



CHALLENGES IN ADOPTION OF BIG DATA IN CONSTRUCTION INDUSTRY OF PAKISTAN

^aSulaiman Javed, ^bFurqan Ali ^cWajahat Ali Khan, ^dHamza Nadeem, ^eDr. Khurram Iqbal Ahmad Khan

a: Author. NUST Institute of Civil Engineering, National University of Sciences and Technology, Islamabad, Pakistan.
Email: sulaiman.javaid987@gmail.com

b: Author. NUST Institute of Civil Engineering, National University of Sciences and Technology, Islamabad, Pakistan.
Email: faroki@live.com

c: Author. NUST Institute of Civil Engineering, National University of Sciences and Technology, Islamabad, Pakistan.
Email: wajahatkhattak97@yahoo.com

d: Author. NUST Institute of Civil Engineering, National University of Sciences and Technology, Islamabad, Pakistan.
Email: hamza.jutt689@gmail.com

e: Corresponding Author. NUST Institute of Civil Engineering, National University of Sciences and Technology, Islamabad, Pakistan. Email: dr.khurram.iqbal.khan@gmail.com

ABSTRACT

Construction industry has an important part to play in the development of a country. There has been a recent growth in this sector after government incentivizing the industry; however, due to the prevalent traditional practices projects often exceed the constraints. With increasing infrastructure development, there has been felt a need to employ Big Data management in the construction sector to manage the huge chunks of data being produced annually. Big Data, being a rising concern, is driving huge IT investments to manage and maintain it in different sectors like genomics, simulations, environmental research, urban informatics, business and e-science etc. A research was carried out to identify the basic challenges that pose in way of formulation of a Central Big Data Management System in Pakistan for construction sector, under government supervision. The challenges were identified through a frequency analysis of the respondents, which included clients, consultants and contractors. The study highlights the importance of a central management system to increase productivity and efficiency, lower costs and risk involved and optimize the construction practices.

Keywords- Big Data in construction industry, Big Data in Pakistan, Big Data Management System, Hadoop.

1. INTRODUCTION

Once considered an archaic industry, the construction world is going through a rapid shift. Numerous people and organizations are trying their best to make this one of the modern industries. Construction industry carries out the most expensive and huge projects and generates large amount and variety of information [1]. This data and information come from people, documents, computers, machines, or any other data-generating devices or agents [2]. However, due to lack of proper storage and analytics of the information, the construction sector is not using the past data.

This information will lead towards the decrease in the risks and costs, and increase in productivity and efficiency as Big Data helps organizations to get around 5-6% more profit [3]. Furthermore, activity duration and work schedule can be determined when project is in conceptual stage with the help of algorithm analysis of the data [4]. But this data is not being utilized in the best of its ways because construction industry of Pakistan lacks probing of ways to manage the data and research on central Big Data management system where data can be stored and retrieved easily.

1.1 Big Data

Big Data is the term used for the representing immense amount of data sets containing huge, much diverse, having both structured and unstructured data that is so huge and problematic to process by using customary techniques and software methods, and have problems of storage, analyzing, evaluating and envisioning for more processes or results [5]. The most prominent attributes of Big Data are referred as 3 Vs i.e. Volume (Amount of Data), Variety (Type or format of Data) and Velocity (Speed or Rate of Data Processing or Generation) [6].



1.2 Big Data Implementation

Big data is useless in the vacuum. Its importance is revealed while making decisions. To allow such evidence and research-based processes for making decisions, organizations need effective methods and processes to make great volumes of very fast moving variety of data into significant results [7]. The overall process for the extraction of results and insights from big data can be divided into five stages i.e. acquisition, extraction, integration, analysis and interpretation [8].

The most commonly used method for Big Data is the Hadoop, which is based on Google's Map Reduce method and Google File System. Hadoop is a distributed batch-processing infrastructure, which consists of the Hadoop kernel, Hadoop Distributed File System (HDFS), Map Reduce and several related projects [9]. It is a block-structured distributed file system, which is aimed to hold massive amounts of data, in a consistent, reliable, accessible and an easy way to function and operate with avoiding failure [10].

2. RESEARCH METHODOLOGY

Our research work comprised of qualitative literature review and questionnaire survey.

2.1 Qualitative Literature Review

Qualitative Literature Review was necessary to draw insights on the vast and wider research avenue of Big Data. This review was entirely aimed to map out the potential factors that are influencing the implementation of Big Data in construction industry. A thorough study of research papers highlighted twenty-eight factors. All the factors were assigned frequency and ranking (Low, Medium, High according to its emphasis in research paper) and were later shortlisted based on their normalized score obtained through computations on Microsoft Excel as shown in Table 1:

Table 1: Content Analysis

Factors Affecting Adoption of Big Data	Literature Score	Rank	Factors Affecting Adoption of Big Data	Literature Score	Rank
Data Management	0.4	1 st	Acquisition of Data	0.1	8th
Data Volume	0.36	2 nd	Complexity of Data	0.1	8th
Data Storage	0.35	3 rd	Adopter's Readiness	0.1	8th
Data Quality	0.35	3 rd	Legal Issues	0.09	9th
Data Analysis	0.35	3 rd	Lack of Technology	0.09	9th
Type of Data	0.27	4 th	Lack of Senior Management's Interest	0.09	9th
Security of Data	0.2	5 th	Innovation	0.09	9th
Data Collection Capacity	0.2	5 th	Hadoop Expertise	0.06	10th
Lack of IT expertise	0.2	5 th	Policy Making	0.06	10th
Organizational Capability	0.15	6 th	Pressure from Business Partners	0.05	11th
Regulatory Support (Govt. Support)	0.15	6 th	Attitude towards technology adoption	0.05	11th
Data Sharing	0.15	6 th	Trust and Cooperation	0.04	12th
Confidentiality	0.15	6 th	Competitive Advantage	0.03	13th
Data Velocity	0.12	7 th	Client Requirement	0.01	14th

2.2 Survey

In order to validate the potency of factors extracted from qualitative literature review, a web-based questionnaire was developed using Google Forms. The questionnaire consisted of three portions; first section was about respondent's profile, second section was about awareness of Big Data leading to a third section that consisted of a list of factors on Likert scale of 1 (Very Low) to 5 (Very High).

The questionnaire was shared via emails and was circulated through personal contacts among concerned academia and industry personnel with experience and knowledge of Big Data in construction Industry. A total of 129 responses were received from the survey conducted.



2.2.1 Respondents' Profile

It has been observed that majority of our respondents were contractors (47%) followed by consultants (23%), client (15%) and academia (15%). Figures 1 shows respondents' percentage depending upon their professional background. Whereas, Figure 2 gives the percentage of government and public sector representation of the participating respondents.

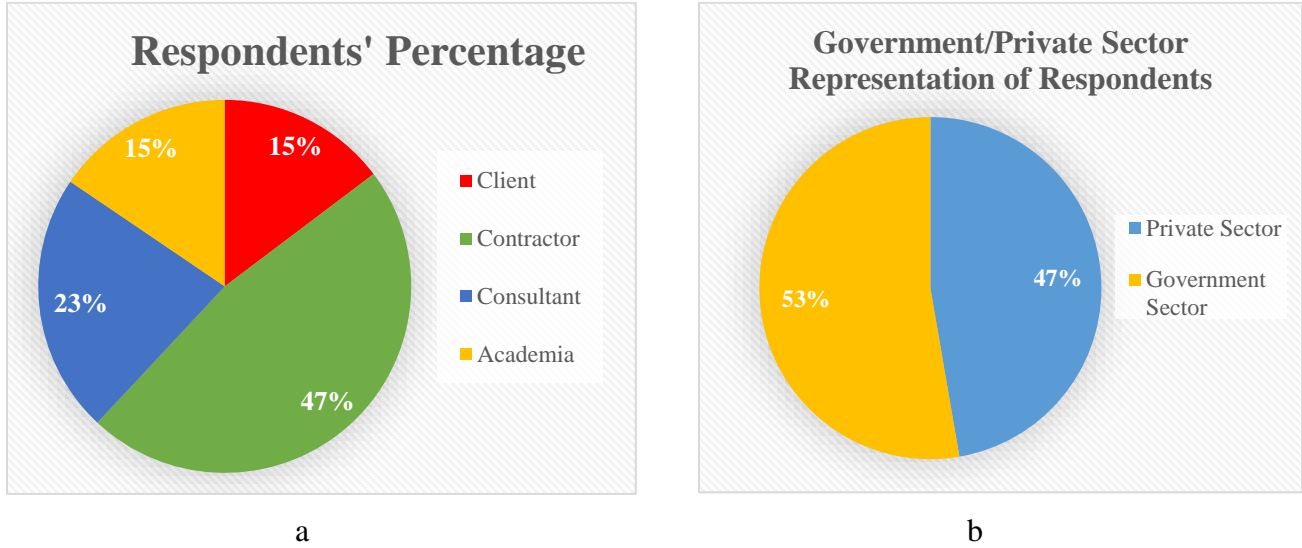


Figure: a, b Respondent's Data

3. RESULTS

Responses obtained from the survey form were analyzed through frequency analysis in a statistical software "IBM SPSS Statistics 20" to rank the factors that are major roadblocks in the way of adoption of Big Data. It comes out that Security of Data, Data Acquisition and Policy Making are the forefront issues in establishing a Central Big Data Management System. Figure 2 shows the spectrum of factors along with their average value on Likert scale.

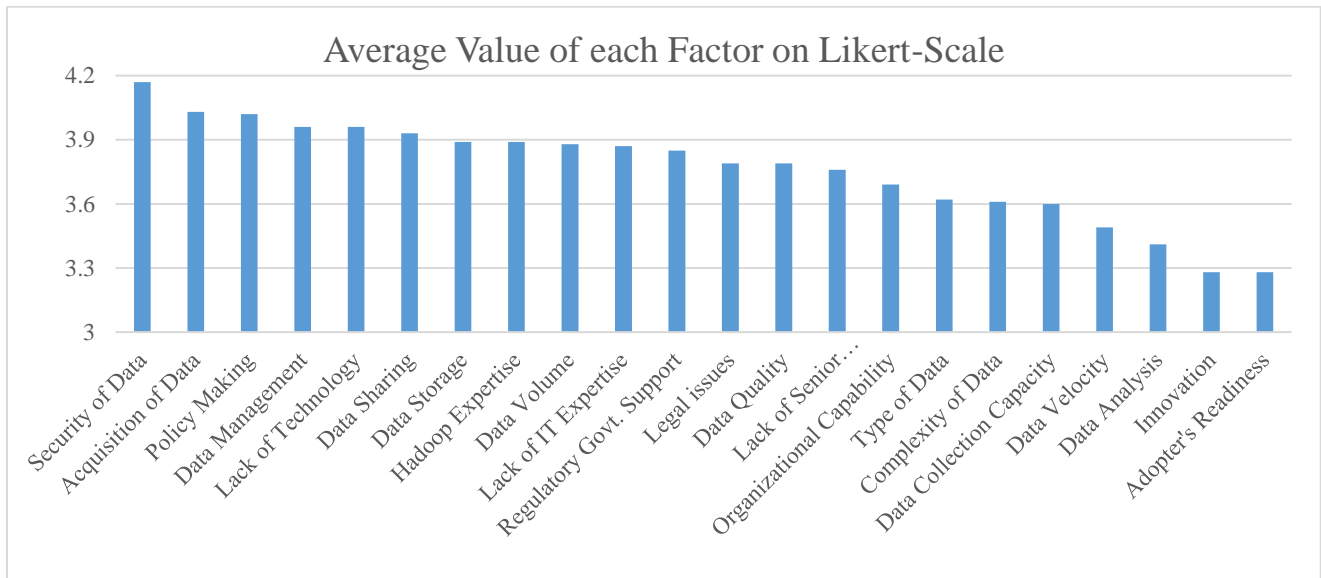


Figure 3: Factors on Likert-Scale



4. FRAMEWORK

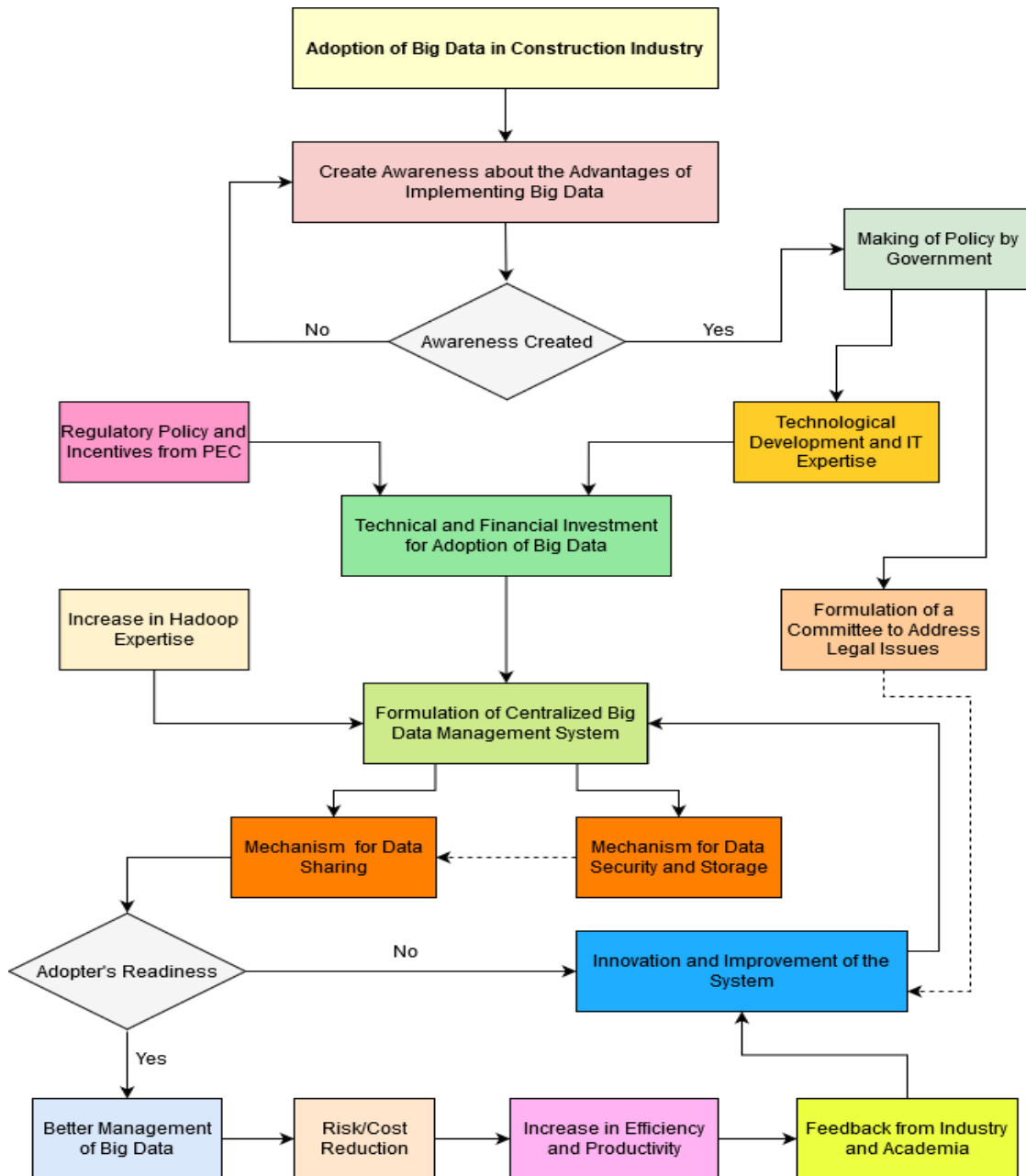


Figure 4: Conceptual Framework for Adoption of Big Data

After identification of the factors, a conceptual framework has been devised to map out a way forward for the adoption of Big Data in the construction industry of Pakistan. It comprised of, and not limited to the following major steps:

- The framework begins with the substantial awareness about the advantages of Big Data for the construction firms, which are working under Pakistan Engineering Council (PEC).
- Proper policy should be formed in this regard with the help of ministerial level support to formulate a Centralized Big Data Management System (BDMS) to store and share data. It will lessen the roadblocks as well as converge people towards relying on better technologically advanced methods for construction practices in Pakistan and applying them in order to achieve results that are more beneficial.



- Increase of Hadoop expertise in the country, which is a software utility to manage Big Data.
- Formation of a committee to address the legal issues that possibly may arise during the process.
- Seek adopter's readiness to improve the BDMS based on the feedback.

Once applied in its entirety, this system shall ensure a competitive advantage for the exercising firms and help in increasing efficiency and productivity in construction practices. Efficient Big Data management shall also reduce cost involved in major projects carried out in Pakistan.

5. CONCLUSIONS

This research paper primarily focusses on identifying hindrances in the adoption of Big Data in construction industry. Qualitative literature review was conducted and because of that, we obtained literature score and challenging factors were shortlisted. It was followed by Frequency Analysis of the responses received from survey, which helped ranking the challenges that inhibit the leveraging of Big Data among practitioners. A conceptual framework was proposed highlighting that a proper management system shall be made under government support that can ensure the collection, secure storage, and retrieval of data maintaining the competitive advantage of the contributing firms. This will largely require technological development and financial investment. Government should lower the legal barriers as well as take measures to make the senior management in the construction firms' adaptive to the new technology.

The project scope encompassed a general roadmap towards the adoption of Big Data in the local industry whereas future research should endorse the validity of proposed framework by translating it into practice and amending new possibilities that may arise with time.

LIMITATIONS

The research on Big Data adoption had several limitations, first one being the lockdown situation during the outbreak of pandemic COVID-19, due to which we had to limit our scope and physical outreach to the stakeholders. Secondly, a large number of people in Pakistan are not even aware of the term Big Data, and hence could not participate in the survey.

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Department of Civil Engineering
Capital University of Science and Technology, Islamabad Pakistan

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