Benefits of BIM implementation in the French construction industry

M Lahiani
Senior economist in The Scientific and Technical Centre for Building, Paris, France.
E-mail: Mouchira.lahiani@cstb.fr

Abstract

As for aeronautics or automobile industry, digital transition has been well underway in the building sector. These new technological and managerial developments have been entailed changes in the construction process. Building Information Modeling, or commonly called "BIM", is a new digital approach in the building sector that introduced new management materials, new concepts and ICT-based designs and communication. This new digital tool is moving away from traditional methods that lead to isolated and static understanding of building performance in terms of design, to processes and practices that contribute to sustainable patterns of living throughout the built environment. These ecological gains have yet to be proven as research has not been able to objectively demonstrate the actual costs and benefits of BIM. The goal of this study is to detect the impact of this new dynamic digital tool and its contribution to a better understanding of the implications of the building lifecycle and their ecological performance. Through a focus group discussion and interviews with BIM related participants from France, we discovered how digital approach improve institutional mechanisms to ensure building compliance in terms of sustainability. Therefore, we highlighted the importance of collaboration within BIM project teams in the construction phase improved by the ease of access to information and its interoperability. Our results provide quantitative and qualitative measures of the benefits of BIM related to cost savings and energy performance for better sustainable construction.

Introduction

The building sector remains a source of concern in terms of sustainable development. In fact, it represents 43% of total consumed energy in France and 25% of greenhouse gas emissions (heating, air conditioning, equipment, etc.). In addition, it causes considerable waste not only during construction phase, but also during management and demolition phases. To save this waste and reduce the future energy bill of new or renovated buildings, it’s imperative to provide traceability of the data used to perform energy simulations in the design phase, to serve as a blueprint for the facility management. To achieve this, the Building Information Modelling (or BIM) approach turned out to be the adequate technology that create database around the building’s innards with detailed 3D representations of the overall structure.

In our study, we conducted a survey of different construction profiles who have led or are currently leading projects with the BIM approach in France. For that purpose, we developed questionnaire for each stakeholder during the three construction phases to find out which are the most significant BIM benefits for each phase? This interrogation allows us to analyze with more details the advantages of the digital approach throughout the life cycle of the construction project as well as the nature of its benefits.

1. Economic and environmental benefits of BIM by construction phase

Compared to the traditional 2D drafting tools, BIM is an integrated process that enables architects, engineers, contractors and owners to perceive, from the pre design phase, what their building will look like and more importantly, how it will perform. This new technology helps not only in 3D representations but also in coordinating consistent information used and sustained throughout the life cycle of a construction project [1]. In the following paragraphs, we will discover its economic and environmental benefits by construction phase.

1.1. Benefits in the Design phase

The main advantage of BIM in the early stages of a construction project is to enable exhaustive analysis of environmental indicators by the ease of access to information provided by digital models. In fact, many data obtained by BIM software contribute to facilitate the measure of environmental indicators (like LCA and LCCA)
Robust analysis of simulations ining its subcontractors by environmental with economic clash of analysis structural, sharing of. monitoring detection and (acoustic, and designers). BIM respond to a vital issue for workers on a demolition site since digitized models allow predictive classification of hazardous waste (especially asbestos) and inert construction materials already used, this can help minimize construction waste after each demolition. or thrown away. This kind of information is essential for reconstruction, which will encourage the recycling of cycle allows a better understanding of the nature of construction materials and notably those when the building is delivered, the owner receives a huge volume of scattered and heterogeneous files (.xls, .doc, .pdf, .dwg, .dxf...) for the operation phase. The usefulness of BIM in this phase is to gather all this data in a common format and integrate it into a single platform. In fact, a well-managed database can optimize occupancy, energy consumed or scheduling of maintenance and repair works. BIM approach improves a better reflection before operation phase, this can help owners in choosing the most adequate maintenance operating company and the nature of the contract that will bind them. Digital executed work folder enables operation managers to have an interoperable model with maintenance operating software to preserve the building with fully completed management tool. For better forecasting of equipment breakdowns and improved repairer productivity, most of facility managers need information about material and equipment obsolescence.

1.2. Benefits in construction phase

It is not enough to apply BIM in the design phase to get the maximum benefit from it. The flow of information must continue out in the field to ensure actual organization, coordination and collaboration sharing information in accurate and timely way help the construction company for its various tasks. Once design phase is complete, the construction company takes responsibility for the site and begin by training its subcontractors by specifying the work schedule and sequencing their tasks. BIM has a real use in this stage of the project since it enables team members to communicate and collaborate rapidly and efficiently avoiding misunderstanding errors aids in saving considerable losses of building materials and potential demolition and repair operations which are often very expensive and out of budget.

1.3. Benefits in operation phase

In most cases, when the building is delivered, the owner receives a huge volume of scattered and heterogeneous files (.xls, .doc, .pdf, .dwg, .dxf...) for the operation phase. The usefulness of BIM in this phase is to gather all this data in a common format and integrate it into a single platform. In fact, a well-managed database can optimize occupancy, energy consumed or scheduling of maintenance and repair works. BIM approach improves a better reflection before operation phase, this can help owners in choosing the most adequate maintenance operating company and the nature of the contract that will bind them. Digital executed work folder enables operation managers to have an interoperable model with maintenance operating software to preserve the building with fully completed management tool. For better forecasting of equipment breakdowns and improved repairer productivity, most of facility managers need information about material and equipment obsolescence.

1.4. Benefits in demolition reuse and recycling phase

The usual duration of a building is often indicated by building experts as being between 30 and 50 years. When the building is digitized from its design, the flow of information maintained by professionals throughout its life-cycle allows a better understanding of the nature of construction materials and notably those which will be recycled or thrown away. This kind of information is essential for reconstruction, which will encourage the recycling of construction materials already used, this can help minimize construction waste after each demolition. In addition, BIM respond to a vital issue for workers on a demolition site since digitized models allow predictive classification of hazardous waste (especially asbestos) and inert waste.

Figure 1: BIM benefits in every construction phase
2. Materials and method

Evaluating the economic and environmental contribution of BIM in each construction phase requires meticulous monitoring throughout the life cycle of a project [5]. For this reason, we developed an “evaluation grid” that gather several qualitative and quantitative indicators examined in the literature. This monitoring tool is fed by the results of various questionnaires which have been distributed to different professionals working in the experimental project (architect, engineers, project and BIM managers…). These projects follow-ups allow us to have more precise results of the economic and environmental impacts of BIM according to the type and nature of the building.

In this survey, we followed-up 8 new construction projects and interviewed 16 executives: 10 project owners, 4 architects and 2 BIM managers. Each questionnaire dedicated to a professional contains 12 questions including 3 related to his level of expertise in the BIM approach. The other questions concern the perspective and the estimation of the most significant qualitative and quantitative benefits of BIM.

3. Results

Among the proposed list of BIM advantages, most of professionals agreed that the communication with 3D models is one of its main added value (figure 2). They expressed that the 3D audiovisual models provide better understanding of the future building, especially for non-expert viewers. This advantage is very important for local authorities who want to enforce compliance of environmental and urban regulations in their district from the pre-design stage of the building.

Figure 2: Most significant qualitative BIM contributions in the programming/design phase

In design phase of a construction project, building experts have highlighted the perception of a gain in quality of design and time savings that the BIM provides through the ease of access to precise data on construction materials’ properties and objects. In addition, BIM approach provides better supervision and coordination between stakeholders which promotes actual savings in terms of monitoring valued between 5 and 10% of design costs by 40% of interviewees. Moreover, 20% of them estimate a cost reduction of more than 10% (figure 3).

Figure 3: BIM gain estimates by surveyed professionals

In construction phase, the most important benefit of BIM is the reduction of additional construction works on site which generate considerable endorsements and delays to construction execution contracts. This benefit is the result
of the decrease in errors and omissions in the design phase provided by the BIM approach. Note that avoided costs due to additional construction works can be very expensive for large-scale projects. In our sample, most of observed construction projects are small-scaled, that’s why we found an estimation of the avoided costs between 0 and 5% for 40% of interviewees.

Figure 4: Most significant benefits of BIM in construction / operation phase

| Benefit                                                                 | Agreement with the statement (from 0 "not agree" to 5 "Totally agree") |
|------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Better operational restructuring throughout the building’s life cycle  | 5                                                                       |
| Reduction of errors or omissions                                      | 4                                                                       |
| Improving the brand image of the construction company                 | 3                                                                       |
| Reduced claims and litigation risks                                    | 2                                                                       |

Even if most of the professionals did not really confirm this advantage, since they did not have enough perspective in the operation phase, many of them demonstrated their expectation for better prevention of operational interventions in the medium and long term. In this context, we found that restructuring of equipment maintenance and monitoring operations are the most approved advantage of BIM in operation phase.

Conclusion and perspectives

The BIM framework help engineers and project managers to conduct performance studies by analyzing different alternatives. The ease of access and the quality of information provided by BIM databases allows them to make optimal choices in terms of economic and environmental aspects. This approach enables all construction stakeholders to have a dynamic flow of data that enforce transparency and communication between them.

Even though BIM is gradually gaining awareness as an increasingly interesting solution to reduce construction and operating costs, we note that the number of digital real estate projects does not exceed 30% in France (2017). This observation shows that it’s becoming crucial to identify more projects managed with BIM in order to provide quantitative metrics or a baseline for a comparison of investments and returns. In this research framework, this paper constitutes a starting point for exploring significant quantitative and qualitative indicators on BIM benefits. One of the perspectives of this study is to build up a larger database by following more BIM projects and by interviewing more professionals from all areas of the construction industry.

References

[1] Bryde D, Broquetas M and Volm JM 2013 Int. J. of Project Management 31 971-980.
[2] Shin Y and Kyuman C 2015 Mathematical Problems in Engineering ID 281640.
[3] Orea M, Hosseini R, Edwards D, Li H, Papadonikolaki E and Cao D 2019 Int. J. of Project Management 37 839-854.
[4] Barry H 2017 Presses universitaires de Bordeaux 52 201-2016.
[5] Barlish K and Sullivan K 2012 Automation in Construction 24 149-159.