

# Increase the Profit by Upgrading the Organization's Capabilities through Implementation of the Building Information Modeling

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**ABSTRACT:** Building information modeling (BIM) is changing how buildings, infrastructures, and utilities are planned, designed, built and managed. Though very widespread for association and coordination in fundamental, mechanical, fixtures and electrical professions in multi-family ventures, this study displays that BIM is infrequently used for approximating cost and planning time it takes to complete. However, BIM is provided that broad remunerations and becoming a crucial construction document module for huge projects. The objective of this work is to recognize the chief obstacles to using BIM for a project's approximating and planning. Personal interviews and electronic questionnaires for 30 corporations were used to response the research purposes. The study dedicated on how sub-contractors are currently using BIM for approximating and planning. This comprehensive view of existing conditions provides all stakeholders with greater clarity which helps them to take decisions against changes. Visualizations from this information-rich model can be shared with nonprofessional stakeholders, helping to ease approvals and further efficiency for planning process. Just as important, the information and decisions at this point are captured in the model and will remain consistent through project completion. As an example, let's say underground utility locations are captured with Ground Penetrating Radar (GPR) and incorporated into the model for a plant reintegration project. This kind of information is vital during construction to avoid damage and expensive delays and change orders. Using this BIM model we can reduce the cost as well as time respectively. Later, when the municipality contemplates future expansion or repair, the utility data persists in the model and can be updated as changes are made, with timeconsuming. To investigate real time construction we also collect data from some questionnaire surveys. The G+9 building has consider for both kind of surveys, our actual investigation behind this study to compare the project with BIM assisted building not BIM assisted. The change order's cost of both buildings and how it is reduced using BIM. For the design we used of Autodesk Revit, MSP and Green Building studio 2013. The results has compare with different approaches of design. The final outcome of this works how BIM is beneficial for cost saving as well as time reduction of technical issues

**KEYWORDS:** Building Information Modeling, Benefits of BIM, 3D Modeling.

## I.INTRODUCTION

Project management achievement is mainly evaluated by assessing the capability of managing time, cost, quality and nowadays, health and safety. Time and budget overruns can arise by various reasons in different projects especially roads and highways. These project types can also benefit from using Building Information Modelling (BIM) from the inception till the operation.

Although the allegation of BIM in building industry has been observed theoretically and practically, its application in road and highway design and construction seems to be moderately slower than building design and construction particularly in developing countries such as Iran. Moreover, construction firms are still reluctant to admit changes even by facing delay and cost rise in almost 100% of their construction projects.

In a general sense, diversification in the construction business is a complex of activities connected to changes in production processes in order to expand a spectrum of offered works, services and goods, connected or otherwise with

the primary activity as well. Additionally, it will be measured a demonstration of product and process diversification with regard to a wide tenure as a construction company. By the span of the construction company, the authors will understand any company which operates within the architectural/ engineering/ construction industry. The use of such a wide term is described by the widespread scope of diversification application. For example, a design company on the base of BIM can extend the sphere of their services and products to facility services because the most necessary information had been collected throughout the design stage, etc. When a construction business has chosen a specific direction of diversification, markets or market segments, the company has to decide its own positioning within it. Here are two possible ways of taking a competitor's position into consideration. The first way is to take a competitive place amongst contestants who previously operate in the market and to start a struggle for market share. The second and more perceptive mode is to use such kind of material and/or technology which either does not exist in the market, or has been poorly developed. The following step on this path is to offer products and/or services with a special difference made with special materials and technology and thereby winning consumers. BIM operation operates precisely alongside this second path.

## II.LITERATURE REVIEW

Literature concealed the subject of BIM mainly for collaboration and coordination counter to the usage of BIM for estimating, which is still considered an innovation. Large construction firms ongoing to recognize the importance of BIM model especially in design-build projects and implement them in the design phase and in during the construction for scheduling and clash detection, other construction companies especially building subcontractors did not see the incentive of developing a BIM model for their personal use especially when it is not given to them by the architect of the Construction company. Since most documents favor large-scale developments, this study explored multi-family projects. Broad questions were framed from the literature review owed to the absence of research in this topic. This paper attempted to add rigor to the existing research by addressing the subcontractors' challenges to adopt BIM for estimating with a framing design BIM module. According to McCuen, (2008) affirmed the broad benefits of containing scheduling (4D) and cost estimating (5D) in the project which gives spirit to BIM, "Adding 4D and 5D to a BIM project creates an environment that enhances profitability". A case study by McCuen, (2008) proved the planning and estimating involvement that resulted in the success of the project "University of Washington (UW) Research Building" by its completion 40% faster than the projected time. BIM facilitated the alliance between the diverse stakeholders, and exceeded the owner's quality expectations of the project.

Mortenson, (2007) claimed that, "The model has proven comprehensive and durable enough to assist in all phases of the project lifecycle—from conception, through design and construction, to operations and maintenance."

Lu, Fung et. Al. in 2014 proposed the remunerations and result of BIM implementation can be consumed to justify the need to promote BIM in the architecture, engineering and construction industry.

Edward (2007) claimed "One of the chief benefits of BIM is that it includes information about length, width, and volume, as well as information about content such as doors, windows, and finishes, all of which can be used for estimation." Furthermore, approximating based on BIM eradicates overlooked particulars when doing quantity takeoff from traditional 2D mostly with common updates which makes it hard to catch. (Joyce & Erin, 2014).

In 2012 Nassar conducted research related to BIM application in estimating. The research based on statistics collected from students functioning on project with BIM/Estimating, a course offered for graduate students, outcomes from the actual projects were used and examined as follow: The application of BIM for estimating purposes can dramatically improve time savings and quantities' accuracy at any time during the construction process. Since the 3D model is based on updated documents by the side of the relevant data, yet, this process is still delayed by the absence of understanding (Nassar, 2012). Moreover, the automatic takeoff cannot be produced only by BIM. Findings by Stanley and Thurnell (2014) show that "5D BIM takes place outer the core BIM model by live linking it to a third party estimating software". Thus, an importance of introducing approximating software to link BIM and the model (Nassar, 2012). Nassar also maintained the importance of making a specific BIM model for contractor's benefit rather than working on the BIM model provided by architects and engineers, "The estimating process is more difficult than only listing objects and their sizes". According to Thurairajah and Goucher (2013) settled that the application of BIM within the project changed the dream of the construction. Surveying specialists are being prejudiced by the growth of BIM. Thus, it promotes its use and makes its presence necessary to the project success. Otherwise, they will chance the menace of dropping behind the competition. It is critical to understand the benefits and challenges of BIM; BIM's magnitude to impact the project in all aspects and phases. Furthermore, the effective and accurate delivered information, estimates that cost consultants can rely on. Thurairajah and Goucher (2013) found that there is a likely time enhancement with the

procedure of automation while meeting the owner’s expectations and the project team’s expectations. However, an absence of motivation of investment is noticed.

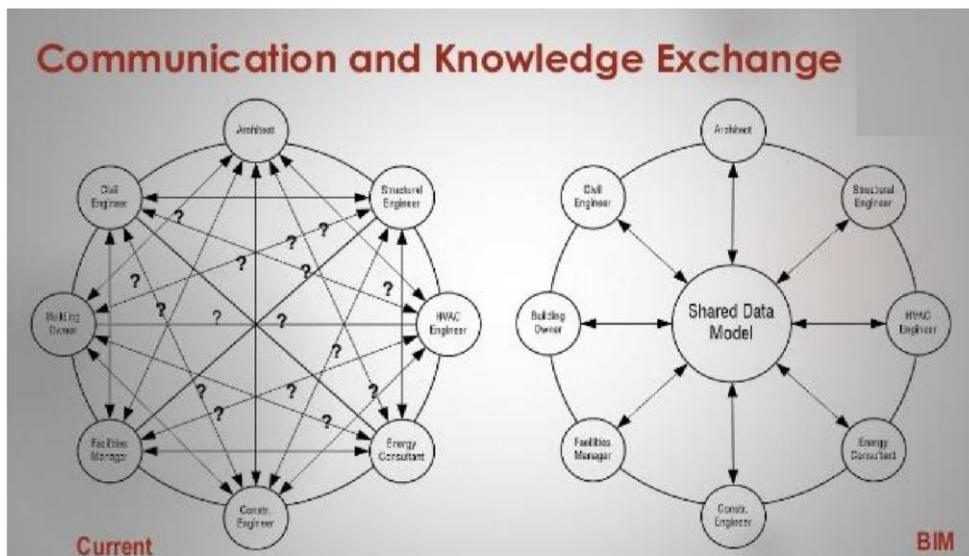
**Thurairajah and Goucher (2013)** stated “It is vital that BIM is introduced to organizations as part of a structured implementation plan, with the required levels of sensitivity.” The study also pointed out the shortage of comprehension of BIM among cost consultants, and an essential need for training.

Stanley and Thurnell (2014) found that BIM approximating is extra efficient, accurate, detailed, and predictive for eventual future problems in counter of a conventional quantity surveying. Nevertheless, BIM approximating is reserved to adoption by the succeeding obstacles: Cost, absence of software compatibility, absence of specific coding for BIM elements, deficiency of full info for data, absence of united models. **McCuenproposedin(2009)** clarified that mined info from BIM are not necessarily efficient (National Institute of Building Sciences, 2007). “The information needs to be in the suitable format and measured accurate and complete before use in decision making” McCuen (2009). This will happen by transmitting data linking numerous dimensions using software that is interoperable (National BIM Standard, 2008).

### III.METHODOLOGY

In this study, we use a triangulated method which involved both qualitative and quantitative methods for a multidimensional view of the subject. The research procedure involves survey of construction and Architecture Company, interview with contractors and a case study of using BIM for approximating and shop drawings, decision-makers related to using BIM for cost estimating. The questionnaire was sent to 10-15 people in different companies and collected to all surveys.

BIM describes the mechanism by which a computer generated model is created and used to simulate the planning , design , construction and operation of a building. The resulting model is a data-rich, object-oriented, analytical and parametric digital representation of the facility, from which views and data tailored to the needs of various users can be extracted and analyzed to produce information that can be used to make decisions and enhance the facility delivery process.



**Figure 1 : Comparison between Traditional & BIM-assisted Project approach**

#### A.Integrating BIM and Management

The basic principles of BIM; 3D modeling, interoperability, parametric objects and advance information management features, hold a lot of potential for improving the state of cost management practice by resolving problems identified in the traditional practice, as presented previously. The following discussion proceeds to establish importance of integrating cost management with BIM in relation to addressing the issues identified with the traditional practice of cost management.

At the commencement of the 12 week detailed design and tender documentation phase for the Parcel 5&6 Façade project, the BIM team assume their role of coordinators, assembling 3D CAD models from the architects and structural engineers 2D CAD drawings. The BIM co-ordination engineers worked on tasks as to identifying design clashes, conflicting information and missing details on the consultant's drawings. A schedule of work was developed with the design team to integrate the 3D CAD design validation review into the overall design co-ordination process. The 3D structural modeling team assembled the structural frame model from the Arup 2D CAD drawings. The 3D architectural modeling team built the GRC façade models from the architects' 2D CAD drawings. As the design for each of the 18 themed facades was completed, a report was compiled by the BIM coordinators identifying issues which required the attention of the architects and engineers. These issues included conflicting information between architectural plans, sections and elevations, misalignment and setting out issues between the structural framing and GRC panels and many other technical queries. These issues were previously discovered by the main contractor on site. The architect and structural engineers issued drawings to the BIM team on a weekly basis. One week later a design co-ordination workshop was facilitated by the client to review the design progress and to resolve the technical queries raised from the 3D modeling process. The 3D models were used throughout the design co-ordination process to review details and to illustrate different design conditions. The 3D models became the focal point for discussions between the client, architect and engineers. The architects and engineers made design changes and revised their respective 2D drawings according to decisions made during the co-ordination work-shops. The updated drawings were then incorporated in the 3D CAD models to ensure that the issues raised previously were fully resolved. There was an initial resistance from the Architects and Engineers to the inclusion of an independent check by the 3D CAD modeling team. But designers soon became fully engaged when they found the BIM models and technical query process facilitate better understanding of the issues. At the end of the scheduled 12 week tender documentation process, the architects and engineers produced a set of fully coordinated design drawings and the 3D Modeling consultant produced a detailed interactive model of the podium façade. The 3D model was included with the tender documents issued to the specialist façade contractors. As the client noted, the BIM coordinated tender was completed in a shorter duration than the previous phase.

#### IV. BUILDING INFORMATION MODELING

Information Modeling is a process including the generation and management of a digital representation of physical and functional features of a facility. This process results in a building information model. Building Information Model is: well-coordinated, agreed upon and interconnected, ready for calculations and analysis, having a geometrical binding, suitable to the computer usage, allowing the necessary update of numerical information concerning a projected or already existing object that can be used for:

- (1) Accepting a concrete design choice;
- (2) Creating of high-quality design documentation;
- (3) Predicting of a functional performance of an object;
- (4) Estimating and making building plans;
- (5) Ordering and manufacturing of materials and equipment; (6) Controlling of a building erection;
- (7) Controlling of maintenance of the building and means of technical accessories throughout all life cycle;
- (8) Governing of a building as an object of commercial activity;
- (9) Projecting and controlling of reconstruction or repairing of a building;
- (10) Pulling down and utilizing of a building; (11) Other purposes connected with a building.

#### V. RESULTS AND DISCUSSIONS

According to the respondents, the two major causes for project delays are delay in finalization of design and drawings (78%) and change in the design (76%). Indeed, these two causes are effectively resolved by using BIM. According to the respondents, the two major causes for cost overrun are reworks (73%) and increased wastage of materials (72%).

Rework is resulting from the unclear drawings or the works completed before the final drawings received. Again, these two causes are effectively resolved by using BIM. According to the respondents, the top four qualitative benefits are, Reduced errors and omission (85%), Early and more accurate visualization of project (85%), Better process automation (85%), Greater predictability of project time and cost (80%), BIM makes quantity takeoff easier (80%), Strategic competitive advantages (80%), Improved document management (78%), Thoughtful design and improved design quality (77%) and enhancing organization image (77%). The quantitative benefits of BIM envisaged by the respondents, respondents believes that BIM-assisted project will reduce technical issue resolution time by about

13.95%, reduce RFI's by about 13%, reduce overall project duration by 12.75%, reduce project cost by 12.64%, reduce structural wastage by 11.80% and reduce reinforcement steel wastage by 11.75%.

Project A (Pre-BIM) and Project B (BIM Assisted) were incomparable in terms of size, scope, contract value and construction type. . However, tender submission time for both the tender was same and the resources (Manpower) utilized for both the tender was same. During the Bidding of Project A and B, we used the 3-D model for visualization and we had achieved followed benefits. Project A (Pre-BIM) and Project B (BIM Assisted) were incomparable in terms of size, scope, contract value and construction type. . However, tender submission time for both the tender was same and the resources (Manpower) utilized for both the tender was same. During the Bidding of Project A and B, we used the 3-D model for visualization and we had achieved followed benefits

**Table 1: Benefit analysis with 3D and without 3D model using BIM**

Sr. No.	Description	Pre-BIM (Tendering without 3-D Model)		BIM- Assisted (Tendering with 3-D Model)	
1	Tender Manager (TM)	Working on Project simultaneously for 1.5 Months	Rs. 2,51,250/-	Working on 2 Project for 1.5 Months	Rs. 1,50,750/-
2	Sr. Estimator	Working on 2 Project simultaneously for 1.5 Months	Rs. 2,01,000/-	Working on 2 Project for 1.5 Months	Rs. 1,34,000/-
3	Quantity Surveyor	Working on 1 Project simultaneously for 1.5 months	Rs. 2,01,000/-	Working on 2 Projects simultaneously for 1.5 months	Rs. 1,00,500/-
4	Planning Manager	Working on 2 Project simultaneously for 1.5 months	Rs. 1,50,750/-	Working on 2 Projects simultaneously for 1.5 months	Rs. 1,00,500/-
5	Planning Engineer	Working on 1 Project simultaneously for 1.5 months	Rs. 2,01,000/-	Working on 2 Project for 1.5 Months	Rs. 1,00,500/-
6	AutoCAD Draftsmen	Working on 1 Project simultaneously for 1.5 months	Rs. 1,50,750/-	Working on 1.5 Project for 1.5 Months	Rs. 1,00,500/-
<b>Total (INR)</b>			<b>Rs. 11,55,750/-</b>		<b>Rs. 6,86,750/-</b>

By using 3-D visualization model at tendering stage, we increased productivity of the staff by around 41%. Also the 3-D model facilitated the finalization of equipments, methodology of work, reduced errors in the quantity calculation but these benefits are non-measurable and treated as intangible benefits. During the execution stage, below is the saving achieved due to the reduced paperwork (Less Documentation which is resulted due to the client is using the BIM) and clear understanding of the project to the execution staff by 3-D visualization.

**Table 2: Comparison of Pre-BIM and BIM assisted project**

Sr. No.	Description	Project without BIM assisted (G+9)	BIM Assisted (3D View Only G+9)	% Reduction
1	Project Value	Rs. 12,94,45,972/-	Rs. 12,69,96,762/-	
2	Project Type	Item rate	Item rate	
3	Duration	710 Days	682 Days	
4	Total Number of drawings	816 Nos.	220 Nos. + 3 D Model	73%
5	Site Transmittals	383 No.	160 No.	58%
6	Site Engineering Query (SEQ)	317 No	121 No.	62 %
7	Site Instructions (SI)/ Change Order	91 No	10 No.	89%
8	Total Change Order's (CO's)	Rs. 82,01,215/-	Rs. 90,45,987/-	
10	BIM Preventable Change Orders	Rs. 82,01,215/-	Rs. 39,56,875/-	

Here table compare the different projects with BIM assisted as well as without BIM assisted. Basically we focus on how no. of drawings, site transmittals and Site Engineering Query has reduce that can be prevent the change order cost the proportion with actual value. The above table shows the how BIM can prevent the total change order values of project

**Table 3: Comparison of Pre-BIM and BIM assisted project**

Sr. No.	Indicator	Without BIM	With BIM
1	Actual Project value	Rs. 12,94,45,752/-	Rs. 12,69,96,762/-
2	Change Order	Rs. 82,01,215	Rs. 90,45,987/-
3	BIM Preventable Change Orders	Rs. 82,01,215/-	Rs. 39,56,875/-
4	CO's Value	6.33%	3.11%

The above table shows the actual Change Order's Values of project using below formula

**CO's Value** = (BIM-Preventable Change Orders \*100/Actual project value)

After overall calculation we can conclude the BIM assisted project can prevent the 3.22% of amount with actual cost of project

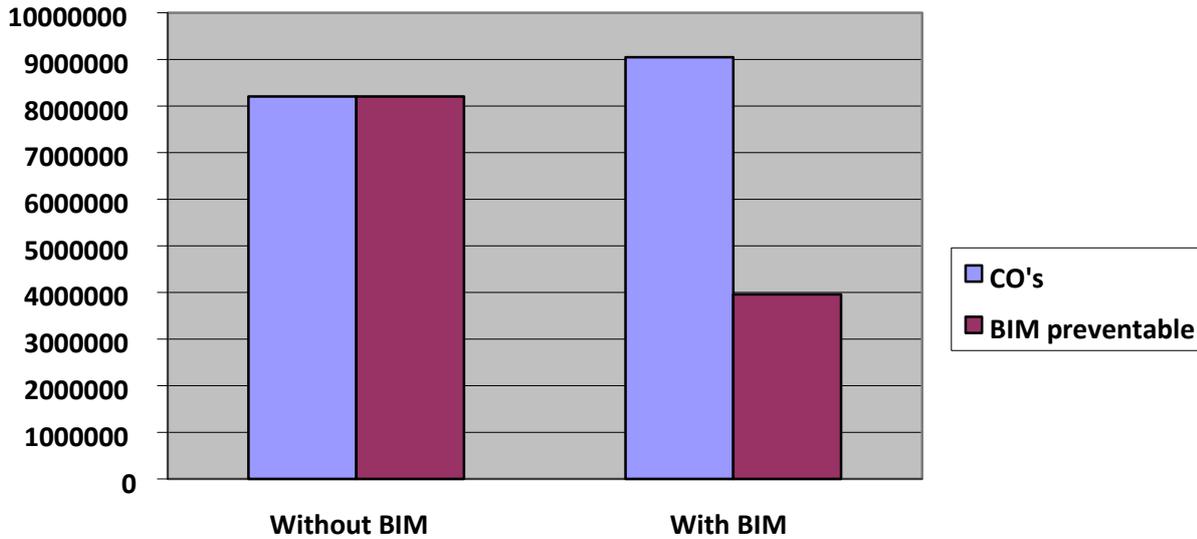


Figure 2: Comparison of order change value in INR with Pre-BIM and BIM assisted project

According to figure 2 CO's value is higher in BIM than non-assisted BIM while BIM-Preventable Change Orders much lower than non BIM usage building.

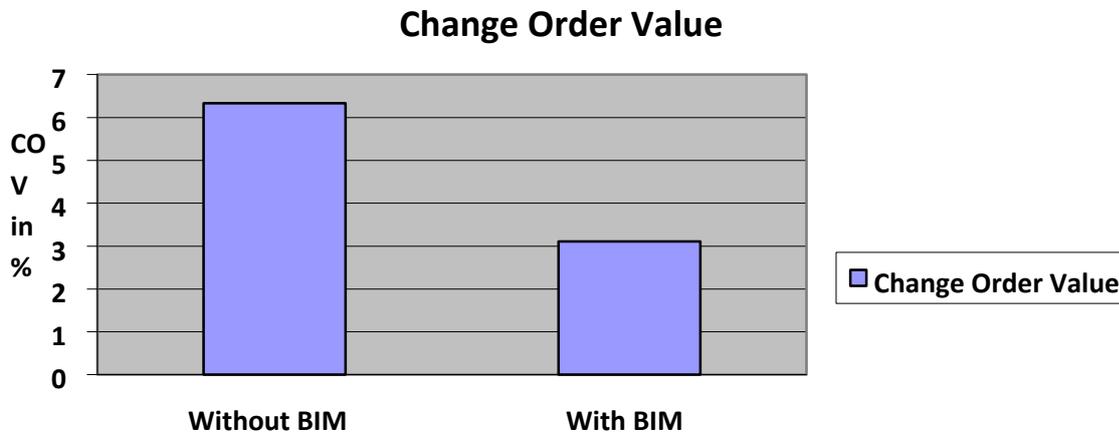


Figure 3: Comparison of order change value in % with Pre-BIM and BIM assisted project

### VI.CONCLUSIONS

After the successful analysis of this work we conclude how BIM has upgrade the organizations capability as well as provide the maximum profit with minimum duration. According to the above case study has done on G+9 two separate buildings and we conclude the changed order value without usage of BIM should be around 6.33% while BIM assisted CO's value should be 3.11% according to entire project cost. Finally we conclude 3.22% cost should be save when we used BIM for this particular construction project. Companies that have well adopted BIM can understand substantial savings in project design and delivery budgets and timetables, create betterinformed decisions at formerly phase in the design procedure, and avoid costly faults and rework. BIM abilities and benefits with an organization's overarching business goals and priorities, including objectives around competitive positioning, operational excellence, and effective delivery.

## REFERENCES

- [1] Azhar, S. (2011). Building Information Modeling (BIM): Trends, Benefits, Risks, and Challenges for the AEC Industry. *Leadership & Management In Engineering*, 11(3), 241-252. doi:10.1061/(ASCE)LM.1943-5630.0000127.
- [2] Choi, J., Kim, H., & Kim, I. (2014). Open BIM-based quantity takeoff system for schematic estimation of building frame in early design stage. Retrieved from <http://www.sciencedirect.com/science/article/pii/S2288430014000037>
- [3] Giel, B. K., & Issa, R. A. (2013). Return on Investment Analysis of Using Building Information Modeling in Construction. *Journal Of Computing In Civil Engineering*, 27(5), 511-521. doi:10.1061/(ASCE)CP.19435487.0000164
- [4] Goldberg, H. E. (2007). Automated Estimating and Scheduling Using BIM. *Cadalyst*, 24(9), 45-48.
- [5] Joyce, E. (2014). Show Me the Money: 5D-Cost Estimating Tools Paying Off. *ENR: Engineering NewsRecord*, 273(6), 44.
- [6] Kraus, W. E., Watt, S., & Larson, P. D. (2007). Challenges in Estimating Costs Using Building Information Modeling. *AACE International Transactions*, 01.1-01.3.
- [7] Lu, W., Fung, A., Peng, Y., Liang, C., & Rowlinson, S. (2014). Cost-benefit analysis of Building Information Modeling implementation in building projects through demystification of time-effort distribution curves. *Building & Environment*, 82, 317-327. doi:10.1016/j.buildenv.2014.08.030
- [8] McCuen, T. L. (2008). Scheduling, Estimating, and BIM: a Profitable Combination. *AACE International Transactions*, 1-8.
- [9] McCuen, T. L. (2009). The Quantification Process and Standards for BIM. *AACE International Transactions*, BIM.01.1-BIM.01.11.
- [10] Nassar, K. (2012). Assessing Building Information Modeling Estimating Techniques Using Data from the Classroom. *Journal Of Professional Issues In Engineering Education & Practice*, 138(3), 171-180. doi:10.1061/(ASCE)EI.1943-5541.0000101
- [11] Sattineni, A. (2011). Building Information Modeling: Trends in the US Construction Industry. *Design Principles & Practice: An International Journal*, 5(4), 187.
- [12] Smith, P. (2014). BIM & the 5D Project Cost Manager. *Procedia - Social And Behavioral Sciences*, 119 (Selected papers from the 27th IPMA (International Project Management Association), World Congress, Dubrovnik, Croatia, 2013), 475-484. doi:10.1016/j.sbspro.2014.03.053
- [13] Stanley, R., & Thurnell, D. (2014). The benefits of, and barriers to, implementation of 5D BIM for quantity surveying in New Zealand. *Australasian Journal Of Construction Economics and Building*, The, 14(1), 105.