# SUITABLE GOVERNMENT INITIATIVE STRATEGY FOR BIM IMPLEMENTATION IN SRI LANKA

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## *ABSTRACT*

*Construction industry has encountered various innovative technologies over the past decades. Growth of these innovative technologies has paved the way to improve the performance and productivity in the industry. Building Information Modeling (BIM) is a revolutionary paradigm which supports Architecture, Engineering, Construction and Operations (AECO) industry to improve its efficiency and effectiveness to deliver economical and quality products. AECO industries in many countries are gaining immense advantages by adapting BIM. There are six roles which foreign governments have played in BIM implementation strategy. Government authorities in other countries have adopted these roles in their BIM implementation strategy, while encouraging private sector to acclimate. Moreover, there are various BIM implementation strategies developed by different governments all around the world. Majority of successful BIM implementations rest with the improvement of the basic BIM competencies. In Sri Lankan perspective, fewer people aware on BIM and government has completely disregarded this novel technology which can contribute massive benefits to the local construction industry. There are numerous challenges which barricade the adaptation of BIM in Sri Lanka. This research aims to identify a suitable government initiative strategy that can be adapted to implement BIM in Sri Lanka. Espousing this suitable strategy will eliminate barriers against BIM and improve basic BIM competencies which are needed to improve BIM implementation in Sri Lanka.*

***Keywords:*** *Building Information Modelling (BIM); Construction Industry; Sri Lanka.*

## 1. INTRODUCTION

Bestowing to Rameezdeen et al., (2006), the construction industry development is a paramount source for national economic enlargement. Sri Lanka (SL) is experiencing a massive growth in its construction industry after jeopardized by few natural disasters and long lasted civil war (Davies, 2014). Supportively, Davies (2014) explicated that Sri Lankan construction industry has significantly supported the growth of national economy by accelerating 6.6% to 8.7% of Gross Domestic Product (GDP) from 2009 to 2013. As per Wasantha and Jayasinghe (2013), construction sector GDP mounted at US$ 1.9 billion in 2012 by achieving a growth rate of 21.6% compared to the GDP growth 6.4% and industry sector growth of 10.3%. Moreover, Department of Census and Statics (2011) expounded that public sector contribution to the estimated value of work done by all type of construction activities was 74% and private sector contribution was 26%. Further, it mentioned that the highest contribution to estimated value of work has been made by building construction sector and it was accounted for 48% of total value of work done. Henceforth, the construction industry development can be considered as one of the main driven factors of Sri Lankan economy.

Royal Institution of Chartered Surveyors (RICS, 2014) stated that the construction industry is highly vulnerable to late completions, budget overruns and poor quality output. Building Information Modelling (BIM) is one of main technological advances that offers the potential upsurge of efficiency and effectiveness to construction projects (Azhar, 2011). According to Aibinu (2015), BIM is an intelligent model-based method of creating and

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handling construction project information from inception to operations stages by using 3D modelling software to reduce time and material. Further to him, through BIM, project

can be pre-seen before construction and helps to improve the performance of the project. Furthermore, it increases the collaboration between project team members while reducing cost, increasing profitability and improving time management. In order to adapt this transformation in the construction industry, both private and public sector stakeholders in many countries have started different BIM implementation strategies (Wong et al., 2009).

Smith (2014) exposed that the national leadership is an essential prerequisite for successful BIM implementation. Further to him, government should be the pioneer in BIM implementation while the support and collaboration of major private sector clients and professional associations are also vital. Jayasena and Weddikkara (2012) specified that BIM is experiencing its infant stage in Sri Lankan construction industry. Further to them, even if this advanced paradigm can bring a new era for local construction industry, limited people conscious on its applications and supreme benefits. Henceforth, Jayasena and Weddikkara (2012) expounded that BIM is a technology that Sri Lankan construction industry should embrace and most of the challenges are unlikely to be weighty if there is a commitment and proper initiative strategy. Thus, this research aims to identify a suitable government initiative strategy to adopt for implement BIM in SL, considering strategies which were developed by BIM using countries to implement BIM in SL.

## 2. RESEARCH METHODOLOGY

With the requirement of identifying a suitable government initiative strategy to adapt for implement BIM in Sri Lanka, a qualitative approach was utilized. In order to proceed with the qualitative approach, initially, a desk study was conducted through the analysis of online government reports and presentations, online research publications online forums, websites, online newspapers, online magazines and BIM guidelines. After the collection the data, a content analysis was conducted using a computer based content analysis software namely NVivo (version 10). Then, eighteen semi structured interviews were conducted among various field players such as contractors, consultant, architects, government authorities, and educational institute and information technology companies. Since this research is purely focused on a strategic solution to implement BIM in Sri Lanka, most of interviews were carried out with industrial experts in the managerial hierarchy who are engaged in decision making. Table 1 exposes the respondent profile of the conducted interviews.

Table 1: Respondent Profile

| Organization | Respondent | Field player group | Designation | Experience |
|---|---|---|---|---|
| 01 | R1 | Construction | General Manager | 20 years |
| 02 | R2 | Construction | Assistant General Manager | 15 years |
| 03 | R3 | Construction | Assistant General Manager | 16 years |
| 04 | R4 | Consultant (QS) | Contracts Manager | 19 years |
| 05 | R5 | Consultant (QS) | Chief Quantity Surveyor | 17 years |
| 06 | R6 | Consultant (QS) | Director | 22 years |
| 07 | R7 | Architect | Design Manager | 15 years |
| 08 | R8 | Architect | BIM Consultant | 19 years |
| 09 | R9 | Architect | Chief Coordinator | 14 years |
| 10 | R10 | Government authority | Assistant Manager | 12 years |
| 11 | R11 | Government authority | Chartered Engineer | 16 years |
| 12 | R12 | Government authority | Manager | 10 years |
| 13 | R13 | Education institute | Director | 9 years |
| 14 | R14 | Education institute | Student | - |
| 15 | R15 | Education institute | Student | - |
| 16 | R16 | Education institute | Student | - |
| 17 | R17 | Education institute | Student | - |
| 18 | R18 | Information technology company | General Manager | 12 years |

## 3. BUILDING INFORMATION MODELLING (BIM)

BIM is a modern technology which virtually constructs a building in detail before constructing it physically (Smith, 2007). Building SMART alliance (2015) define a building information model as a "digital representation of physical and functional characteristics of a facility. As such, it serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life cycle from inception onward". Chelson (2010) stated that BIM can be used to generate solutions for problems by simulating a graphical model which is built based on the design intention and gives a clear picture of design issues and constructability problems. Therefore, construction productivity upgrade due to adaptation of BIM because those problems can be resolved in the early stage of the project.

## 4. INTRODUCTION ON BIM FRAMEWORK

BIM framework allows AECO industry stakeholders to understand the required primary knowledge layout for BIM and capabilities of BIM which will lead to understand the requirements for BIM implementation. According to Succar (2009), BIM framework is multi-dimensional tri axial model which is comprised of BIM fields, stages and lenses.

### *4.1. BIM FIELDS AND BIM STEPS*

BIM field is a combination of three interlocking but distinctive fields to impelement BIM in a country, there should be an overlap of aforesaid three BIM fields.

Table 2: BIM Fields - Players, Deliverables and Interactions

| BIM field | Extended Field Definition | Players | Deliverables |
|---|---|---|---|
| Technology Field | This field include software hardware and networking systems to support the construction project life cycle. | Software, hardware and networking equipment corporation and their sales channel. | Office/site equipment, software and hardware |
| Process Field | This is the interaction between design, construction and operational requirements to create and maintain structures. | Owners, operators, architects, engineers estimators, surveyors developers, contractors, sub-contractors suppliers, fabricators, facility managers | Deliver construction product and services which comprise drawings, reports, virtual model and physical section of a construction product. |
| Policy Field | Policy field is the interaction of producing research, abilities, standards and guides to reduce conflicts between AECO stakeholders. | Governments, researchers, educational Institutions, insurance companies and regulatory bodies | Regulations, guidelines, standards, best practices, bench marks, contractual agreements, educational programs. |

Source: (Succar, 2009)

From pre BIM to each BIM stage has its own requirements and deliverables, which will generate various BIM steps. These steps are incremental steps and organized into "sets" based on location of the step in the implementation process. It is essential to gain knowledge regarding these steps, because they will support to improve the capability and the maturity level of BIM in an organized way (Succar, 2010).

### *4.2. RELATIONSHIP BETWEEN BIM FIELDS AND BIM STEPS*

Succar (2009) identified that there is a relationship between BIM fields and BIM steps which will improve the capability and maturity level and lead to next BIM stage. This relationship is illustrated in Table 3.

BIM steps are requirements which should be fulfilled to achieve maturity level for specific BIM stages. BIM steps will identify requirements which is necessary to fulfill each BIM stage requirements and support BIM implementation (Succar, 2009).

Table 3: Relationship between BIM Fields, BIM Steps and BIM Stages

| Field/ Competency set | BIM Steps/BIM areas | Example for improving BIM stages. |
|---|---|---|
| Technology | Software, Hardware and Networks | Availability of software, hardware and network as BIM tools, will support to move pre BIM stage to object based modelling stage. |
| Process | Leadership, Infrastructure, Human Resources and Products/Services | Collaboration process and information sharing ability will support to migrate from object based modelling stage to model based collaboration stage. |
| Policy | Contracts, Regulations and Research/Education | Integrated and risk-sharing contract agreements will support to migrate from model based collaboration stage to integrated practices. |

Source: (adapted from Succar, 2009)

### *4.3. BIM USAGE IN ALL-AROUND THE WORLD*

According to Jung and Lee (2015), United States of America (USA), Canada, Netherlands, France, Italy, United Kingdom (UK), Russia, Republic of Korea, India, China (Hong Kong included), Philippines, Taiwan, Singapore, Thailand, Saudi Arabia, Egypt, Lebanon, Jordan, Iran, United Arab Emirates (UAE), South Africa, Qatar, Argentina, Mexico, Brazil, and Chile are some of the countries that immensely using BIM globally. Amongst, governments of some of the countries have become the pioneers and initiators in implementing and developing BIM within their geographical boundaries.

Public sector has a vital role in steering AECO industry for BIM adoption. Accordingly, six main roles of the public sector can be identified based on the review of BIM implementation in different countries for BIM adoption (Cheng & Lu, 2015). Table 4 shows the summary of these six roles of public sector played by countries like USA, UK, Denmark (DEN), Finland (FIN), Norway (NOR), Hong Kong(HK), South Korea (SK) and Singapore (SIN) for successful BIM implementation.

Table 4: Six Roles of Public Sector.

| Public sector role | Activities | Adopted Countries |
|---|---|---|
| Initiators and drivers | Goals and promises, BIM committees, BIM activities | USA, UK, NOR, DEN, FIN, HK, SK, SIN |
| Regulators | BIM guidelines, Standardize BIM | USA, UK, NOR, DEN, FIN, HK, SK |
| Educators | Training programs, Training plans, College BIM education | USA, UK, HK, SIN |
| Funding agencies | Financial support for BIM implementation. | USA, SK, SIN |
| Demonstrators | BIM pilot projects, Internal BIM plans, Test BIM technologies | USA, NOR, DEN, HK, SIN |
| Researchers | R&D projects, Collaborate with research institutions | USA, NOR, DEN, HK, SK, SIN |

Source: (adopted from Cheng & Lu, 2015)

According to Table 4, all the governments have played the roles of initiator and driver, regulator in each and every BIM implementation strategy. Therefore, these two roles can be considered as the main and compulsory roles within a BIM implementation strategy. Other four roles have been used occasionally, while considering the industry characteristics within each country. When the industry characteristics are fulfilling the requirements which should be fulfilled by the particular role within the strategy, then that particular role is not considered to develop the BIM implementation strategy for that particular country. Based on the analysis, due to following industry characteristics some countries have not considered some roles when developing their BIM implementation strategy. After considering all the literature findings, Table 5 illustrates the industry characteristics which should consider when deciding roles with in the BIM implementation strategy.

Table 5: Industry Characteristics that should be Considered when Deciding Roles within the BIM Implementation Strategy

| Role | Industry characteristics |
|---|---|
| Demonstrator | Support of BuildingSMART organization for test and demonstrate BIM. |
| Funding agency | Government funding (UK)<br>Support from leading companies in the industry (NOR)<br>Support from the industry. (DEN)<br>Funding by private companies. (FIN)<br>Fund availability. (HK) |
| Educator | Availability of BIM education. |
| Researcher | Support of BuildingSMART organization for researchers about BIM. |

Source: (adopted from Cheng & Lu, 2015)

Furthermore, in some situations, aforementioned industry characteristics have become supporting factors for the BIM implementation strategy. To be a successful BIM implementation, there should be a support from BIM field players and should have an active construction industry. Based on the analysis, each and every country has different industry characteristics which show an active construction industry and support from BIM field players. All those industry characteristics which support BIM implementation strategy are mentioned below;

- Contribution to GDP from construction industry
- Growth of the construction industry
- Procurement methods used in the construction industry.
- Support from leading companies in the industry
- Client requirement for BIM
- Partnering with industry
- Availability of technology
- Support from technology companies

## 5. INDUSTRY CHARACTERISTICS WHICH SUPPORT BIM IMPLEMENTATION STRATEGY

### *5.1. CONTRIBUTION TO GDP FROM CONSTRUCTION INDUSTRY*

As mentioned in a Sri Lanka GDP from Construction (2016), *"GDP from Construction in Sri Lanka increased to 157,734 LKR Million in the third quarter of 2016 from 142,133 LKR Million in the second quarter of 2016. GDP From Construction in Sri Lanka averaged 128,312.48 LKR Million from 2010 until 2016, reaching an all-time high of 170,122 LKR Million in the first quarter of 2013 and a record low of 77,176 LKR Million in the second quarter of 2010."* According to this statement, there is a significant contribution to GDP from construction industry. Hence, above statement reflects that there is an active construction industry in Sri Lanka.

### *5.2. GROWTH OF THE CONSTRUCTION INDUSTRY*

As revealed in a newspaper in 2014, *"the Sri Lankan construction industry last year continued to grow at 20.2 per cent on the back of declining interest rates and low inflation"*. Accordingly, there is a growth in local construction industry and this statement confirms the reflection of previous statement.

### *5.3. PROCUREMENT METHODS USED IN THE CONSTRUCTION INDUSTRY*

According to the respondents, traditional method, design and build, Build-Own-Operate-Transfer (BOOT), Build-Own-Transfer (BOT) and Public Private Partnership (PPP) are the procurement methods used in Sri Lanka. However, majority of respondents argued that procurement methods such as design and build are BIM favourable methods. Therefore, there are procurement methods which can support BIM implementation strategy in Sri Lanka.

### *5.4. SUPPORT FROM LEADING COMPANIES IN THE INDUSTRY*

All the respondents strongly confirmed to support the government initiative BIM implementation strategy. Some respondents have already implemented BIM in their organizations. Respondent R8 who is a BIM consultant expressed, *"Yes, we already implemented BIM in our firm since June 2016. We have mandated BIM within our organization, we design projects through BIM and deliver 2D drawings or 3D BIM model to other disciplines as per their request"*. Thus, it proves that some organizations have already implemented BIM within their organizations and they are willing to support local BIM implementation strategy.

### *5.5. CLIENT REQUIREMENT FOR BIM*

Five of nine respondents expressed that clients do not require BIM, whereas two respondents stated that clients require BIM in their projects. Further, respondent R6 said, *"BIM is essential for clients to deliver a smooth project by achieving time, cost, and quality targets"*. Respondent R7 expressed that, *"95% of clients do not require BIM. They only require 2D drawings. However, there is a trend to use BIM for apartment projects"*. Accordingly, it is evidently proved that there is a trend to use BIM in local projects and some clients conscious on the essentiality of BIM for the local context.

### *5.6. PARTNERING WITH INDUSTRY*

All nine respondents are willing to be partners with government to implement BIM in Sri Lanka. Respondent R2 strongly stated that, "*Yes of course, if they come, we will definitely give our support."* This statement proves that industry players are ready for a journey which should be initiated by the government. When consider about the government authorities, all three respondents were eager to be partners with the industry, but they have some limitations as well. As per respondents R10 and R12, they are willing to give their utmost assistance for BIM implementing strategy by be partners with industry, but they have to be knowledgeable on the purpose and applications in advance. Considering all these statements, both government authorities and industry like to be partners with each other for a journey which government should be the pioneer.

### *5.7. AVAILABILITY OF TECHNOLOGY*

Respondent R18 discovered that, there are some software related to BIM such as Autodesk products in local context. Further, R10 explicated that *"Capacity of Information Technology Infrastructure (ITI) in Sri Lanka comply with the minimum requirement of ITI in BIM."* Accordingly, ITI in SL is adequate to satisfy the minimum requirement of BIM.

### *5.8. SUPPORT FROM TECHNOLOGY COMPANIES*

*Respondent R18 expressed that, "*Yes, we can provide essential software for clients. Most clients ask for Autodesk products but we able to provide other products too*". Thus, technology companies are willing to provide software related to BIM as per requirement of the client and ready to support BIM implementation in Sri Lanka.*

## 6. INDUSTRY CHARACTERISTICS TO BE CONSIDERED WHEN DECIDING ROLES WITHIN THE BIM IMPLEMENTATION STRATEGY

### *6.1. EDUCATORS*

Bestowing to the literature, education is significant in the preparation of BIM implementation strategy, with reference to all the countries. The research findings revealed that in Sri Lanka, a proper BIM education seems to be absent irrespective of the education on the BIM related software in the government and private education sector. The private institution provides facilities for the BIM software education whereas in government universities provides BIM related education sessions but no complete BIM education. Additionally, at present some of the construction firms have gained knowledge about BIM related software from private BIM software education centres.

Thus, the respondents suggested that the government has to take the initiative for the BIM education which is not covered from private software education centres. Therefore, government has to perform the role of educator within BIM implementation Strategy in Sri Lanka.

### *6.2. FUNDING AGENCIES*

As per literature, some of the countries are not engaged in the funding for the BIM implementation even there is adequate monetary facilities. However, according to respondents, following characteristics are to be considered in Sri Lankan context to make the decision to move along with the following strategy.

Table 6: Current Status of Funding Agencies in Sri Lanka for BIM Implementation

| Factor | Description |
|---|---|
| Government Funding | Funds are available within the government construction organization although there not yet implemented. |
| Funding by private companies | Within current Sri Lankan context private companies are interested, invested and receiving the benefits through the use of BIM related software and training. |
| Support from Leading Companies in the Industry | Leading companies in the industry are interested to support for BIM implementation strategy in Sri Lanka. |

### *6.3. DEMONSTRATORS*

#### 6.3.1. SUPPORT FROM AN ORGANIZATION TO TEST AND DEMONSTRATE NEW TECHNOLOGIES

According to literature, the role of demonstrator with in their BIM implementation strategy is not visible with many countries. Similarly, as per respondents, there is no organization to test and demonstrate new technologies in Sri Lanka too. Thus, government has to perform this role within the BIM implementation strategy.

### *6.4. RESEARCHERS*

#### 6.4.1. SUPPORT FROM AN ORGANIZATION FOR RESEARCHES

More or less countries had an organization to carry out research concerning BIM and since of this support they have not considered this role within the strategy. Consequently, when developing the strategy, it is very vital to consider whether there is an organization to carry out researches regarding BIM in Sri Lanka. However, private organization are not receiving and support from any organization to support for researches regarding BIM. Concerning the government organizations, researches were not conducted within them yet universities conduct researches related to BIM. Subsequently there is no particular organization to carryout researches about BIM government have to perform the role of researcher within BIM implementation strategy in Sri Lanka.

## 7. CONCLUSIONS AND RECOMMENDATIONS

The roles of initiator and driver, regulator are obligatory roles which should be performed with in BIM implementation strategy in Sri Lanka. The role of educator should be performed to fulfil the gap between existing BIM education level and the required BIM education for a successful BIM implementation. The role of funding agency is not much extensive, since funds are available in government organization and private companies also are enthusiastic to invest for BIM. Defiantly, the role of demonstrator should be performed with in the BIM implementation strategy. Currently, there is no government organization to test or demonstrate new technologies such as BIM. The role of researcher could require a less effort because even though there is no specific organization to carry out researches in BIM, universities have started conducting research in BIM. However, the scale of such research does not fully satisfy the requirements of the industry. Thus, finally, considering all findings of the research the roles of initiator and driver, regulator, demonstrator should perform with full effort and the roles of educator and researcher should be included within the strategy but the role of

funding agency cannot be considered within developing BIM implementation strategy for implement BIM in Sri Lanka.

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