GUIDELINE

IMPACT STUDY ON THE IMPLEMENTATION OF 70 IBS SCORE FOR PRIVATE PROJECTS

CIDB TECHNICAL REPORT PUBLICATION NO: 194

CIDB MALAYSIA

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MALAYSIA

PREFACE

The Government has introduced a wide list of initiatives to increase the implementation of Industrialised Building System (IBS) in the Malaysian construction industry, especially in the government projects. The initiative of IBS implementation in the Malaysia construction industry has started since 2003 in IBS Roadmap 2003 – 2010 and followed by the second IBS Roadmap 2011 – 2015. Levy exemption for projects with a minimum of 50 IBS score was also offered to boost the pull of IBS and ultimately its usage in private projects.

At present, IBS continues to be the Government's focus area apart from being chosen as one of the eighteen initiatives under the Construction Industry Transformation Programme (CITP) 2016 – 2020. The first part of the IBS specific initiative aims to scale up further the IBS adoption in government projects while accelerating the IBS usage in private ones. Secondly, it also targets to deepen the IBS value and supply chain through economic mechanisms. Thus, the Government has suggested to implement minimum IBS score in the private projects to widen the usage of IBS in the Malaysian construction industry.

In support of the "Initiative P3: Accelerate Adoption of IBS, Mechanisation and Modern Practices", the Construction Research Institute of Malaysia (CREAM), CIDB Malaysia's research and development arm, has been appointed to conduct a study on the impact of 70 IBS score implementation for private projects. This study will provide the optimum score for IBS implementation for four (4) scenarios which are (1) Apartment; (2) Shop / House Terrace; (3) Office Tower and (4) School. The situation with / without IBS components are set as an example in this study are (1) conventional; (2) precast columns and beams / precast concrete slabs; (3) tunnel formwork and (4) conventional / precast concrete slabs. The authors hope that this report can give comprehensive information to the IBS players to achieve optimum IBS score in the private projects.

IBS Centre,
Technology Development Sector,
Construction Industry Development Board Malaysia (CIDB)

EDITORIAL

This study was funded by the Construction Industry Development Board Malaysia (CIDB) and executed by the Construction Research Institute of Malaysia (CREAM). We would like to thank the following members for their contribution and support.

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EXECUTIVE SUMMARY

The implementation of IBS gives advantages to the country especially for the construction sector. The mandates of 70 IBS score to the government projects seems increases from year to year. The government are currently initiating the intention to make compulsory to the private projects to achieves 70 IBS score in their project. Though the implementation of IBS can give positive impacts to the construction sector, however, the readiness of the players and availability of materials and other matters should be taken into consideration.

This study outlined five (5) research objectives which are to recognise the readiness of private sector to achieve 70 IBS score, to identify the capacity of local IBS contractors and suppliers, to identify the current issues of implementation IBS projects to private sectors, to propose enforcement strategies to implement 70 IBS score for private projects and to determine the optimum IBS score for private projects.

The findings show that the optimum value of IBS score for private projects should be not more than 60 IBS score. The early action which can be taken is to mandate to 60 IBS score for certain project value. Using the latest CIS 18:2018, 70 IBS score is currently difficult to achieve without the usage of precast concrete system
Extra points can be gained through the following:

- Usage of BIM (up to 6 IBS score)
- Usage of block as alternative to bricks (up to 10 IBS score)
- Usage of Prefabricated Bathroom Unit (PBU) and prefabricated staircase (up to 4 IBS score)

If an increment on IBS score needs to be done, it can be increased to 60 IBS score in the future subject to more detailed study. The respondents agree that the 70 IBS score is implement if there are adequate skills of the construction worker, availability of IBS supplier and financial support from the government.

Most (62.3%) mentioned that they are ready to implement 70 IBS score in their company while the remaining 37.7% are still not ready to implement 70 IBS score in their company. This percentage portray that the private sectors is ready implement the IBS in their projects but not ready to achieve 70 IBS score as it involves different stages as compared with conventional construction and some challenges to be taken care before the implementation of 70 IBS Score.

There are ten (10) challenges towards the implementation of IBS for private projects which are as follows:

- Transportation
- Capability
- High Cost
- Supply Demand
- IBS Knnowledge
- Land
- Industry's Acceptance and Perception
- Job Opportunity
- Design
- Skill

The suggestion drawn from this study involves ten (10) initiatives as follows:

- Incentive
- Guideline
- Promotion
- Skills Development
- Policy
- R&D
- Financial
- Supply Chain
- Open system
- Planning

The details of challenges and suggestion as listed above is mentioned clearly in Chapter 4.

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ABBREVIATION

ABM	-	Akademi Binaan Malaysia
BIM	-	Building Information Modelling
CIDB	-	Construction Industry Development Board
CIMP	-	Construction Industry Master Plan
CITP	-	Construction Industry Transformation Plan
CREAM	-	Construction Research Institute of Malaysia
GDP	-	Growth Domestic Product
IBS	-	Industrialised Building System
MPC	-	Malaysian Productivity Corporation
MRT	-	Mass Rapid Transit
PBU	-	Prefabricated Btahroom Unit
PPVC	-	Prefinished Prefabricated Volumetric Construction
PR1MA	-	Perumahan Rakyat 1 Malaysia
REHDA	-	Real Estate Housing Development Association
SPSS	-	Statistical Packages for Social Sciences

PART 01
INTRODUCTION

1.1 Construction Industry in Malaysia

Although Malaysia has encountered headwinds from the global economic slump, its economic performance during the 11th Malaysia Plan (2016-2020) has been extremely well with its GDP growth among the fastest in the region. The quality of life amidst its people has also improved, as reflected by the escalating per capita income and average household income. This is made possible through the implementation of numerous reforms that have been carried out by the government towards enhancing the quality of life amongst its people. The primary keys among the strategic programme implementations refer to the Government Transformation Programme and the Economic Transformation Programme, underpinned by the Tenth Malaysia Plan. As for the 11th Malaysia Plan, a total of 2.7 million B40 households earned an average monthly household income of RM2,537.00.

Table 1.1: Construction in Private and Public Projects

Types of Projects	2010	2011	2012	2013	2014	2015	2016	2017
Private Projects	5,424	5,771	5,997	6,228	6,276	5,711	5,846	5,449
Public Projects	1,878	1,954	2,001	1,971	1,800	1,939	2,098	2,099
Total	**7,302**	**7,725**	**7,998**	**8,199**	**8,076**	**7,650**	**7,944**	**7,548**

The value of construction work performed in 2017 for private projects recorded a moderate growth of 74% instead RM121 billion (2016, 60%, RM151 billion). On the other hand, the public projects recorded a decrease of 26% instead RM42 billion (2016; 40%, RM101 billion). The correlation between national GDP growth and GDP growth of the construction sector from years 2010 until 2017 is portrayed in Figure 1.1.

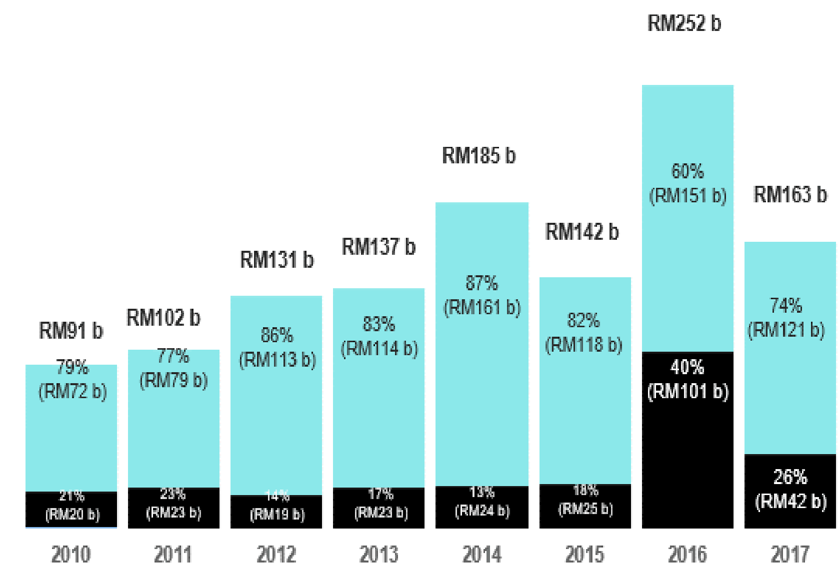
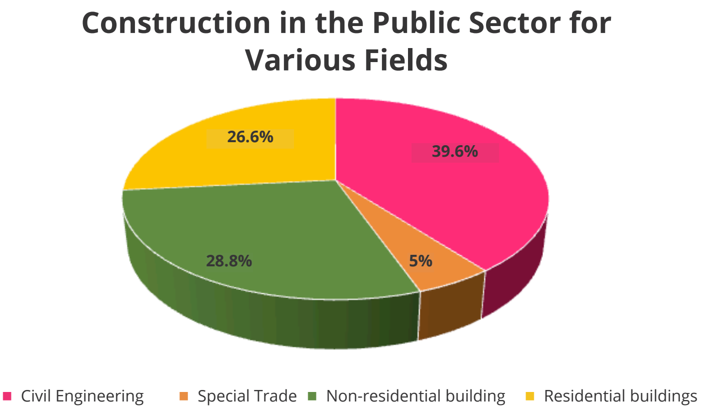


Figure 1.1: Construction in Private and Public Projects

In terms of contribution, the civil engineering subsector dominated the value performance of construction work at 39.6%, followed by non-residential buildings (28.8%), residential buildings (26.6%), and special trades activities (5.0%), as illustrated in Figure 1.2.



Source: Department of Statistics (2018)

Figure 1.2: Construction in the Public Sector for Various Fields

The construction industry in Malaysia is experiencing a migration from conventional methods to a more systematic and mechanised method known as the Industrialised Building System (IBS) (Abdul Kadir, Lee, Jaafar, Sapuan, & Ali, 2005). The word 'system' is a set of interacting or interdependent components forming an integrated whole or a set of elements and relationships which are different from relationships of the set or its elements to other elements or sets. Systems have structure defined by components / elements and their composition (Yildirim, 2012).

The construction methods are generally classified into four (4) categories which are:

i. Conventional construction method

   Components prefabricated on site through timber / plywood formwork installation, steel reinforcement, ready-mix / cast-in-situ concrete.

ii. Cast-in-situ method

   It is applicable to all types of buildings. The steel / fibreglass / aluminium formwork acts as a mould and wet concrete is poured into the mould with steel reinforcement places inside. It is aims to eliminate traditional timber framed formwork.

iii. Composite method

   The components of the building are partially prefabricated.

iv. Fully prefabricated method

   All elements of the building are prefabricated in the factory.

CIDB, MPC, REHDA, & CREAM (2014) defined IBS as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal additional site work. According to CIDB (2007) as compared to conventional construction method, the advantages of using IBS are as follows:

i. Fewer site workers due to simplified construction methods

ii. Quality controlled product through controlled prefabrication process and simplified installations

iii. Reduction of construction materials at site through the usage of prefabricated components

iv. Reduction of construction waste at site with the usage of standardised component and less onsite materials

v. Safer construction site due to reduction of site workers, material and construction waste

vi. Faster completion of construction due to usage of standardised prefabricated components and simplified installation process

vii. Lowered total construction cost

The implementation of IBS in Malaysian construction industry objectively to reduce the dependency of foreign workers. Government has taken into serious about the implementation of IBS as stated in government policy and plan. Starting year 1960, there are many initiatives from the government to implement the IBS. The IBS issue is highlighted in each government circular which the objective is to increase the usage of IBS for government and private sector. Figure 1.1 show the key milestones from 1999 to 2010 on the past efforts and key milestones achieved of IBS.

The Government has decided on the use of component content for each government project worth 10 million and above at not less than 70 IBS scores. The content of this score is based on the Construction Industry Standard (CIS 18: 2010) - Manual for Industrialised Building System (IBS) Content Scoring System. The achievement of IBS's use of Government projects has increased from 24% in 2012 to 69.4% in 2015 (CIDB, 2015a). Figure 1.3 shows the timeline of IBS implementation and policy in Malaysia.

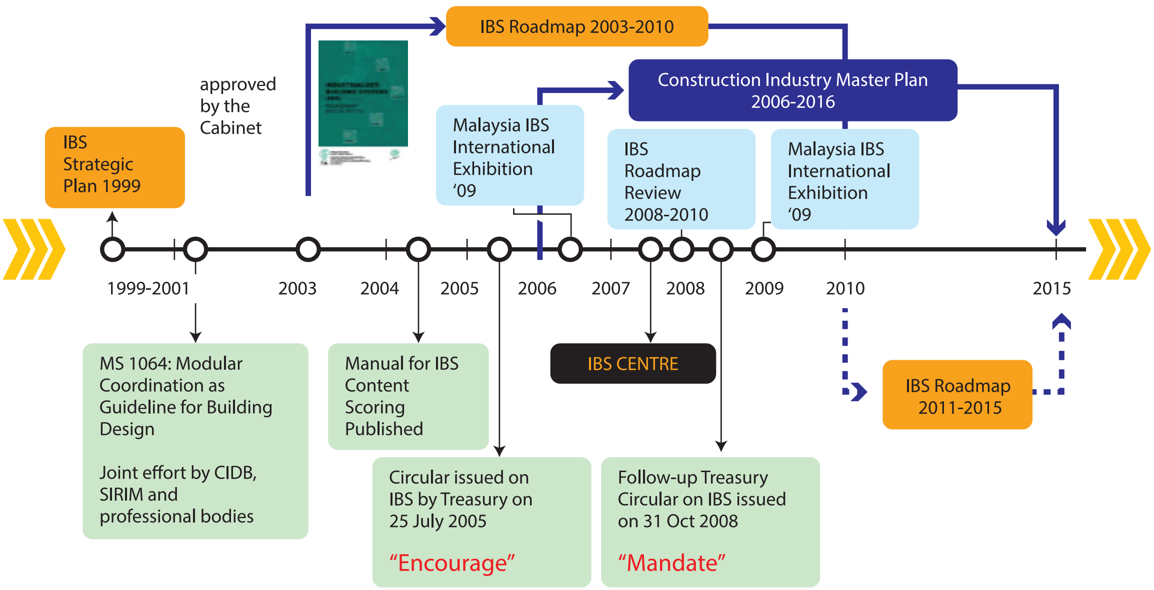


Figure 1.3: Key Milestones from 1999 to 2010 (CIDB, 2010)

IBS Roadmap 2003 -2010 (CIDB, 2003) has highlighted six (6) main IBS system and components as shown in Table 1.2.

Table 1.2: Categorisation of System and Component of IBS

System	Component	Description
Pre-cast Concrete	Column Beam Wall Slab	The common IBS used includes precast concrete elements, lightweight precast concrete and permanent concrete formwork.
Formwork	Column Beam Wall Slab	The common IBS used includes precast concrete elements, lightweight precast concrete and permanent concrete formwork.
Steel Framing	Column Beam Roof truss	Commonly used with precast concrete slab, steel framing system has always been a popular choice and used extensively in the fast track construction of skyscrapers. The recent development of this IBS includes the usage of light steel trusses consisting of cost efficient profiled cold formed channel and steel portal frame system. These are the alternatives to the heavier traditional hot rolled section.
Prefabricated Timber Framing	Column Beam Roof truss	This system consists of timber building frames and timber roof trusses. Timber building frame system also has their market and demand, offering attractive designs from simple dwelling units to buildings that required high aesthetical values such as resorts and chalets.
Block Work	Column Beam Wall	The construction method of using traditional bricks has been revolutionised by the developments of interlocking concrete masonry units and lightweight concrete blocks. The tedious and time-consuming traditional bricklaying tasks are vastly simplified by the usage of these practical solutions.
Innovative	Wall	In order to classify new systems introduced in the Malaysian construction industry that are not belong in the five mains IBS in the CIDB's IBS classifications (2003), CIDB introduced innovative system to classify the new and innovative systems in IBS approach.

1.2 Government Circular on IBS

The IBS Policy began in 1999 with the IBS Strategic Plan to provide clear direction to players in the construction industry in the private and government sectors. Followed by IBS Roadmap 2003-2010, Roadmap IBS 2011-2015 is supported by Construction Industry Master Plan 2006-2015 and Construction Industry Transformation Program (CIDB, 2015b)toxic chemical products formed as secondary metabolites by a few fungal species that readily colonise crops and contaminate them with toxins in the field or after harvest. Ochratoxins and Aflatoxins are mycotoxins of major significance and hence there has been significant research on broad range of analytical and detection techniques that could be useful and practical. Due to the variety of structures of these toxins, it is impossible to use one standard technique for analysis and/or detection. Practical requirements for high-sensitivity analysis and the need for a specialist laboratory setting create challenges for routine analysis. Several existing analytical techniques, which offer flexible and broad-based methods of analysis and in some cases detection, have been discussed in this manuscript. There are a number of methods used, of which many are lab-based, but to our knowledge there seems to be no single technique that stands out above the rest, although analytical liquid chromatography, commonly linked with mass spectroscopy is likely to be popular. This review manuscript discusses (a.

1.2.1 Construction Industry Transformation Programme (CITP) 2016 - 2020

Construction Industry Transformation Plan (CITP) was launched on 10th September 2015 and was initiated in 2014 by Ministry of Works through the Construction Industry Development Board (CIDB) Malaysia. It is a 5-year programme covering the period from 2016 until 2020. The CITP was formulated through a series of engagements with more than 150 government agencies, research institutions and industry players, with the goal of addressing the existing roadblocks in the construction industry while paving the way for a more modern, sustainable and productive sector overall.

The CITP is recognised as an important focus and strategy within the 11th Malaysia Plan. It is aimed at propelling the construction industry forward to meet the demands of the marketplace. The critical role of the construction industry is documented under Chapter 8, Focus Area D of the 5 year 11th Malaysia Plan, which is the last leg towards Malaysia achieving a high income, developed nation status by the year 2020.

There are 4 strategic thrust identified under the CITP which are:

i. Quality, Safety and Professionalism

ii. Environmental Sustainability

iii. Productivity

iv. Internationalisation

The IBS issue fall into Productivity thrust. Productivity is the primary engine of growth towards Malaysia's high-income target and is important strategic thrust that aims to more than double productivity in the construction industry, matched by higher wages. Productivity issues still plague the construction industry and these needs to be addressed.

There is largely unskilled workforce and inadequate or mismatch in training and development. Overall, 40% of the local workforce in the industry is still unskilled and this is compounded by the larger 93% of the foreign construction workers in the construction workers and personnel in the construction industry still has much room for improvement.

Malaysia still has a low take-up rate Industrialised Building System (IBS) in construction. Only 24% (CIDB, 2015b)toxic chemical products formed as secondary metabolites by a few fungal species that readily colonise crops and contaminate them with toxins in the field or after harvest. Ochratoxins and Aflatoxins are mycotoxins of major significance and hence there has been significant research on broad range of analytical and detection techniques that could be useful and practical. Due to the variety of structures of these toxins, it is impossible to use one standard technique for analysis and/or detection. Practical requirements for high-sensitivity analysis and the need for a specialist laboratory setting create challenges for routine analysis. Several existing analytical techniques, which offer flexible and broad-based methods of analysis and in some cases detection, have been discussed in this manuscript. There are a number of methods used, of which many are lab-based, but to our knowledge there seems to be no single technique that stands out above the rest, although analytical liquid chromatography, commonly linked with mass spectroscopy is likely to be popular. This review manuscript discusses (a of public projects worth RM10 million and above achieved IBS score of 70, a far reach from the intended 100% take up rate, despite a Ministry of Finance circular mandating it.

Over and above this, the construction industry lends importance to a sizable pool of entrepreneurial activity. There is a High proportion of sub-scale SMEs, including Bumiputera SMEs and Entrepreneurs. The construction industry is one that is highly fragmented with sub-scale SMEs collectively accounting for 90% of total contractors while large contractors make up the remaining 10%. In addition, Bumiputera firms account for 56% of the construction industry and of this, two third are G1 contractors. This prevents them from investing in high capital-intensive modern construction methods and technology.

Construction Industry Transformation Plan (CITP) has highlighted that IBS equipment has charged high for duty tax import with 40% as compared with other countries which are Singapore (7%), Thailand (7%), Philippines (12%) and Indonesia (20%). Thus, this will bring to increasing of capital cost to the contractor. The upfront payment and long lead time make IBS take-up costlier (CIDB, 2015b)toxic chemical products formed as secondary metabolites by a few fungal species that readily colonise crops and contaminate them with toxins in the field or after harvest. Ochratoxins and Aflatoxins are mycotoxins of major significance and hence there has been significant research on broad range of analytical and detection techniques that could be useful and practical. Due to the variety of structures of these toxins, it is impossible to use one standard technique for analysis and/or detection. Practical requirements for high-sensitivity analysis and the need for a specialist laboratory setting create challenges for routine analysis. Several existing analytical techniques, which offer flexible and broad-based methods of analysis and in some cases detection, have been discussed in this manuscript. There are a number of methods used, of which many are lab-based, but to our knowledge there seems to be no single technique that stands out above the rest, although analytical liquid chromatography, commonly linked with mass spectroscopy is likely to be popular. This review manuscript discusses (a.

1.2.2 11th Malaysia Plan 2016 – 2020

A review on IBS requirements for public and private sector projects will be undertaken to expedite its adoption. A supportive and rewarding environment for the industry to invest in advanced construction methods will also be created, particularly through the review of public procurement policy and Uniform Building By-Laws (UBBL).

The use of IBS in the construction sector will be further enhanced through government procurement to increase efficiency while reducing dependency on unskilled labour. Greater collaboration amongst key stakeholders such as the Ministry of Finance (MOF), Ministry of Works, CIDB, Public Works Department (JKR) and Ministry of International Trade and Industry (MITI) will be forged to increase the uptake of IBS. Regulatory bottlenecks such as incompatibility between UBBL clauses and IBS component specifications will be addressed.

1.2.3 **Construction** Industry Master Plan 2006-2015

The Construction Industry Master Plan 2006-2015 (CIMP 2006-2015) has been published in December 2006 as means to chart the future direction of the Malaysian Construction Industry. The importance and effort to promote IBS is highlighted under Strategic Thrust 5: Innovate through R&D to adopt new construction methods such as IBS in the Construction Industry Master Plan 2006-2015 (CIDB, 2007).

1.2.4 IBS Roadmap 2011-2015

The objective of IBS Roadmap 2011-2015 is to sustain the existing momentum of 70% IBS content for public sector building projects through to 2015 and to start a minimum IBS content for private sector building projects gradually increase by 50% in 2012 to 55% by 2015. There are 4 work streams stated in the roadmap which are through institutional strengthening, focusing on user, focusing on product and focusing on industry.

1.2.5 IBS Roadmap 2003 – 2010

In line with the target of IBS Roadmap 2003-2010, Budget 2005 declared that all new government building projects are required to have at least 50% IBS content. In order to attract private clients, the second announcement was on the levy exemption for housing projects that have minimum IBS Score of 50%. Since then and boosted by the Construction Industry Master Plan 2006-2015 and 9th Malaysia Plan 2006-2010, numerous activities have been executed by the Government.

1.2.6 Treasury Circular Letter No. 7 Year 2008

Two of the latest major initiatives are the release of the Treasury Circular Letter No. 7 Year 2008 (*Surat Pekeliling Perbendaharaan Bil. 7 Tahun 2008*) and the announcement of the Action Plan for IBS Implementation in Government Projects (*Pelan Tindakan Pelaksanaan IBS dalam Projek-Projek Kerajaan*).

It replaces the earlier instruction released on 6th July 2005 by Treasury for the usage of 50% IBS content in all government projects. Released on 31st October 2008, the Treasury Circular Letter was issued to all Secretary Generals, Heads of Federal Department, State Secretaries, Heads of Federal Statutory Bodies as well as to all local authorities. The essence of the instruction is the usage of Open Building, MC design and 70% IBS Score for all projects. Agencies are required to submit periodical reports of IBS project implementation to ICU which acts as the central monitoring agency. Exemptions are offered for certain classes of projects and the IBS Centre will function as the main technical reference centre (Appendix I).

1.2.7 Annual Budget

IBS was mentioned in Malaysian annual budget starting year 2004. The current budget for year 2016, government also mentioned that there was allocation of RM 500 million to promote IBS in Malaysia. Currently, the usage of IBS in government and private sector is far from the expected. Table 1.3 shows the IBS mentioned in the Malaysian Annual Budget starting from year 2004.

Table 1.3: IBS in Malaysian Annual Budget

Year	Description
2004	New government building projects had been strongly encouraged to have at least 50% of IBS content in their construction elements which had been calculated using IBS Score Manual developed by CIDB.
2005	Full exemption from CIDB levy for housing projects with IBS content more than 50%.
2006	Capital expenditure on moulds by IBS manufacturers given Accelerated Capital Expenditure with maturity period of 3 years. This step will facilitate the reduction in the cost for IBS columns, beams, walls and slabs.
2016	Allocation to promote IBS for the construction of homes. It was revealed that there would be an IBS Promotion Fund of RM 500 million which would be provided by the SME bank.

1.3 Significance of the Study

This study is expected to encourage private sector to embark in the IBS industry and to be on a more level playing field. The implementation of IBS for both government and private sector can enhance the productivity of construction industry. This eventually will create a higher demand for IBS components and hence will lower the construction cost and material due to economic of scale.

1.4 Aim and Objectives of the Study

The aim of this research is to study the impact of implementing 70 IBS score for private projects. To achieve the aim of the study, the following objectives need to be carried out:

- To recognise the readiness of private sectors to achieve 70 IBS score
- To identify the capacity of local IBS contractor and suppliers
- To identify the current issues of implementing IBS projects to private sectors
- To propose enforcement strategies to implement 70 IBS score for private projects
- To determine the optimum IBS score for private projects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PART 02

IBS CURRENT STATE IN MALAYSIA

2.1 State of IBS Implementation

IBS in Malaysia has been established, introduced and applied in the construction industry in order to deal with a growing demand for affordable housing , increased of construction cost, lower production rate, solving issues associated with foreign workers and improving quality, efficiency and productivity of construction industry (Mohamad, Ramli, Hn, & Sapuan, 2016).

Despite of all the advantages of IBS construction, the industry is still slow adaptation to the new system. They preferred conventional rather than the IBS system because of some reasons. According to IBS Roadmap Review report, the successful factor of adoption of IBS in Malaysia is a client driven. Client with a good knowledge and awareness of IBS benefit will surely encourage appointed designers to design building according to IBS. Unfortunately, lack of awareness program to understand client needs and giving correct information on IBS has contributing to a lack of interest from the client and decision makers.

As reported by MIDF Research (2014), the IBS implementation in the private sector are still remains low. The Malaysian government has identified IBS as one of the ways forward in the construction industry. The IBS Strategic Plan was launched in 1999 to promote the usage of IBS in the construction industry. Subsequently, the IBS Roadmap 2003-2010 was introduced in 2003. The commitment to IBS was further reaffirmed when the IBS Roadmap was endorsed by the Cabinet as the blueprint to industrialise the construction sector by 2010. However, the adoption of IBS, specifically in the private sector remains low.

The next challenge is to convince the private sector to embrace IBS. Annually, more than half of the value of construction projects in Malaysia are awarded by the local private sector. The goal of IBS Roadmap (2011-2015) is to promote the usage of 50% IBS content in the private sector. In order to achieve this, the buy-in of the private sector is important. Residential projects such as flats, condominium and terrace houses have high IBS potential due to the repetitive nature of production. The private sector-built RM 13.6 billion worth of residential projects compared to only RM 1.8 billion by the public sector in 2013.

In order to implement IBS to the private sector, the supply and demand of the IBS should be matched. The number of manufacturer and supplier should be enough to cater the demand of the IBS construction. Figure 2.1 shows that as of October 2018, it was reported that at least 290 manufacturers are actively involved in the dissemination of IBS in Malaysia, of which 84 are Bumiputera players and 206 are non-Bumiputera. Overall, Selangor contributed the most with 109 suppliers and manufacturers. The components involved are precast, onsite precast, formwork, steel structure, metal roof trusses, timber frame, block and innovative systems.

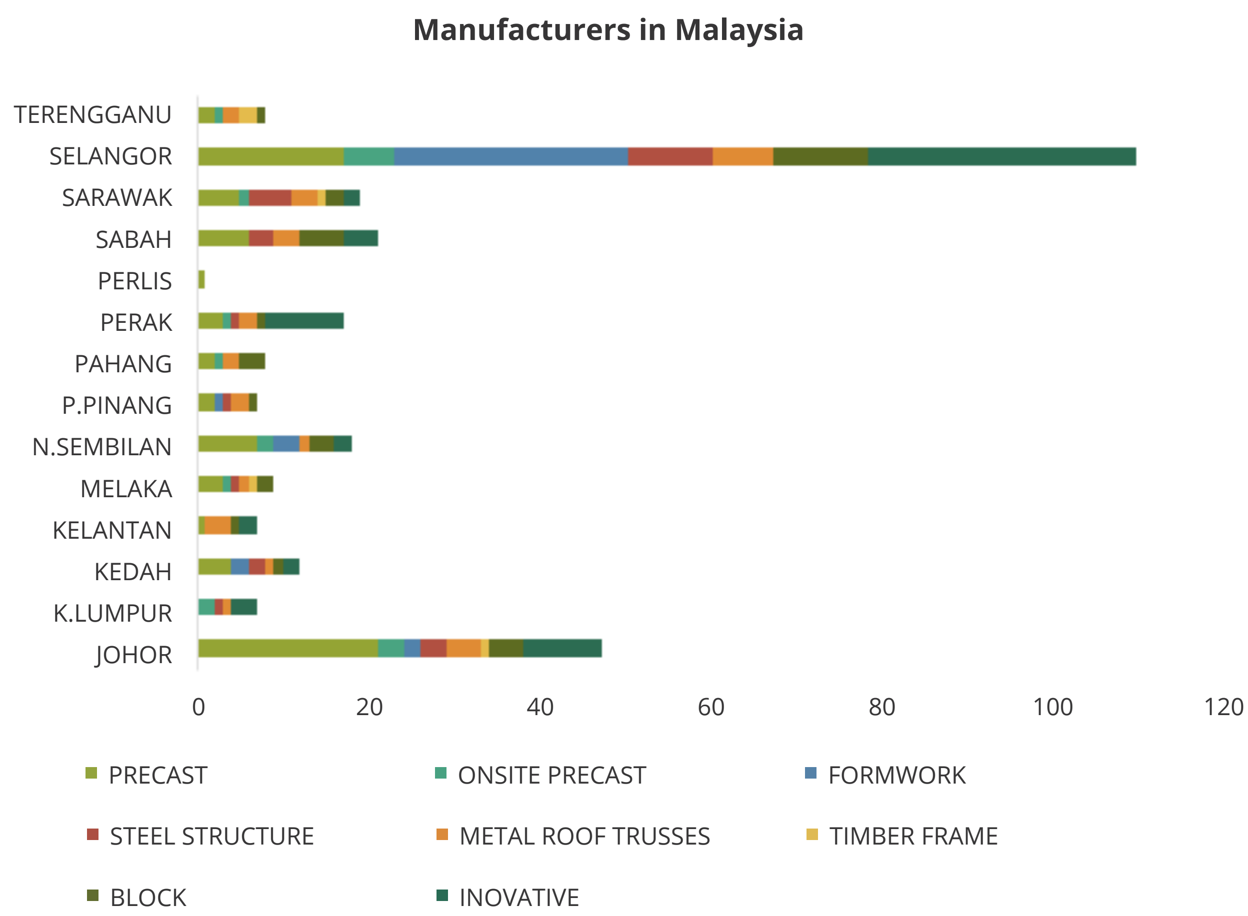

Figure 2.1: Number of Manufacturers in Malaysia

The details number of each system are illustrated in Table 2.1. Precast components recorded the highest number of IBS components manufactured in Malaysia followed by innovative systems. The least number of IBS components manufactured in Malaysia is timber frame due to higher price as compared with other systems.

Table 2.1: Number of Manufacturers and Suppliers Based on System and State

No.	State	Precast	Onsite Precast	Formwork	Steel Structure	Metal Roof Trusses	Timber Frame	Block	Innovative	TOTAL
1	Johor	21	3	2	3	4	1	4	9	47
2	K.Lumpur		2		1	1	0	0	3	7
3	Kedah	4		2	2	1	0	1	2	12
4	Kelantan	1			0	3	0	1	2	7
5	Melaka	3	1		1	1	1	2	0	9
6	N. Sembilan	7	2	3	0	1	0	3	2	18
7	P.Pinang	2		1	1	2	0	1	0	7
8	Pahang	2	1		0	2	0	3	0	8
9	Perak	3	1		1	2	0	1	9	17
10	Perlis	1			0	0	0	0	0	1
11	Sabah	6			3	3	0	5	4	21
12	Sarawak	5	1		5	3	1	2	2	19
13	Selangor	17	6	27	10	7	0	11	31	109
14	Terengganu	2	1		0	2	2	1	0	8
TOTAL		**74**	**18**	**35**	**27**	**32**	**5**	**35**	**64**	**290**

2.2 Impact of IBS to the Economy and Sector

The implementation of IBS will give a positive impact to the economy of Malaysian generally and construction sectors specifically. Based on findings from MIDF Research (2014), the IBS implementation have potential to reduce the government development expenditure. Potential savings as a result of implementing IBS would help to reduce the Government's development expenditure. IBS construction can therefore be a strategic initiative as part of the Government's move towards fiscal austerity. The Government has adopted a policy that its project must have at least 70 IBS score. The rate of IBS usage in Government projects is currently about 80% to 90%.

The job-skill ladder could be increase if the implementation of IBS is done. IBS can help to reduce the country's reliance on the mostly foreign unskilled labour in the construction industry and will also improve the industry's image as well as create awareness among local workforce on the benefits of joining the industry. Apart from attracting local manpower, IBS implementation would also help to up-skill existing labour force.

IBS can enhance the technology transfer and affordable houses in Malaysia. PR1MA is pursuing a partnership with a major Japanese company to undertake IBS housing projects. We can expect beneficial technology transfer as well as healthier bilateral trade relationship between the two countries, Malaysia and Japan, as a result of this initiative. The usage of the Japanese IBS is expected to help increase the supply of more houses within the affordable price range.

It also can reinforce Malaysia's ambition to be a hub of knowledge and technology. Malaysia is developing its technological base and convert its knowledge into value-added product and services. The transfer and development of IBS technology is an area that will contribute to this. as reported by MIDF Research (2014), only a small portion of the IBS technology used currently in Malaysia originate domestically.

The implementation of IBS can rise the construction sector specifically such as can offers positive impact on both, the construction and property sector. IBS will undoubtedly support the development of the construction and property sectors in Malaysia. The IBS construction method will contribute towards the improvement of design, components and building quality. More importantly, it will improve the net profit margin of companies. The previous research has proved that IBS will reduce costs such as labour and wastage costs. Combined with better project delivery in terms of time, earnings will therefore be less volatile and more visible.

Besides that, construction sector will have better management of building material. During robust construction period, there could be a supply shortage in building material such as sand, aggregates and ready-mixed concrete. As a result, the increase in demand over the supply can raise the construction costs and burden builders. The adoption IBS will enable companies to manage their usage of building material better. A more widespread use of IBS will probably even have the effect of stabilizing building material prices.

The implementation IBS can increase the competitive price and better-quality products as it is increasing availability and standardisation of IBS components will help to further reduce construction costs hence make house prices more affordable. Apart from that, the ISO certification for manufacturers will boost buyer's confidence in the quality of the IBS product.


ZÜBLIN
2

PART 03

METHODOLOGY

3.1 Introduction

This study employed explanatory mixed methodological approach utilizing both quantitative and qualitative approach. Questionnaire and focus group are used in this study. Qualitative approach involved focus group methods while quantitative approach involved survey questionnaire method. The focus group method is used to validate the questionnaire before it is distributed while the questionnaire method is used to undertake the study. In order to support the quantitative data, it is needed to undergo the qualitative method. The interview method is used to collect some additional information on the implementation of IBS. The purpose of using qualitative method after applying quantitative research is to understand unanticipated results from quantitative data. The qualitative method is also used to identify issues or obtain information on variables not obtained by quantitative surveys.

3.2 Research Process

Literature review was conducted to understand the current status of IBS adoption in Malaysian construction industry and the challenges that hinder the implementation of IBS. Several informal interviews were carried out to grasp the idea on the suggestion of IBS implementation for private projects.

Input from literature review and informal interview were used as guidance to construct questionnaire, to collect data from the targeted group of contractors, consultants, manufacturer and developer. Once the data collection completed, the survey data were analysed using the Statistical Packages for Social Sciences (SPSS) version 23.0. During the analysis, outputs from the informal interviews and focus group discussion are incorporated with the survey data to produce an in-depth data interpretation. Finally, conclusions are drawn and their compatibility with research objectives is examined. A conclusion needs to be drawn in-line with the objectives of the research. At the same time, some appropriate recommendations related to the problems may be made for a better solution in relation to the said problem. Figure 3.1 illustrates the entire research process from the early process until the end of the process.

The five (5) objective outlined in this research are to recognise the readiness of private sector to achieve 70 IBS score, to identify the capacity of local IBS contractors and suppliers, to identify the current issues of implementation IBS projects to private sectors, to propose enforcement strategies to implement 70 IBS score for private projects and to determine the optimum IBS score for private projects.

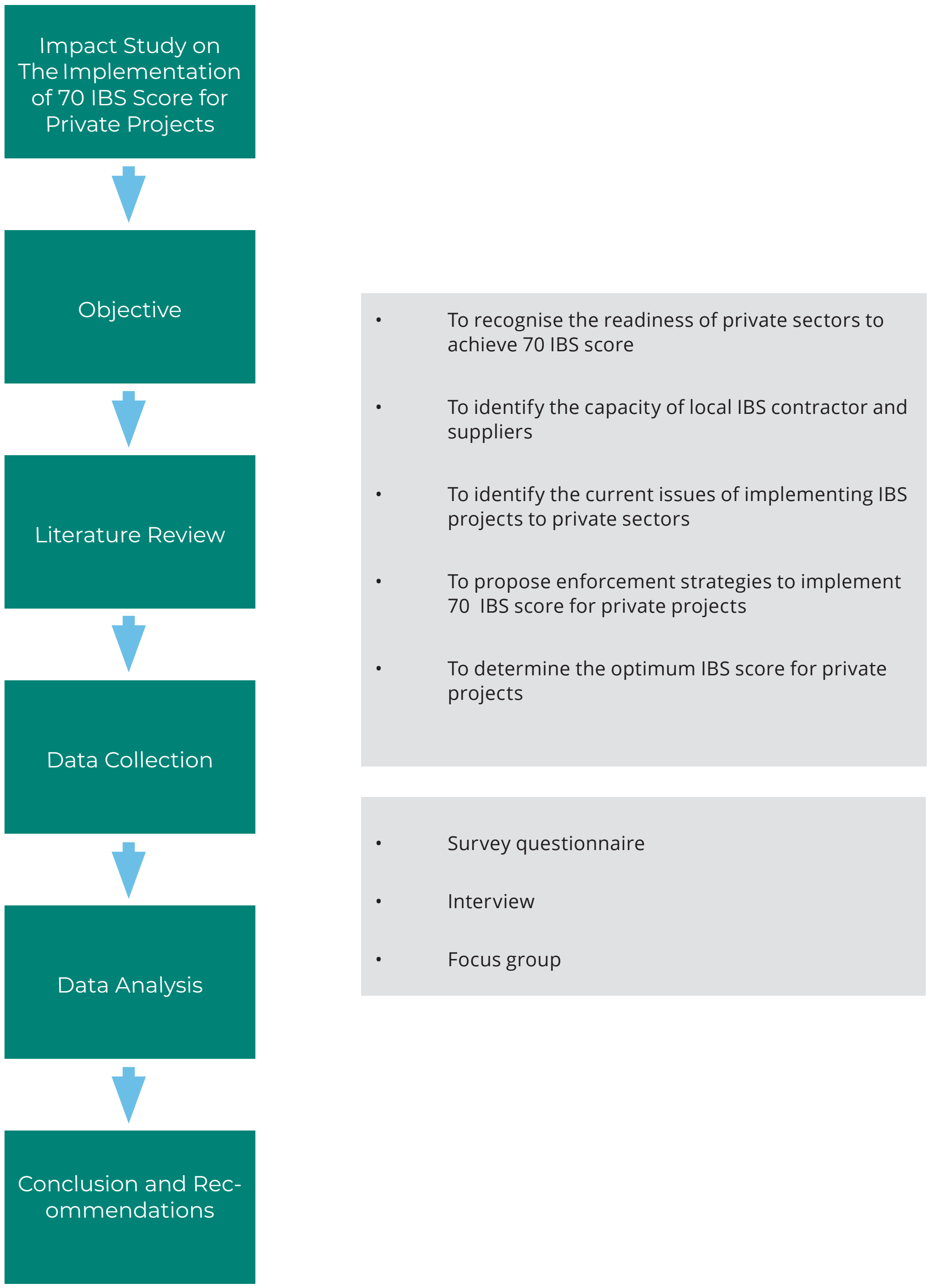

Figure 3.1: Research Process

3.3 Quantitative Method

The analysis is based on four (4) main parties in the Malaysian construction industry which are contractors, consultants, developers and manufacturers. 40 samples for each category was selected to carried out an analysis. There are two (2) parts in the questionnaire which Part A explains about the demographic profile of the respondents while Part B demonstrate the readiness of private sector to achieve 70 IBS score. In the part B, the opinion about the compulsory of IBS projects in the private projects, suitable IBS score, level of IBS usage in the company, issues in implementing IBS, challenges in IBS implementation and suggestions are included. The Likert scale used for issues in implementing IBS and the challenges in IBS implementation. The distribution of questions in the questionnaire is distributed as follows (Table 3.1):

Table 3.1: Distribution of Questions

Part	Number of Questions
Part A: Demographic Profile	2
Part B: Readiness of private sector to achieve 70 IBS score	24
TOTAL	**26**

3.4 Reliability Statistics

Nunnally & Bernstein(1994) and Bland & Altman (1997) stated that there are different reports about the acceptable values of alpha, ranging from 0.70 to 0.95. A low value of alpha could be due to a low number of questions, poor interrelatedness between items or heterogeneous constructs. George & Mallery (2003) provide the rules of thumb as shown in Table 3.2.

Table 3.2: Indication of Cronbach's Alpha Value

Cronbach's Alpha Value	Indication
>0.90	Excellent
>0.80 – 0.90	Good
>0.70 – 0.80	Acceptable
>0.60 – 0.70	Questionable
>0.50 – 0.60	Poor
< 0.50	Unacceptable

Since the Cronbach's Alpha value in this study is 0.822 as shown in Table 3.3, it is indicated that the content of the questionnaire reliable as rated as "Good". This statistic proves that the sampling in this study reflects the population.

Table 3.3: Cronbach's Alpha Value

Cronbach's Alpha	N of Items
.822	25

3.5 Qualitative Method

The workshop has been done on 23rd November 2018 (Friday) at IBS Centre from 9.00 am until 5.00 pm. The workshop involves the industry to discuss on the suitability to implement the 70 IBS score to the private sector. It also discusses whether the 70 IBS score is achievable or another score suitable for private sector implementation.

3.6 Population and Sample

In this study, purposive sampling is chosen as the sampling design. The sampling is necessary to obtain information from specific target groups. The sampling is confined to specific types of people, in this case the contractors who can provide the desired information, either because they are the only ones who have the knowledge (Sekaran & Bougie, 2010). They have characteristics such as their wide experiences in payment issues which will best enable them to answer the research questions. Purposive sampling can also provide researchers with the justification to make generalisations from the sample that is being studied. The sample involved in this study are contractor, consultant, manufacturer and developer. 40 sample is selected for each group of stakeholders. The data collected are through questionnaire and validated by focus group approach.

3.7 Data Analysis

In this stage, it can determine whether the stated objectives have been achieved or vice versa. Different types of analysis will be carried out according to the requirements of the objectives. The data is analysed using SPSS version 23.0. Excel is also used to produce graphics for the report. Descriptive statistics were used to illustrate the findings of the study.

Frequencies can be referring to the number of times various subcategories of a certain phenomenon occur, from which the percentage and the cumulative percentage of their occurrence can be easily calculated. Frequency distribution, bar charts, histograms and pie charts provide a great deal of basic information about the data. Formula for calculated percentage is as follow:

Percentage: $\% = F / N$

Where:

% = Percentage

F = Frequency

N = Number of respondents

The mean or the average is a measure of central tendency that offers a general picture of the data without unnecessarily inundating one with each of the observations in a data set. Formula of mean for Likert Scale is as below:

Mean: $X = \Sigma f(x) \ / \ N$

Where:

Σx = sum of all data

f = Indication of Likert Scale (1,2,3,4,5,6)

N = number of respondents

PART 04

DATA ANALYSIS & DISCUSSIONS

4.1 Introduction

This section discusses on the analysis done for qualitative and quantitative method. The analysis is based on the four (4) main parties which are contractor, consultant, developer and manufacturer. Qualitative method involved the discussion, workshop and face to face interview while the quantitative method involved the distribution of the questionnaire to the respondents.

4.2 Quantitative Analysis

The quantitative analysis is based on the questionnaire distributed to the respondents (contractor, consultant, developer and manufacturer). The analysis undertaken is based on the overall percentage and distributed based on stakeholder.

4.2.1 Analysis on Demographic Profile

Table 4.1 shows the working experience of the respondents. Majority (37.7%) of the respondents have working experience within 15 to 20 years in the construction industry. The least (3.1%) have working experience less than 5 years in the construction industry. 18.2% of the respondents have working experience longer than 21 years old. This percentage indicates that most of the respondents have enough knowledge and information on the evolution of construction industry starting from conventional era until the current practice.

Table 4.1: Working Experience of the Respondents

Working Experience	Frequency	Percentage (%)
Less than 5 years	5	3.1
0-5 years	18	11.3
5-10 years	47	29.6
15-20 years	60	37.7
Longer than 21 years	29	18.2
Total	**159**	**100.0**

Figure 4.1 shows the distributed frequency on the working experience in the construction industry based on stakeholder. From the figure, it shows that all contractors have experience more than 5 years and above. The consultant is distributed into all range of working experience from less than five years until longer than 21 years in the construction industry. Majority of the developer have working experience between 5 to 20 years in the construction industry. Only minority have working experience less than 5 years involving consultant, manufacturer and developer.

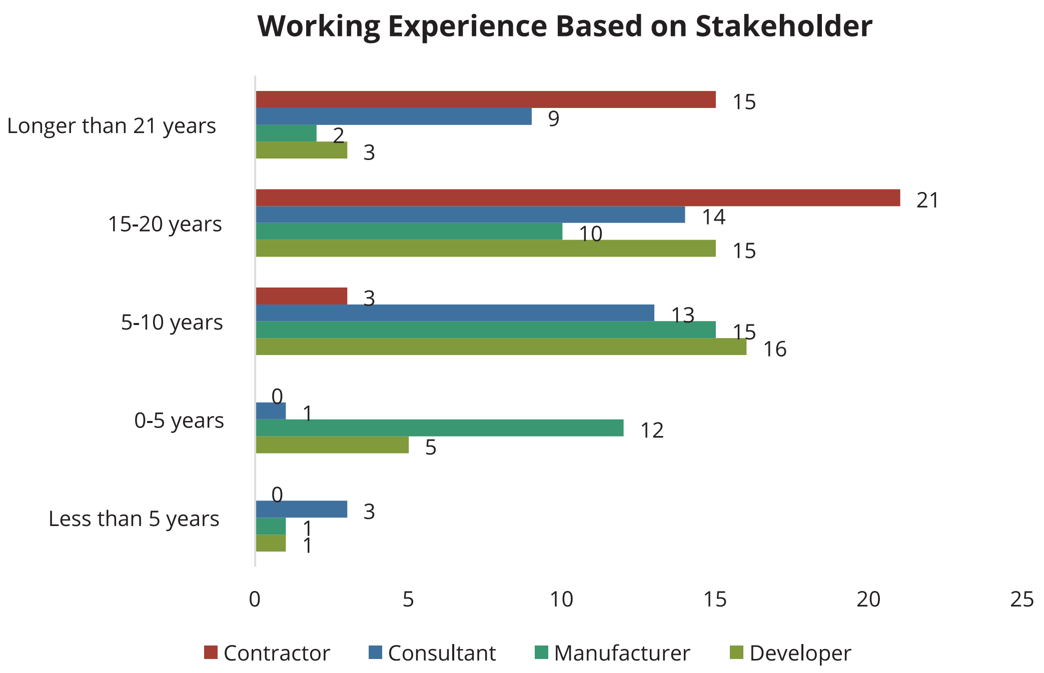

Figure 4.1: Working Experience of Respondents Based on Stakeholder

4.2.2 Analysis on the Readiness of private sector to achieve 70 IBS score

Part B shows the analysis on the readiness of private sector to achieve 70 IBS score. The questions including the compulsory of IBS for private projects, 50 IBS score, suitable IBS score, 70 IBS score, IBS usage in the company, issues in implementing IBS, challenges in implementing IBS and suggestion for future recommendation.

4.2.3 Compulsory of IBS for Private Projects

Figure 4.2 shows the percentage of the opinion of the respondents if IBS construction method is to make compulsory to the private projects. Most (83.8%) of the respondents agree to mandate the IBS construction method for private projects. However, the balance of 16.2% did not agree to mandate the IBS in their project because of the few reasons. Some of the reasons are the background of the business does not suitable to implement IBS, the industry not yet ready to implement IBS and many more.

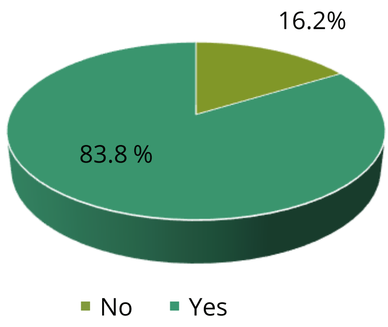

Figure 4.2: Compulsory of IBS for Private Projects

Figure 4.3 shows the opinion of the respondents on the proposal to mandate the IBS for private projects. From the figure, all stakeholders are mainly agreeing if IBS is to make compulsory to the private project. However, there is several the respondents who does not agree if IBS is to make compulsory to the private projects. The highest number of respondents agree to make it compulsory to the private projects is manufacturer followed by contractor, consultant and lastly is developer.

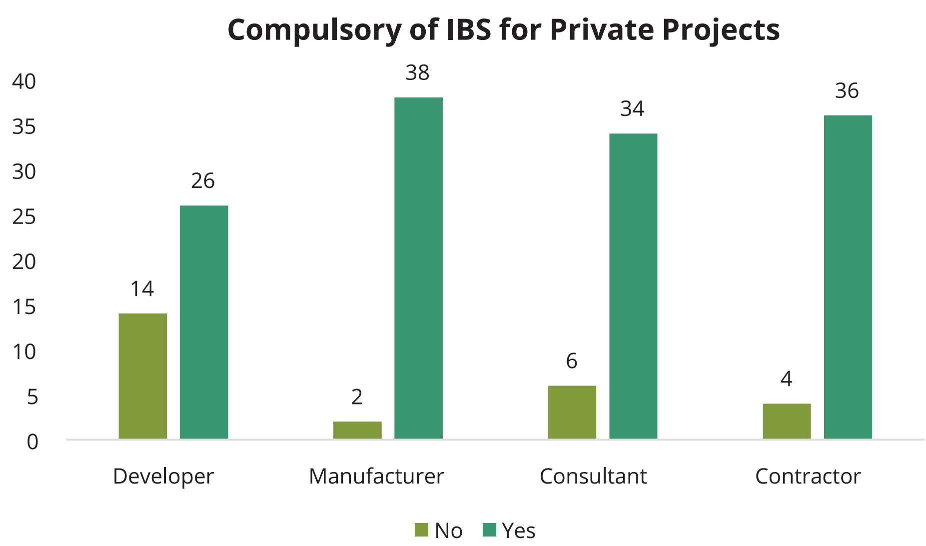

Figure 4.3: Compulsory of IBS for Private Projects Based on Stakeholder

4.2.4 Private Projects Need to Achieve 50 IBS Score as Stated in CITP 2016 -2020

Figure 4.4 shows the percentage of opinion of the respondents whether they agree or not if private projects need to achieve 50 IBS score as stated in CITP 2016 – 2020. Majority (80%) of them agree that the private project shall achieve at least 50 IBS score in their project as stipulated in CITP 2016 – 2020. The balance of 20% did not agree to achieve 50 IBS score as stated in CITP 2016 – 2020 for private projects.

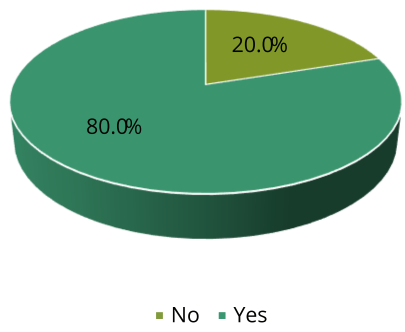

Figure 4.4: Private Projects Need to Achieve 50 IBS Score as Stated in CITP 2016 -2020

Figure 4.5 shows the number of opinions from the respondents if private project needs to achieve 50 IBS score as stated in CITP 2016-2020. The findings show that all stakeholders agree that the private projects shall achieve 50 IBS score as stipulated in CITP 2016 – 2020. The highest frequency is manufacturer followed by consultant, contractor and developer respectively.

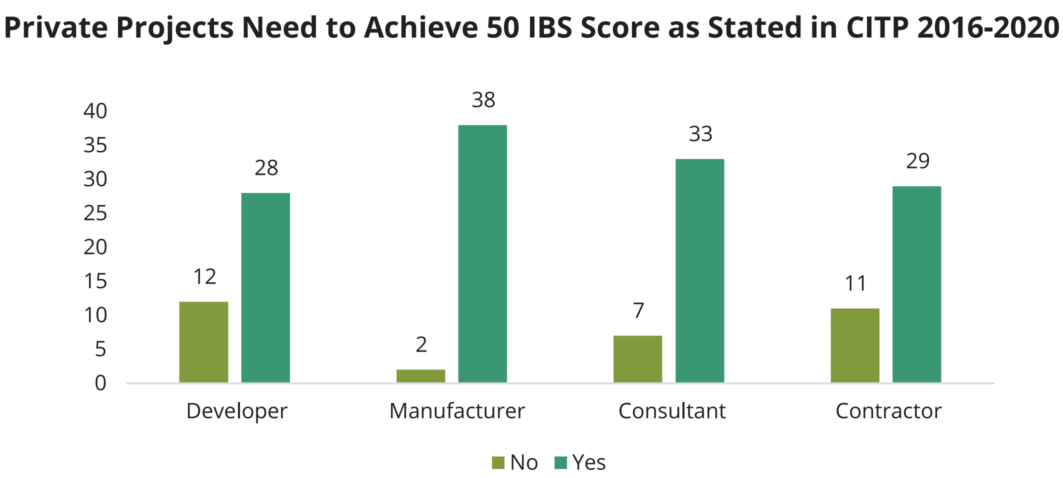

Figure 4.5: Compulsory of IBS for Private Projects Based on Stakeholder

4.2.5 Suitable IBS Score

Figure 4.6 shows the suitable IBS score to implement to private sector. From the finding, half (50.0%) of the respondents mentioned that the score of 61-70 is the most suitable score if the government wish to mandate the usage of IBS in private sectors. 4.1% of the respondents have others opinion on IBS score which is more than 70 IBS score and some of them mentioned the IBS score is different based on type of building.

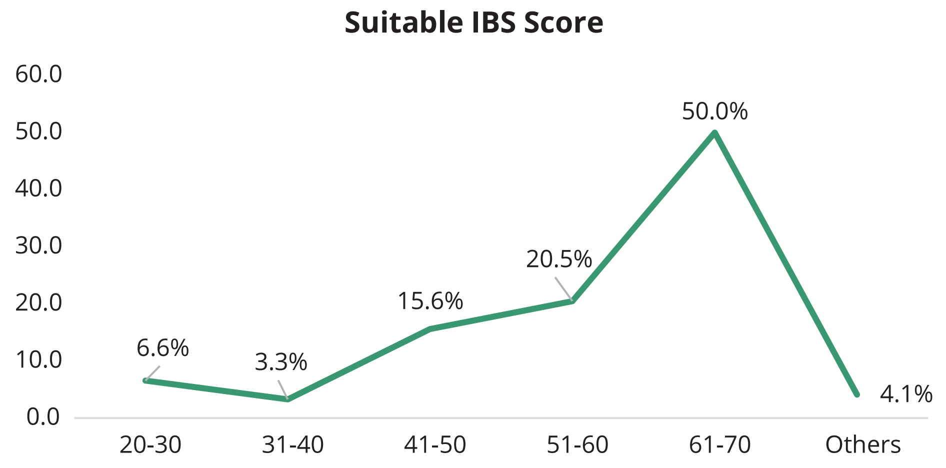

Figure 4.6: Suitable IBS Score

Figure 4.7 shows the respondent's opinion on the suitable IBS score based on stakeholder. The finding shows that almost all stakeholder agree that the suitable IBS score is between 61 until 70 except manufacturer.

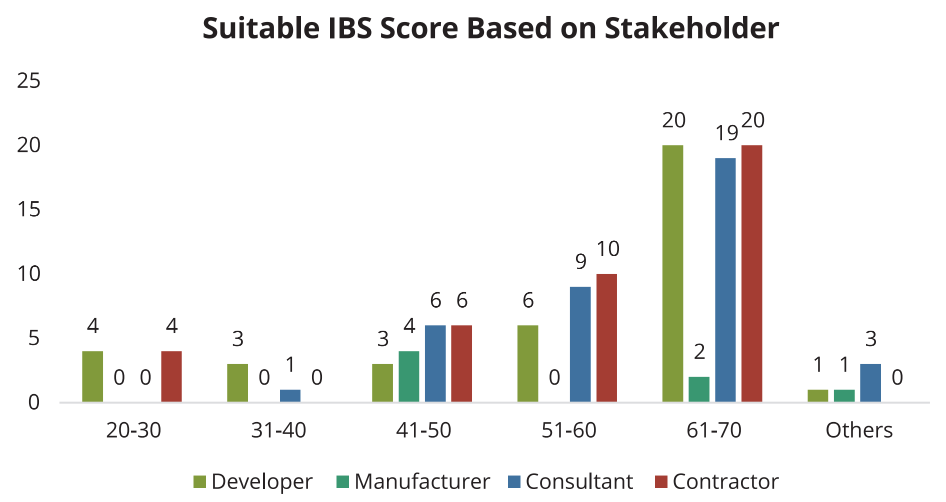

Figure 4.7: Suitable IBS Score Based on Stakeholder

4.2.6 Readiness of 70 IBS Score to the Private Project

Figure 4.8 shows the level of readiness to implement 70 IBS score to the private project. Majority (62.3%) mentioned that they are ready to implement 70 IBS score in their company while the remaining 37.7% are still not ready to implement 70 IBS score in their company.

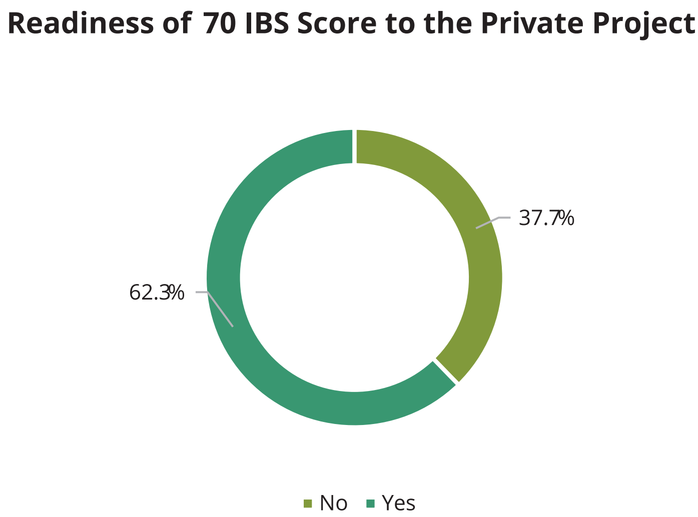

Figure 4.8: Readiness of 70 IBS Score to the Private Project

4.2.7 IBS Usage in the Company

This section explains the IBS usage in the respondent's company in term of skill readiness. Figure 4.9 shows the percentage of company have implemented IBS but not ready in term of skills. The findings show majority (61.7%) of the respondents does not have skill in IBS and the balance of 38.3% have skills in IBS.

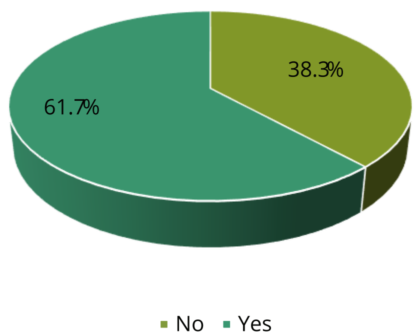

Figure 4.9: Implemented IBS with Skills

4.2.8 Current issues of implementing IBS projects to private sectors

Table 4.2 shows the mean for issues of implementing IBS projects to private sectors. The comparison between four (4) stakeholders are measured in this section. In term of IBS knowledge of contractors and engineers in the construction methods, all the stakeholders are almost agreeing to that statement. Most of the stakeholders (consultant, contractor and developer) agree that the IBS should be campaigning to assure that IBS system are able to provide fast, economical and high-quality products. However, the manufacturer feels that the engineer should have good technical knowledge in analysis, design, manufacturing and ability to produce systematic IBS systems.

Table 4.2: Issues of Implementing IBS Projects to Private Sectors

Statement	Mean			
	Consultant	Contractor	Developer	Manufacturer
Many contractors and even engineers are well aware of the IBS system and involved with the use of any IBS system in their construction methods	3.98	3.75	3.45	3.98
Campaigning is required to reassure that IBS systems are able to provide fast, economical and high-quality products should be carried out.	4.45	4.25	3.80	4.15
IBS system if properly designed can deliver a more efficient construction process due to many advantages such as greater speed of construction, simpler construction process, reduced environmental impact and reduce reliance on traditional labors	4.30	3.98	3.50	4.13
Engineers with good technical knowledge in analysis, design, manufacturing and construction have the ability to produce systematic IBS systems	4.23	3.88	3.48	4.30
If the components are skilfully designed, erection can be carried out efficiently	4.28	3.88	3.48	4.23
Complying with good practices in design and construction leads to high quality precast concrete structures.	4.20	3.95	3.48	3.90
IBS usage for precast beam is the most significant usage in low cost housing project	4.05	3.78	3.40	3.98
The steel formwork system is yet to gain popularity in Malaysia as the timber formwork is a cheaper option and solution to most construction projects.	4.18	3.75	3.50	3.93
Precast concrete systems are also known as hybrid system because it uses conventional method and precast slabs	4.20	3.78	3.48	4.13
Conventional construction methods have been known and proven to be wasteful, dangerous and messy due to the process of constructing buildings	4.08	3.78	3.48	4.08

4.2.9 Challenges on IBS Implementation

Table 4.3 shows the comparison of challenges on IBS implementation from the perspective of consultant, contractor, developer and manufacturer. The findings show that the contractor does not much affected by the challenges of IBS implementation and it seems that they are ready to implement IBS in their project. However, it is different opinion from the perspective of consultant, developer and manufacturer. Both developer and manufacturer face difficulty in lacking knowledge in the appropriate technique to be used in jointing the IBS components. The consultant feels that the high usage of plant and machinery for assembling of IBS components is the main challenges of IBS implementation.

The respondents also mentioned other issue related to the IBS implementation. There are ten (10) issues related to the IBS implementation as follows:

i. **Transportation**

IBS required adequate access to transport IBS components from the factory plant to the construction sites. It will give difficulty if the site is long distance from factory and construction site. Based on study done by the study by (Abraham Warszawski, 1999) on the suitable distance from the new potential development area to the fabrication plant should be the distance with a variance from 50km to 100km.

ii. **Capability**

The mandatory of IBS implementation should not be forced to the private sector since it will destroy the small contractor because they did not have any factory facilities. The industry should be prepared in term of skills, monetary and knowledge to implement IBS construction.

iii. **High Cost**

The implementation of IBS construction will increase the cost about 20% since the labour cost of skilled worker is expensive. Besides that, to implement IBS along with BIM, the purchasing of Revit software is needed which incurred cost in the project. The IBS construction related so much with the volume of the demand. If the demand is huge, the cost could be reduced as compared with the conventional construction because of the fast construction. The high cost also includes the plant and machinery preparation for assembling IBS components.

iv. **Supply and Demand**

The issue of monopoly is still happening in all states. There is also issue in demand. As reported by one of the respondents, the demand of IBS construction is still low.

v. **IBS Knowledge**

There is still lack of knowledge of IBS amongst the industry player. The training and skills development will take time for the industry player to adopt IBS construction in their project.

vi. **Land**

The scarcity of land available especially in the centre area is also contributes to the challenges of IBS adoption.

vii. **Industry's Acceptance and Perception**

Some of the industry player would prefer conventional method rather than new system because they already familiar with the current practice. They can't accept the new system because it will involve new knowledge and skills. Besides that, not all field suitable with IBS construction especially in civil engineering and manufacturing. Most of them agree if the IBS score will remain at 50 IBS score. The implementation of 70 IBS score should be focusing on the G3 to G7 contractor.

viii. **Job Opportunity**

The respondent mentioned that the job opportunities will decrease if the IBS is adopted. This is the challenges for government and related parties such as CIDB to disburse the information to the player that the main objective of the IBS implementation is to reduce the foreign worker and it will create the new job opportunities with high skills such as precaster, installer and prefabricator of IBS components.

ix. **Limitation of Design**

There is an issue of the design if adopted IBS in their project. They mentioned that the IBS design is very limited and not attractive.

x. **High Skills Required**

Specialised skills require onsite for assembly and erection of IBS components. This issue can resolved through the training and practical provided by the Akademi Binaan Malaysia (ABM) or other related agency.

Table 4.3: Challenges on IBS Implementation

Statement	Mean			
	Consultant	Contractor	Developer	Manufacturer
Lack of IBS knowledge among contractors	3.45	2.50	3.43	4.05
Manufacturers are not capable enough to produce adequate facilities of IBS components and inability to utilise the IBS components increases the project cost	3.30	2.33	3.30	3.98
Lack of knowledge in the appropriate technique to be used in jointing the IBS components	3.08	2.40	3.48	4.08
Problem of defective joints work of IBS components in the construction	3.15	2.45	3.40	4.13
Lack of precise measurements due to design problem of IBS components	3.25	2.48	3.33	3.93
Specialised skills require onsite for assembly and erection of IBS components	3.43	2.53	3.40	4.05
high usage of plant and machinery for assembling of IBS components	3.50	2.58	3.45	3.85

4.3 Readiness on the Implementation of 70 IBS Score to the Private Sector

The analysis involved four (4) type of building which are apartment, house terrace, office tower and school on the suitability of IBS score to implement to the private sector. The analysis is based on the Construction Industry Standard (CIS) 18: 2018. The first IBS scoring standard has started in 2005, the "Manual for Industrialised Building System (IBS) Content Scoring System". After 5 years of industry use, several improvements have been made including making the IBS Score as a standard in the construction industry and is named as "Construction Industry Standard (CIS 18: 2010) Manual for IBS Content Scoring System". In 2016, improvements were made with the addition of components and reviewing the entire CIS content of 18: 2010 (CIDB, 2015a).

4.3.1 Scenario 1: Apartment

No of floors : 10

Structure ratio area : 0.91

Roof ratio area : 0.091

Situation 1: Conventional

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional	0	0.91	0
Roof	Prefab metal roof truss	1	0.091	5
Subtotal IBS Score				5

Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brickwalls	0	1	0
Subtotal IBS Score				0

Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of modular gridline in drawings				4
			SUBTOTAL IBS SCORE	30
			TOTAL IBS Score	35

Situation 2: Precast columns and beams / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Precast columns and beams / Precast concrete slabs	1	0.91	45
Roof	Prefab metal roof truss	1	0.091	5
Subtotal IBS Score				50
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4

Doors		75	4
Windows		75	4
2) Repetition of Structural Layout			
a) For building of floor more than 2 storeys			
i) Repetition of floor to floor height			2
ii) Vertical repetition of structural floor layout			2
iii)Horizontal repetition of structural floor layout			2
b) For building 1 or 2 storeys			
i)Horizontal repetition of structural floor layout			
3) Other Productivity Enhancing Solutions			
i) Usage for prefabricated bathroom unit (PBU)			
ii) Usage for prefabricated staircases			
iii) Usage of BIM models for IBS score submission			
iv) Usage of modular gridline in drawings			4
Subtotal IBS Score			30
TOTAL IBS Score			79

Situation3: Tunnel formwork

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel formwork	0.5	0.91	23
Roof	Prefab metal roof truss	1	0.091	5
Subtotal IBS Score				27
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel Formwork	0.5	0.5	5
Ground	Common brick walls	0	0.5	0
Subtotal IBS Score				5
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2

b) For building 1 or 2 storeys			
i)Horizontal repetition of structural floor layout			
3) Other Productivity Enhancing Solutions			
i) Usage for prefabricated bathroom unit (PBU)			
ii) Usage for prefabricated staircases			
iii) Usage of BIM models for IBS score submission			
iv) Usage of modular gridline in drawings			4
Subtotal IBS Score			30
TOTAL IBS Score			62

Situation 4: Conventional / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional / Precast concrete slabs	0.5	0.91	23
Roof	Prefab metal roof truss	1	0.091	5
Subtotal IBS Score				27
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				

iii) Usage of BIM models for IBS score submission		
iv) Usage of modular gridline in drawings		4
Subtotal IBS Score		30
TOTAL IBS Score		57

4.3.2 Scenario 2: Shop / House Terrace

No of floors : 2

Structure ratio area : 0.67

Roof ratio area : 0.333

Situation 1: Conventional

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional	0	0.67	0
Roof	Prefab metal roof truss	1	0.333	17
Subtotal IBS Score				17
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brickwalls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				
ii) Vertical repetition of structural floor layout				
iii) Horizontal repetition of structural floor layout				
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				6
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				

iii) Usage of BIM models for IBS score submission		
iv) Usage of modular gridline in drawings		4
Subtotal IBS Score		30
TOTAL IBS Score		47

Situation 2: Precast columns and beams / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Precast columns and beams / Precast concrete slabs	1	0.67	33
Roof	Prefab metal roof truss	1	0.333	17
Subtotal IBS Score				50
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				
ii) Vertical repetition of structural floor layout				
iii) Horizontal repetition of structural floor layout				
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				6
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of modular gridline in drawings				4
Subtotal IBS Score				30
TOTAL IBS Score				80

Situation3: Tunnel formwork

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel formwork	0.5	0.67	17
Roof	Prefab metal roof truss	1	0.333	17
Subtotal IBS Score				33
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel Formwork	0.5	0.5	5
Ground	Common brick walls	0	0.5	0
Subtotal IBS Score				5
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				
ii) Vertical repetition of structural floor layout				
iii)Horizontal repetition of structural floor layout				
b) For building 1 or 2 storeys				
i)Horizontal repetition of structural floor layout				6
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of modular gridline in drawings				4
Subtotal IBS Score				30
TOTAL IBS Score				63

Situation 4: Conventional / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional / Precast concrete slabs	0.5	0.67	17
Roof	Prefab metal roof truss	1	0.333	17
Subtotal IBS Score				33
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				
ii) Vertical repetition of structural floor layout				
iii)Horizontal repetition of structural floor layout				
b) For building 1 or 2 storeys				
i)Horizontal repetition of structural floor layout				6
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of modular gridline in drawings				4
Subtotal IBS Score				30
TOTAL IBS Score				63

4.3.3 Scenario 3: Office Tower

No of floors : 20

Structure ratio area : 0.95

Roof ratio area : 0.048

Situation 1: Conventional

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional	0	0.95	0
Roof	Prefab metal roof truss	1	0.048	2
Subtotal IBS Score				2
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of modular gridline in drawings				4
Subtotal IBS Score				30
TOTAL IBS Score				32

Situation 2: Precast columns and beams / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Precast columns and beams / Precast concrete slabs	1	0.95	48
Roof	Prefab metal roof truss	1	0.048	2
Subtotal IBS Score				50

Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i)Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of modular gridline in drawings				4
Subtotal IBS Score				30
TOTAL IBS Score				80

Situation3: Tunnel formwork

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel formwork	0.5	0.95	24
Roof	Prefab metal roof truss	1	0.048	2
Subtotal IBS Score				26
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel Formwork	0.5	0.5	5
Ground	Common brickwalls	0	0.5	0
Subtotal IBS Score				5
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4

Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of modular gridline in drawings				4
Subtotal IBS Score				30
TOTAL IBS Score				56

Situation 4: Conventional / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional / Precast concrete slabs	0.5	0.95	24
Roof	Prefab metal roof truss	1	0.048	2
Subtotal IBS Score				26
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				

i) Repetition of floor to floor height			2
ii) Vertical repetition of structural floor layout			2
iii) Horizontal repetition of structural floor layout			2
b) For building 1 or 2 storeys			
i)Horizontal repetition of structural floor layout			
3) Other Productivity Enhancing Solutions			
i) Usage for prefabricated bathroom unit (PBU)			
ii) Usage for prefabricated staircases			
iii) Usage of BIM models for IBS score submission			
iv) Usage of modular gridline in drawings			4
Subtotal IBS Score			30
TOTAL IBS Score			56

4.3.4 Scenario 4: School

No of floors : 4

Structure ratio area : 0.80

Roof ratio area : 0.200

Situation 1: Conventional

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional	0	0.80	0
Roof	Prefab metal roof truss	1	0.200	10
Subtotal IBS Score				10
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brickwalls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2

ii) Vertical repetition of structural floor layout			2
iii) Horizontal repetition of structural floor layout			2
b) For building 1 or 2 storeys			
i) Horizontal repetition of structural floor layout			
3) Other Productivity Enhancing Solutions			
i) Usage for prefabricated bathroom unit (PBU)			
ii) Usage for prefabricated staircases			
iii) Usage of BIM models for IBS score submission			
iii) Usage of BIM models for IBS score submission			4
Subtotal IBS Score			34
TOTAL IBS Score			44

Situation 2: Precast columns and beams / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Precast columns and beams / Precast concrete slabs	1	0.80	40
Roof	Prefab metal roof truss	1	0.200	10
Subtotal IBS Score				50
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brick walls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				

iii) Usage of BIM models for IBS score submission		
iii) Usage of BIM models for IBS score submission		4
Subtotal IBS Score		34
TOTAL IBS Score		84

Situation3: Tunnel formwork

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel formwork	0.5	0.80	20
Roof	Prefab metal roof truss	1	0.200	10
Subtotal IBS Score				30
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Tunnel formwork	0.5	0.5	5
Ground	Common brick walls	0	0.5	0
Subtotal IBS Score				5
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iv) Usage of BIM models for IBS score submission				4
Subtotal IBS Score				34
TOTAL IBS Score				64

Situation 4: Conventional / Precast concrete slabs

Part 1: Structural System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Conventional / Precast concrete slabs	0.5	0.80	20
Roof	Prefab metal roof truss	1	0.200	10
Subtotal IBS Score				30
Part 2: Wall System				
Level	**Construction Method**	**IBS Factor**	**Coverage**	**IBS Score**
Ground	Common brickwalls	0	1	0
Subtotal IBS Score				0
Part 3: Other Simplified Construction Solutions				
1) Utilisation of Standardised Components based on MS1064				
Element	**Size**	**Percentage of Usage**		**IBS Score**
Beams		75		4
Columns		75		4
Walls		75		4
Slabs		75		4
Doors		75		4
Windows		75		4
2) Repetition of Structural Layout				
a) For building of floor more than 2 storeys				
i) Repetition of floor to floor height				2
ii) Vertical repetition of structural floor layout				2
iii) Horizontal repetition of structural floor layout				2
b) For building 1 or 2 storeys				
i) Horizontal repetition of structural floor layout				
3) Other Productivity Enhancing Solutions				
i) Usage for prefabricated bathroom unit (PBU)				
ii) Usage for prefabricated staircases				
iii) Usage of BIM models for IBS score submission				
iii) Usage of BIM models for IBS score submission				4
Subtotal IBS Score				34
TOTAL IBS Score				64

PART 05

CONCLUSION, SUGGESTION ANDRECOMMENDATION FOR FUTURE RESEARCH

5.1 Conclusion

In conclusion, IBS should be an innovative improvement in the construction industry. IBS is seen as an evolution of construction using new and innovative techniques rather than revolution. IBS have high quality of finished product and minimal wastage due to factory-controlled prefabrication environment. IBS also can reduce the construction time periods and can save valuable time and help to reduce monetary losses. The implementation of IBS among private sector will enlarge the IBS adoption in Malaysia. However, certain things should be considered before mandate the policy. Using the latest CIS 18:2018, 70 IBS score is currently difficult to achieve without the usage of precast concrete system

Extra points can be gained through the following:

- Usage of BIM (up to 6 IBS score)
- Usage of block as alternative to bricks (up to 10 IBS score)
- Usage of Prefabricated Bathroom Unit (PBU) and prefabricated staircase (up to 4 IBS score)

If an increment on IBS score needs to be done, it can be increased to 60 IBS score in the future subject to more detailed study. The respondents agree that the 70 IBS score is implement if there are adequate skills of the construction worker, availability of IBS supplier and financial support from the government.

5.2 Suggestion

The suggestion drawn from this study objectively to increase the adoption of IBS in Malaysian construction industry. Fully acceptance of IBS in government and private sectors can be the starting point to implement the 70 or maybe more IBS score to the both sectors. Suggestions from the respondents in this study can be grouped into ten (10) categories which are:

5.2.1 Incentive

The incentive should be given to the IBS implementer (contractor, consultant, manufacturer and developer) to attract the IBS adoption in Malaysian construction industry. The incentive to buy the Revit software would help the consultant to adopt IBS and Building Information Modelling (BIM) from the planning stage until the implementation stage. The incentive of training and class to the industry will help the industry to have more knowledge on IBS and prefabrication. Thus, with the guarantee of the incentive to the private sectors, it can help to increase the adoption of IBS in Malaysian construction industry and boost the productivity and skills of the construction workers.

5.2.2 Guideline

To increase the adoption level of IBS in Malaysia, the IBS standards and guidelines should be developed. The conventional and IBS construction method is different in term of procurement, construction process and technology used. Thus, the development of own IBS standard and guideline would help enlighten the process of IBS adoption in Malaysian construction industry.

5.2.3 Promotion of IBS Usage in Malaysia

The exposure on the IBS usage in the Malaysian construction industry is still low based on the opinions from the respondents. The information about IBS does not reach full audience of the industry and only reach certain parties. The information about the IBS usage in low-cost housing projects should be disbursed to the public to increase the awareness about IBS. Besides that, the improvement on the scientific information about the economic benefits of IBS and worker's experience in IBS projects. The knowledge and information about IBS can be spur through campaign and roadshow in all states in Malaysia. The introduction on Modular Component (MC). In term of academic purposes, the knowledge and information of IBS should start from universities and vocational school.

5.2.4 Skills Development

Skills development could be established through course and practical to the contractor related to IBS. Besides contractor, the training should be provided to the construction worker to gain more knowledge on the implementation of IBS. The promotion and training related to IBS should be spread to the government agencies, private developer, architect, engineer, contractor and manufacturer. The development of skills will increase the productivity level of construction industry.

5.2.5 Planning

In term of planning stages, the contractors need to do proper planning and installation to reduce IBS construction cost and manufacturer should register their available components to CIDB.

5.2.6 Open System

The open system should be encouraged to the industry to promote the interchange ability of components by various manufacturer.

5.2.7 Supply Chain

To continue the supply chain in the IBS industry, IBS supplier should be available in all state and provided with enough knowledge and skills of IBS construction. Besides that, it is important that every parties carry their responsibility efficiently. The contract term especially for private project should be revised align with the flow of work of IBS construction.

5.2.8 Financial Support

The financial support to the private projects should be provided to ensure the construction work run smoothly especially in the early stage of construction due to high initial cost in the IBS construction such as machinery, mould preparation, skills workers and factory preparation.

5.2.9 Research & Development (R&D)

The role of research institute, Construction Research Institute of Malaysia (CREAM) is to provide the latest research about the positivity of IBS construction to increase the positive impact and confident of stakeholders to use IBS in their next project. The centre should become the bridge the gap that may disbursed the information on the productivity, quality and utilisation of IBS project.

5.2.10 Policy

The government policies for the IBS construction should be changed according to the work of flow of IBS construction. The support from government in campaign awareness to the industry should be augmented. The IBS component should be controlled by the government to avoid the issue of monopoly.

5.3 Suggestion for Future Research

One of the suggestions to be taken into consideration is the classification of IBS should be expanded to cater the scope of volumetric (modular) and hybrid construction. IBS is not to be a threat to traditional methods. Both methods should be able to work in tandem and improve their processes collectively. IBS should move up the degree of industrialisation from prefabrication to reproduction through innovation. IBS needs to play more roles and must be involved in project life cycle. The reproduction level of industrialisation will involve the whole project life cycle from planning to maintenance. IBS is a solution to the whole life cycle if only it can achieve reproduction level of industrialisation.

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APPENDIX 1: QUESTIONNAIRE

SURVEY ON IMPACT STUDY ON THE IMPLEMENTATION OF 70 IBS SCORE FOR PRIVATE PROJECTS

QUESTIONNAIRE SURVEY

Construction Industry Transformation Program (CITP) has been developed with the goal of transforming the construction industry today to become the industry a modern, productive, and sustainable and able to achieve sustained growth and enable Malaysian companies to compete with international players either within or outside the State. There are four core strategies under CITP, namely (i) Quality, Safety and Professionalism (QSP), (ii) Environmental Sustainability, (iii) productivity, (iv) Internationalization. Each of these strategic pillars is the main pillar of the construction industry towards transforming Malaysia. Under productivity initiative, (P1) including continue investment in human capital development in construction, (P2) enhance control and balance of workforce supply, (P3) accelerate of adoption of IBS, mechanization and modern practice, (P4) roll out technology advantage across project life-cycle, (P5) enhance availability of strategic information via National Construction Industry Information (NCIIC) and (P6) advanced SME/bumiputera capacity and capacity building.

The aims of this survey are measure the level of 70 IBS score for private projects. The questionnaire survey serves as a tool for data collection on the level of 70 IBS score for private projects in Malaysia. Successful and effective implementation of IBS in the Malaysian construction industry can offer various benefits compare to conventional systems. Client with a good knowledge and awareness of IBS benefit will surely encourage appointed designers to design building according to IBS specification. These benefits are very important aspects in achieving the efficient and effective which will enhance the market share of construction industry as well as contributing to the Malaysian economy. It is hoped that the respondents can provide relevant information as to facilitate the data collection process. It is our gratitude if you can help us to answer the following questions and kindly submit the survey form through following address:

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The results of this survey will be used solely for the CIDB research purpose and all personal information is guaranteed to be confidential.

Thank you very much in advance for your participation.

GENERAL INFO

Name of organization/company: ____________________

Position of respondent____________________

1. SECTION A

Demographics information

i) Choose type of the stakeholder.

Developer	
Manufacturer	
Consultant	
Contractor	

ii) Working experiences

Less than 5 years	
0-5 years	
5-10 years	
15-20 years	
Longer than 21 years	

2. SECTION B

Readiness of private sector to achieve 70 IBS score

i) Should IBS projects be a compulsory for private projects?

Yes	No

ii) Do you agree that private projects need to achieve 50 IBS Score as stated in CITP 2016 -2020?

Yes	No

If not, please state the IBS Score you are suggested.

20-30		41-50	
31-40		51-60	
61-70		Others	

iii) If the policy maker wishes to increase the IBS score to 70, is the industry ready? If yes, when is the prime time to implement it?

Yes	No

Section B

Please indicate the level of importance of each of the following factors which are often suggested by others as a measure which can help to enhance IBS in construction industry.

iv) **Please select the statement that best describe your company for using IBS**

Items	Yes	No
My company has implemented IBS, but we have yet to establish a skill of implement use		
My company has implemented IBS, and we have established a skill of implement use		

v) **Current issues of implementing IBS projects to private sectors**

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Many contractors and even engineers are well aware of the IBS system and involved with the use of any IBS system in their construction methods					
Campaigning is required to reassure that IBS systems are able to provide fast, economical and high quality products should be carried out					
IBS system if properly designed can deliver a more efficient construction process due to many advantages such as greater speed of construction, simpler construction process, reduced environmental impact and reduce reliance on traditional labours					
Engineers with good technical knowledge in analysis, design,manufacturing and construction have the ability to produce systematic IBS systems					
If the components are skilfully designed, erection can be carried out efficiently					
Complying with good practices in design and construction leads to high quality precast concrete structures.					
IBS usage for precast beam is the most significant usage in low cost housing project					
The steel formwork system is yet to gain popularity in Malaysia as the timber formwork is a cheaper option and solution to most construction projects.					

Precast concrete systems are also known as hybrid system because it uses conventional method and precast slabs					
Conventional construction methods have been known and proven to be wasteful, dangerous and messy due to the process of constructing buildings					

vi) **Challenges of IBS Usage**

Items	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Lack of IBS knowledge among contractors					
Manufacturers are not capable enough to produce adequate facilities of IBS components and inability to utilise the IBS components increases the project cost					
Lack of knowledge in the appropriate technique to be used in jointing the IBS components					
Problem of defective joints work of IBS components in the construction					
Lack of precise measurements due to design problem of IBS components					
Specialised skills require onsite for assembly and erection of IBS components					
high usage of plant and machinery for assembling of IBS components					

vii) Please indicate your suggestion to improve usage of IBS in construction industry

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THANK YOU

APPENDIX 2: SUGGESTION, CHALLENGES AND AGREE STATEMENT

No.	Suggestion	Details
1.	Incentive	provide incentive / tax reliefs to private sectors and contractors, adopt IBS standards and guidelines into local municipal guidelines, penalty driven
		Incentive for manufacturer. Training and class
		Incentive to players
		Incentive to the contractor
		Incentive to the implementers
		Incentive for consultants, contractors, developer and manufacturer to improve usage of IBS.
		give incentive for consultant to buy revit software
		Perhaps by giving incentives especially to private sectors the developers would encourage the IBS usage
		give guarantor incentive to stakeholders.
2.	Guideline	Increasing R&D programmes and promoting best practice guidelines
3.	Promotion	Awareness on IBS usage in low cost housing projects
		Expand the usage of IBS and exposure on IBS
		Exposure about IBS to the workers, engineer, contractor
		Exposure of IBS to the contractor
		Exposure on IBS
		Improve scientific information about the economic benefits of IBS and workers experience working in IBS projects
		exposure on skills related to IBS and knowledge to the construction workers
		Need more campaign and training for IBS
		Campaign
		need more exposure
		Promoting modularisation and standardisation / MC
		Universities should provide more subject related to IBS

No.	Suggestion	Details
4.	Skills Development	To establish course and practical to the contractor related to IBS
		Training to workers
		Provide training to gain knowledge about IBS among contractors, developer, manufacturer and consultant
		Promoting education and training and transfer of technology for government agencies, private developer, architects, engineers, contractors and manufacturers
		Training
		More training of IBS to gain knowledge and information
		Course to all contractor and construction workers related to IBS
		Training and campaign on IBS.
		Training of workers on IBS to ensure productivity of its components and
		Training to gain knowledge for all stakeholders.
5.	Planning	contractors need to do proper planning and installation to reduce IBS construction cost and manufacturer to register their available components at CIDB
6.	Open system	Encourage open system that promotes the interchange ability of components by various manufacturer
7.	Supply Chain	IBS supplier should have in every state. conduct training to all contractors on IBS installation
		Integration of roles
		Revise contract for private company
8.	Financial	Need financial sector to help give the loan for stakeholders
9.	R&D	write up research so they have confident.
		establish research and development centre for IBS to bridge the gaps that may be encountered can really improve the utilisation of IBS project
		establish R&D centre for IBS to improve productivity and quality of IBS system
10.	Policy	changes in government policies in implementation of IBS
		Support from government in campaign awareness to local contractor is needed
		Government should control IBS components. Not only monopoly by big company

No.	Challenges	Details
1.	Transportation	IBS require adequate access to transport all IBS components of the plants up to the construction sites
		long distance between factory and site. Difficult to reach construction site
2.	Capability	Don't force to public. will kill small contractor. small company does not have factory.
3.	High Cost	Increase cost by 20% involved IBS component
		Labor cost of IBS is expensive. High cost labour. big company efficient in IBS. Need to use revit software costly
		Labour not familiar. Expensive IBS components but speed in construction. Sabah already use long time ago. More usage more cost wise.
		the high usage of plant and machinery for assembling of IBS components
4.	Supply Demand	Lack of demand in Labuan
		Monopoly issue.
5.	IBS Knowledge	Lack of knowledge on IBS
6.	Land	Land issue related to the lack of IBS adoption
7.	Industry's Acceptance and Perception	Not interested in IBS system. prefer conventional
		Not all field suitable to implement IBS. Based on field especially in civil and manufacturing
		Agree with remaining 50 IBS score
		Company required to remain at 50 IBS score
		Company required remain at 50 IBS score
		Remain at 50 IBS score
8.	Job Opportunity	Works opportunities will decrease if implement IBS
9.	Design	Weakness on design if applied IBS
10.	Skill	Specialised skills require onsite for assembly and erection of IBS components,

No.	Agree Statement
1.	Agree to impose 70 IBS score for private project but high expensive to pay IBS labour. site manager same price to hire
2.	Easy to achieve 50 IBS score for private and government company. need to mandatory IBS score to ensure they use IBS
3.	Easy to predict because same components. Long term benefit
4.	High quality of finished products and minimal wastages due to factory-controlled prefabrication environment
5.	IBS able to reduce the number of workers for example concreter, carpenter, bar bender and plasterer
6.	IBS construction methods are cheaper than the traditional method but less demanding of IBS method
7.	IBS construction projects are able to reduce the construction time periods, and this can save valuable time and help to reduce monetary losses
8.	IBS products are as good quality as construction using structural components had assured its strength, even enabling it to be used as strong working platforms
9.	IBS project datelines will not be affected thanks to the rapid rates of completion due to the fast construction
10.	Mandatory 70 IBS score
11.	Moving the construction industry towards zero defects
12.	Need to implement IBS score.
13.	Need to impose 70 IBS score
14.	Need to mandatory for 70 IBS score
15.	Plenty of manufacturing, easy to get. High quality if using IBS
16.	Precast can up to 80 IBS score
17.	Speed construction time
18.	Steel formwork cheaper and quality because for wall casting. beam includes in the slab. the price same with shear wall
19.	only G3-G7 comply the 70 IBS score

APPENDIX 3: LIST OF RESPONDENTS

Stakeholder	Respondent
Contractor	1. ABH Mega Sdn. Bhd.
	2. Aljafry Jaya Enterprise
	3. Ambang Wira Enterprise
	4. Awang Bin Bakar
	5. Besacon Sdn. Bhd.
	6. Bukit Losong Construction Sdn. Bhd.
	7. Bulatan Mekar Sdn. Bhd.
	8. Consoline Sdn. Bhd.
	9. Daya Usaha Bumiputera
	10. Dinar Dynamic (M) Sdn. Bhd.
	11. DME Solution Sdn. Bhd.
	12. Dorbo Sdn. Bhd.
	13. Himpun Daya Sdn. Bhd.
	14. Ifora Heights Sdn. Bhd.
	15. Ilhamsama Sdn. Bhd.
	16. Izzateq Enterprise
	17. Jentayu Utara Sdn. Bhd.
	18. Jujur Perangsang Sdn. Bhd.
	19. KR Associates
	20. Mahir Symfony Sdn. Bhd.
	21. MIQ Sediabina Sdn. Bhd.
	22. Mohamad Bin Rasek
	23. Mus Maju Enterprise
	24. Muzana Enterprise Sdn. Bhd.
	25. Pembinaan Low Kam Chong
	26. Pembinaan Nur Sejahtera Sdn. Bhd.
	27. Sha Itma Construction Ang Engineering
	28. Silang Bina Sdn. Bhd.
	29. Sinar Bebas
	30. Sirma Bina
	31. SLB Sdn. Bhd.
	32. Smart Mega Construction Sendiri
	33. Sri Cahaya Enterprise
	34. T&L Civil Construction Sdn. Bhd.
	35. Tenaga Kini Sdn. Bhd.
	36. Turntech Construction
	37. Usahasama A&M Construction Sdn. Bhd.
	38. V-Grass Sdn. Bhd.
	39. Wangsa Hebat Sdn. Bhd.
	40. Zircon Kith Sdn. Bhd.

Stakeholder	Respondent
Consultant	1. RPM Engineers Sdn..Bhd.
	2. Aaries Engineering Consultant
	3. AD Consultants (M) Sdn. Bhd.
	4. AKK Engineering
	5. Arcadis Malaysia
	6. DSCAFF Group
	7. Freysinnet PSC (M) Sdn. Bhd.
	8. Iman Consultants
	9. J. Roger Preston (Malaysia) Sdn. Bhd.
	10. JFE Engineering (M) Sdn. Bhd.
	11. Jurutera Perunding Zaaba Sdn. Bhd.
	12. MRQS Consultant
	13. Neapoli Sdn. Bhd.
	14. Nexus Engineering Consultants
	15. Pyramid Engineering & Construction Works
	16. Petareka Engineering
	17. Prefab Consultants
	18. Ranhill Consulting Sdn. Bhd.
	19. Sharifah consultants
	20. Unicorn Engineering
	21. SMEC (M) Sdn Bhd
	22. Aathaworld Sdn. Bhd.
	23. ARR QS Consultancy
	24. CSI Consultant
	25. Pemola Niaga Sdn. Bhd.
	26. DPI Konsult Sdn. Bhd.
	27. EC Life Marketing (Malaysia) Sdn. Bhd.
	28. Econcos Consultants Sdn. Bhd.
	29. Grandhome Development Sdn. Bhd.
	30. IEN Consultants Sdn. Bhd.
	31. IPC Island Property Consultants Sdn. Bhd.
	32. Jutamas Harmoni Sdn. Bhd.
	33. Matrix Concepts Sdn. Bhd.
	34. Mersing Construction & Engineering Sdn. Bhd.
	35. Merx Construction Project Management
	36. MS Trading & Engineering
	37. PDC Properties
	38. PWK Kreatif
	39. Qistina Sdn. Bhd.
	40. QSNS Construction Consultants

Stakeholder	Respondent
Manufacturer	1. Plytec System Industries Sdn Bhd
	2. Besaram Hardware And Machinery Sdn. Bhd
	3. Axelchem Sdn. Bhd
	4. Jeks Engineering Sdn Bhd
	5. HDD Technology Sdn. Bhd
	6. KCSS Wiremesh Sdn. Bhd
	7. TET Tafa Fence & Mesh Sdn Bhd
	8. Alex Manufacturer Sdn. Bhd
	9. Pumpline (KL) Sdn. Bhd
	10. SQC Wire Mesh Sdn Bhd
	11. Creative Precast Technics Sdn Bhd
	12. Alliance Precast Industries Sdn Bhd
	13. C&G United Trading
	14. Hume Concrete Sdn Bhd
	15. SPC Industries Sdn. Bhd
	16. E-RETE (Malaya) Sdn Bhd
	17. HC Precast System Sdn. Bhd
	18. Aathaworld Sdn Bhd
	19. Projalma Sdn Bhd
	20. Ban Lee Hin Engineering & Construction Sdn Bhd
	21. Hitachi Construction Machinery (Malaysia) Sdn Bhd
	22. ATC Hydro Engineering
	23. Kim Hoe Thye Building Materials Sdn Bhd
	24. Kimson Marketing Sdn Bhd
	25. Southern Steel Mesh (SSM) Sdn. Bhd
	26. Hap Seng Consolidated Berhad
	27. Prima Laguna Sdn Bhd
	28. Penn Elcom
	29. Malaysia Dong Ji(M) Sdn Bhd
	30. Mudajaya Group Berhad
	31. Aluminium Company of Malaysia Bhd
	32. Calart Engineering Sdn Bhd
	33. Eastern Pretech (M) Sdn. Bhd.
	34. Teraju Precast
	35. AME Construction
	36. AxelChem Sdn.Bhd
	37. Creative precast technics sdn,bhd
	38. Evergold Metal Roofing Sdn. Bhd.
	39. IRRIQuip construction sdn.bhd
	40. KTN Construction

Stakeholder	Respondent
Developer	1. Gamuda Land
	2. Sabah Urban Development Corporation Sdn. Bhd.
	3. Sendayan Group of Companies
	4. Sime Darby Properties
	5. TCS Construction Sdn. Bhd.
	6. UEM Property
	7. WTS Property
	8. Ahmad Zaki Resources Berhad
	9. Alam Tenggara Sdn. Bhd.
	10. Asia Baru Construction Sdn. Bhd.
	11. Bazarbayu Sdn. Bhd.
	12. Bina Setul Sdn. Bhd.
	13. Dergahayu Sdn. Bhd.
	14. Galeri Tropika Sdn. Bhd.
	15. Glenmarie Properties Sdn. Bhd.
	16. GUH Group
	17. IJM Properties
	18. JS Group
	19. Lone Pine Group of Companies
	20. Malaysian Land Property Sdn. Bhd.
	21. Masteron Group
	22. Medini Iskandar Malaysia
	23. Mega 3 Housing Sdn. Bhd.
	24. Menang Development (M) Sdn. Bhd.
	25. Mitrajaya Holdings Berhad
	26. Nakano Construction Sdn. Bhd.
	27. Peremba Development
	28. PLB Land Sdn. Bhd.
	29. PMB Façade Technology
	30. QSE Construction Sdn. Bhd.
	31. Sejahtera Corporate
	32. Seri Mutiara Development
	33. Setia Haruman
	34. SP Setia Sdn. Bhd.
	35. Sunrise MCL Land Sdn. Bhd.
	36. Suntrack Development
	37. Syarikat Pembinaan Bersaty Maju (M) Sdn. Bhd.
	38. Tanjung Ratna Sdn. Bhd.
	39. Tenggara Dinamik Sdn. Bhd.
	40. Toyo Engineering & Construction Sdn. Bhd.

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