# To Investigate Utility of Building Information Modelling (BIM) to Improve Productivity of the Construction Industry

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## Abstract

Productivity of construction industry is lower in contrast to other industries. The industry is also lacking behind to adopt technology as equivalent to other industries. Building Information Modelling (BIM) is a revolutionary development in the Architecture, Engineering and Construction (AEC) industry. There are numerous factors that contribute to reduce efficiency in the industry. The study aims to investigate the potential of BIM to solve issues that can reduce productivity. Moreover, a questionnaire survey is conducted for this purpose from the practitioners of the construction industry. The results of 171 valid responses greatly support the hypothesis that BIM has the potential to solve issues that can cause loss of productivity. Linear regression analysis is also conducted. The analysis shows that collaboration, elimination of rework and conflicts are significant factors. This research will be beneficial for academics, as well as, industry to enhance productivity of the construction industry by identifying factors and mitigating them with the help of BIM.

**Keywords: Construction Industry, Productivity, BIM, AEC**

## 1. INTRODUCTION:

According to Global Construction 2030 (2015) the extent of construction production will increase by 85% to $15.5 trillion globally by 2030 due to China, India and USA. These countries are leading the way and rate for 57% of over-all global growth. Construction sector is the second largest contributor in Pakistan's economy. Around 30-35% of employment is directly or indirectly linked to the construction industry. The industry has played a significant function in creating jobs and facilitating the increase of the economy (Rizwan *et al.*, 2008). According to estimates published by Economic Survey of Pakistan (2018), the industry grew via 9.13% in the past year and contributed 2.82% to a country's gross domestic product (GDP). Regardless of its remarkable contribution to the GDP, Pakistan's development industry is one of the most unnoticed and unorganized sectors.

Productivity in construction industry is usually defined as output per labor hour. As the labor comprises a significant proportion of a construction value and the quantity of labor hours in accomplishing a task in the industry is greater inclined to the influence of administration than are materials, this productivity rate is frequently referred to as 'labor productivity' (David, 1994). The literature shows that a number of factors have an effect on productivity, however, there are unidentified factors that need to be studied even in advanced nations (Makulsawatudom and Emsley, 2002).

Certain policies to improve productivity of construction industry are not usually comparable in every country. It is found that there are some special factors that affect labor productivity and are bracketed together according to their attributes such as design, execution plan, material, equipment, labor, fitness and safety, management, work-time, tasks, collegiality and coordination, owner/consultant, and some external factors (Arditi, 2005).

Building Information Modelling (BIM) represents physical and functional chrematistics of a facility digitally. It's a revolutionary development in the Architecture, Engineering, and Construction (AEC) industries. It simulates a construction project virtually at the outset of the project (Eastman et al., 2008).

Building Information Model is an intelligent parametric virtual representation of a building that provides all the necessary data required by various users for analysis and to generate information that can be utilized in different decision-making processes (AGC, 2005 in Azhar *et al.*, 2008, p.436).

## 2. RESEARCH METHODOLOGY:

Literature review is conducted on productivity in construction industry, factors that can reduce productivity, BIM and its potential benefits. A questionnaire is prepared to conduct survey from the industry to find out if BIM can improve productivity of the construction industry. A total of 180 responses were obtained but 171 responses were valid. The results of the surveys

are analyzed and shown in terms of pie charts. Additionally, linear regression is also employed to find out significance contribution of factors. The methodology adopted in shown below:

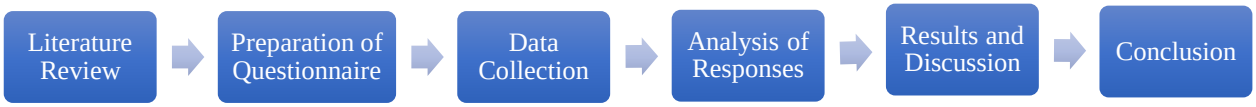


**Figure 1: Steps of Methodology**

## 3. RESULTS AND DISCUSSION:

The results of the survey are given in the form of bar charts. The responses of questionnaire from the industry shows a spectrum between strong agreement and strong disagreement as shown in the table below.

| RESPONSES | QUESTIONS | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| STRONGLY AGREE | 29% | 20% | 27% | 31% | 31% |
| STRONGLY DISAGREE | 2% | 2% | 5% | 1% | 0% |

### 3.1 Summary of SPSS Analysis:

- **Predictors:** (Constants), Digitalization, Collaboration, Rework, Conflicts.
- **Dependent Variable:** Intelligent Parametric 3D Model.

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| **1** | **.599[a]** | **.358** | **.343** | **.906** |

| MODEL | UNSTANDARDIZED COEFFICIENTS | | STANDARDIZED COEFFICIENTS | T | SIG. |
|---|---|---|---|---|---|
| | B | STD. ERROR | | | |
| (Constant) | .393 | .537 | | .732 | .465 |
| (Collaboration) | -.252 | .121 | -.175 | -2.072 | .040 |
| (Rework) | .634 | .093 | .459 | 6.808 | .000 |
| (Conflicts) | .490 | .086 | .382 | 5.669 | .000 |
| (Digitalizing) | -.026 | .117 | -.017 | -.224 | .823 |

$$[Y = 0.393 - 0.252*B_1 + 0.634*B_2 + 0.490*B_3 - 0.026*B_5]$$

$B_1$ (improving coordination using shared model) is a significant factor because lack of coordination can result in poor design and conflicts in the design that would lead to rework, which means loss of man-hours spent, as well as, material used. Additionally, access to updated information would be readily available through a shared BIM model. $B_2$ (avoiding rework by detecting clashes in design phase) is a significant factor because rework results in cost and time overruns. Since BIM uses parametric 3D model technology, it can detect clashes during design phase. $B_3$ (conflicts) is a significant factor since by using BIM designing and constructing a facility would be more efficient and information is available through shared model. As all information can be integrated into a single model so there is no point of ambiguity for the consultant, contactor or the client and disputes can be easily tackled. $B_5$ (Insignificant - Improving design by constructing/deconstructing project digitally) since number of factors considered for this study are few therefore this might be the main reason of insignificancy of this point, as well as, R square value. Its significance and value of R square might increase in future by adding more factors to the survey.

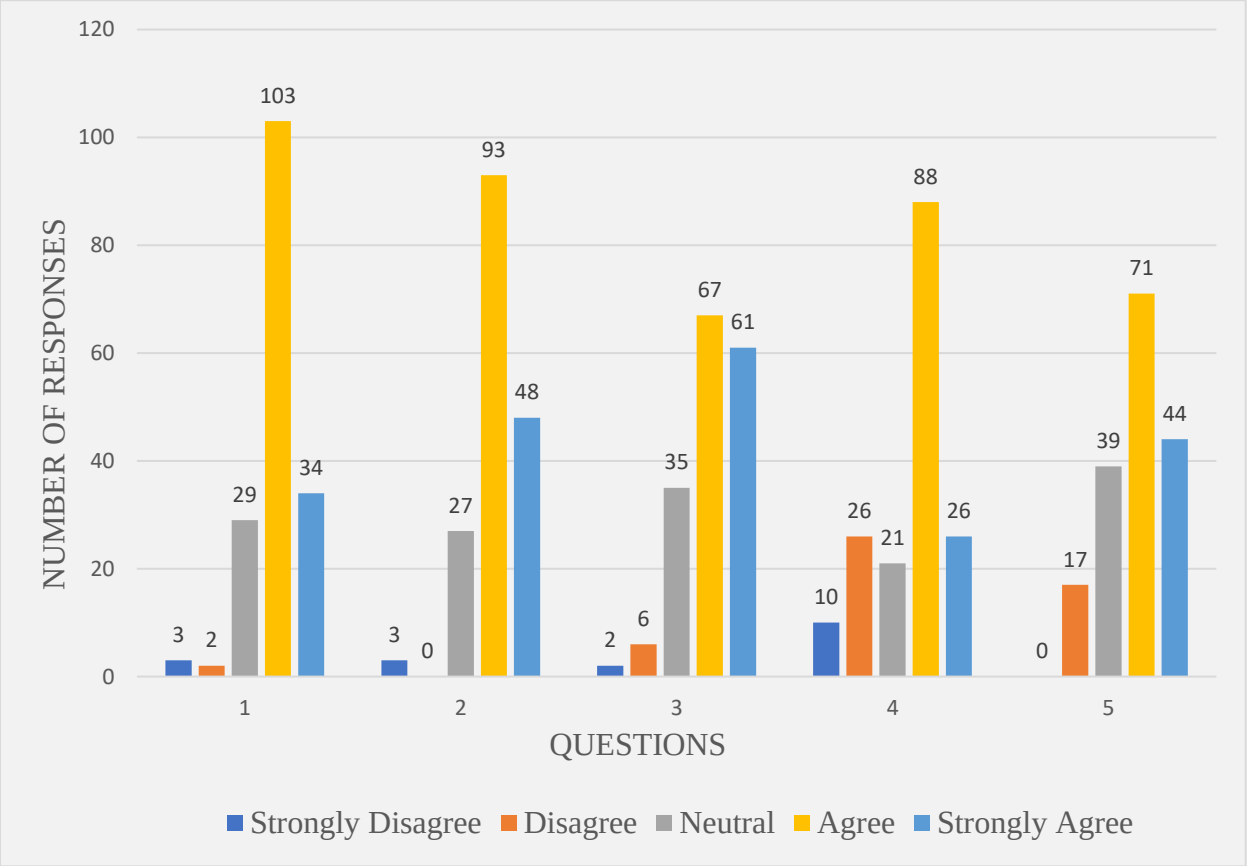


**Figure 2: Survey Results**

## 4. CONCLUSION:

The results of this research show that practitioners of the construction industry of Pakistan believe that BIM has potential to boost productivity of the construction industry. Most of the

respondents agree with potential strengths of BIM to solve an issue that can lead to loss of productivity. Additionally, the value of R square is .358 but the model is significant. Nevertheless, more factors would be taken in future studies. Collaboration is significant for productivity, which is the prime objective of BIM. Furthermore, lack of rework due to clarity in scope of work would yield better progress during execution phase. Moreover, mitigation of conflicts because of co-ordination plays a significant in improving productivity.

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