Identifying and Analyzing the Effectiveness of Building Information Modeling (BIM) on Small Scale Projects in India

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Abstract

A Building Information Model (BIM) is "A digital representation of physical and functional characteristics of a facility. BIM is a complex multiphase process that gathers input from team members to model the components and tools that will be used during the construction process to create a unique perspective of the building process. The 3D process is aimed at achieving savings through collaboration and visualization of building components into an early design process that will dictate changes and modifications to the actual construction process. Building Information Modeling has emerged as a construction method which saves time and cost when used properly. It is essential to figure out the nature of this method on local construction practices as this is the future of the construction practice. BIM is implemented on a local low rise residential building "AURUM ENCLAVE" and results are carried out. Scheduling work and cost estimation has been performed and ROI is taken out to find the actual profitability of the BIM in small scale low rise residential projects. Series of meetings were performed with respective stakeholders of the project to execute BIM. It was observed that BIM has numerous benefits but it is also important that every agency involved in the project is well aware with the BIM and willing to evolve with the technology along with keeping the steady growth of their respective work.
Keywords: Building Information Modeling, Return on Investment, 3D process, Construction Process

I. INTRODUCTION

"BIM (Building Information Modeling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure."

Building Information Model (BIM) is "A digital representation of physical and functional characteristics of a facility."

BIM, in most simple terms, is the utilization of a database infrastructure to encapsulate built facilities with the specific viewpoints of stakeholders. It is a methodology to integrate digital descriptions of all the building objects and their relationships to others in a precise manner, so that stakeholders can query, simulate and estimate activities and their effects of the building process as a lifecycle entity. Therefore, BIM can provide the required valued judgments that create more sustainable infrastructures which can satisfy their owners and occupants. However, it is necessary to realize that while the users and owners can change over the lifecycle of a building within different intervals the most important aspect is to minimize the impact to the natural environment. Although this can be achieved in a variety of ways using maturated BIM integrated construction methodologies they are not discussed here due to our specific focus on construction lifecycle management.

II. SCOPE

1) The considered project is in Rajkot region of Gujarat low rise residential project named "AURUM ENCLAVE"
2) Only low rise residential buildings will be considered for the study.

III. ANALYZING EFFECTS OF BIM WORLDWIDE

Construction experiences low productivity compared to other industries, largely attributed to poor planning and communication. Building Information Modeling (BIM) is a process that is used to resolve these problems by simulating physical space and expressing design intent graphically, providing a clearer image of design conflicts or constructability issues so that they are resolved before construction begins. Productivity rates increase as BIM practices are implemented because rework and idle time are reduced for laborers. Case studies of projects utilizing BIM indicate field productivity gains from 5 to 40%, depending on how the process is managed. Although the amount of savings is guarded closely by those who measure and track the changes in their productivity rates and unknown to many contractors, there are indicators that reveal increased productivity.

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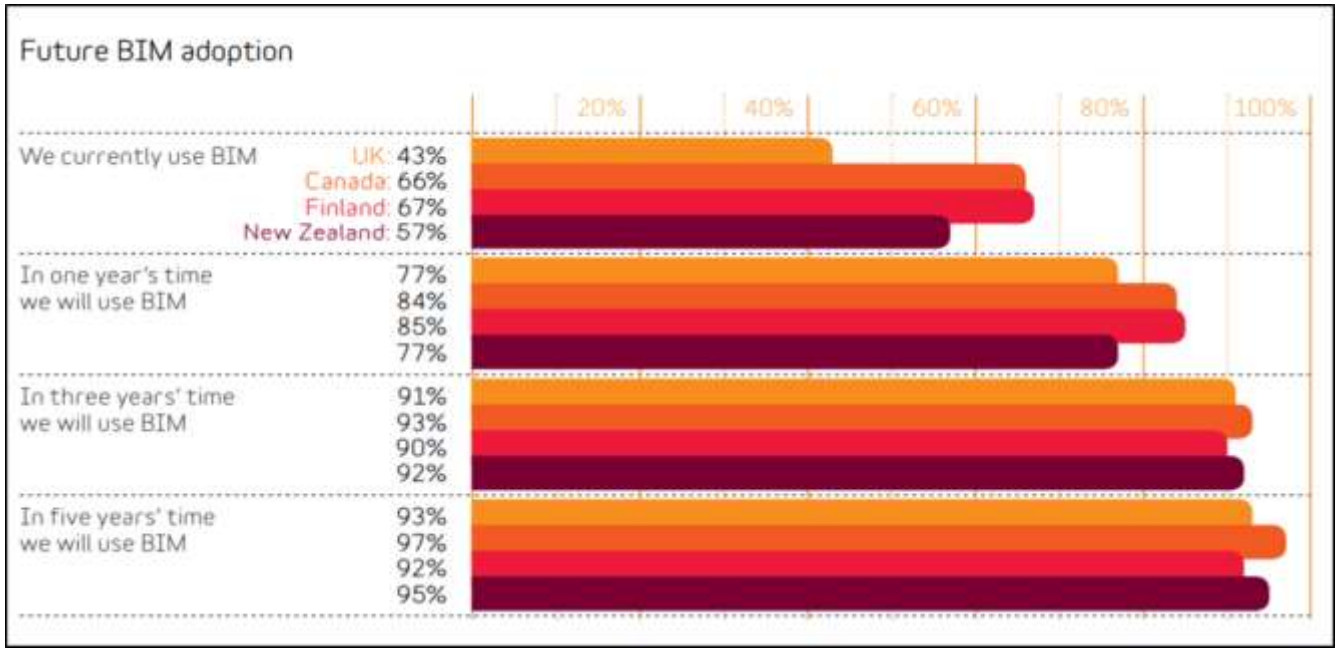

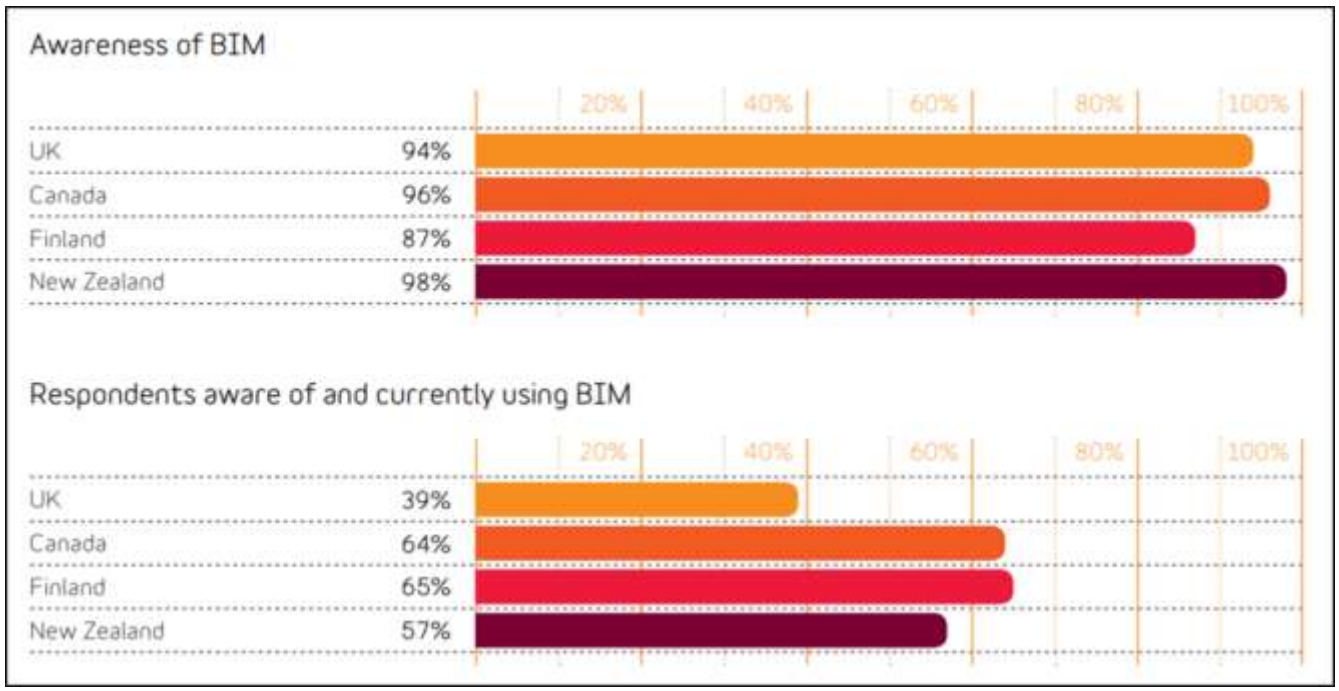

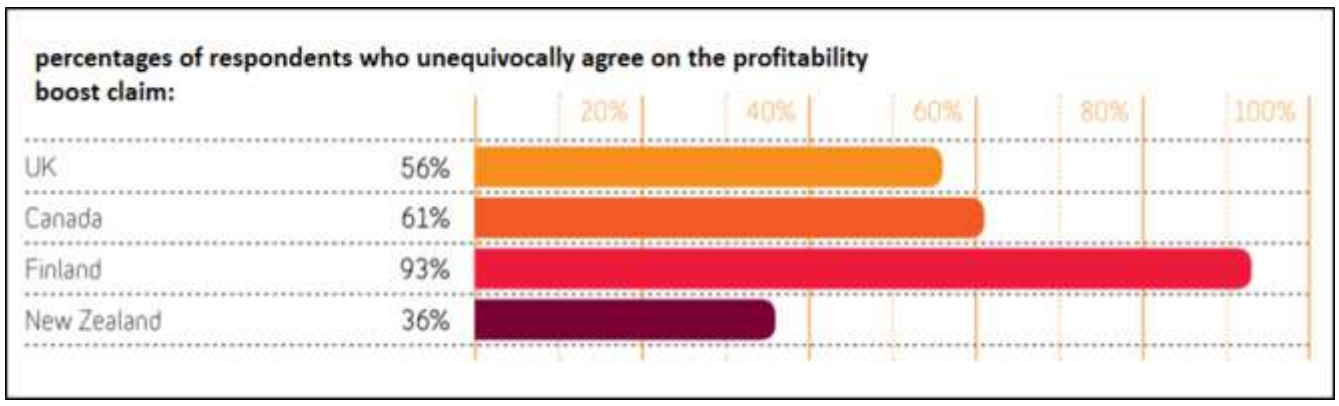

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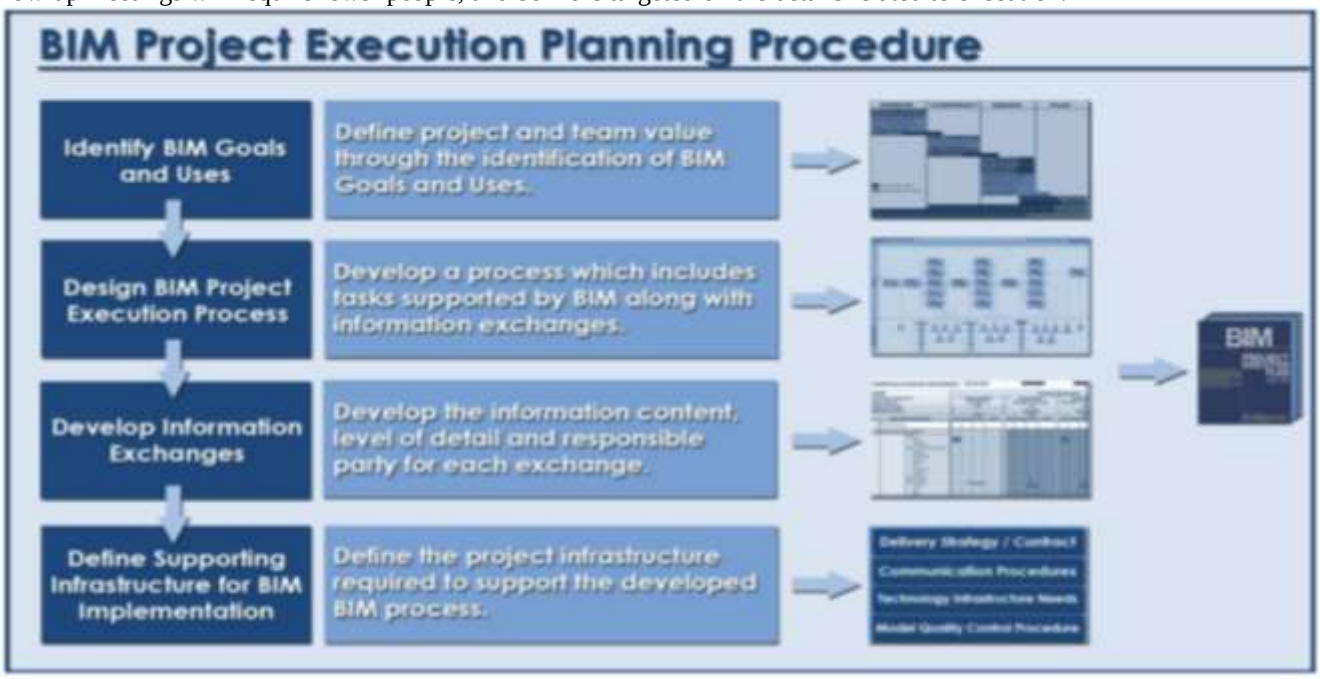
IV. BIM EXECUTION PLAN

The BIM Plan for the project cannot be developed in isolation. No one party within the project team can adequately outline the execution plan, while also obtaining the necessary team member commitments for successful BIM implementation. In order to have a successful project using BIM, full coordination and collaboration by all parties is an absolute necessity. The planning team should conduct a series of planning meetings to develop the execution plan. On most projects a minimum of two or three meetings will be needed to develop the overall BIM Plan. The initial meeting will need to have key decision makers for all organizations. Follow-up meetings will require fewer people, and be more targeted on the details related to execution.



BIM model is to be prepared for the ongoing local construction site "Aurum Enclave"

Building Information Modeling (BIM) is a process of creating and managing 3D building data during its development. BIM is a complex multiphase process that gathers input from team members to model the components and tools that will be used during the construction process to create a unique perspective of the building process. Construction companies who focus on small projects tend to be wary of Building Information Modeling (BIM), and rightly so. BIM calls for extensive training, costs a pretty penny, and it does not necessarily make you more profitable. It includes following works.

The software used to achieve BIM is AUTODESK REVIT 2016. Revit is a single application built for Building Information Modeling with features for architectural design, MEP (mechanical, electrical and plumbing) and structural engineering and construction.

- Collecting 2D drawings from the architect and structural engineer.
- Preparing BIM model
- Use of Building Information Modeling (BIM) to perform drawing work tasked
- Input finishing with more details (if any)
- Monitor/checking if there is any clashing.
- Coordinate and monitor drawing submission schedule.
- Produce drawings as per detail given by engineer/manager.

V. DESIGNING BIM EXECUTION PROCESS FOR "AURUM ENCLAVE"

After each BIM Use is identified, it is necessary to understand the implementation process for each BIM Use and the implementation process of the project as a whole. This chapter describes a procedure to design the BIM Project Execution Process. The process map developed in this step allows the team to understand the overall BIM process, identify the information exchanges that will be shared between multiple parties, and clearly define the various processes to be performed for the identified BIM Uses. The use of process mapping techniques allows the team to effectively perform this step. These process maps will also serve as the basis for identifying other important implementation topics including contract structure, BIM deliverable requirements, information technology infrastructure, and selection criteria for future team members.

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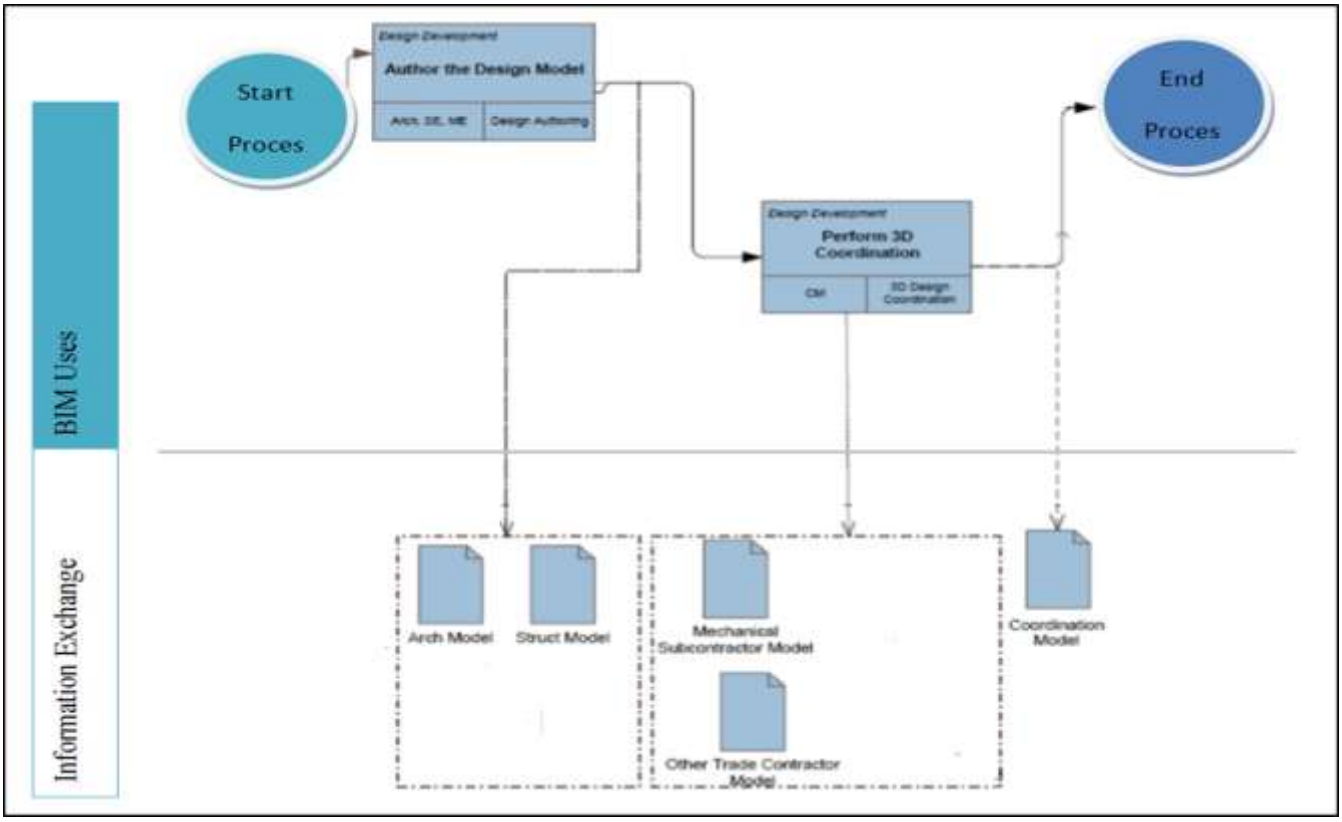

VI. MODELS DEVELOPED

1) Architectural Model
2) Structural Model
3) MEP model

VII. RETURN ON INVESTMENT

– Estimated amount could be saved avoiding the delays and implementing BIM for the better understanding as discussed with contractor is as below.

EXTRA EXPENSES	*COST*	*CAUSE*
ON MASONRY	*1,71,712/-*	*INEFFICIENT FLOW OF INFORMATION*
ON PLASTER	*2,34,587/-*	*INEFFICIENT FLOW OF INFORMATION*
BECAUSE OF TIME DELAY	*80,000/-*	*INEFFICIENT FLOW OF INFORMATION*
MACHINERY EXPENDITURE	*27,000/-*	*INEFFICIENT FLOW OF INFORMATION*
TOTAL	*5,13,299/-*	

– Investment On BIM around 3% of Contract Value i.e. 4,13,070/-

TOTAL ESTIMATED SAVING	*5,13,299/-*
COST OF BIM	*4,13,070/-*
NET BIM SAVING	*1,00,229/-*
ROI	*24.30%*

– Estimated expense on software and training programs for an architectural firm of 5 employees is…

Autodesk Revit 2017 1 year - 77,204/- x 5 = 3,86,020/-
+
Training Programs - 5,00,000/-
= 8,86,020/- for first year
Expense on Designing Phase = 2,50,345/-
Cost of BIM = 4,13,070/-

It is viable for the Designing firms to achieve breakeven point in 2 years if the investment in designing phase is proliferated by 55-60% by the owners.

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VIII. CONCLUSION

Extensive research and industry practice recognize the essential need for proper design process management. Before implementing BIM to improve the design phase, it is necessary to realize that the major source of information waste is sub-optimal information sharing, and to thoroughly understand the iterative nature of the conceptual and schematic design stages. It is also necessary to highlight the drawbacks in the traditional design practice across the industry. The two models are then explained and compared to realize the benefits of BIM use and to highlight the obstacles preventing unnecessary information flow. The results of the comparison show a high ability for transforming the traditional design phase into a lean design process by the use of building information modeling. Project success is getting increasingly reliant on the entire information channel between the entities of its supply chain. By analyzing the interactions within the participants and the respective information exchange, the required interventions and desired changes can be implemented. Such changes can boost connectivity between project players to give way to a free flow of information throughout the entire project life span, which transforms its delivery into a more efficient process. When compared with the construction industries overseas, our traditional industry seems rigid to such changes. For BIM to be implemented efficiently, it is essential that all the involved agencies understand the process and work accordingly which is a hard task.

It can be concluded from the above studies that BIM surely has numerous benefits but the changeover from 2D CAD drawings to BIM at once is too big a task for all the agencies at the moment. With the willingness of the owners to invest more in the designing phase, BIM could be the future of the construction method in India.

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