



Barriers in BIM Adoption and the Legal Considerations in Vietnam

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Abstract: Building Information Modelling (BIM), an emerging trend in the construction industry worldwide, has been officially introduced to Vietnam recently in some piloted projects. However, in Vietnam, the BIM market is still immature due to that the players in the construction industry have perceived many barriers in adopting this new solution. In a country with a civil law system like Vietnam, the legal environment is considered as the most important enabler for the construction industry to adopt innovative technologies, including BIM. This paper, using a hybrid research approach of surveys and expert judgment, discusses the most popular barriers in BIM adoption in the construction industry in Vietnam, which include five internal and five external barriers. The country's BIM roadmap, policies and relevant legal documents that are currently in effective are then collected and analyzed in line with the discovered barriers in order to explore their effectiveness in creating an enabling environment for BIM adoption and implementation in the local conditions. After that, legal considerations on the clarity and feasibility roadmap for BIM adoption, the reasonableness of the strategy/plan to grow the industry's BIM capacity, the system of relevant laws and regulations to govern the BIM-enabled construction projects, the need for a new set of standards and codes for BIM-related processes, and an incentive system for the pioneers in BIM adoption in public sector are discussed. Recommendations on the legal document system, governmental policies, incentives and supports from the Government to encourage the construction industry to apply BIM are then presented. Further research can be developed beyond this research to validate the research results in a broader coverage.

Keywords: BIM, BIM adoption barriers, internal barriers, external barriers, legal considerations, BIM roadmap, BIM enabling environment

1. Introduction

Building Information Modelling (BIM) has gained a wide adoption internationally, as it has been proved to bring lots of benefits to the construction industry (Cao, Zhang et al., 2019, Chan, Olawumi et al., 2019). Vietnam is one of the countries that is behind regarding this technology (Nguyen and Tran, 2018), leading to that only a small number of projects have adopted BIM so far. Though some cases on BIM-enabled projects have been reported (Viet-Hung Nguyen, Ngoc-Binh Ta et al., 2015, Nguyen, Luu et al., 2020), most of the players in the construction industry in Vietnam are still reluctant to BIM adoption. Reasons reported include the low awareness of the AEC (architect, engineering and construction) industry regarding BIM, the challenges when adopting BIM and the lack of an enabling environment for BIM implementation (Viet-Hung Nguyen, Ngoc-Binh Ta et al., 2015, Nguyen and Tran, 2018), which create barriers for

the country to adopt BIM. In order to promote BIM in the construction industry, it is necessary to identify and analyze the barriers that their players may face. Literature shows that if a Government plays a proactive role in BIM promotion in its country, this will help reducing or removing barriers for the construction industry to adopt BIM more easily (Wong, Wong et al., 2011, Yuan and Yang, 2020). The Governments need to create an enabling environment for BIM adoption with proper legal considerations, which will contribute to mitigate the BIM challenges and therefore, to help the construction industry to overcome BIM adoption barriers.

This research aims at exploring the barriers perceived when the players in the construction industry in Vietnam adopt BIM, then discuss the legal considerations which can create an enabling environment for this matter. Firstly, it presents the literature review regarding the barriers to BIM adoption. Then, the barriers discovered from data collected in 3 surveys and 5 case studies are explored in comparison to the barriers reported in the literature. Selected legal considerations such as the BIM legal documents, BIM roadmap, the governmental policies and guidelines, as well as contractual templates are then discussed regarding their contribution to the creation of an enabling environment for BIM adoption of contractors in the country. The paper concludes with some suggestions for contractors regarding BIM adoption strategies to overcome the significant barriers leveraging the legal considerations in Vietnam.

2. Literature Review

2.1 Barriers to BIM Adoption

Barriers to BIM adoption is a popular topic which attracts the interest of both academics and professionals. Barriers to BIM adoption are investigated for construction projects or the construction industry in general (Kekana, Aigbavboa et al., 2014, Cao, Zhang et al., 2019), as well as for important stages such as design (Chan, 2014), prefabrication (Tan, Chen et al., 2019), construction (Marefat, Toosi et al., 2019), operation and renovation (Elagiry, Marino et al., 2019). Barriers to BIM adoption are also explored for the players in the construction industry, such as designers (Chan, 2014), quantity surveying firms (Wong and Yew, 2017), manufacturers (Mostafa, Kim et al., 2020), contractors (Hamada, Haron et al., 2016), asset management firms (Ashworth, Tucker et al., 2016); for small and medium-sized companies (Hosseini, Namzadi et al., 2016, Saka and Chan, 2020) and large firms, for new and existing buildings (Hossain and Yeoh, 2018) etc.

Though there are different barriers reported regarding BIM adoption, there are some common barriers recognized, which can be grouped as legal issues, financial issues, management issues, lack of qualified human resources, and the resistance to change to adopt BIM (Ahmed, 2018). For a particular organization, barriers can be classified into internal and external barriers. Internal barriers reported for organizations include lack of in-house expertise (Zahrizan, Ali et al., 2014), high investment cost, no time to get up to the speed of BIM, no clear and effective drivers, under expected ROI for BIM investment (Hosseini, Namzadi et al., 2016). External barriers include legal issues (Dao, Nguyen et al., 2020), including the lack of governmental policies (Hatem, Abd et al., 2018) and lack of contractual framework (Chong, Fan et al., 2017), the reluctance to change of the stakeholders (Chan, Olawumi et al., 2019), immature BIM market (Eadie, Odeyinka et al., 2014), lack of BIM industry standards (Chan, Olawumi et al., 2019), and also challenges or difficulties in adoption and implementation which make organizations hesitate to invest into BIM. These internationally perceived barriers will be compared with that discovered in the Vietnamese construction industry.

2.2 Legal Considerations Regarding BIM Adoption

Legal issues have been discussed in relation to barriers to BIM adoption worldwide. These issues may bring risks to the BIM adopters, therefore, need to be addressed. Also, proper legal considerations can create an enabling environment for facilitating the BIM adoption of the construction industry, including contractors.

As summarized by Liu, S., et al. (Liu, Xie et al., 2015), legal considerations for facilitating BIM adoption need to cover the following issues: ownership, responsibility for inaccuracies, licensing problems, incomplete national standard, and lack of information sharing in BIM. In an earlier research, Olatunji et.al (Olatunji and Sher, 2010) have also agreed that the model ownership (copyrights) should be considered as one of the legal implications of BIM adoption, together with the rights for controlling BIM models, the professional liabilities in electronic and integrated project delivery systems, especially in the open collaborative processes (Sebastian, 2010). Another research discusses the reliance, privity of contract, and third party rights (Greenwood, 2010), as these issues are considered very complicated by the nature of the BIM models which need to be shared among multi-users who have different rights and roles to access and edit, update the models. Several issues in managing BIM-enabled projects are pointed out, including immature dispute resolution mechanisms, lack of legal provisions for protecting BIM-related intellectual property (Zhou, Yang et al., 2019), liability for wrong or incomplete data (Alreshidi, Mourshed et al., 2017).

In order to reduce the relevant potential risks, previous research studies emphasize the development of a legal framework (Olatunji and Sher, 2010), including the contractual framework for BIM-enabled projects (Greenwood, 2010, Olatunji and Sher, 2010) to create an enabling environment for facilitating the BIM adoption. Different initiatives regarding contractual protocols have been put into practice, including AIA Document E202 and ConsensusDOCS 301 (McAdam, 2010). Several research studies discuss the government policies (Papadonikolaki, 2017), roadmap and strategies (Hadzaman, Takim et al., 2015), guidelines and standards (Miettinen and Paavola, 2014) together with other

legal documents and also the contractual framework (Chong, Fan et al., 2017) as the factors in the enabling environment for BIM adoption.

3. Research Approach and Data Collection

This research applied a hybrid research approach with two surveys, and case studies. The first survey was conducted in late 2018 when the Government has implemented several policies to promote BIM adoption and implementation in the construction industry in Vietnam (Table 1). This survey aimed at measuring the need for BIM trainings in organizations, therefore, only internal barriers of the organizations in adopting BIM were discovered. Therefore, it was recognized that another survey needed to be conducted for exploring the external barriers regarding BIM adoption.

Table 1 - Information on the survey participants samples (Survey 1)

Criteria	Frequency (%) in Survey 1 (sample size = 199)
Types of organization they work for	
Designer / consultant	61 (30.65%)
Project Management	24 (12.06%)
Contractor	65 (32.66%)
Clients	42 (21.11%)
Other	7 (3.52%)
Years of experience in construction	
1-5	107 (53.77%)
6-10	45 (22.61%)
11-20	40 (20.10%)
20 +	7 (3.52%)
Respondents from organizations adopted BIM, among them:	
Designer / consultant	30 (55.66%)
Project Management	8 (12.96%)
Contractor	10 (18.52%)
Clients	7 (12.96%)
Total	199 (100%)

Though people often refer to types of the stakeholders of a construction project to discuss barriers in BIM adoption for those organizations separately, it is noted that one should also consider phases in the life-cycle of a typical construction project, such as construction survey, design, and construction etc. to discuss BIM application. In each of these phases, there are several types of stakeholders involved in the project, while the client/owner will be involved in the whole life cycle. Survey 2 was conducted to discover the barriers in BIM adoption in a different perspective. It aims to discuss the barriers with different types of professionals: client's members of staffs who oversee the whole life-cycle of the projects, architects and engineers who join in the design phase, and site engineers of all of the stakeholders who work for the project in the construction phase, etc. Since this survey aims at discovering the external barriers of the organizations, demographic information are not crucial. Table 2 shows the key information of the second surveyed group.

Table 2 - Information on the survey participants sample (Survey 2), sample size = 116

Criteria	Frequency	Percentage (%)
Clients' staff	18	15.52%
Designers	84	72.41%
On site engineers	14	10.07%

Since the construction stage attracts less interest toward BIM than the design stages (Nguyen, Luu et al., 2020), leading to that only a small number of contractors in the country have adopted BIM so far, therefore, it is worth exploring the barriers that this type of firms have faced. Five experts who for firms having contracting businesses selected from firms which have adopted BIM or have a plan for BIM in near future were recruited for an expert judgement research

study, and their firms are selected as case studies for this research. The experts have been recruited by snowball - a convenient sampling method - for semi-structured interviews. To maintain the confidentiality, the surveyed firms are coded from A to E.

Firm A, Firm B, Firm C, Firm E are private companies while Firm D is a state-own company. Firm A, Firm C and Firm E have adopted BIM in some projects already while Firm B and Firm D have a plan and are seeking a consultancy company for BIM adoption. Firm D just focuses on the market segment of projects funded by the local budgetary sources while other firms are also open for projects in the private or foreign direct investment sectors. It is noted that though these firms play the role of a contractor, four of them also run other business lines, of which the active ones include investment (as investors – 2 firms), design consultancy (as a designer – 1 firm), provision of equipment rental (1 firm), provision of on-site construction supervision services (1 firm). Therefore, experts selected have experience in variety of businesses in construction as well as of stages in the life cycle of construction projects.

Legal documents and other documents issued by the Government developed for promoting BIM adoption and implementation in Vietnam were then collected. Those legal considerations were analyzed to discuss if they can facilitate the construction industry to overcome their barriers to BIM adoption.

4. Results

4.1 Legal environment for BIM adoption in Vietnam

Recognizing the benefits that BIM adoption can bring to the construction industry, as Matthews and Ta have summarized (Matthews and Ta, 2020), in 2014, the Institute of Construction Economics belonging to the Ministry of Construction of Vietnam (MOC) conducted a research project on “Building Information Modeling (BIM) roadmap for improving efficiency of design, construction and facility management activities in Vietnam”. As a result of this research, several legal documents and policies, guidelines have been issued to create a legal environment for BIM adoption (Table 3).

Table 3 - Legal documents and policies to promote BIM adoption in Vietnam

Documents	Relevant contents
Law on Construction, 50/2014/QH13, dated June 18, 2014, in effective from January 01, 2015.	In Article 4, the basic principles of construction investment activities include: Implement the use of sciences and technologies, building information modelling to construction investment activities (Point 3). In Article 66, one of the domains for construction investment project management is “Management of the building information system” (Point 3).
Decree 32/2015/ND-CP on construction cost management, dated March 25, 2015, in effective from May 10, 2015 to September 30, 2019.	In Article 23, Point 2 states that eligible costs include costs for application of science and technology, construction information system management (including BIM). Applicable to public projects.
Decree 68/2019/ND-CP on the management of construction investment costs, dated August 14, 2019, in effective from October 1, 2019 (replacing Decree 32/2015/ND-CP)	In Article 21, Point 2 states that eligible costs include costs for application of science and technology, construction information system management (including BIM). Applicable to public projects.
Circular 06/2016/TT-BXD guiding on determination management construction investment costs, dated March 20, 2016, in effective from May 1, 2016 to February 14, 2020.	In Article 3, Point 1a and 1b state that eligible costs include costs for managing BIM and costs for applying BIM. Applicable to public projects.
Circular 09/2019/TT-BXD guiding on determination management construction investment costs, dated December 26, 2019, in effective from February 15, 2020.	In Article 3, Point 1a and 1b state that eligible costs include costs for managing BIM and costs for applying BIM. Applicable to public projects.
Decision 76/QD-BXD dated February 15, 2017 on the norms for project management and construction consultancy costs	Guides on estimate BIM-related costs available, indirectly confirm the costs are eligible.
Circular 16/2019/TT-BXD dated December 26, 2019, in effective from February 15, 2020.	Guides on estimate BIM-related costs available, indirectly confirm the costs are eligible.
Decision 2500/QD-TTg dated December 22, 2016	Implementing the roadmap for applying Building Information Modelling for construction and project operation and management activities.
Decision 203/QD-BXD dated March 21, 2017	Forming the BIM Steering Committees in Vietnam.

Documents	Relevant contents
Decision 204/QD-BXD dated March 21, 2017	Issuing the plan for applying BIM in design, construction and operation management activities.
Decision 1056/QD-BXD dated October 11, 2017	Issuing the curriculum for training BIM for BIM piloting projects.
Decision 1057/QD-BXD dated October 11, 2017	Issuing temporary guidelines for BIM application in BIM piloting projects. Guides include: General guidelines, Contractual Framework for BIM-enabled projects, estimating BIM-related costs, managing information in BIM, LOD, EIR Template, BIM Execution Plan (BEP) and terminologies.

Among the legal documents as in Table 3, the Law on Construction has set up some initial conditions for BIM adoption, allowing BIM-related activities to be delivered in construction projects. For public projects, this allow the BIM-related cost to be eligible, then investor can include some budget for BIM adoption and implementation. Then, several decrees and circulars, especially the cost management related, have included some detailed regulations for managing BIM-related costs. These legal documents have created a legal environment for the implementation of the Project on “Applying Building Information Modelling for construction and project operation and management activities” (hereafter called Government BIM Project) issued with Decision 2500/2016/QD-TTg. Other decisions that follow have been published to pursue this Project, to establish a BIM task group for the country, as well as to provide guides for BIM adoption and implementation.

In addition to the legal documents in Table 3, the BIM Steering Committees has sent correspondences to ministries and public clients in the country to encourage them to register their projects to be piloted with BIM. Until January 2019, there have been 32 projects registered (Minister of Construction - Vietnam, 2018, Minister of Construction - Vietnam, 2019), but just 7 projects have been reported to apply BIM in reality (Vietnam BIM Steering Committee, 2020).

4.2 Barriers in BIM Adoption in Vietnam

Six internal barriers reported in the literature have been validated in the research surveys. Table 4 shows the frequencies that respondents perceived each of them as barriers. It is noted that barriers 1, 2 and 4 were confirmed by more respondents than barriers 3 and 5. Only barriers 1 and 4 have been selected by a majority of respondents.

Table 4 - Internal barriers perceived in BIM adoption

Barriers	Frequency (%) in Survey 1 (sample size = 199)
1. Lack of in-house expertise	129 (64.82%)
2. High investment cost	84 (42.21%)
3. Not enough time to get BIM in the projects	30 (15.08%)
4. No clear and effective drivers	102 (51.26%)
5. Low ROI for BIM investment	49 (24.62%)

The external barrier of “Immature BIM market” has also been partly validated with Surveys 1. 51 respondents (25.63%) reported that “No client demand” was one among the reasons for them not to proceed with BIM adoption. Other external barriers of legal issues, the reluctance to change of the stakeholders, lack of BIM industry standards and also other challenges or difficulties as a type of barriers have also been validated in Survey 2. Table 5 shows the number of the participants from Survey 2 confirming each of these external barriers.

Table 5 - External barriers perceived in BIM adoption

Barriers	Frequency (%) in Survey 2 (sample size =116)
1. Legal issues	106 (91.38%)
2. Stakeholders’ reluctance to change	95 (81.90%)
3. Immature BIM market	111 (95.69%)
4. Lack of BIM industry standards	103 (88.79%)
5. Other challenges or difficulties	116 (100%)

Concepts of barriers emerged from the interviews with respondents as experts recruited from firms as case studies. Table 6 shows the concepts and also the categories which have been developed from the concepts. In order to be

comparable to the data collected from the three surveys, categories are put into two groups of internal and external barriers. Apart from the categories listed in the Table, which confirm the barriers, the respondents also noted some categories that do not confirm the barriers. These categories will be discussed later to explain why respondents did not confirm any of the barriers listed above.

Table 6 - Categories of barriers in BIM adoption emerged from the case studies

Barriers	Categories (Categories confirming the barriers)
<i>External Barriers</i>	
1. Legal issues	<ul style="list-style-type: none"> - Lack of contract forms to mandate the BIM practices and address the legal concern - Lack of government requirements, policies on the use of BIM - No clear fund for BIM adoption in public projects due to the unavailability of the cost norm for BIM - No guidance on calculating budget for BIM, therefore there is not any reliable basis for proving BIM-relevant expenses as rationale costs for projects - No clear ownership of BIM model - Designers can refuse their responsibility when using BIM models instead of their CAD drawings due to no clear regulations - Investment into BIM may not be considered as rationale expenses to the firms' stakeholders or project sponsor due to the unavailability of relevant accounting regulations - No relevant guidance for changing projects which have been approved to add in some budgets for BIM
2. Stakeholders' reluctance to change	<ul style="list-style-type: none"> - Change to use BIM can contain lots of risks that can affect their businesses. - BIM requires a rigorous process different from the traditional method where people may make mistakes before they can be familiar with that. - Projects have been approved to implement with a fixed budget without BIM, the procedure to propose a change to the project to add some budget for BIM is very complicated, should be avoided. - The traditional method is still working. - Lessons learnt from some projects reported to use BIM prove that BIM did not bring in significant value. - Cannot adopt the change due to the unavailability of the human resources who have skills in 3D software. - BIM is new, and every new thing is very expensive and risky, the stakeholders cannot afford. - Projects need speed, BIM adoption will slow it down, due to some more tasks emerging and being inserted in the current processes. Also, the new things need more time to do. - BIM model is virtual, cannot be touched, so it is hard to know if it is good, correct or not. - No or low value added is perceived by the clients since they have no chance to contact with BIM in the practice.
3. Immature BIM market	<ul style="list-style-type: none"> - I can see firms using Revit to develop drawings, and it is not BIM in full meaning. - BIM level 1 does not prove efficiency to clients, leading to low or no demand. - BIM-enabled projects to firms are one-off projects, then firm cannot get economies of scale. - In other market segments (in terms of sources of capital and type of construction works), customers require consultants and contractors to use BIM, but in the firm's market segment, there is not any similar order. - As BIM market in Vietnam is only in the early stages, so applying BIM is a challenge; the process will take a lot of time and effort of the pioneers.

Barriers	Categories (Categories confirming the barriers)
	<ul style="list-style-type: none"> - No similar project with the same type of construction works have used BIM, so cannot find lesson learnt. - Clients may not find enough consultants and contractors who can work with BIM for their projects, so they keep using the traditional approach.
4. Lack of BIM industry standards	<ul style="list-style-type: none"> - Due to the lack of policies, the government's BIM standards have not been developed. - Lots of BIM standards have been introduced to Vietnam, firms do not know what to apply. - Clients do not know how to select capable BIM consultants and contractors, do not know how to monitor and check the virtual models.
5. Other challenges or difficulties	<ul style="list-style-type: none"> - Low level of awareness of BIM and BIM benefits among the professionals and firms in the construction industry. - BIM software are too complicated, not many firms in our market segment can deal with - Prices quoted for BIM services are high due to high investment cost, not very attractive to clients. - Projects must go through some procedures by government agencies, such as appraisal of feasibility study report or design documents and drawings, those agencies never accept BIM models, leading to high cost and time consuming to convert from 2D CAD. - Clients do not have budget for BIM in their projects. - There are only large construction firms who have capability in BIM, and they do not target to public projects.
Internal barriers	
1. Lack of in-house expertise	<ul style="list-style-type: none"> - Lack of skilled modelers, software users. - Adopting BIM requires personnel to have experience and expertise in the whole life cycle of construction projects as well as information technology, BIM as well, firms do not have that type of people. - No captain to lead the firm's BIM adoption campaign. - Adopting BIM requires changes in our workflow, practices and procedures, and firms do not know how to make the changes and incorporate into the current system.
2. High investment cost	<ul style="list-style-type: none"> - BIM human resources require higher salary. - Costs incur for software and hardware purchases, for training human resources. - Costs also incur while firms change their processes and practice BIM, the money to change the process is very high. - Costs incur for marketing, due to that different marketing approach is needed with BIM-enabled projects (e.g. develop 3D model to show potential clients). - Costs incur for paying personnel waiting for BIM job (less frequent demand than the traditional jobs)
3. Not enough time to get BIM in the projects	<ul style="list-style-type: none"> - The procedure when BIM goes in is longer and more complicated. - Current procedures and estimated durations for project phases have been widely recognized, the use of BIM will lengthen the total duration. - All projects have design completed, getting BIM in will delay the construction process. - Firms are too busy with the current jobs and have no time for BIM at the moment.
4. No clear and effective drivers	<ul style="list-style-type: none"> - New things are often not efficient due to high initial investment. - No clear incentives from clients for adopting BIM. - We are the followers in the market, so will wait and see first. - Immature market for BIM, so it is not promising in terms of profit.

Barriers	Categories (Categories confirming the barriers)
	- All projects have design completed, getting BIM in will not bring in any significant benefits.
	- Lack of support and commitment from senior managers.
5. Low ROI for BIM investment	- BIM level 1 does not prove efficiency to clients, so investment into BIM brings in low ROI.
	- Demands for BIM-enabled projects are less frequent, so it takes more time to get to the payback point.

5. Discussions

Regarding the internal barriers, only two barriers “Lack of in-house expertise” and “No clear and effective drivers” were confirmed by majority of the participants in the first survey, with 129 (64.82%) and 102 (51.26%) respondents’ confirmation respectively. Less number of participants confirmed “High investment cost” as a big barrier, with 84 (42.21%) survey participants. A minority of participants perceived “Not enough time to get BIM in the projects” (30 respondents, 15.08%) and “Low ROI for BIM investment” (49 respondents, 24.62%) as barriers.

Since BIM is new in the country, if the firms do not have in-house experts and skilled personnel for BIM, the firms will find it difficult to realize its strategies, then implement the strategies for BIM adoption. In other words, firms have no ideas what to do to adopt BIM. Data from the case studies also confirm this. According to the firms in the case studies, there is a need of one captain to lead the firm’s BIM adoption campaign, though the firm can hire a consultant to develop its BIM adoption strategies. Case studies explain in-house expertise as the inclusion of a BIM captain, multidisciplinary experts (in construction field, also in information technology and BIM) and skilled modelers, who are good at BIM software. This explains why “Lack of in-house expertise” can become the most perceived barrier to BIM adoption.

“No clear and effective drivers” is the next significantly perceived barrier. According to the case studies, drivers can be for the whole firm to adopt BIM or for the personnel who join in the BIM team. For some firms, new things are not attractive to them due to the perception that they may bring low profit while high initial investment is needed. Also concerning the profitability, data from all of the case studies confirmed that the BIM market in Vietnam is immature, therefore it is not considered a promising market in terms of profit. The firms find no clear incentives from clients for adopting BIM. From the point of view of a member of staff of the firms, they found “Lack of support and commitment from senior managers” as a reason for lacking drivers. Some firms are consent to be the followers in the market, so they would rather wait and see if other firms can be successful with BIM adoption before they make their decision.

Less than a half of the participants in the survey confirmed “High investment cost” as a big barrier to BIM adoption. This is not like in other countries, where this barrier often has been confirmed by most of the cases. Due to the popularity of the subcontracts in Vietnam, firms can hire subcontractors if they need some special expertise. However, if they use in-house resources, they will need a significant amount of investment for compensating the costs as listed in Table 6. Therefore, this is considered a barrier, but not perceived by the majority of the research participants as significant.

Regarding the barrier of “Not enough time to get BIM in the projects”, though it was confirmed by some previous research studies, it was not considered as important by most of the respondents of the first survey. This can be explained by the fact that not many survey respondents have practical experiences on BIM (less than 30% come from organizations that have adopted BIM), so, they may not understand thoroughly the processes of BIM and underestimate this barrier. The people in the case studies showed some evidences confirming this barrier. They recognized that the procedure when BIM goes in is longer and more complicated. Also, current procedures and estimated durations for project phases have been widely recognized, then the use of BIM will lengthen the total duration. Some claimed that they are contractors, so when they can get into the projects, the design phase has completed, then BIM will have limited use and benefits. Also, a firm in the case studies revealed that they are too busy with the current workload and cannot afford to spend time for BIM, though it has a plan for BIM adoption in the near future.

“Low ROI for BIM investment” is also considered as a significant barrier to BIM adoption from the literature. Some respondents from the case studies agreed that demand for BIM-enabled projects are less frequent, so it takes more time to get to the payback point. Also, BIM level 1 does not prove efficiency to clients, but the prices quoted for BIM services are high due to high investment cost, making BIM services not very attractive to clients, then the rate of success in bidding for contracts is low. However, a respondent has another view on that. In his opinion, firms with BIM services can apply Pricing Skimming strategies, which can improve their ROI. That is why not many respondents from Survey 1 perceived this as a significant barrier in Vietnam (less than a quarter of the sample size).

Regarding the external barriers, it is noted that all of the barriers perceived by the majority of respondents (see Table 5), the least frequent confirmation for a barrier is 81.90% (95 /116 respondents). This shows the dependence of the firms on the external environment. In other words, firms need an enabling environment for BIM adoption, which can facilitate them in starting and working with BIM. That explains why legal issues have been recognized as a significant barrier by most of the firms both in the survey and in the case studies. Legal issues confirmed in this research include issues with BIM contract forms, policies, cost norms, guidance on calculating budget for BIM, basis for proving BIM-relevant

expenses as rationale costs for projects, also other issues such as the ownership of BIM models, the responsibility of designers when using BIM models, etc. In a BIM-enabled project, relationships and processes are very different from that in a traditional project (see Fig. 1), but the current system of guidance, management and collaboration standards and codes in construction do not address the new working styles. There do not exist any data management and exchange standards, which can facilitate BIM processes. Though the Government has issued a number of policies and guidance (see Table 3), but the detailed regulations and guidance are only for the pilot projects, not applicable to all of the projects. Also, there has not been anything called BIM “standards” developed for the country so far. Different firms may use different standards from Singapore, the USA, or the UK, or their own standards for their BIM jobs, this limits the collaboration between stakeholders.

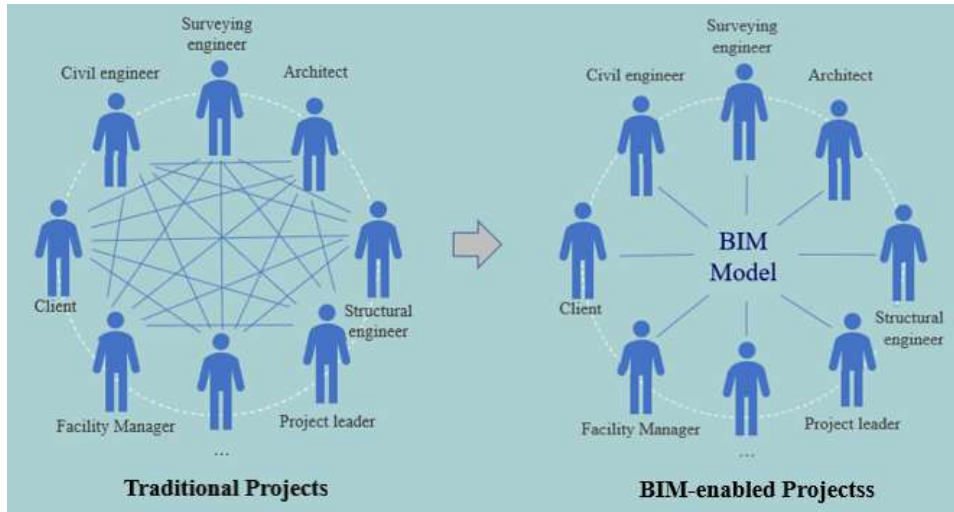


Fig. 1 - Changes in the working relationship in BIM-enabled projects adopted from (BES-BIM, 2019)

Since a typical construction project needs the involvement of a number of stakeholders with different roles and expertise, if only the client or any of the stakeholders have drivers for BIM adoption but other stakeholders do not have or refuse to use BIM due to the difficulties and risks perceived (Table 6), BIM cannot be applied in that project. Clients can set requirements for selecting consultants, contractors who have experience on BIM for their projects, but they may face the risk of failing in the procurement due to the current immature BIM market. There are not many firms in the construction industry which may meet those BIM requirements, though some consultancy firms have started using 3D software to develop drawings instead of 2D software.

The barriers explored in the construction industry in Vietnam in this research study have brought to the following legal considerations for creating an enabling environment for BIM adoption in the industry:

- A clear and feasible roadmap for BIM adoption for the country is needed.
- A reasonable strategy/plan to grow the industry’s BIM capacity.
- A new system of relevant laws and regulations to govern the BIM-enabled construction projects, especially public projects.
- A new set of standards and codes for BIM-related processes, especially for data management and exchange.
- An incentive system for the pioneers in BIM adoption in public sector.

The roadmap for BIM adoption for Vietnam was issued with the Decision 2500/QĐ-TTg dated December 22, 2016 (Table 3). It sets out the perspectives (visions) and objectives for BIM adoption and implementation in projects, detailing the necessary tasks and progress for different stages for achieving the objectives. The needs for the following have been addressed clearly in the Decision (The Prime Minister (Vietnam), 2016):

- Modifying and revising relevant regulatory policies and standards,
- Reviewing and revising the system of technical regulations, standards or economic and technical norms,
- Developing instruction manuals, contract template,
- Delivering workforce training
- Developing policies on financing the BIM-related jobs in projects, and,
- Running campaigns for communicating BIM-related information and disseminating lessons learnt in pilot projects as well as best practices from overseas.

A detailed plan is included in the Decision to show the timetable for improving the awareness of the construction industry and stakeholders regarding BIM, developing an outline for the legal framework for BIM application, developing BIM instructions and manuals, developing the curriculum for BIM training, providing training to construction stakeholders etc.

By clarifying the visions, objectives, needs and detailed plan, this Decision has provided a full roadmap for BIM adoption in Vietnam. This roadmap is the first stepping stone for guiding other activities for promoting BIM in the country. However, this roadmap has not shown clear phases for BIM mandate in the country, i.e. when to mandate BIM in projects with different types and sizes. Therefore, BIM-oriented businesses cannot see a clear vision of the construction industry regarding BIM, then find it difficult to form their strategies. The BIM Vietnam Steering Committee will need to address this and propose to the Government to detail the roadmap in clearer phases.

As the results of the research show, some of the most significant barriers for BIM adoption include the low awareness of the industry for BIM and lack of a qualified workforce. Therefore, a reasonable strategy/plan to enhance the industry's BIM capacity is needed for the industry to overcome these barriers. In Vietnam, this job of growing BIM capacity was hand overed to the Vietnam BIM Steering Committee. Based on the plan/strategy in the roadmap accompanied to Decision 2500/QD-TTg, this Steering Committee has planned and delivered lots of training sessions to ministries with construction works (Ministry of Construction, Ministry of Transport, Ministry of Agriculture and Rural Development, Ministry of Industry and Trade), to professionals both in the public and private sectors. At first, the Steering Committee developed some initial training documents following the Decision 1056/QD-BXD and delivered trainings to selected key people from the ministries. Then, with the support from the Global Infrastructure Program by the United Kingdom, some train-the-trainers training sessions by the experts from the United Kingdom were conducted. Also, experts from the United Kingdom, together with the local trainers delivered some trainings to members of public project management units in 2019. In 2020, due to COVID-19, face-to-face meetings were limited in the country, therefore, the later trainings were switched to online mode. This brought in some new advantages such as more audience can join than the normal mode, and the trainings can also benefit people from the private sector. Apart from the trainings, the Steering Committee also gradually organize online seminars, in which they invite a number of local and international professionals to share their BIM experience, and the seminar series is still on-going. The trainings and seminars have undeniably contributed much on developing the BIM workforce for the country. Also, in order to exploit the most from the BIM uses, all of the key stakeholders of a construction projects who are involved directly in developing and appraising, verifying designs, construction permitting, in the construction and operation stages, need to work on BIM. However, the trainings only target the AEC (architecture, engineering and construction) industry, also the academic and researchers, the members of the public management units, but the civil servants have been left out. Apparently, the country needs to revise its training objectives and plan to include all of the necessary types of human resources in order to ensure that BIM can be applied in all of the stages of the project life cycle.

Regarding the legal environment, as discussed in Section 4.1, a set of legal documents have been issued for facilitating the BIM roadmap for the country in Decision 2500/2016/QD-TTg. These legal documents have created a brief framework which enables BIM adoption in construction projects, especially public projects. However, the barriers discussed in this research study show that, BIM uses should be applied in all project phases, in some of which the governmental agencies involve. Therefore, the related regulation should stipulate the BIM mandate in clearer phases, as lesson learnt from other countries such as Singapore, Ireland or the United Kingdom etc. Also, as Vietnam is a country with a civil law system, the practitioners in the construction industry expect more detailed guiding regulations for BIM adoption and implementation, to make sure that all they can do in the projects are eligible in order to avoid legal risks. Detailed guiding regulations on the following are needed:

- Management of BIM-related costs for public projects. There are some initial regulatory articles regarding the management of BIM-related costs for public projects, but the industry needs more detailed guidance. They need to make sure that BIM-related costs are eligible to allocate suitable budget and also to avoid legal risks regarding improper use of the national budgetary funds.
- Contract forms in BIM-enabled projects and contract management, especially contract disputes. There is a contract template accompanied to the BIM guides for pilot projects, but that is presented as an appendix to the main contract, then require an adaptation to each of the BIM projects. This template is more suitable when considering BIM as an additional service or a subcontracting job. Also, the template is simple and may not help much the contract parties to manage the risks related to BIM adoption in the construction projects.
- Digitalized procedures for appraising, verifying construction designs and issuing construction permits. If only the industry uses BIM but the governmental agencies do not, not only the total benefit of BIM adoption cannot be reached, but also some risks may arise for the BIM adopters due to that the project stakeholders do not work in the same platform.
- Roles and responsibilities of project stakeholders in BIM-enabled projects. To avoid risks such as unclear liabilities and intellectual properties, roles and responsibilities of project stakeholders should be clearly defined to facilitate the collaboration in BIM-enabled projects.

As discussed in the research results, BIM adopters in the country find it difficult to select BIM standards to apply due to the lack of a national system for the standards and codes for BIM-related processes. At the time being, the Vietnam BIM Steering Committee is developing BIM guidance. This can be considered as temporary solution, for long-term, professional associations and experts should be mobilized for developing a new set of localized standards and codes.

Though BIM has been reported to bring lots of benefits, including cost reduction, to construction projects, for the pioneers, this may not be true in their initial stage of BIM adoption. The early BIM adopters often face risks in low ROI in their investment due to the limited demand in BIM services, in collaboration with other project stakeholders who do

not have enough BIM capability. Also, if BIM uses are implemented in only some stages of the project life cycle, such as concept and design stages, the BIM-related costs will be high. BIM only can bring significant benefits when it has a total adoption, at least in the key phases of the construction projects. It is reported from the case studies that using BIM in the design stage may reduce risks in the next stages such as construction, therefore, stakeholders in the late stages will face fewer risks and their contingencies for risk management can be reduced. The surplus amount from the contingencies can be used for compensating the designers, then the total cost for the whole life cycle may reduce. However, new things often bring risks, therefore, stakeholders in the construction stages (i.e. contractors, project management body, construction supervision consultancy etc.) will never accept to lower their prices. Therefore, an incentive system for the pioneers in BIM adoption in the public sector should be established. As proved in different countries such as Singapore or the European countries (EU BIM Task Group, 2017), the public sector should take the lead in BIM adoption, then other sector will follow.

6. Conclusions

Though BIM has been introduced to Vietnam several years ago, the BIM market in the country is still immature. The AEC industry still finds lots of barriers when they are thinking of adopting BIM. Barriers include internally perceived factors such as lack of in-house expertise, high investment cost, not enough time to get BIM in the projects, no clear and effective drivers, and low ROI for BIM investment. Five groups of external factors are also confirmed as barriers, which include legal issues, stakeholders' reluctance to change, immature BIM market, lack of BIM industry standards and other recognized challenges or difficulties. It is noted that those barriers are interrelated, though this research study does not emphasize. A legal environment facilitating the BIM adoption has been created to promote BIM in the country with the leading role of the Vietnam BIM Steering Committee. However, the current legal environment has not yet fully eliminated all of the barriers in BIM adoption. Therefore, five legal considerations in terms of the roadmap improvement, the strategy/plan to grow the industry's BIM capacity, a new system of relevant laws and regulations to govern the BIM-enabled construction projects, especially public projects, a new set of standards and codes for BIM-related processes, especially for data management and exchange and an incentive system for the pioneers in BIM adoption in public sector have been discussed. The recommended improvements of the legal environment will help the construction industry players to overcome their barriers for being more confident in BIM adoption as well as BIM implementation. Therefore, the construction industry in Vietnam can exploit mostly the benefits that BIM can bring in. Further research can validate the recommendations of this research study in a broader coverage.

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References

- Ahmed, S. (2018). "Barriers to implementation of building information modeling (BIM) to the construction industry: a review." *Journal of Civil Engineering and Construction* **7**(2): 107-113
- Alreshidi, E., et al. (2017). "Factors for effective BIM governance." *Journal of Building Engineering* **10**: 89-101
- Ashworth, S., et al. (2016). The role of FM in preparing a BIM strategy and employer's information requirements (EIR) to align with client asset management strategy. EuroFM's 15th research symposium at EFMC2016. Milan, Italy: 218-228
- BES-BIM (2019). "What is BIM?". Retrieved 15 August 2020, from <http://www.besbim.hu/what-is-bim/>
- Cao, Y., et al. (2019). *The Benefits of and Barriers to BIM Adoption in Canada*, IAARC Publications
- Chan, C. T. W. (2014). "Barriers of implementing BIM in construction industry from the designers' perspective: A Hong Kong experience." *Journal of System and Management Sciences* **4**(2): 24-40
- Chan, D. W. M., et al. (2019). "Perceived benefits of and barriers to Building Information Modelling (BIM) implementation in construction: The case of Hong Kong." *Journal of Building Engineering* **25**: 100764
- Chong, H.-Y., et al. (2017). "Preliminary contractual framework for BIM-enabled projects." *Journal of Construction Engineering and Management* **143**(7): 04017025
- Dao, T.-N., et al. (2020). *BIM Adoption in Construction Projects Funded with State-managed Capital in Vietnam: Legal Issues and Proposed Solutions*. CIGOS 2019, Innovation for Sustainable Infrastructure, Springer: 1211-1216

- Eadie, R., et al. (2014). "Building information modelling adoption: an analysis of the barriers to implementation." *Journal of Engineering and Architecture* **2**(1): 77-101
- Elagiry, M., et al. (2019). "BIM4Ren: Barriers to BIM Implementation in Renovation Processes in the Italian Market." *Buildings* **9**(9): 200
- EU BIM Task Group (2017). *Handbook for the introduction of Building Information Modelling by the European Public Sector – Strategic action for construction sector performance: driving value, innovation and growth*
- Greenwood, D. (2010). *Contractual Issues in the Total Use of Building Information Modelling*. W113 - Special Track 18th CIB World Building Congress. P. Barrett, Dilanthi Amaratunga, R. Haigh, K. Keraminiyage and C. Pathirage. Salford, United Kingdom, CIB: 363-371
- Hadzaman, N. A. H., et al. (2015). *BIM roadmap strategic implementation plan: Lesson learnt from Australia, Singapore and Hong Kong*. 31st Annual ARCOM Conference. A. B. Raidén and E. Aboagye-Nimo. Lincoln, UK, Association of Researchers in Construction Management: 611-620
- Hamada, H. M., et al. (2016). "Benefits and barriers of BIM adoption in the Iraqi construction firms." *International Journal of Innovative Research in Advanced Engineering* **3**(8): 76-84
- Hatem, W. A., et al. (2018). "Barriers of adoption Building Information Modeling (BIM) in construction projects of Iraq." *Engineering Journal* **22**(2): 59-81
- Hossain, M. A. and J. K. W. Yeoh (2018). "BIM for Existing Buildings: Potential Opportunities and Barriers."
- Hosseini, M. R., et al. (2016). *Barriers to BIM adoption: Perceptions from Australian small and medium-sized enterprises (SMEs)*. The 40th Australasian Universities Building Education Association Conference, Queensland, Australia, Central Queensland University
- Kekana, T. G., et al. (2014). *Building information modelling (BIM): Barriers in adoption and implementation strategies in the South Africa construction industry*. International Conference on Emerging Trends in Computer and Image Processing (ICETCIP'2014). Pattaya (Thailand): 1-3
- Liu, S., et al. (2015). "Critical barriers to BIM implementation in the AEC industry." *International Journal of Marketing Studies* **7**(6): 162
- Marefat, A., et al. (2019). "A BIM approach for construction safety: applications, barriers and solutions." *Engineering, Construction and Architectural Management*
- Matthews, A. and B. Ta (2020). *Applying a National BIM Model to Vietnam's National Implementation of BIM: Lessons Learned from the UK-Vietnam Collaboration for the Industry*. CIGOS 2019, Innovation for Sustainable Infrastructure, Springer: 57-66
- McAdam, B. (2010). *The UK Legal Context for Building Information Modelling*. W113 - Special Track 18th CIB World Building Congress. P. Barrett, Dilanthi Amaratunga, R. Haigh, K. Keraminiyage and C. Pathirage. Salford, United Kingdom, CIB
- Miettinen, R. and S. Paavola (2014). "Beyond the BIM utopia: Approaches to the development and implementation of building information modeling." *Automation in construction* **43**: 84-91
- Minister of Construction - Vietnam (2018). Decision No. 362/QD-BXD dated 02 April 2018 announcing the list of piloting projects to implement Building Information Modelling in construction activities and operation management of construction works. Decision No. 362/QD-BXD
- Minister of Construction - Vietnam (2019). Decision No. 01/QD-BXD dated 03 January 2019 announcing the additional list of piloting projects to implement Building Information Modelling in construction activities and operation management of construction works. Decision No. 362/QD-BXD

- Mostafa, S., et al. (2020). "Exploring the status, benefits, barriers and opportunities of using BIM for advancing prefabrication practice." *International Journal of Construction Management* **20**(2): 146-156
- Nguyen, T.-Q., et al. (2020). "Application of BIM in design conflict detection: a case study of Vietnam." *IOP Conference Series: Materials Science and Engineering* **869**: 022038
- Nguyen, T.-Q. and V. T. Tran (2018). "Designing the training curriculum for BIM train-the-trainer course in Vietnam." *Journal of Science and Technology in Civil Engineering, National University of Civil Engineering, Vietnam* **12**(1): 3-10
- Olatunji, O. A. and W. Sher (2010). Legal implications of BIM: model ownership and other matters arising. W113 - Special Track 18th CIB World Building Congress P. Barrett, Dilanthi Amaratunga, R. Haigh, K. Keraminiyage and C. Pathirage. Salford, United Kingdom, CIB. **CIB Publication 345**: 453
- Papadonikolaki, E. (2017). Unravelling project ecologies of innovation: A review of BIM policy and diffusion. IRNOP 13 (International Research Network on Organizing by Projects). B. Xie. IRNOP 13 (International Research Network on Organizing by Projects), IRNOP (International Research Network on Organizing by Projects): 639-667
- Saka, A. B. and D. W. M. Chan (2020). "Profound barriers to building information modelling (BIM) adoption in construction small and medium-sized enterprises (SMEs)." *Construction innovation*
- Sebastian, R. (2010). Breaking through business and legal barriers of open collaborative processes based on building information modelling (BIM). W113 - Special Track 18th CIB World Building Congress. P. Barrett, Dilanthi Amaratunga, R. Haigh, K. Keraminiyage and C. Pathirage. Salford, United Kingdom, CIB: 166-186
- Tan, T., et al. (2019). "Barriers to Building Information Modeling (BIM) implementation in China's prefabricated construction: An interpretive structural modeling (ISM) approach." *Journal of Cleaner Production* **219**: 949-959
- The Prime Minister (Vietnam) (2016). Decision No. 2500/QD-TTg dated 22nd December 2016 on the approval of the project to apply Building Information Modelling in construction activities and the operation management of construction works. Decision No. 2500/QD-TTg
- Viet-Hung Nguyen, et al. (2015). BIM Roadmap In Vietnam
- Vietnam BIM Steering Committee (2020). "Pilot Projects." Retrieved 26 December, 2020, from <http://www.bim.gov.vn/du-an-thi-diem>
- Wong, A. K. D., et al. (2011). "Government roles in implementing building information modelling systems." *Construction innovation*
- Wong, S.-S. and Z.-U. Yew (2017). Barriers in implementing building information modelling (BIM) in quantity surveying firms. 21st Annual Pacific Association of Quantity Surveyors Congress. Vancouver, BC, Canada
- Yuan, H. and Y. Yang (2020). "BIM adoption under government subsidy: technology diffusion perspective." *Journal of Construction Engineering and Management* **146**(1): 04019089
- Zahrizan, Z., et al. (2014). "Exploring the barriers and driving factors in implementing building information modelling (BIM) in the Malaysian construction industry: A preliminary study." *Journal of the Institution of Engineers, Malaysia* **75**(1): 1-10
- Zhou, Y., et al. (2019). "Barriers to BIM implementation strategies in China." *Engineering, Construction and Architectural Management*