of the least digitized industries of the world. Further, insufficient data-driven decision making is the root cause of the deliberate changes made by the industry. (Castagnino et al., 2016)

On the other hand, it could be noted that, the productivity growth in construction has been lower in construction than any other industry. (Sveikauskas et.al, 2016). The fact can be supported by MGI (2011) as well. MGI (2011) has also claimed that the lowest potential to explore big data value by the construction industry could be a potential reason for this.

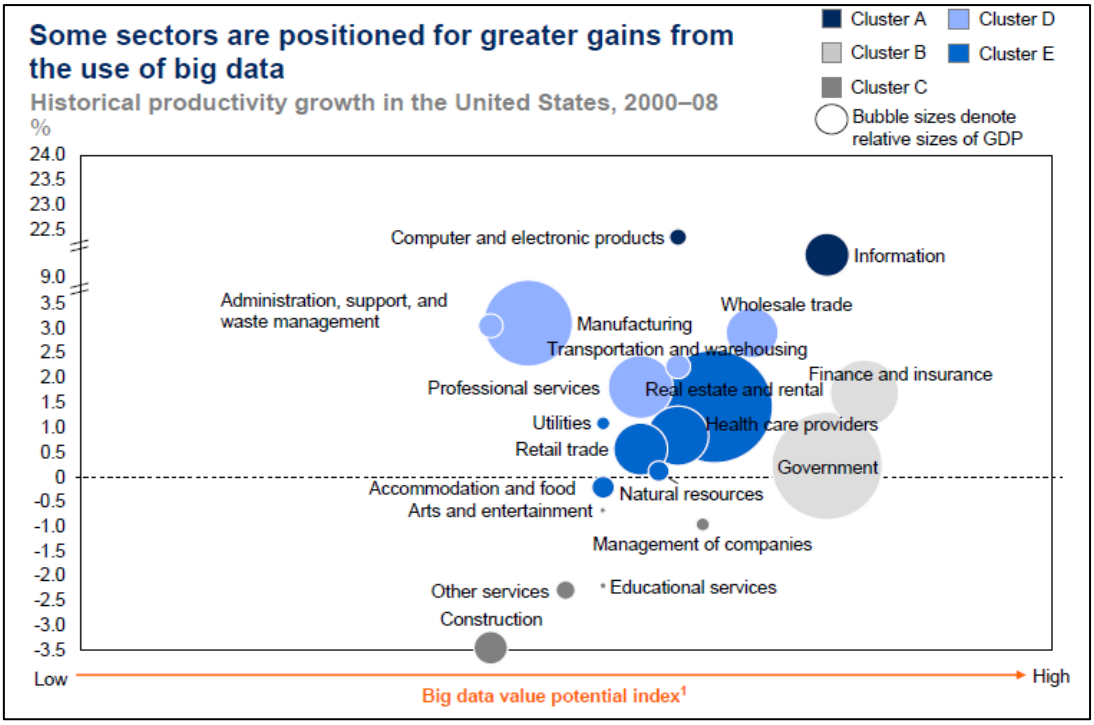

Figure 01. Big Data Value Potential Index (Source: US Bureau of Labor Statistics; McKinsey Global Institute Analysis)

Data and the construction industry are inseparable as the particular industry is highly influenced with a huge amount of heterogeneous data. Bilal et al. (2016) has also predicted that the amount of data would rise exponentially with the advancement of technologies and the Internet of Things (IoT) in the specific field. Further, the huge amount of data obtained thus, can be explored and mined to gain potential insights and several new opportunities (AddoTenkorang & Helo, 2016).

4. CONCRETE WASTAGE IN CONSTRUCTION INDUSTRY

The construction industry is mainly suffering from the concrete wastages which contributes to a significant amount of loss of money. Data is said to be an important factor in enhancing the productivity of any industry by providing broadened insight to operational performance (Peiffer, 2016). However, the massive amount of data exploded from the construction industry is not being fully utilized for construction wastage management. Further, a study that focuses on the potential application of big data in the construction industry, especially on wastage management, has not been comprehensively undertaken (Bilal et al., 2016) and this limits understanding of its potential.

The Figure 02 shows the several researches employing the techniques and technologies of big data in six areas of construction such as Computation and Analytics in Construction, Construction Project Management, Concrete and Construction Material, Building Energy and Performance, Architecture and Infrastructure. It could be seen that concrete waste management is an area that lacks the use of big data for the better management of it.

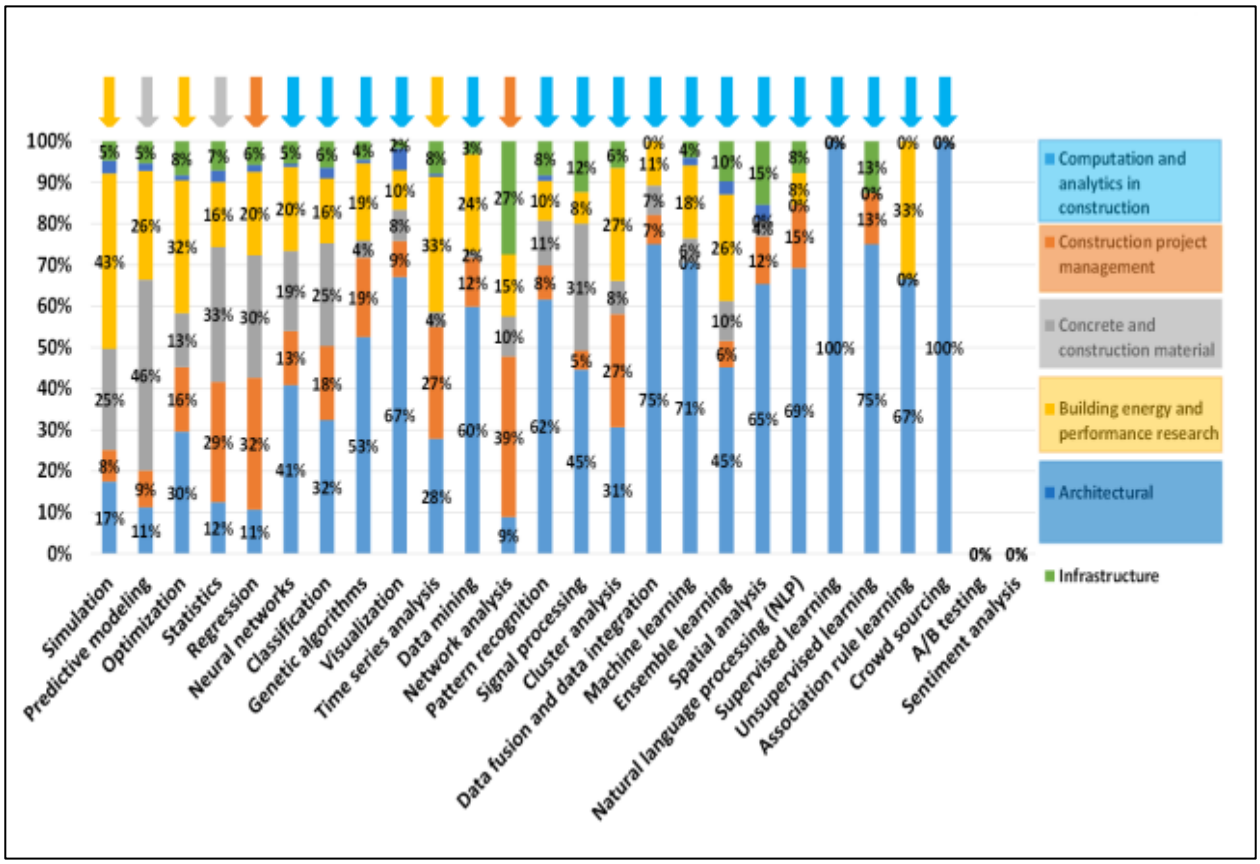

Figure 02. Distribution of Papers Using Each Big Data Technique in Six Construction-Related Research Areas (Omran, 2016)

5. CONCLUSION

Big data is one of the most crucial driving factor that could configure the path of improving the efficiency of any industry (Peiffer, 2016). In that way, the construction industry, which is intensively influenced by the use of modern technologies, generates a huge volume of data every day. The big data being exploded from the construction industry could have a possible positive impact on the construction industry for an improved productivity.

The gap between the construction industry and the digitization of data in construction is a major obstacle for the construction industry to gain the full value of data assets for concrete management. In addition to this, many researches of the construction industry are based on basic statistical analysis. This paper forwards the use of big data analytics and suitable predictive models for concrete waste management in construction industry.

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