BIM Effectiveness Implementation In Construction Projects

CIDB MALAYSIA

CIDB TECHNICAL REPORT PUBLICATION NO. 2112

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PREFACE

The construction sector is one of the major industries that contribute to the development of gross domestic product (GDP). As one of the vital industries around the world, the construction industry has undergone digital transformations, including the sectors in Malaysia. With the strategic initiatives led by the Ministry of Works (MoW) Malaysia that are cooperatively supported by Construction Industry Development Board (CIDB) Malaysia, the Malaysian construction industry has undergone tremendous changes towards digitalisation in recent years.

CIDB Malaysia, one of the agencies under MoW, has diligently worked together to boost the construction industry towards more productive and innovative industries. Guided by their vision, 'To Be an Esteemed Organisation That Delivers Construction Excellence in Malaysia', CIDB Malaysia has launched the Construction 4.0 Strategic Plan (2021 – 2025) to spur the Malaysian industries to suit the current trend and changes around the world, including the bloom of Industrial Revolution 4.0 (IR 4.0).

Construction 4.0, a new term subset from IR4.0, has become the main agenda to grow industries towards digitalisation. Building Information Modelling (BIM), one of the twelve emerging technologies listed in the Construction 4.0 Strategic Plan, is expected to assist the development and goal of the industry to become more competitive and productive. BIM has become an added value throughout construction projects in Malaysia. However, the implementation of BIM needs to be assessed and evaluated to increase and improve the benefits and barriers, respectively.

After several years of implementation throughout construction projects, the current adoption of BIM has yet to be evaluated. This report is a first look at the adoption and effectiveness of BIM for construction projects worth RM10 million and above in Malaysia. Throughout this report, CIDB Malaysia will set a baseline and continue to boost the implementation of BIM throughout construction projects in Malaysia across the whole supply chain, and collaboratively work with every stakeholder involved to ensure the development and advancement of the Malaysian construction industry.

CIDB
MALAYSIA

CONTENTS

EDITORIAL

This report was successfully done by the Construction Industry Development Board (CIDB) Malaysia and in collaboration with the Construction Research Institute of Malaysia (CREAM. We would like to thank the following members for their contribution and support to make this report successful.

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LIST OF ABBREVIATIONS

BCA - Building Construction Authority

BIM - Building Information Modelling

BIRAC - BIM in Rail Academy

CDE - Common Data Environment

CIDB - Construction Industry Development Board Malaysia

CPCF - Construction Productivity and Capability Fund

CR4.0 - Construction 4.0

CREAM - Construction Research Institute of Malaysia

GDP - Gross Domestic Product

GIS - Geographic Information System

IR4.0 - Industrial Revolution 4.0

JKR - Jabatan Kerja Raya

KPI - Key Performance Indicator

MRT - Mass Rapid Transit

NBeS - National BIM e-Submission

NBIMS - National BIM Standard

SME - Small & Medium Enterprise

VDC - Virtual Design and Construction

CHAPTER 1

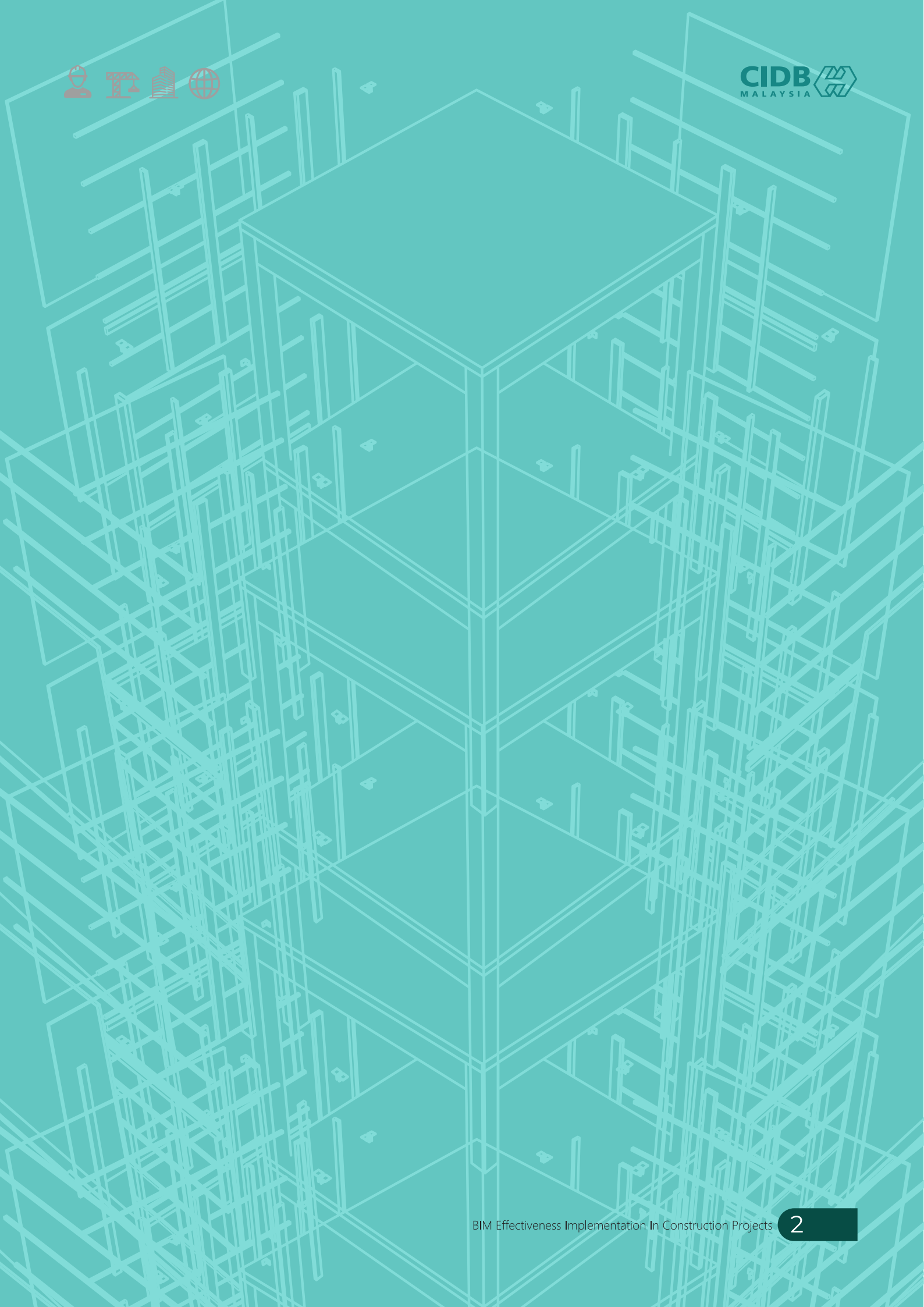
GLOBAL BIM POLICY BENCMARKING

OVERVIEW OF GLOBAL BIM POLICY

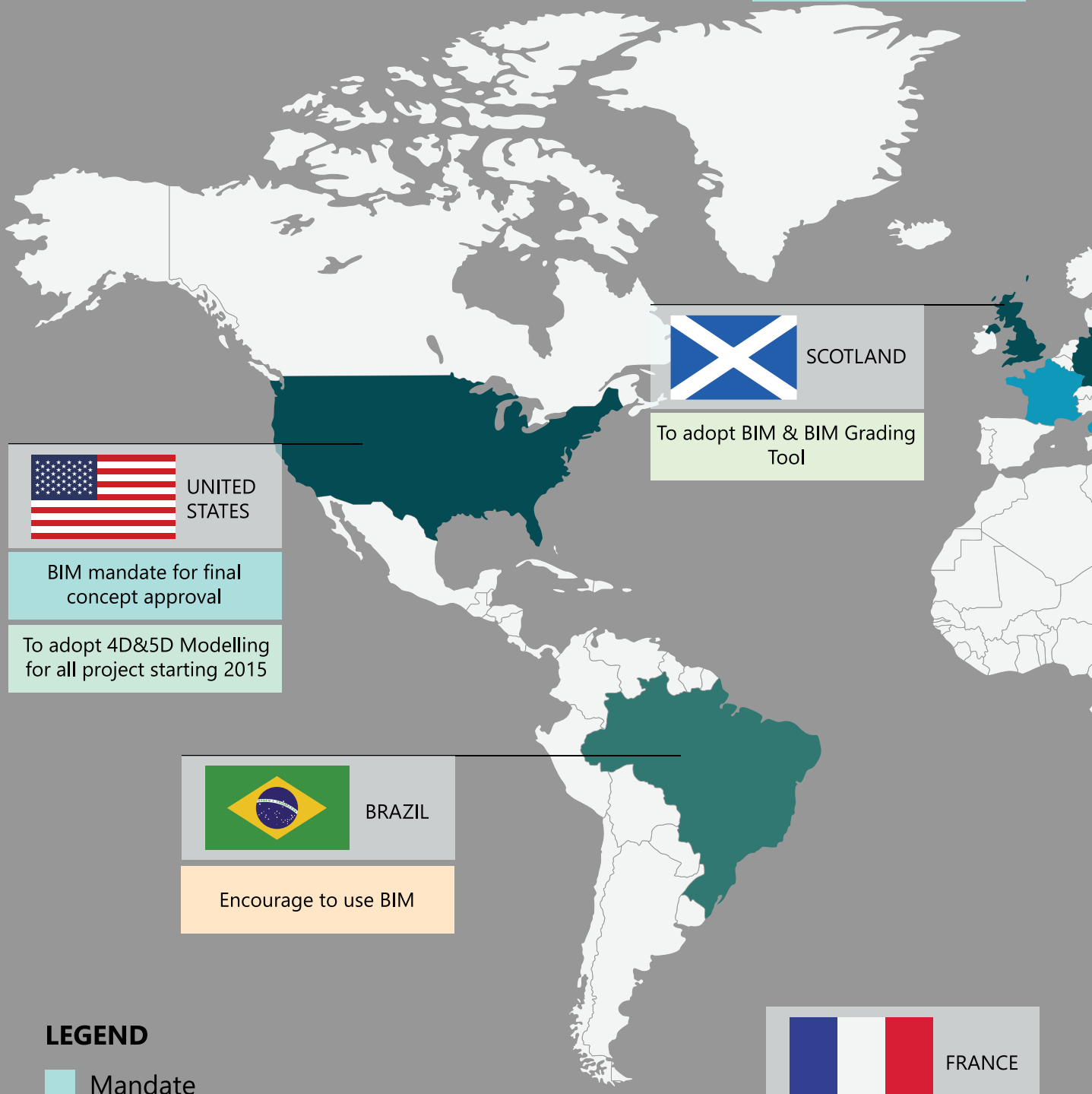
The bloom of the Fourth Industrial Revolution has hit most of the industrial sectors globally. Zooming into the Fourth Industrial Revolution, the construction sector is among the main industries that are currently moving together with the digital transformations, also known as Construction 4.0. The twelve emerging technologies listed in Construction 4.0 have been identified as future technologies that are currently or will change the whole construction life cycle process. Among the twelve technologies, Building Information Modelling (BIM) has been identified as one of the crucial technologies that shape the construction industry (Snook, 2019). Transforming traditional practice into a digitisation approach, BIM is a process for creating a collaborative way of managing information that draws on a model across the construction project life cycle, whereas it involves multiple stakeholders for decision making resulting in greater value for the project and organisation (NBS, 2016b; Lorek, 2018a).

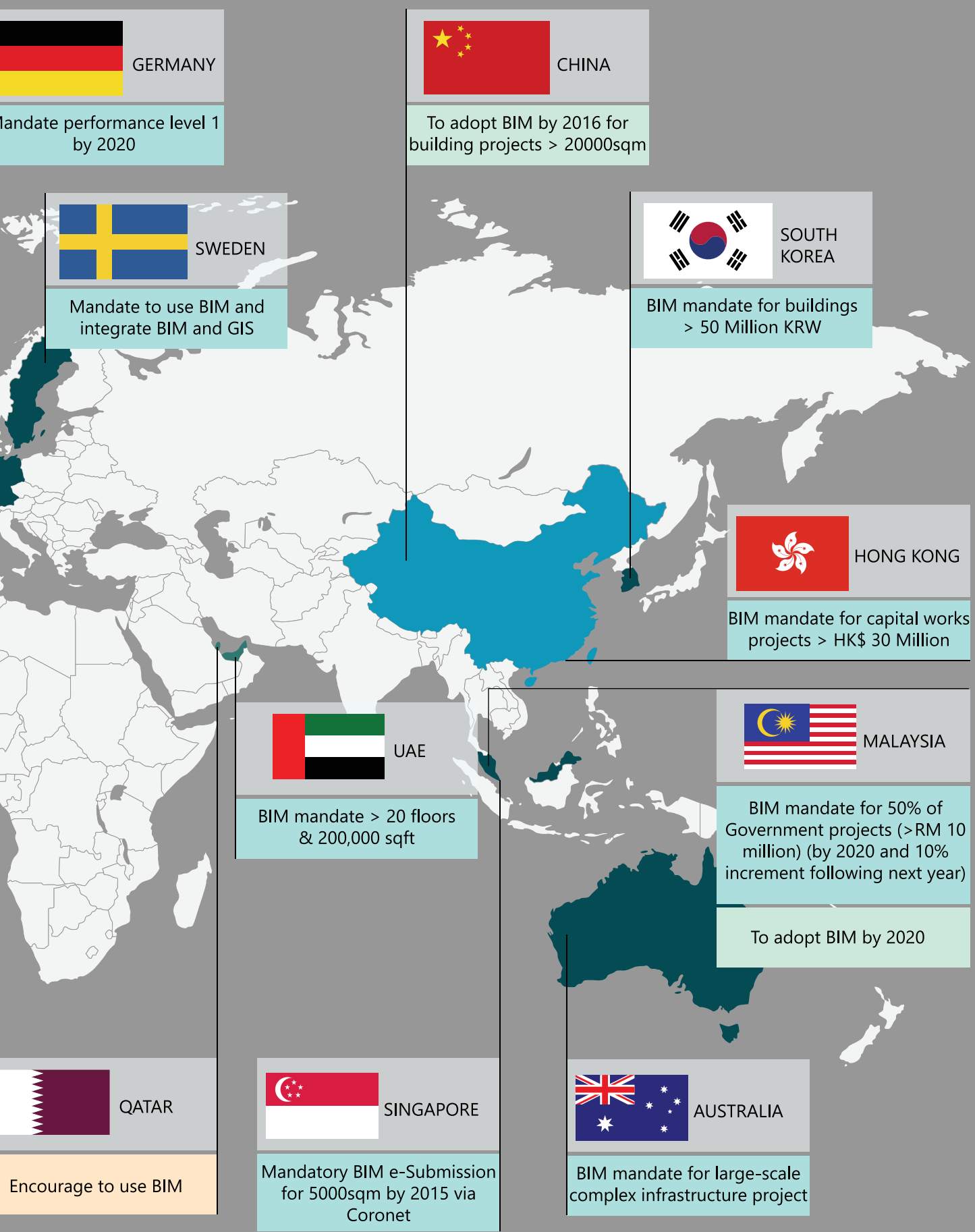
The question that remains in mind is how far BIM has been practised in the real construction world? Is BIM fully adopted throughout the whole construction life cycle process or partially implemented for certain phases of construction, for instance, design, construction, or operation phases (Xu, Ma, & Ding, 2014). The need to measure the level of BIM adoption throughout the construction life cycle is crucial to evaluate BIM progress around the world. The case for changes in BIM implementation lies in several initiatives, for example, government, organisation, and individual initiatives. To keep up with the global digital construction trend, every stakeholder must take part to realise the potential of using BIM across the project life cycle.

To ensure BIM implementation in each country, every stakeholder, especially the government, should take the initiatives to drive the BIM industry. Steps that should be implemented by the Government can range from encouraging to mandating BIM usage in construction projects to assure the development of the BIM industry globally. Table 1 discusses different BIM policies that are currently or will be implemented in each country listed. The benchmarking on BIM policy is made for 15 countries.



OVERVIEW OF GLOBAL BIM POLICY




GERMANY
Mandate performance level 1 by 2020
CHINA
To adopt BIM by 2016 for building projects > 20000sqm
SWEDEN
Mandate to use BIM and integrate BIM and GIS
SOUTH KOREA
BIM mandate for buildings > 50 Million KRW
HONG KONG
BIM mandate for capital works projects > HK$ 30 Million
UAE
BIM mandate > 20 floors & 200,000 sqft
MALAYSIA
BIM mandate for 50% of Government projects (>RM 10 million) (by 2020 and 10% increment following next year)
To adopt BIM by 2020
QATAR
Encourage to use BIM
SINGAPORE
Mandatory BIM e-Submission for 5000sqm by 2015 via Coronet
AUSTRALIA
BIM mandate for large-scale complex infrastructure project

Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
 Malaysia	Ministry of Works and Construction Industry Development Board (CIDB)	Construction Industry Transformations Programme (CITP) 2016 – 2020 (CIDB, 2020); (CIDB Malaysia, 2020)	• 70% of private and public building projects above RM10 million to adopt BIM by 2021 • 100% of all public building projects above RM100 million (for Government projects) to use BIM by 2021	• 237 JKR BIM Certified Professional •519 JKR BIM professional trained • 3618 BIM professionals trained • BIM Transformations Incentives Scheme distributed to 62 SMEs • 14 BIM Satellite • BIM Road Tour, seminar, conference, and BIM Day • National BIM Library (MyBIM centre) • National BIM e-submission (NBES)
	Ministry of Works and Jabatan Kerja Raya (JKR)	• BIM Adaptation Policy for JKR Projects through "Surat Arahan KPKR Bil. 18/2020) • Pelan Strategik JKR Malaysia 2021-2025 •Reference document (Garis Panduan BIM JKR, Piawaian BIM JKR, Manual Penggunaan Template BIM JKR, etc)	• Mandatory for 50% of government projects worth RM10 million and above to implement BIM and increment of 10% for the subsequent years	• Technical Excellence Programme • Engagement session with project team (contractor & consultant) • Internal training programme

Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
Singapore	Building Construciton Authority (BCA)	Singapore BIM Roadmap (Fatt 2014)	• Mandatory Architecture & Engineering BIM e-Submissions fo all new building projects above 5,000 m2 by 2015 • BIM e-Submission was mandated in the govement web portal for approvals, known as Coronet	• Construction Prductivity and Capability Fund (CPCF) through workforce development, Technology adoption, and capability development (Fatt, 2014) • Singapore Virtual Design and Construction (VDC) Guide • Center for Lean & VIrtual Construction (CLVC)
		Construction Industry Transformations Map (ITM) (K.S.Boon,2019)	• The industry fully digitalising itself called Integrated Digital Delivery (IDD) • Train 20,000 personnel in IDD, 35,000 in DfMA and 25,000 in green buildings	• Set up Built Environment Skills Future Tripartite (BEST) taskforce • Integrated Construction Quality Assurance (ICQA) Scheme (BCA, 2019)
South Korea	Ministry of Land, Infrastructure, and Transport of Korea (MOLIT)	Rail BIM 2030 Roadmap	• Mandated to use BIM for all public buildings over 50 billion KRW by 2012 and expanded to mandate for all public building projects managed by the Public Procurement Services by 2016 • Mandating BIM on more than 20% of civil engineering projects by 2020	• Develop Civil BIM Library in 2015

Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
 China	Ministry of Housing and Urban-Rural Development of China (MOHURD) and Shanghai Municipality	• Outline of Development of Construction Industry Informatisation (2016-2020) (Liu, Wang, Zhang, Liu, & Wang, 2017) • Guide to Promote Implementation of BIM in Construction Industry (Jiang, Khan, Vian, & Cheng, 2015) • Guidance on Building Information Model Application (Liu et al., 2017)	• Improve the level of construction information through integrated construction technology (e.g., BIM, big data, etc.) • Adoption of BIM for government-invested public building projects which have a total area of more than 20,000 m2 by 2016 • Construction stakeholers* should adopt integrated construction technologies by achieving 90% of BIM in survey design, construction, operation, and maintenance for large and medium-sized buildings with state-owned capital investment, and public buildings which declare as a green building or green ecological demonstration area class A reconnaissance and design unit, premium and class-A building construction enterprise - class A reconnaissance and design unit, premium and class-A building construction enterprise	• Extra points for BIM practitioners when they declare outstanding engineering survey and design awards • Extra points in integrity evaluation for enterprise and personnel which promote the development, construction, and investigation

Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
 Hong Kong	The Government of the Hong Kong Special Administrative Region and Construction Industry Council	Development Bureau Technical Circular (Works) No. 9/2019 Adoption of Building Information Modelling for Capital Works Projects in Hong Kong (HK, 2019)	• Capital works projects with project estimates of more than $30 Million shall use BIM technology for investigation, feasibility, planning, design, or construction stages in the Capital Works Programme irrespective of the modes of delivery	• SME Loan Guarantee Scheme • New Technology Training Scheme • Small Enterprise Research Assistance Fund • Other schemes such as University-Industry Collaboration Fund, SME Export Marketing Fund, SME Development Fund, and Genera Support Programme Fund (CIC, 2014)
 Qatar	Public Works Authority Ashghal, Qatar	Ashghal Corporate strategy 2018-2022 and Qatar Deserve The Best	• Strongly supported by the government to be implemented in public and private projects	
 Sweden	Swedish Transportation Administration (Trafikverket) and BIM Alliance Sweden	Smart Built Environment (SBE) (EUBIM Task Group, 2017)	• Integration of Geographic Information Systems (GIS), Building Information Modelling (BIM), and Industrialised Construction.	

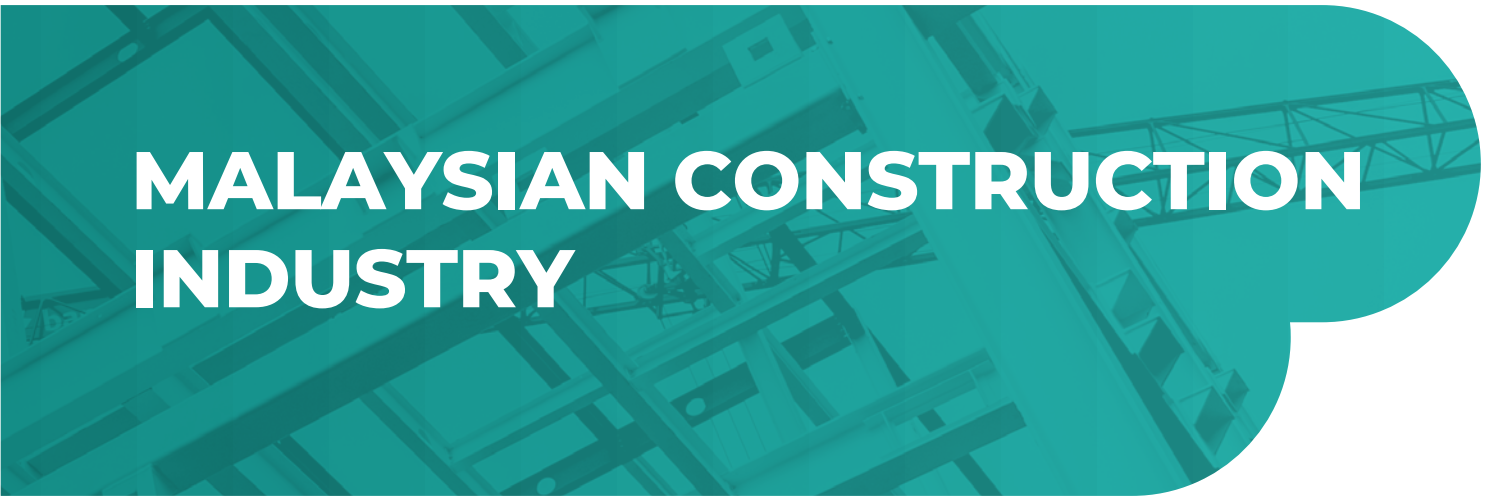
Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
 United Kingdom	Infrastructure and Project Authority	Government Construction Strategy 2016-2020 (The Cabinet Office, 2016)	• Fully collaborative 3D BIM on centrally procured government construction by 2016 (irrespective of project size)	• The BIM Working Group • Agreed BIM Level 2 maturity measure by 2016
	HM Government	Construction 2025 (HM Government, 2013)	• Level 3 BIM implementation from 2016 -2025	• £220 million in developing a high-performance • More than £650 million in delivering high-speed broadband throughout the UK
	HM Government, Construction Leadership Council, and UK BIM Task Group	Digital Built Britain (HM Government, 2015)	New delivery model on BIM Level 3 (3A, 3B, 3C, 3D)	
 United State	US General Administration (GSA)	• National 3D-4D-BIM Program (Edirisinghe & London, 2015; Ltd., 2019) • 8 BIM Guide Series (BibLus, n.d.)	• Spatial BIM program as minimal requirements for the Office of the Chief Architect (OCA) for final concept approvals from 2007 and beyond • 3D, 4D, and BIM technology deployment encouraged in all GSA projects	
	NBIMS-US Project Committee and building SMART alliance	National BIM Standard (NBIMS) Version 3 (Ltd., 2019)	• Open standards and guidance documents for all aspects of building information modeling	
	The US Army Corps of Engineers (USACE)	The US Army Corps of Engineers Roadmap for Life-Cycle BIM (2012 Edition) (USACE, 2012)	• 4D and 5D modelling use on all projects starting 2015	

Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
 Brazil	Ministério Da Indústria, Comércio Exterior E Serviços (Ministry of Industry, Foreign Trade and Services)	BIM BR Construção Inteligente (Ministry of Industry, Foreign Trade, and Services, 2018)	BIM BR Construção Inteligente (Ministry of Industry, Foreign Trade, and Services, 2018) • Fully collaborative 3D BIM on centrally procured government construction by 2016 (irrespective of project size) • Encourage training about BIM processes and methods • Rules on public contracts based on the adoption of BIM • Develop technical standards, guidelines, and specific protocols for the adoption of BIM • Develop a platform and a national BIM archive (BNBIM) • Encouraging the use of BIM-based tools and their development • Intensify the development and application of new technologies related to BIM Source: (BibLus, 2017)	• Boost BIM courses and post-graduate training courses in the faculties of Engineering and Architecture • Creating incentive programs for investments by small and micro businesses • Establishment of a BIM National Library (BNBIM)

Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
 France	Ministre De La Cohésion Des Territoires Et Des Relations Avec Les Collectivités Territoriales (Minister of Territorial Cohesion and Relations with local authorities)	PLANBIM 2022 (Minister of Territorial Cohesion and Relations with Local Authorities, 2018)	• Aware of and supported in the formulation of a clear and structured request on the expectations of the digital model • Develop BIM maturity assessment grids for each type of player.	• Digital Building Platform, called KROQI
	European Commission	Digital Transition Plan for Buildings (PTNB) (Commission, 2018)	• Convince and mobilise construction industry stakeholders to increase the use of digital technologies • Enhance digital skills and stimulate the development of tools tailored to small projects • Develop a trusted digital ecosystem	• Awards for the best digital transition projects • BIM Barometers • Virtual BIM Workshop • Set up a collaborative platform for construction SMEs and micro-enterprise • Call for pilot construction projects based on the use of BIM • Develop common BIM norms and standards
 Germany	German Federal Minister of Transport and Digital Infrastructure	Road Map for Digital Design and Construction (German Federal Ministry of Transport and Digital Infrastructure, 2015)	• Mandate Performance Level 1 to be used by 2020	• Four BIM pilot projects including accompanying research in the road and rail sectors with a total fund of €3.8 million
 Australia	Australian Governments and Australasian Procurement and Construction Council	10-Point Plan, Australian BIM Strategic Framework, and Au stralian Infrastructure Plan (Infrastructure Australia, 2016)	• Should mandate for the design of large-scale complex infrastructure projects	

Country	Lead Ministry / Agency	Policy / Publication / Document	Initiatives / Targets	Incentives / Programmes
 United Arab Emurates (UAE)	Dubai Municipality	Dubai Municipality Circular No. 207 (Guides, 2017)	• Buildings above 20 floors, • Buildings and facilities and compounds with areas larger than 200,000 square feet • Buildings and special facilities, such as hospitals and universities • All government projects, and all buildings and projects that are requested from a foreign office	

CHAPTER 2



MALAYSIAN CONSTRUCTION INDUSTRY

BIM IN MALAYSIA

BIM in Malaysia has been widely known by most of the construction industry players. Under the Malaysian government's initiatives, BIM is listed as one of the twelve emerging technologies to boost the level of BIM adoption among industry players, especially throughout the whole construction projects. In Malaysia, CIDB has carried out and published two reports on the adoption of BIM among industry players in 2016 and 2019, respectively. Why is there a need to transform the Malaysian construction industry into a BIM working environment? The evidence that comes out from the Malaysia BIM Report 2016 and 2019 has projected a good outcome for the adoption. In 2016, the adoption level among construction industry players was recorded at 17%. Surprisingly, the adoption level significantly rose within three years (2019), with the adoption level recorded at 49%.

Whilst there is previous evidence of BIM adoption increment amongst industry players, BIM use is still immature, especially amongst the Small and Medium Enterprises (SMEs) players (Hore, McAuley, & West, 2017). Why is BIM important to transform the conventional working environment? Generally, the construction industry is one of the industries that continue to lag behind other sectors, especially in digitalisation. However, BIM has been identified as an emerging technology that provides the opportunity to transform the conventional working environment towards a more productive, competitive, and higher quality outcome (J. Boon, 2009).

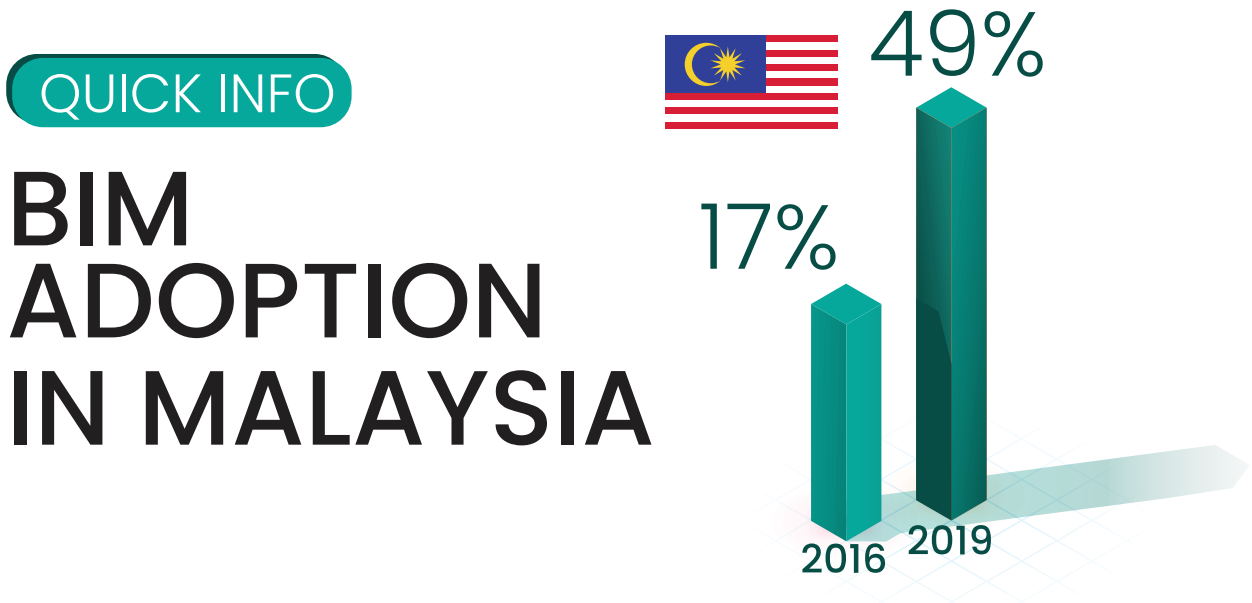
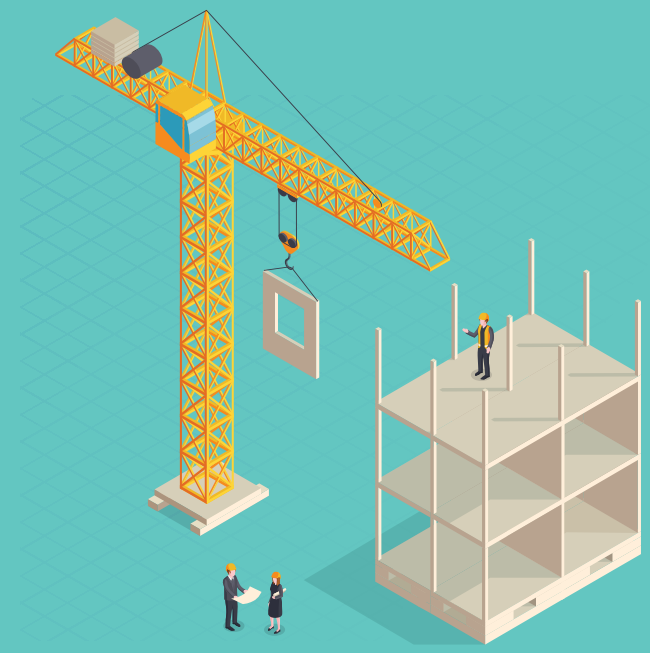


Figure 2. BIM adoption rate among construction industry players in Malaysia



2.1 BIM ADOPTION ACROSS CONSTRUCTION PROJECTS

The establishment of the Construction Industry Transformation Programme (CITP) 2016-2020 has brought a new light to the Malaysian construction industry. Under CIDB Malaysia, BIM has been set as a Key Performance Indicator (KPI) under Productivity Thrust which targets private and public building projects above RM10 million to adopt BIM by the year 2021. This early initiative has assisted the BIM industry to deliver construction projects in Malaysia through the full support of government agencies, for example, CIDB and Jabatan Kerja Raya (JKR). The role of both agencies as well as other professional associations in enhancing the implementation of BIM in Malaysia has significantly brought a positive impact on the development of BIM in Malaysia.

Along with the implementation of BIM, there are some issues and challenges that have been faced among the industry players to deliver their projects, for instance, cost. Cost has been identified as one of the main challenges that inhibit the application of BIM in construction projects due to the high initial cost and renewal of software. All of these issues must be tackled wisely to ensure the benefits of BIM can be reaped perfectly. Nevertheless, up until today, there has been no research or study purposely done to evaluate the implementation of BIM throughout construction projects, including building and infrastructure project type.

A study needs to be done to evaluate the effectiveness of BIM adoption focusing on the construction projects in Malaysia. To achieve the KPI listed under Productivity Thrust, a study on the effectiveness of BIM for construction projects worth RM10 million and above has been carried out to monitor and evaluate the impact of BIM in the Malaysian construction industry.

This report is the first outlook to monitor the evaluation of BIM effectiveness among construction projects in Malaysia. The survey questionnaire has been used as the approach method in collecting the data and responses from a total of 517 respondents that represent different types of projects including public and private sectors. The survey questionnaires were disseminated to the respondents via several online platforms and methods, such as digital blasting and online surveys due to the Movement Control Order (MCO) by the government to prevent the spreading of COVID-19. For this survey to be a success, we rely on the support and contribution from many organisations representing their own experience to express their opinion and ideas regarding BIM implementations in projects.

The survey questionnaire consists of ten sections, with each section carrying out its objectives to collect responses and opinions from the respondents. This report succeeded in collecting a total of 517 construction projects from the respondents. The details are shown in Figure 3.

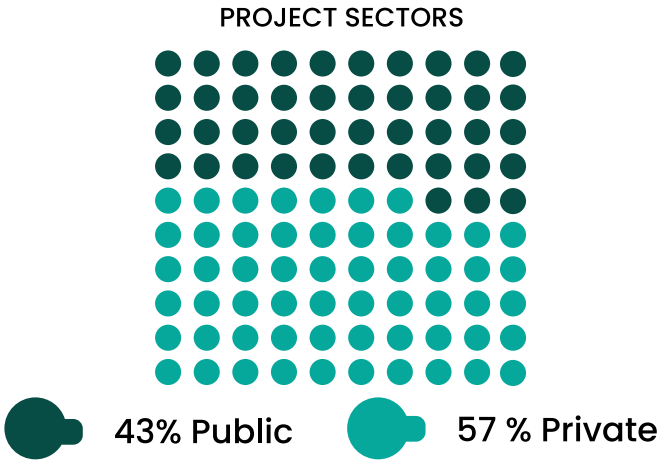


Figure 3. Project sectors from the survey

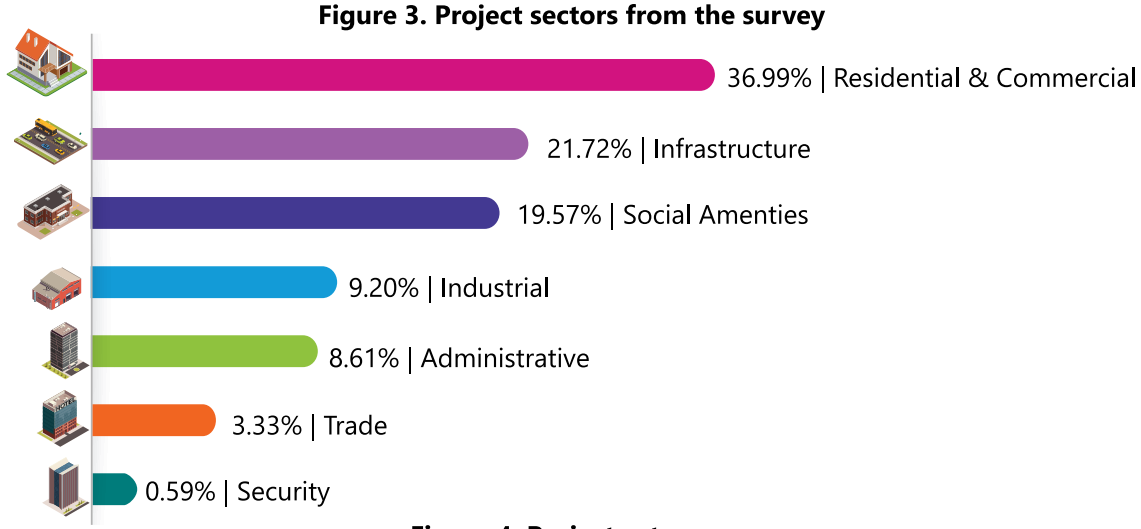


Figure 4. Project category

Figure 3 and Figure 4 reveal the categories and sectors of the projects from the data collection. As shown above, 57% of the projects come from the private sectors, while the remaining 43% represent the public projects in the Malaysian construction industry. Meanwhile, the data also shows the distribution of project categories into seven main categories: residential and commercial, infrastructure, social amenities, industrial, administrative, trade, and security. The highest project category was recorded at 36.99% for residential and commercial, while only 21.72% of the respondents represented infrastructure projects. Each of these projects collected through the survey questionnaire

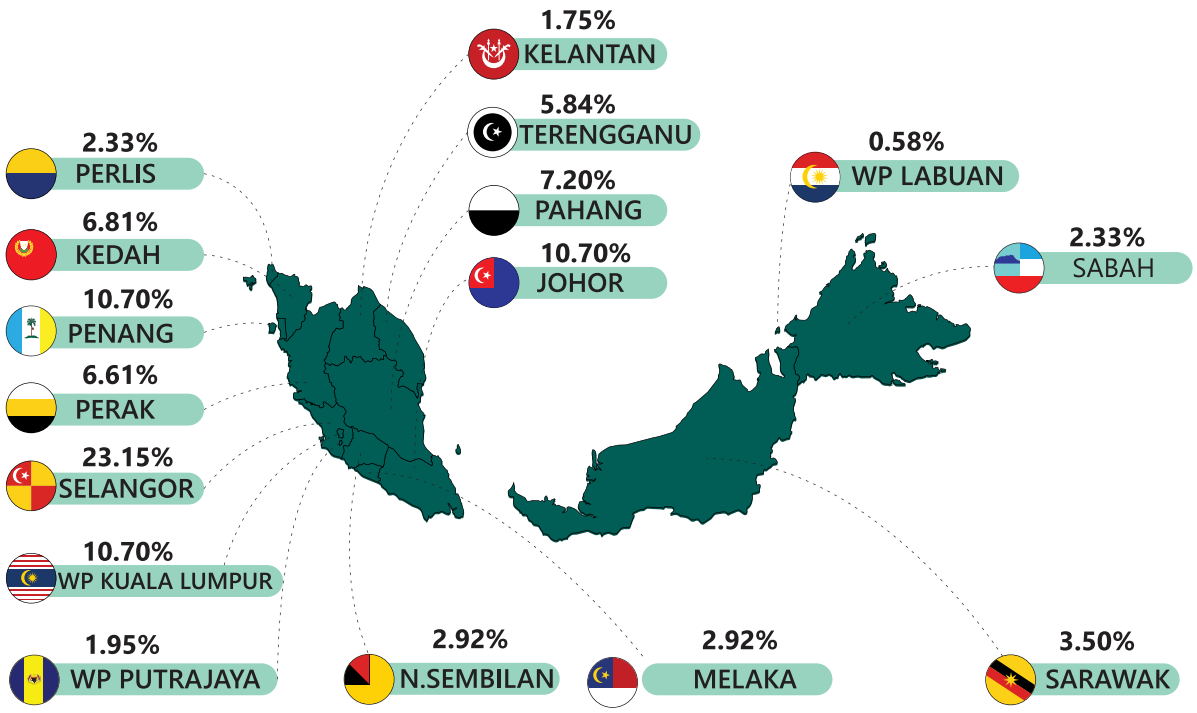


Figure 5. Respondents project state

Figure 5 shows the distribution of construction projects according to states in Malaysia. From the map, Selangor has recorded the highest response from the respondents with 23.15% from the total construction projects, followed by the Federal Territory of Kuala Lumpur (10.70%), Johor (10.70%), and Penang (10.70%). In Malaysia, most of the construction projects are located in the Klang Valley area where it contributed to the highest number of respondents who answered this survey from this area.

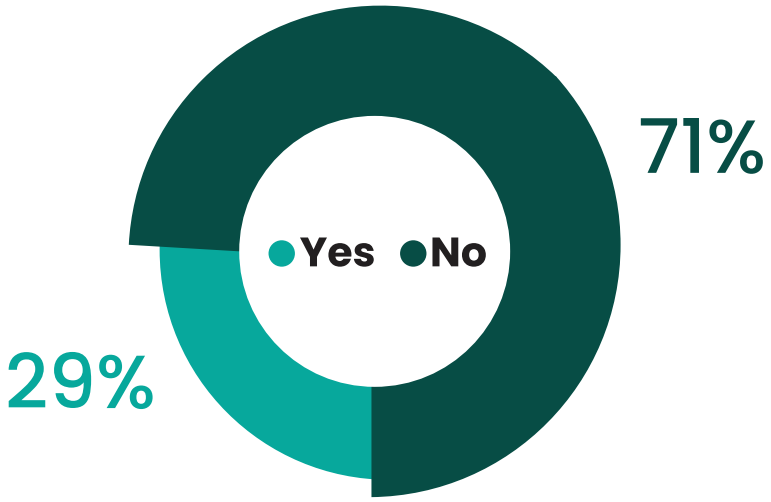


Figure 6. BIM Implementation in Construction Projects

To assess the effectiveness of BIM projects in Malaysia, it is important to know how much the adoption level has been achieved throughout the years. As this is the first look at BIM adoption throughout construction projects, it will become a benchmark for the level of adoption in the future. Figure 6 displays the percentage of BIM implementation in 517 construction projects in Malaysia. From the pie chart, about 71% of the construction projects (365 construction projects) did not implement BIM in the projects, while the remaining 29% have adopted BIM throughout the construction life cycle. However, let's take a look at a more detailed analysis of the BIM adoption level by comparing the public and private sectors, type of projects, as well as state adoption.

BIM IMPLEMENTATION ACCORDING TO SECTOR

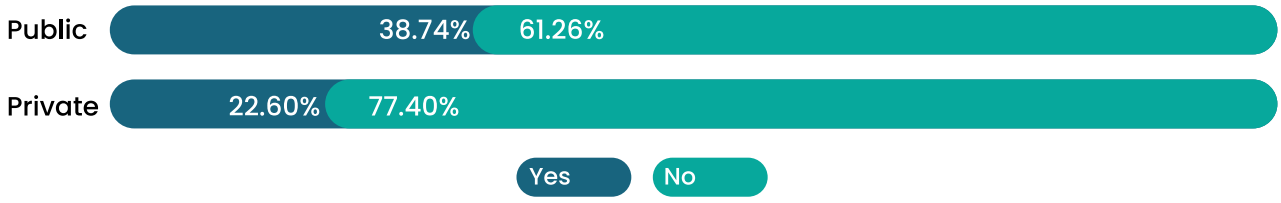


Figure 7. Percentage of BIM Implementation for public and private sectors

Based on our analysis of the sectors (public and private) as shown in Figure 7, the adoption level of BIM in the public sector (38.74%) projected a higher rate of adoption compared to the private sectors (22.60%). The data revealed a good indicator of the rate of BIM adoption in government projects. The reason might be due to the enforcement of BIM usage for government projects worth RM50 million and above, as well as the need for change by our construction industry players to move into digitalisation.

Table 2. Summary of BIM implementation by comparing according to the public and private sector

BIM Implementation	Public Sector	Private Sector
Yes	38.74% (*86)	22.60%(*66)
No	61.26%(*136)	77.40%(*226)

***Indicate the number of projects**

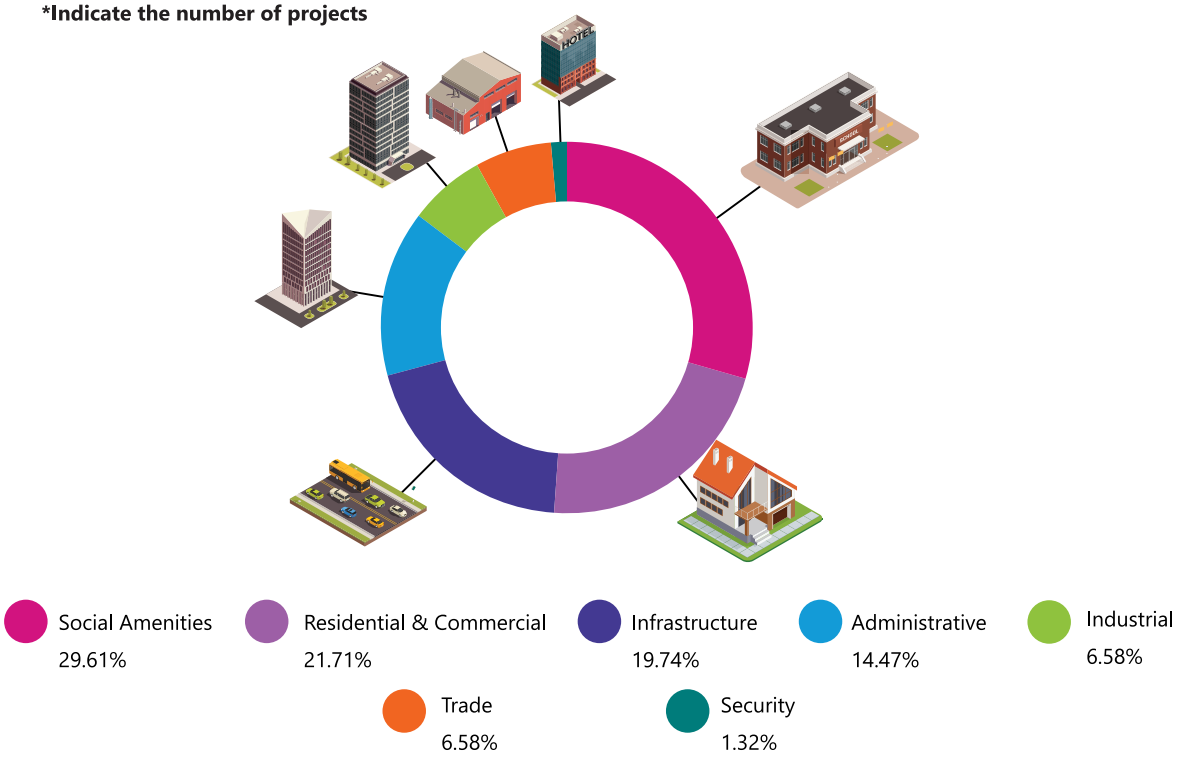


Figure 8. Percentage of BIM adoption for project type

Figure 8 depicts another crosstab analysis of BIM implementation among project types. By zooming into the 29% of BIM adoption in the construction projects, the data shows that social amenities display a higher percentage of BIM adoption (29.61%) compared to the other project types, such as residential and commercial (21.71%) and infrastructure projects (19.74%). Through the analysis, most of the social amenity's projects were used for the construction of schools, hospitals, public clinics, and educational institutions. The initiatives for the implementation of these projects came mainly from government requirements which exhibit a good example to be implemented in future projects.

Table 3. Summary of BIM Implementation according to Project Type

Project Type	BIM Implementation	
	Yes	No
Residential & Commercial	21.71%	43.45%
Infrastructure	19.74%	22.56%
Social Amenities	29.61%	15.32%
Security	1.32%	0.28%
Administrative	14.47%	6.13%
Industrial	6.58%	10.31%
Trade	6.58%	1.95%

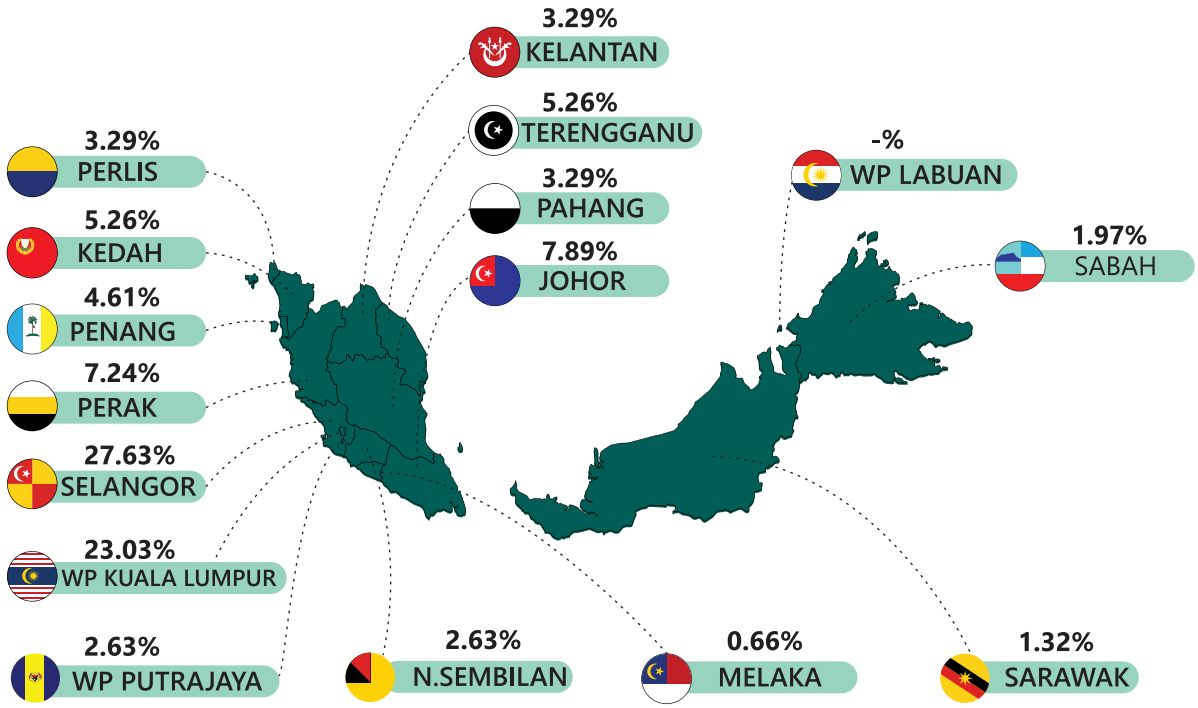


Figure 9. Percentage of BIM adoption according to the state

Another analysis was made by analysing the adoption of BIM within the states in Malaysia as revealed in Figure 9. From the map, Selangor projected the highest percentage of BIM adoption for construction projects (27.63%), followed by the Federal Territory of Kuala Lumpur (23.03%) and Johor (7.89%). The rapid development that is currently happening in the Klang Valley area has caused most of the construction projects to implement advanced technology to cope with the current demands and situations. Moreover, the rise of development in the state of Johor also led to the rise of construction projects in the southern area of Malaysia, especially near Singapore. However, it is crucial to have a look at BIM implementation in a certain state, for example, the Federal Territory of Labuan, Malacca, Sabah, and Sarawak, which projected a percentage of adoption of less than 2.00%. More awareness action should be enforced by the government and supported by the private sectors to enhance and increase BIM adoption for these states.

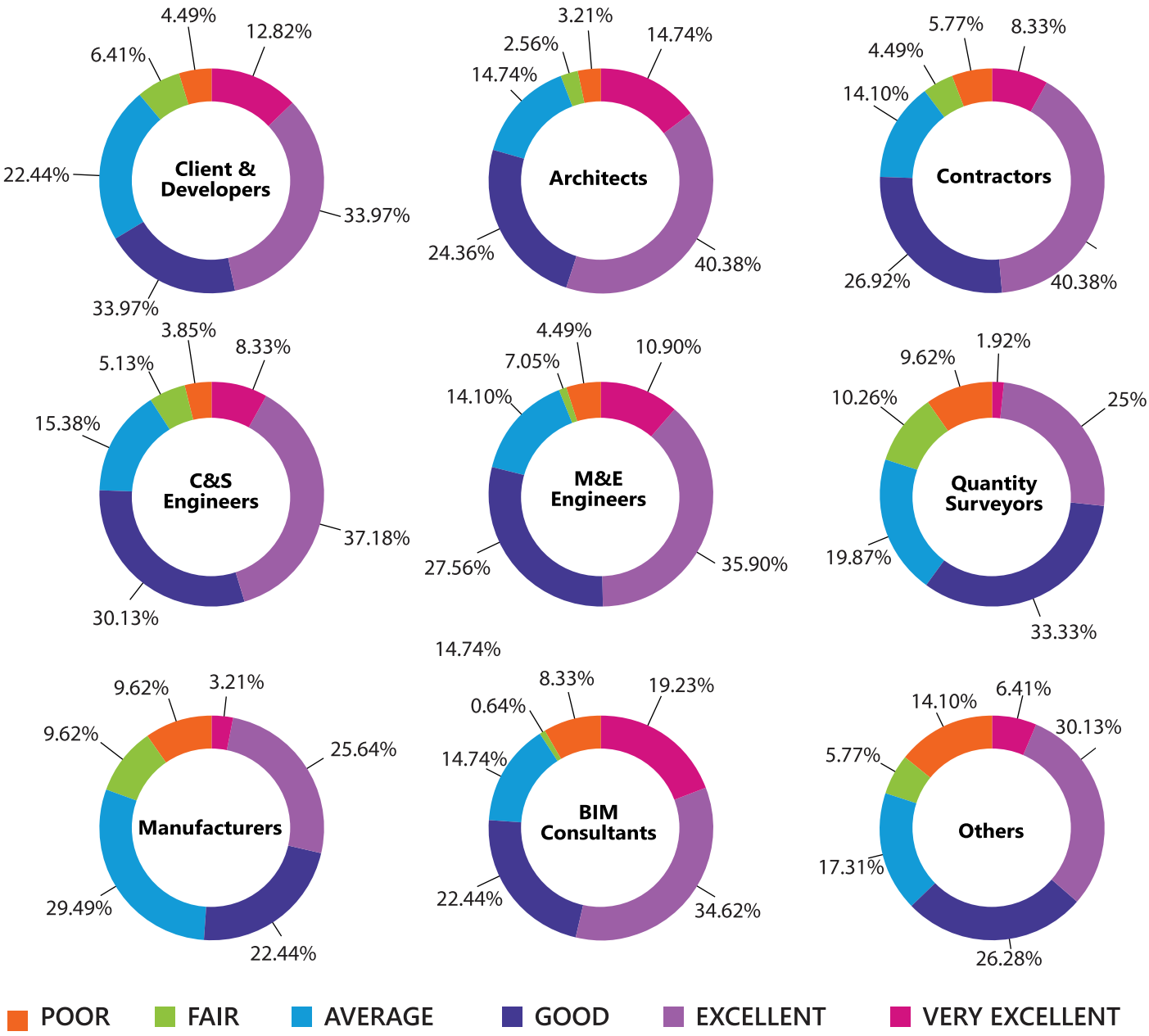


Figure 10. Perception of project team capability in the projects

The use of BIM throughout construction projects needs a highly skilled and competent worker to deliver the outcome. Without professional training and experience in BIM, it can lead to some delays and incur additional costs and time to achieve the target of the projects. Here, capability and capacity play an important aspect to ensure that the collaborative and integrated working environment could provide full benefits to the other stakeholders involved along the construction supply chain. Therefore, it is crucial to assess how one's stakeholders evaluate the project team's capability in the projects as shown in Figure 10.

From the survey, the graph above shows the highest percentage of Excellent ratings were agreed by the respondents in evaluating the Contractors and Architects with 40.38%. Meanwhile, the respondents also agreed that BIM Consultant provided the highest Very Excellent rating in delivering the projects with 19.23%. An average percentage ranging from 19.87% to 33.33% was agreed by the respondents who gave a Good rating for project team capability. How is this perception important for delivering the outcome and output of the projects? As BIM is a platform that requires a collaborative and integrated working environment, all parties must play a vital role to provide and deliver their best performances to ensure the smooth running of the project and eventually improve productivity.

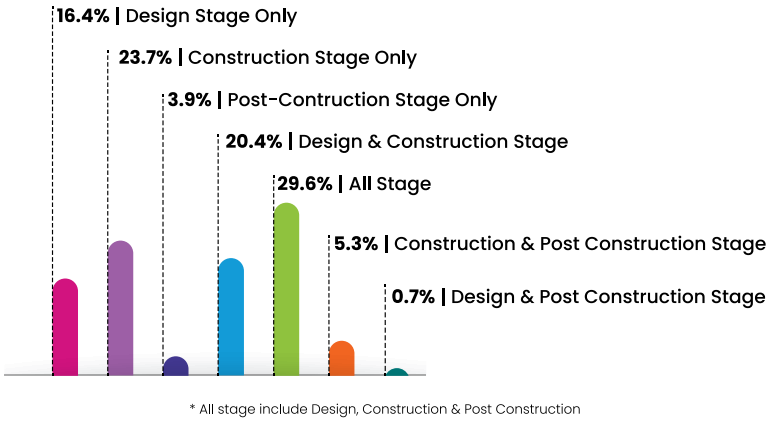


Figure 11. Comparison of BIM adoption at different construction stages

Measuring the effectiveness of BIM adoption throughout a construction project requires the evaluation for each of the three keys of the whole construction stage: design, construction, and post-construction stages. The survey assessed how much BIM is being implemented on each of the construction stages as shown in Figure 11. A detailed analysis was divided into seven categories, whereby 29.6% of all respondents have implemented BIM in every stage, starting from design, construction, and post-construction. Apart from that, 23.7% of the respondents have implemented BIM during the construction stage, followed by 20.4% for the design and construction stage. From these results, we can conclude that the data revealed BIM implementation has been widely implemented throughout all construction stages and is not only focused on a single construction stage. Eventually, the effectiveness and benefit of BIM can be reaped at the highest rate by implementing it through all construction stages.

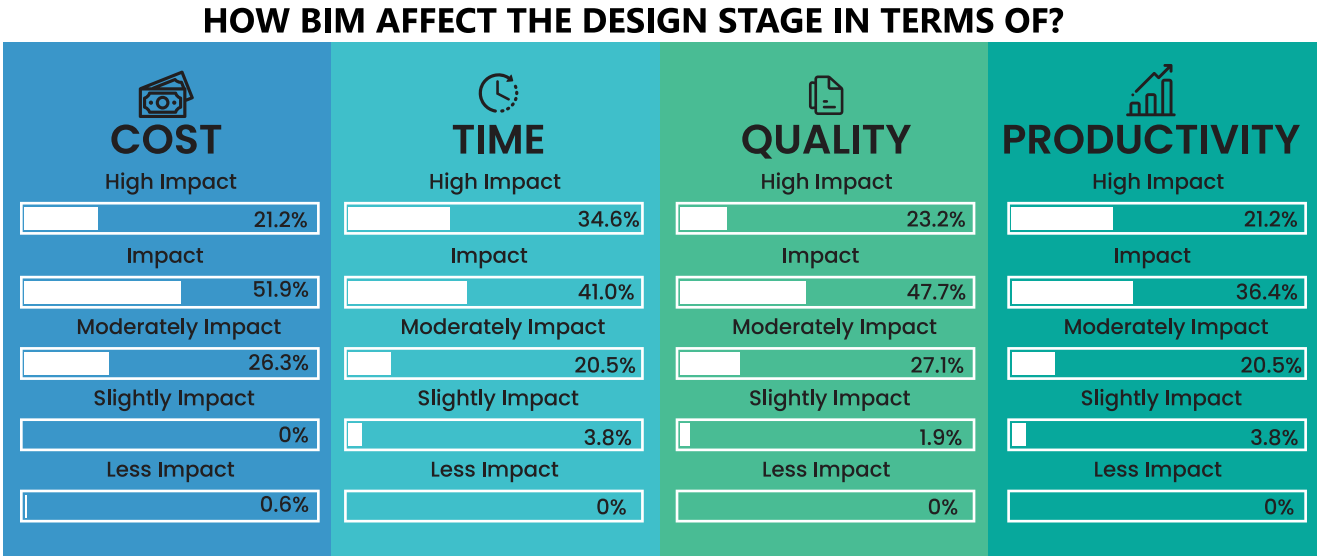


Figure 12. The respondents were asked how BIM affects the design stage in terms of cost, time, quality, and productivity

Cost, time, quality, and productivity were four elements that have been used as an indicator to assess the impact of BIM implementation. From Figure 12, 51.9% of the respondents agreed on the Impact rating scale on how BIM has affected the cost during the design stage. In terms of quality during the design stage, it was clear that 47.7% of the respondents chose the Impact rating scale, while an equal percentage of time and productivity was achieved as shown in the graph. It was clear that the cost factor played an important role during the design stage as it would reduce the cost of the project as a whole compared to conventional methods. Moreover, the ability to conceptualise the design and model before construction begins has enabled any sort of changes to be made earlier (Autodesk, 2016).

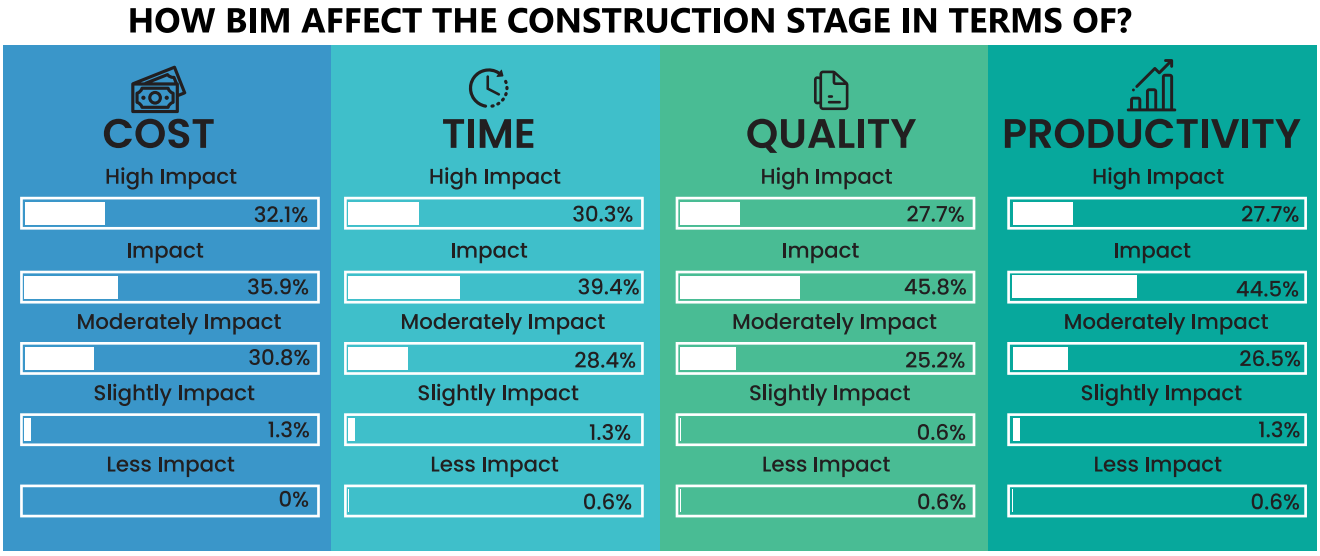


Figure 13. The respondents were asked how BIM affect the construction stage in terms of cost, time, quality, and productivity

The construction stage also plays a vital role in effective BIM implementation. Figure 13 reveals the results on how BIM affects the construction stages for all four parameters asked. From the graph, 45.8% of respondents agreed on the Impact rating scale that quality gave a big impact during construction stages, followed by the productivity aspect (44.5%). During the construction stage, the use of BIM enables all stakeholders involved to gain quality through proper coordination and collaboration. Eventually, it will improve the construction stage productivity for better outcomes.

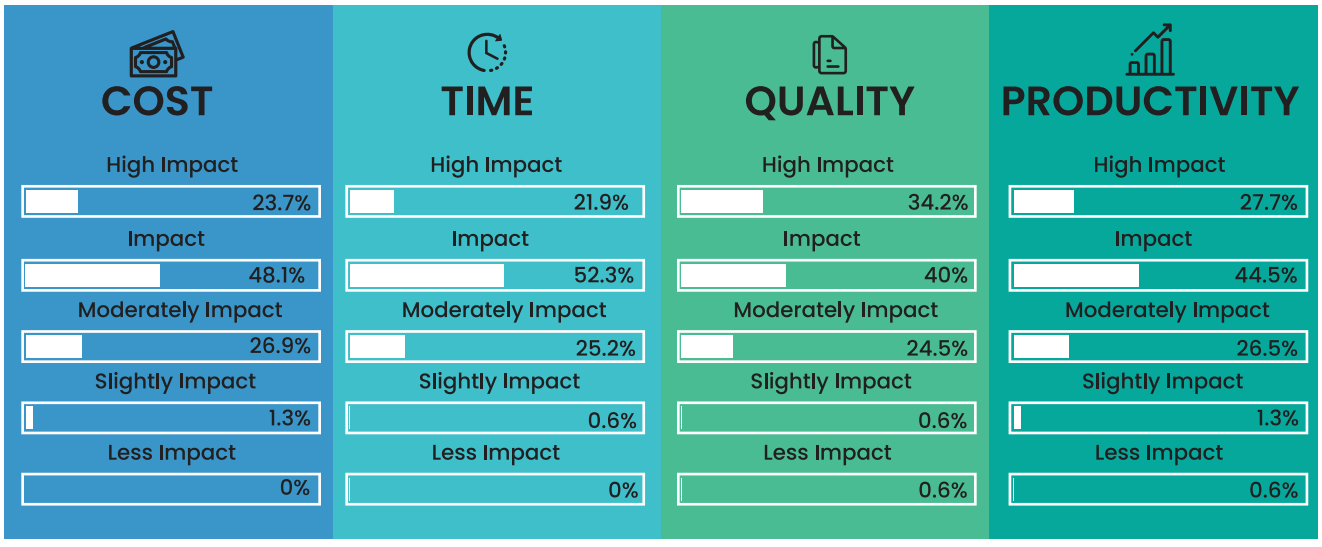


Figure 14. The respondents were asked how BIM affect the post-construction stage in terms of cost, time, quality, and productivity

The post-construction stage is a stage that involves the close-out phase, facilities management, and operation and maintenance phase. In this stage, the 'after-effect' of the construction stage will portray how much digital data has been stored and archived, starting from the design until the construction stage by using BIM. BIM enables the creation and storing of digital data and models which provide the necessary information for facilities management when needed (A2K, 2021). Indirectly, less time is needed to store, record, and search the as-built model, drawings, and all information by using BIM. The results also show that 48.1% of the respondents agreed on how much BIM gave an Impact rating in terms of cost for post-construction stages. Usually, for post-construction stages, it would require operation and maintenance works as well as the facilities management of the building or infrastructure. Here, BIM plays an important role to ensure the reduction of cost for these works through all information and digital data stored and collected in the BIM models.

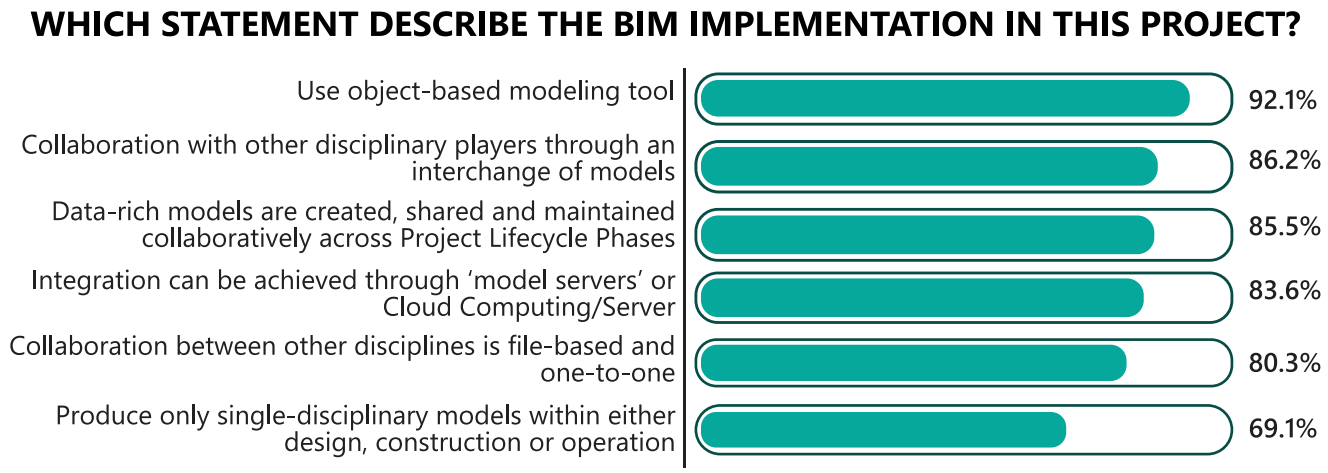


Figure 15. Statement on BIM implementation in the projects

Different projects have different approaches when it comes to the BIM implementation. In some projects, BIM is used only up until the design stage while in other cases, BIM is integrated and collaborated with all the stakeholders at every construction stage. Figure 15 portrays how far the implementation of BIM is being practiced in the projects. From the result, 92.1% of the respondents have only used BIM up to object-based modeling tools in their projects. However, the use of object-based modelling tools only constitutes a single discipline without integrating and collaborating with the other disciplines. Furthermore, about 86.2% of the respondents have collaborated with other disciplinary players through an interchange of models, for example using 'proprietary' formats (e.g. RVT) and non-proprietary formats (e.g. IFC). This statement proves that a collaboration with other stakeholders or disciplines has been made, but it is solely for the purpose of sharing the same format of models among the stakeholders involved. However, one thing to bear in mind is that BIM is a collaborative and integrated platform that enables different stakeholders to share and work together by using the Common Data Environment (CDE). This type of collaboration and integration have been agreed upon by 83.6% of the respondents whereby integration can be achieved through 'model servers' (using proprietary, open or non-proprietary formats) or Cloud Computing/Server, this is to allow complex analyses to be made at the early stages of virtual design and construction. By using cloud computing/servers in the early coordination and integration works, it will allow the stakeholders involved to decide on which type of format for the model is most suitable to be used to share and collaborate the model among themselves. Eventually, the use of a cloud-based BIM model will enhance collaboration and coordination throughout the whole construction process (CIDB, 2016).

WHICH BIM OBJECTS LIBRARIES DO YOU USE

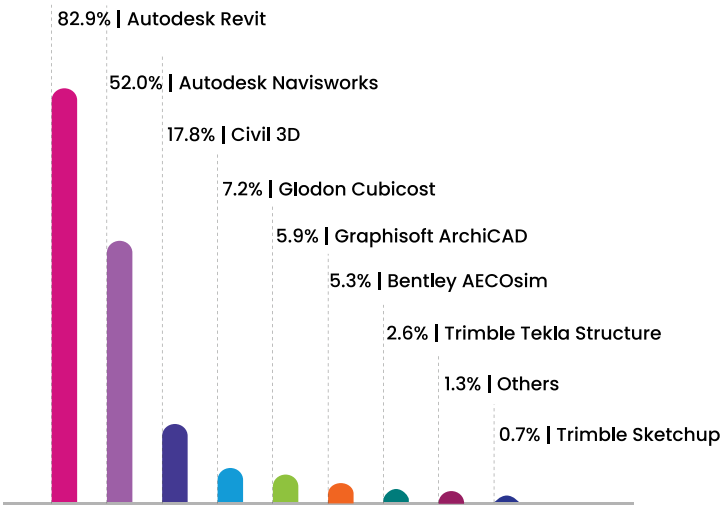


Figure 16. The main BIM tool for project implementation

In a BIM project implementation, choosing the right BIM tool to be implemented is one of the most important things because it will affect the delivery and outcome of the project. The adoption of BIM is facilitated by the use of various types of tools and resources. Figure 16 shows the percentage of the main BIM tools that have been widely used by most of the respondents in their BIM project implementation. From the survey results, it clearly shows that Autodesk Revit is leading as the most used and favoured BIM tool (82.9%) by industry players in their project, followed by Autodesk Navisworks (52.0%).

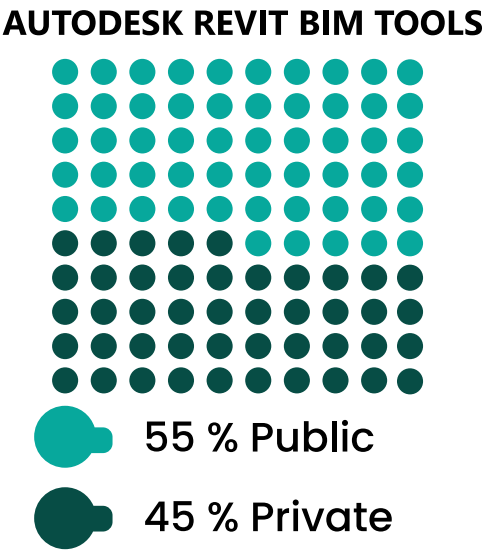


Figure 17. The rate of Autodesk Revit adoption vs Project Sector

An analysis has been made to check on how far the Autodesk Revit is being favoured by comparing the public and private project sectors that implement BIM. Figure 17 shows that the rate of Autodesk Revit adoption being used in public sector projects is 55% and the other 45% are private sector projects. One of the main reasons why public sectors prefer using Autodesk Revit compared to other tools is due to the written rule and requirement of government projects to use Autodesk Revit in BIM project implementation. JKR and CIDB are examples of authorities that encourage and expedite the use of Autodesk Revit through their professional BIM module course training, and one of the main factors that contributes to the high percentage of its adoption.

WHICH BIM OBJECTS LIBRARIES DO YOU USE?

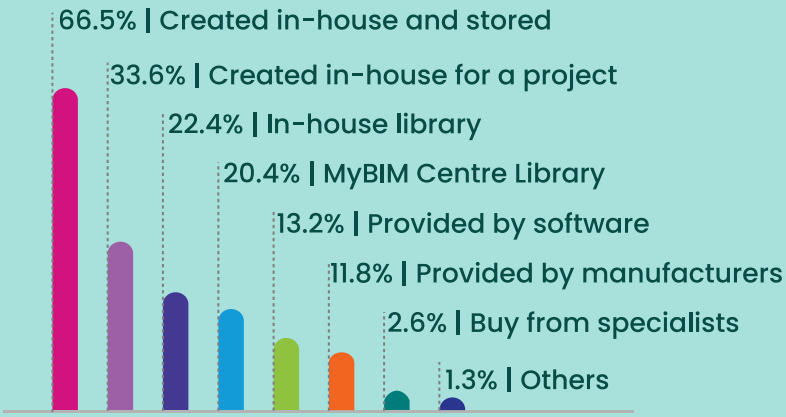


Figure 18. The most preferable BIM object libraries sources

BIM object libraries are important during the design process as it enables the designer to choose and design according to the requirements. In certain cases, the requirements needed by the clients are not in the standard size available so the designer has to create the objects themselves. This is where most of the respondents agreed that 66.5% of them have created in-house and stored the BIM object libraries in their server or cloud as shown in Figure 18. While the remaining 33.6% of the respondents also created in-house for a project and only 22.4% is from their in-house library. The most common way of acquiring the BIM objects is by creating the object in their own organisations and storing it for the use of future projects. The result also provided some interesting facts about the use of BIM object libraries from the myBIM Centre library (20.4%). Under the initiatives of CITP (2016-2020), the purpose of myBIM Centre is to establish the National myBIM Library which enables the practitioner to obtain and acquire their BIM object libraries for free, as well as encouraging and enhancing the industry players to use BIM. National myBIM Library was also established to cater as an accurate and up-to-date object library that will assist the practitioner to reduce the time taken for designing a new BIM object and delivering the project faster. A study conducted by NBS (2019) highlighted the issue of BIM object libraries sources whereby 62% of their practitioners have created the BIM object in-house and to reuse it later for future upcoming projects.

WHAT KIND OF SHARING PLATFORM DO YOU USE TO WORK COLLABORATIVELY?

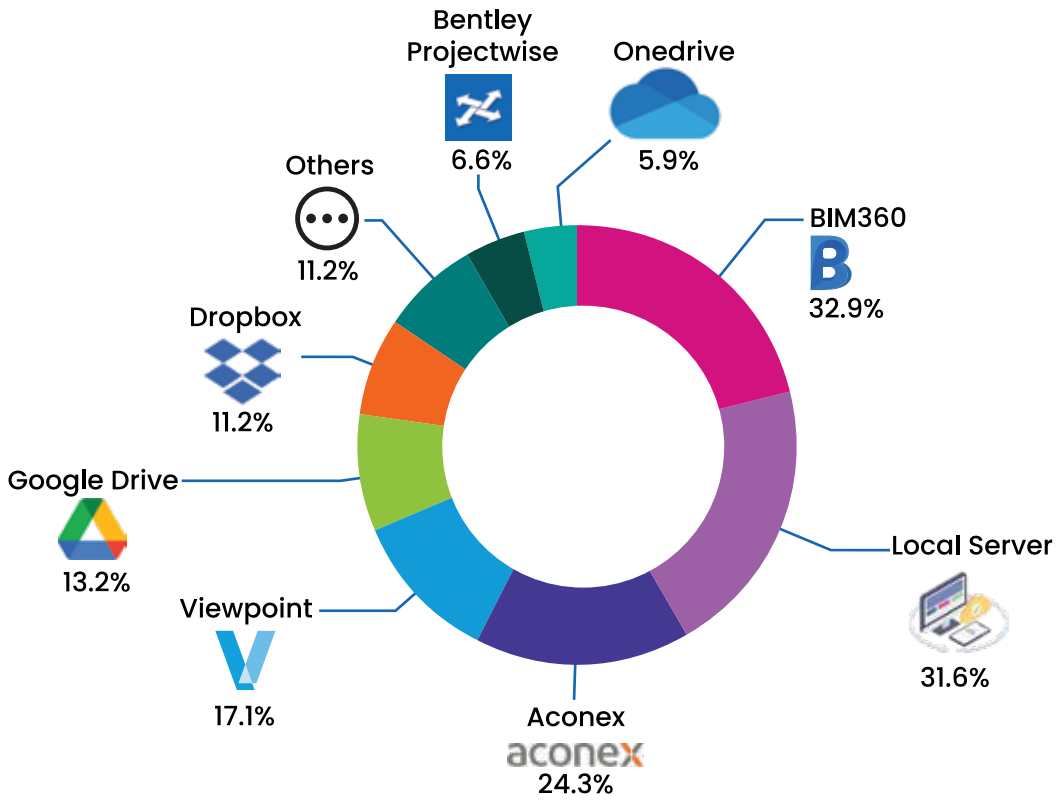


Figure 19. Various types of sharing platform

For the BIM to be effectively worked out, all stakeholders need to collaborate and integrate their work through the sharing platform or more commonly known as Common Data Environment (CDE). Figure 19 exhibits the different types of sharing platforms that have been widely used in BIM project implementation. The data shows that 32.9% of the respondents have used the BIM360 as their main sharing platform in their project team while 31.6% of them used their local server to work collaboratively. BIM360 is seen to be quite a popular sharing platform among Malaysian industry players as it ensures that projects become more efficient and productive. Apart from that, the sharing platform enables the stakeholders involved to store the data in an integrated place, where it will remove any redundancy and errors in the designated models as well as creating project team transparency (up to their needed level of access) (NBS, 2019).

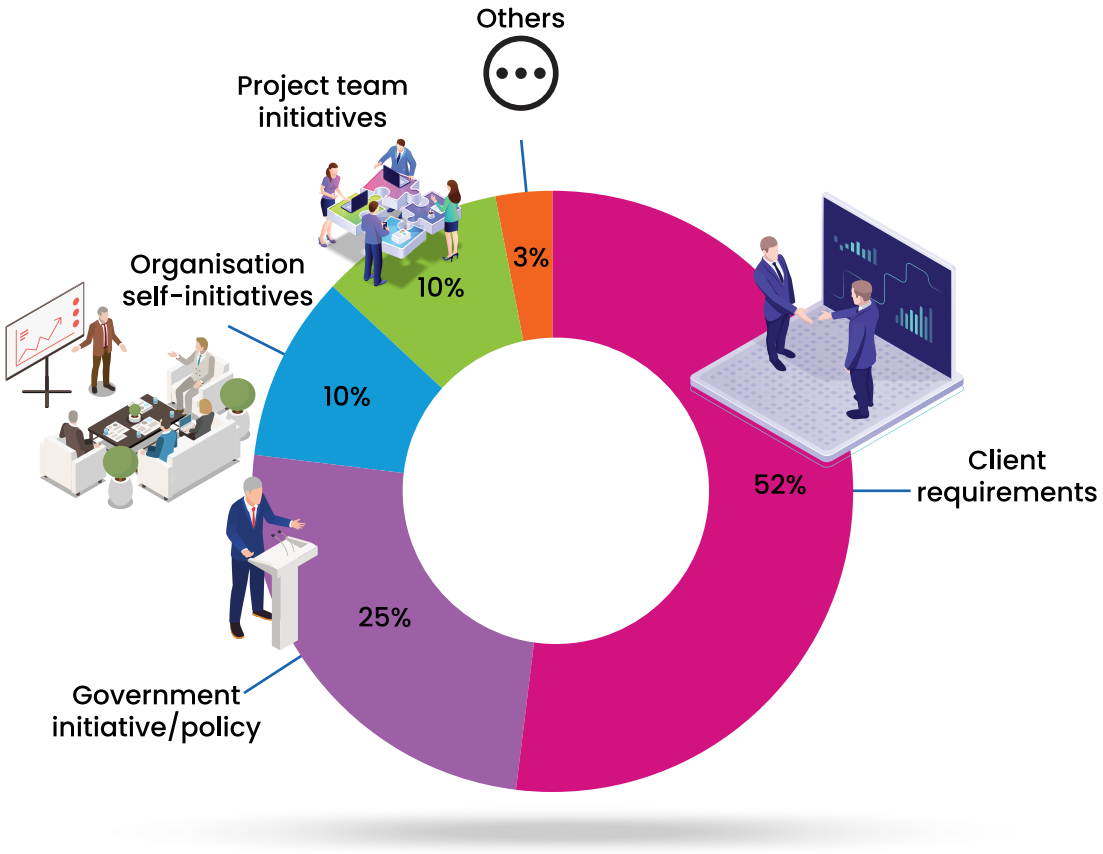


Figure 20. The main drivers for BIM implementation in projects

For BIM implementation, it is crucial to know who are the main parties that played a big part in changing the working environment from conventional to a BIM working environment. In Figure 20, the data shows that almost 52% of the respondents agreed that client requirements are the main driver in expediting the use of BIM in construction projects. JKR is the main authority body that leads public sector projects worth RM50 million and above to use BIM. Apart from that, the demand from most big private clients on BIM implementation for their construction projects is also one of the main factors that led to the high percentage of client requirements for BIM implementation. Moreover, initiatives made by Productivity Thrust in CITP and others through awareness and policy led to the 25% of the respondents saying that government initiatives/policy are the drivers for BIM in Malaysia. Some highlighted drivers could potentially be one of the main drivers in the future, one which is the organisation's self-initiatives.

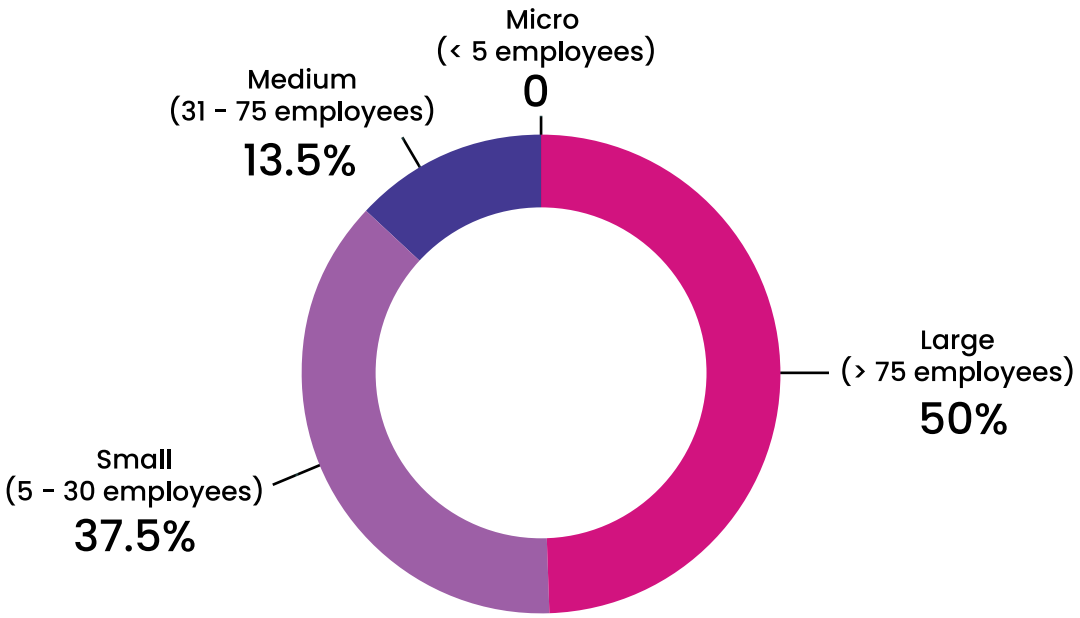


Figure 21. The distribution of organisation self-initiatives vs organisation size

Figure 21 shows the percentage of organisation's self-initiatives done to implement BIM according to the organisation size. From the result, it shows the highest initiatives by the organisation come from large organisations with more than 75 employees and 38% of them come from small organisations with only 5-30 employees. This can serve as great data in predicting the future implementation of BIM, especially among the SMEs because more than 70% of the industry players out there are SMEs. It could also be a form of motivation for other SMEs to move into BIM implementation through their organisation's self-initiatives.

HOW BIM AFFECT THE PROJECTS OUTCOMES IN TERMS OF COST, TIME, QUALITY & PRODUCTIVITY

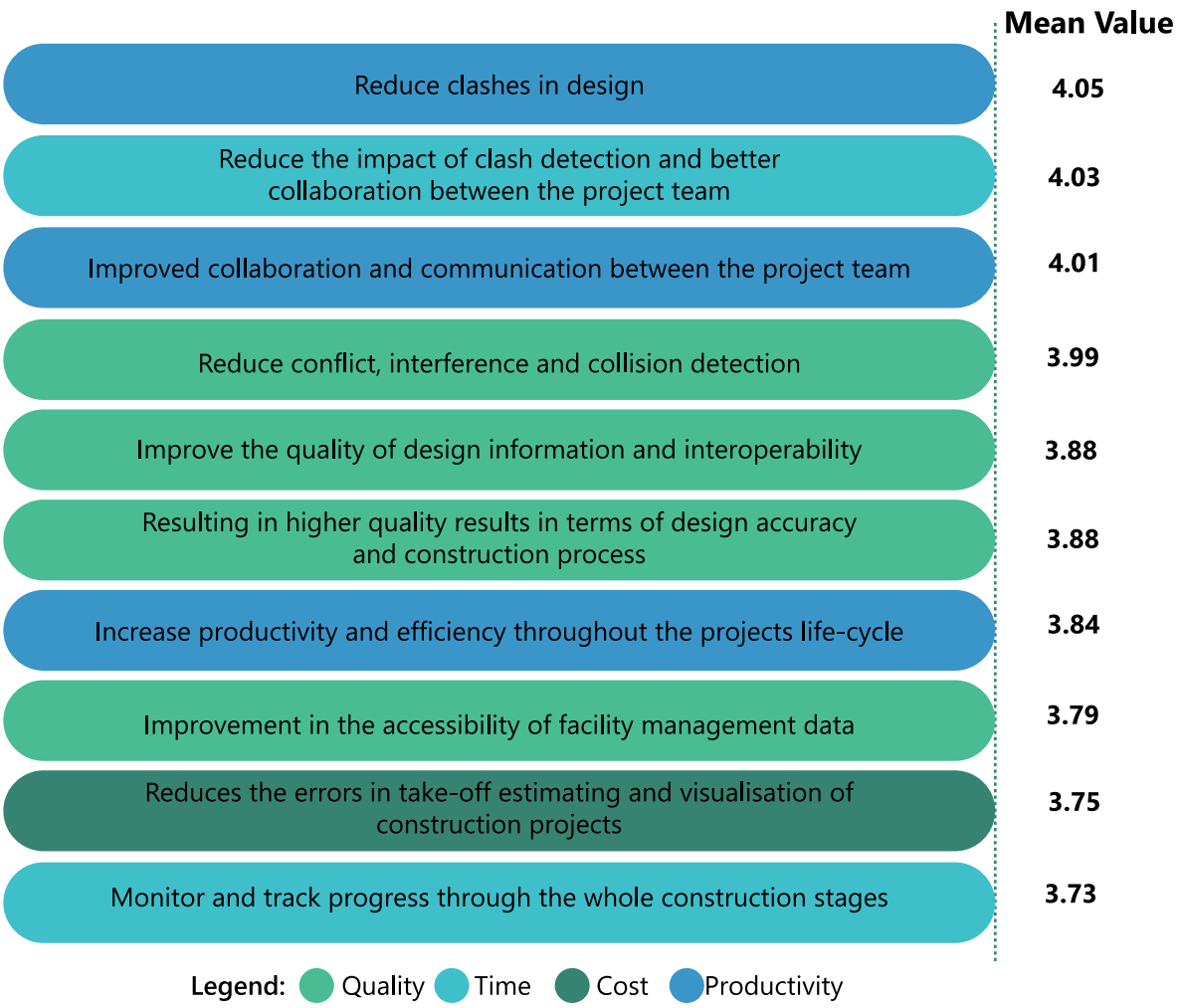


Figure 22. The respondent's views on BIM effectiveness in terms of Cost, Time, Quality, and Productivity

The respondents were asked for their opinion on how the BIM affects their project outcomes based on the four factors: Cost, Time, Quality, and Productivity. A 5-point Likert scale (Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, and Strongly Agree) was used to categorise the respondent's opinions. Figure 22 displays the result from the survey questionnaire conducted, where the biggest factor that could affect the BIM project outcome is by reducing the clashes in design which improves the productivity of the construction. This is followed by reduced time of impact of clash detection and better collaboration between project teams coming up next as the second-highest factors that would improve the project outcomes for BIM implementation. Logically, when the number of clashes has been reduced and solved during the design stage, it saves time as it does not need to be rectified at the construction site anymore. Moreover, the result also shows that BIM can improve collaboration and communication among project teams because a collaborative and integrated BIM working environment uses CDE and does early analysis.

2.2 ISSUES AND CHALLENGES

After analysing the input from the survey questionnaire, we can look into the main issues and challenges that affect the implementation of the BIM project as a whole. The data was analysed and grouped into five main categories: competency of all parties, coordination among project team, cost, human factors, and others.

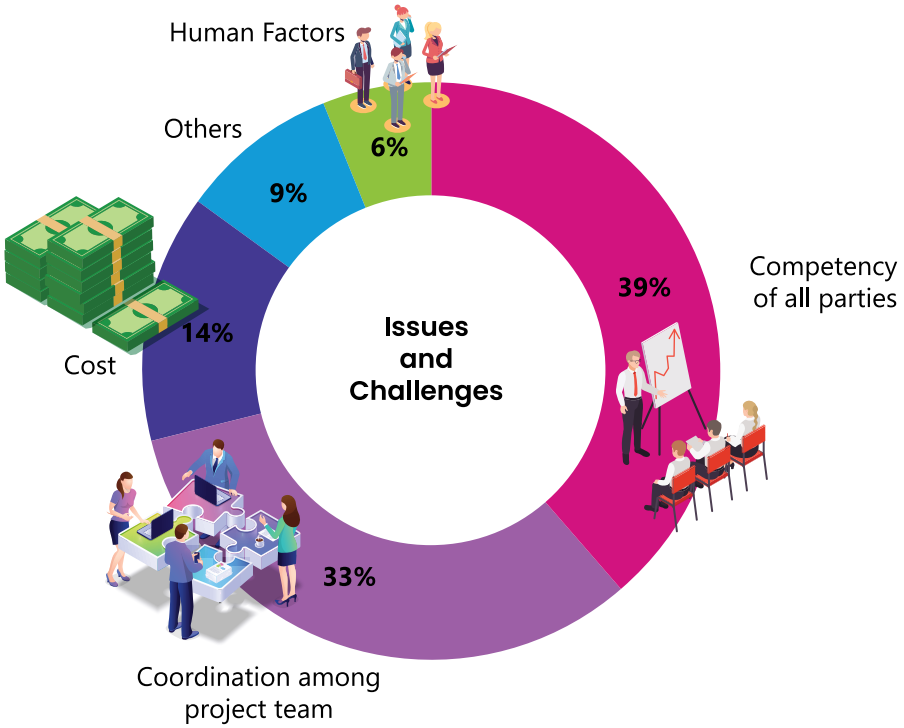


Figure 23. The main issue and challenges highlighted

All the respondents gave responsive feedback on the issues and challenges they faced on BIM implementation in their projects. All the issues and challenges were grouped into five main categories after the analysis. It is vital to know what are the main factors that affect the productivity and effectiveness of using BIM in their project. Next, further actions will be taken to address the issues and challenges highlighted to overcome the problems. There are few reasons why the BIM industry is still at its low intake. Based on Figure 23, the main issue and challenge highlighted is the competency. The competency of all parties involved plays an important role to ensure a good project outcome. Most organisations lack in having competent staff hence why they need more time and additional costs to deliver the BIM output. Also, if there is only one competent stakeholder equipped with BIM knowledge and skills while the others are not, it still would not work. Instead, more time and costs will be needed for the stakeholders to integrate and work well among themselves. In the end, it will affect the overall performance of the BIM project.

It takes a high level of coordination for the stakeholders to work collaboratively. Without good coordination among the players, there will be poor communication between the parties. Naturally in a construction project, the design or model will undergo various changes throughout the stages, therefore, if the coordination among the stakeholders is poor especially regarding the BIM workflow, it will affect the whole supply chain significantly. It will decrease productivity and eventually jeopardise the BIM benefits in terms of cost, time, quality, and productivity.

Next, the cost factors made up about 14% of the issues and challenges highlighted. When talking about cost, it includes the cost of buying new hardware and software to cope with BIM implementation. Not to be forgotten, the cost for upgrading the old hardware and software as well as maintenance and renewal costs need to be considered in implementing BIM for projects. For small SMEs, this might be costly as an upfront investment to implement BIM but it will benefit them in the long run.

2.3 BACKGROUND OF RESPONDENTS

About 517 respondents participated in this survey questionnaire report. They come from various organisational backgrounds with different working experience in the construction industry. Hence, each and every one of their opinions would be useful in this study regarding the BIM implementation. For a better overview, the respondents working experience and their BIM working experience is discussed further in Figure 24.

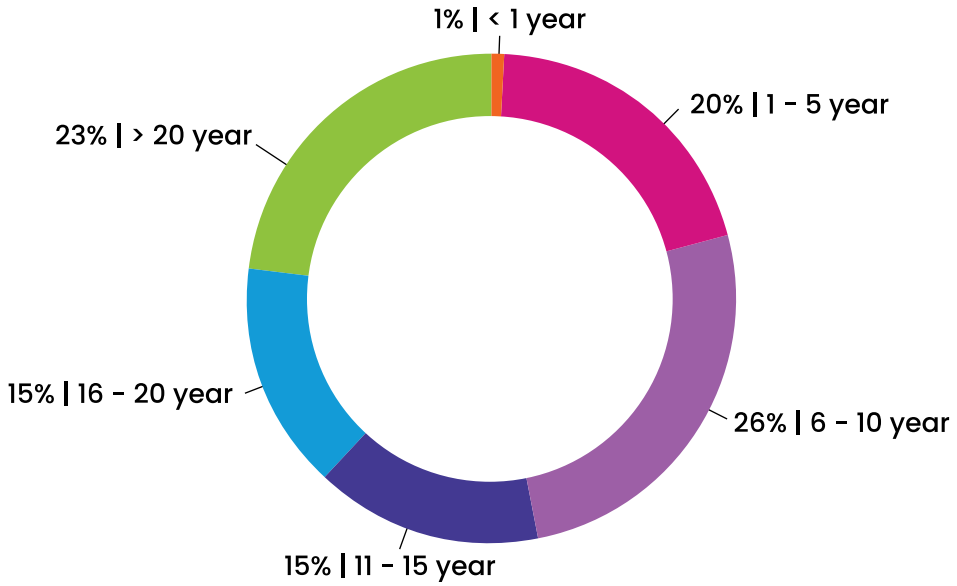


Figure 24. Respondents working experience in the construction industry

Respondent's working experience will give an impact on how productive the construction projects are being delivered. From Figure 24, the data shows that most of the respondents have 6-10 years of working experience (26%) in the construction industry while 23% of them have more than 20 years of experience. Only 1% of the respondents have less than one year of experience in the construction industry. However, a deeper analysis is made to see how many of the respondents in Figure 24 had experience in conducting BIM projects. The data is shown in the figure below.

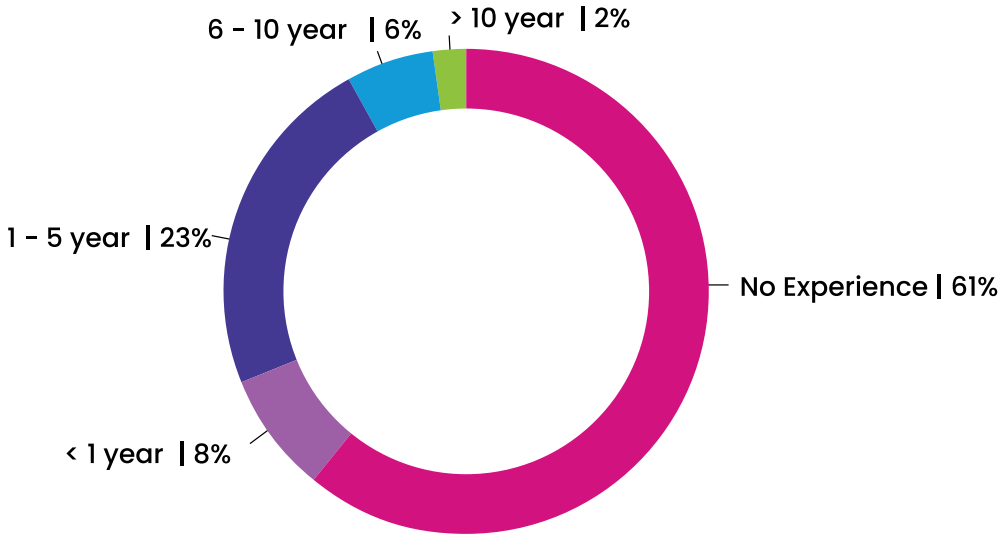


Figure 25. Respondents working experience in BIM

Most of the respondents (61%) do not have any background in using BIM for their projects, this constitutes the highest percentage among the other years of working experience in using BIM. However, the data in Figure 25 shows a promising prospect where 23% of the respondents do have 1-5 years of experience in using BIM. This shows that the young generation in Malaysia is gaining experience and exposure in using BIM. This is followed by 8% of the respondents who have less than a year of experience. To analyse the industry working experience with the BIM working experience, the data is shown in Figure 26.

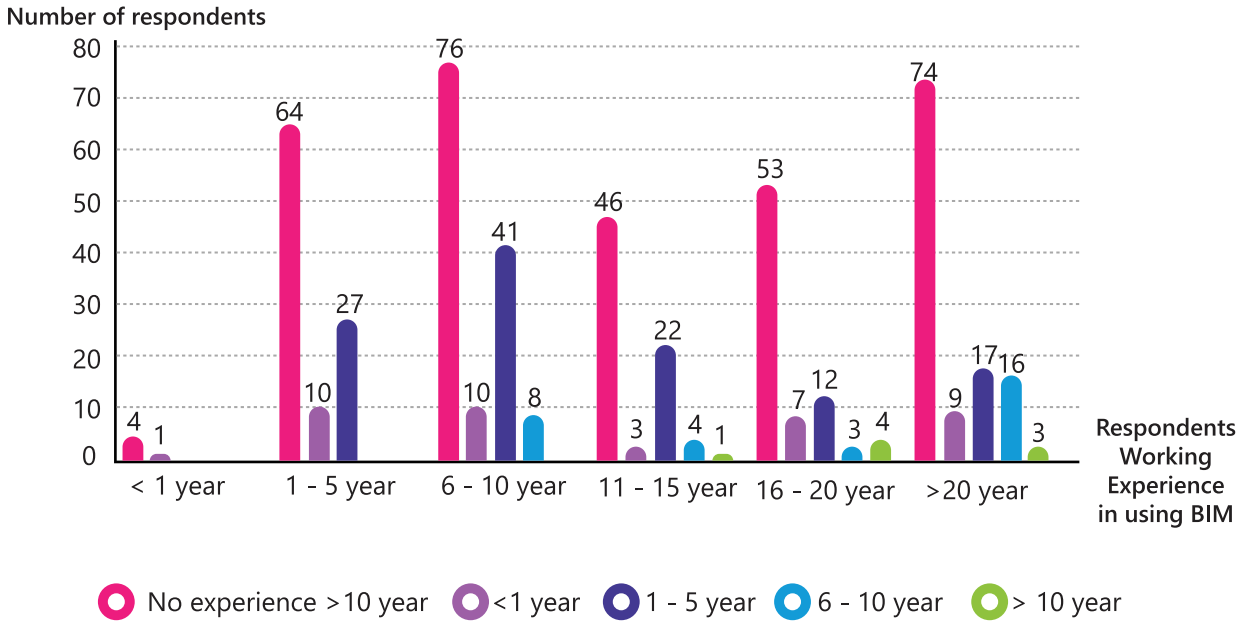


Figure 26. A crosstab analysis for respondents working experience in the industry vs BIM experience

Figure 26 shows the analysis made to see how many of the respondents have BIM working experience with regards to their construction industry working experience. From the graph, it shows that 41 respondents (6-10 years of industry working experience) have 1-5 years of BIM working experience followed by 27 respondents (1-5 years of working experience) who have 1-5 years of BIM working experience. However, the analysis of more than 20 years of industry working experience showed that about 17 and 16 of the respondents have 1-5 years and 6-10 years of BIM working experience respectively.

So, what are the factors that can be related to this working experience? One of the main factors that can be discussed in detail is how many of them have attended BIM professional courses to increase their competency and knowledge.

Table 4. BIM Professional course attended vs Respondents Working Experience

BIM Professional Course Attended	Respondents Working Experience					Total
	No Experience	<1 year	1 - 5 year	6 - 10 year	>10 year	
BIM Concept and Theory / related	0	24	66	20	4	114
BIM Fundamental Modelling (architects, C&S etc.)/related	1	17	56	22	1	97
BIM Coordinator/related	0	5	25	21	2	53
BIM Manager /related	1	1	8	14	3	27
BIM Facilities Management/related	0	2	2	6	1	11

Table 4 displays the analysis of the respondents' competency by evaluating the number and types of BIM professional courses attended with regards to their working experience. BIM Concept and Theory course/related projected the highest number of attendance at 114, where most of them were those with 1-5 years of working experience. Moreover, the highest number of same working experience also has been shown in the table for BIM Fundamental Modelling course/related attended (56 respondents) which enables most of them to become a BIM modeller in future. As the course progresses to be more difficult, the number of attendance also decreases. This can be seen as only 25 of the respondents have attended the BIM Coordinator course/related to increase their competency and knowledge. Furthermore, from the 6-10 years of working experience group, 14 of them have attended the BIM Manager course/related and six of them attended the BIM Facilities Management course/related. This can be considered a good indicator that the Malaysian construction industry will continue to expand their expertise and knowledge in BIM as long as the exposure of BIM to the young generations is consistently given.

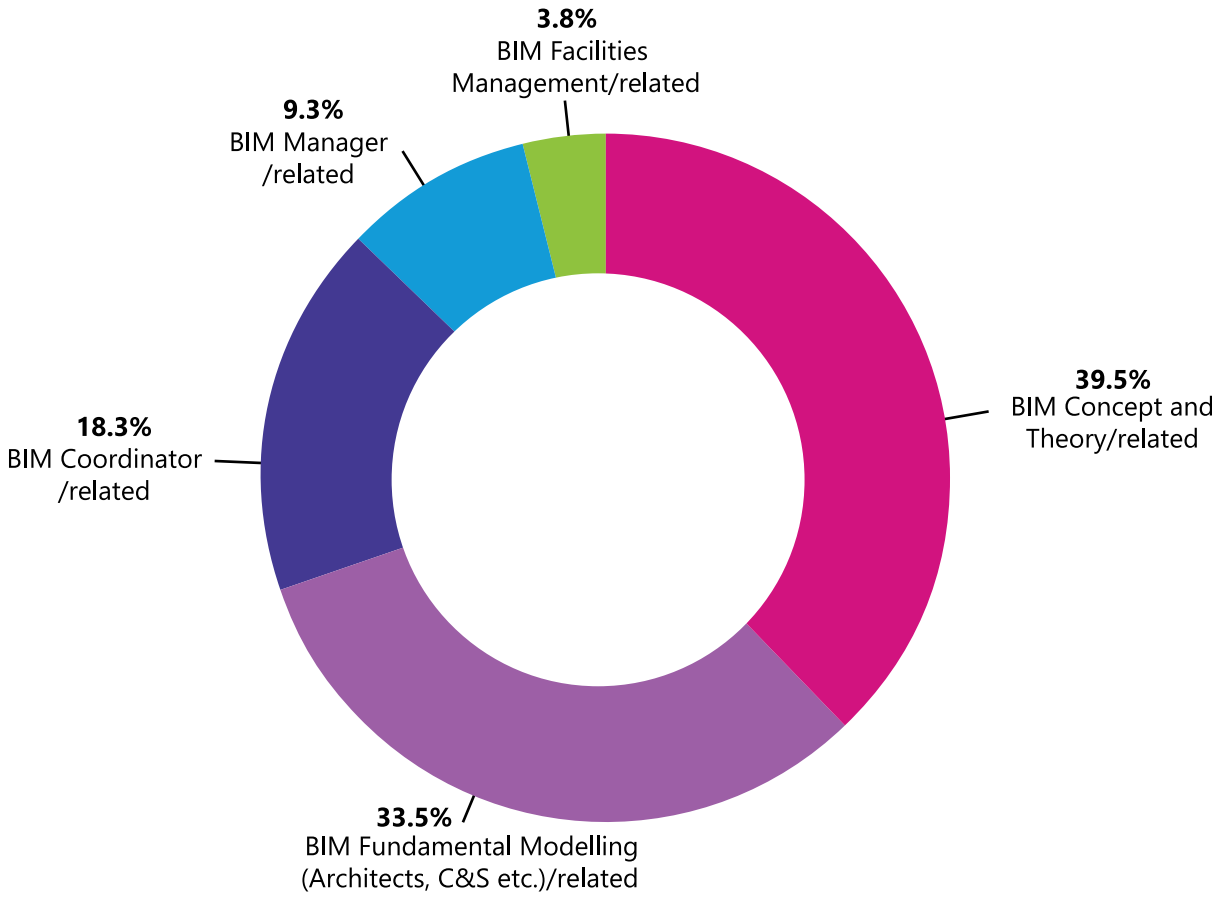


Figure 27. The most attended BIM course by the respondents

BIM Concept and Theory is the most popular course attended by the respondents. Early exposure is important to kick start the implementation of BIM in the projects as well as to build the capacity and capability of the individual regarding BIM. 39.5% of the respondents have already attended this course while 33.5% of the respondents have undergone the BIM Fundamental Modelling courses/related. The hypothesis that can be made from Figure 27. The most attended BIM course by the respondents is that as the difficulty of the course increases, the number of participants from the respondents decreases.

2.4 BACKGROUND OF ORGANISATION

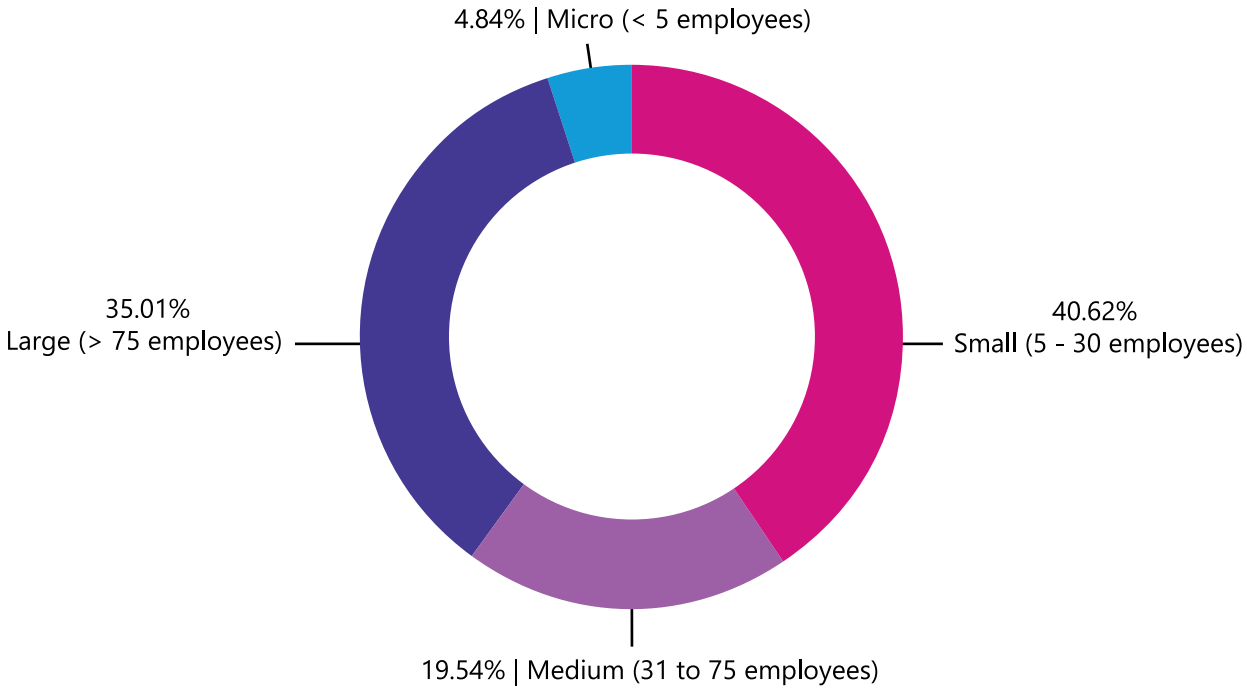


Figure 28. The size of organisation of the respondents

As shown in Figure 28, 40.62% of the respondents come from small organisation backgrounds with 5-30 employees. About 35.01% of the respondents are already in large organisations followed by medium-sized organisations (19.54%). This result prompted the question of how the size of the organisation gives impact on BIM implementation. Therefore, the next part will discuss further on the BIM implementation in the project with regards to the organisation size.

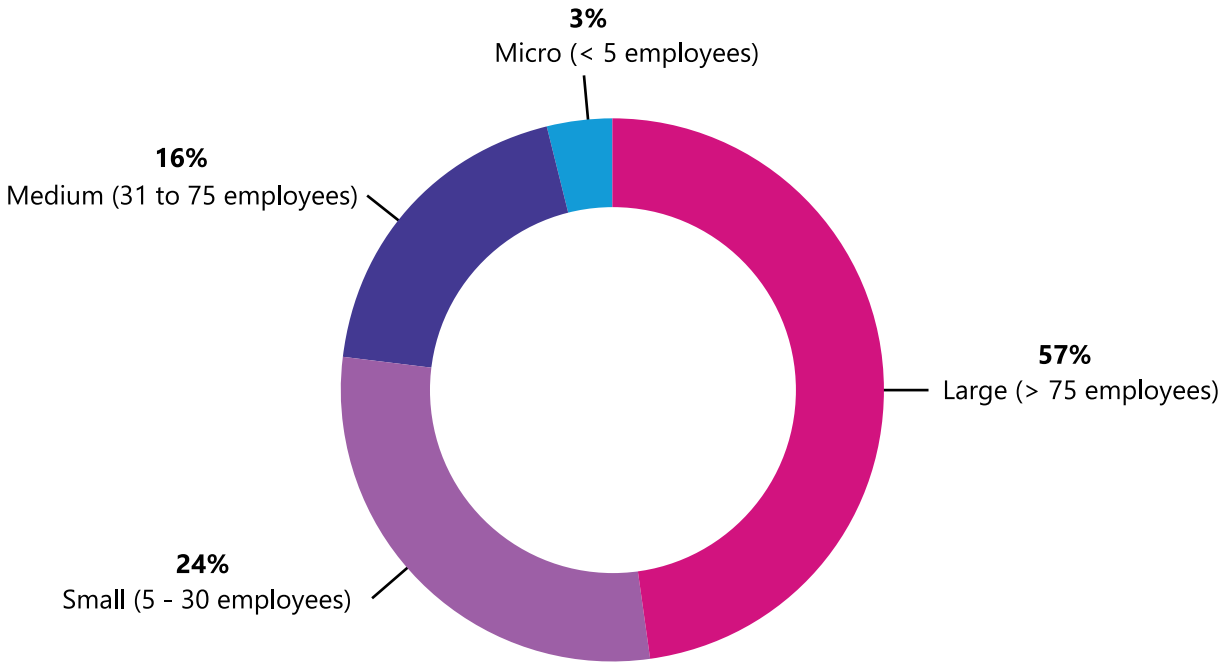


Figure 29. BIM implementation in the project versus organisation size

Figure 29 shows that most large-sized organisations implement BIM in their construction projects, mainly because most of them have the capacity and capability when it comes to manpower and financial stability. Nevertheless, the data also projected quite surprising results which is about 24% of the BIM implementation in this report came from small-sized organisations then followed by medium-sized organisations (16%). This is proof that despite only having a handful of employees, it does not act as a barrier for them to implement BIM in their projects and build up their capability well.

Figure 30. Nature of respondents' business

It was recorded that most of the respondents have a contractor background, this can be seen as it constitutes 67.3% of the total respondents followed by the Government with 12.8%. In general, contractors make up most of the industry players in the Malaysian construction industry, hence this might affect the results of the survey as most of the answers are from the contractor's point of view.

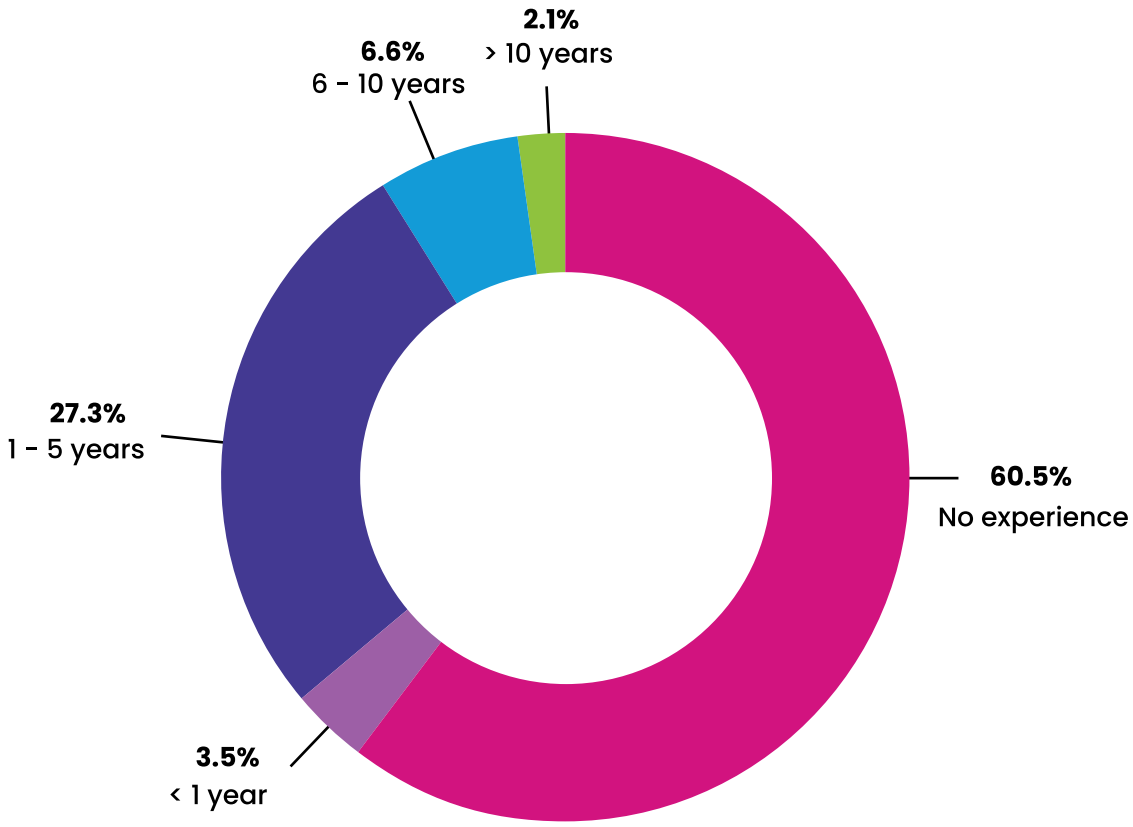


Figure 31. Organisation experience in using BIM

Based on the survey's result, an analysis of organisation experience in using BIM has been made to see how much experience has been obtained by the industry players. From Figure 31, the data reveals that 60.5% of organisations do not have any experience in conducting BIM projects while 27.3% of them have 1-5 years of organisation working experience in BIM. In the future, more approaches need to be done to focus on increasing the awareness and adoption of BIM implementation in projects, this includes all types of organisation sizes especially SMEs.

CHAPTER 3

WAY FORWARD

FUTURE OF MALAYSIAN CONSTRUCTION INDUSTRY

3.1 WHAT IS NEXT?

Slowly, BIM is currently changing the Malaysian construction industry to digitalisation. The awareness of BIM has been made before, but still, the level of implementation is quite low among construction projects. The need for a change is a must to ensure the industry is well equipped to enter the new phase of Construction Revolution 4.0, a subset of Industrial Revolution 4.0. With rapid development currently going on, the Malaysian construction industry should pay more attention to the initiatives that should be made to gain momentum for the upcoming digital transformation, especially among SMEs. So, are most of our industry players aware that BIM is a part of the digital transformation in Industrial Revolution 4.0?

ARE YOU AWARE THAT BIM IS PART OF EMERGING TECHNOLOGIES THAT WILL TRANSFORM THE CONSTRUCTION INDUSTRY TOWARDS THE FOURTH INDUSTRIAL REVOLUTION (4IR) / IR4.0?

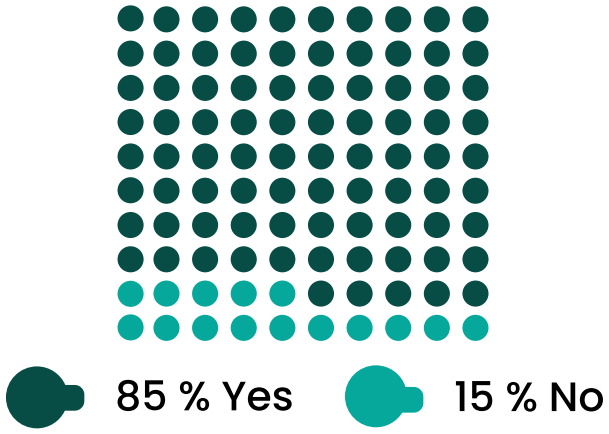
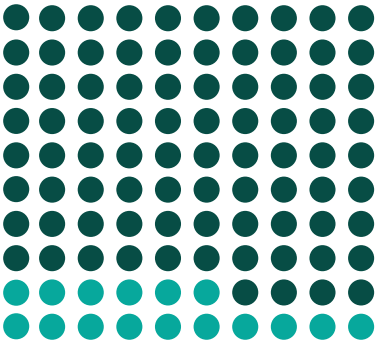


Figure 32. Awareness of BIM in IR4.0

85% of the respondents agreed that BIM has become an important part in emerging technologies for IR4.0. Only 15% are still not aware of how much BIM can change the whole ecosystem of the Malaysian construction industry throughout the supply chain. Awareness campaigns have been made for years on BIM implementation. Mandating BIM as a part of construction projects should be done as it will assist the industry players to smoothly ease into digital transformation, along with several initiatives and incentives to boost the construction industry players especially the SMEs.

ARE YOU INTERESTED IN ESTABLISHING OR USING BIM WITHIN YOUR ORGANISATION?



84 % Interested

16 % Not Interested

Figure 33. Establishing BIM in organisation

From Figure 33, the data reveals 84% of the respondents are interested in/already implemented BIM in their organisation due to the benefit gains during the whole construction stage such as cost savings, give positive impact to the industries, and improve the productivity of the construction. However, about 16% of the respondents are not interested in establishing BIM in their organisation. The reasons from the analysis are as follows:

Less exposure on the use of BIM in their organisation and projects

Cost for implementing BIM in terms of hardware, software, renewal, and maintenance

No enforcement from the authorities

No case for change into BIM working environment

Engaging third parties to run BIM projects

More time is required to learn new things

DOES YOUR ORGANISATION WILLING TO / ALREADY CHANGE FOR BIM IMPLEMENTATION?

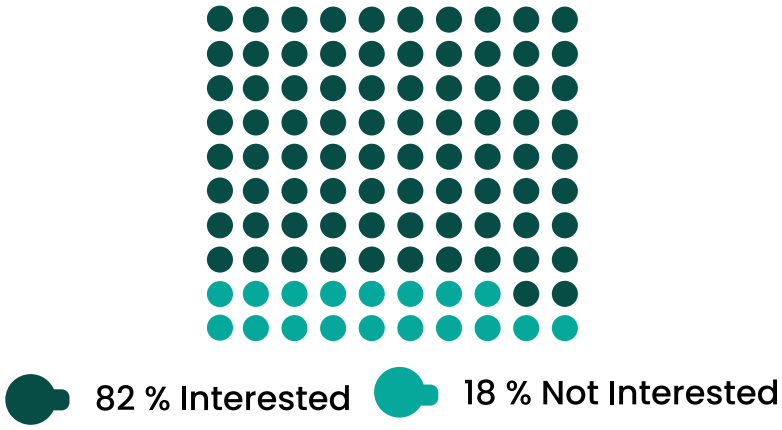


Figure 34. Willingness to change for BIM approach

82% of the respondents are willing to/already moved into BIM implementation in their projects and organisation whereas 18% of them are not willing to change for BIM implementation. The reason why most of the respondents agreed to change/already moved into BIM implementation is that majority of the contractors realised and see the benefit of using BIM in their projects for the long run. However, there are also some issues that hindered some organisations from using BIM in their projects, and there as follows:

a) Lack of expertise and BIM competent personnel in the organisation
b) High cost of implementation
c) Not a requirement in tender contracts

DO YOU HAVE ADEQUATE RESOURCES TO ASSIST BIM IMPLEMENTATION IN YOUR ORGANISATION?

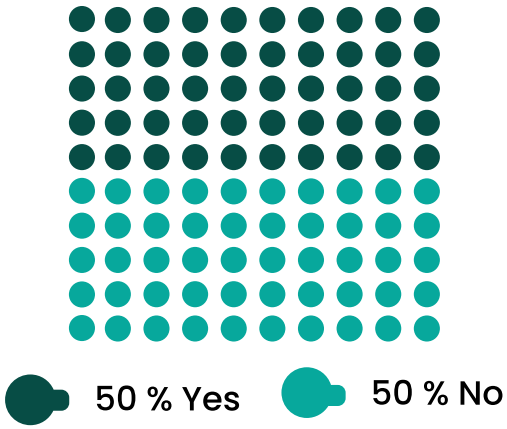


Figure 35. Resources adequacy

When talking about resources, it deals with the four main aspects: people, process, technology, and organisation. To ensure the best BIM implementation in the organisation and project, all these four elements must be well-equipped to give out the best project outcome. From Figure 35, the data shows an equal percentage of resources adequacy in terms of BIM implementation in their projects and organisation. For some organisations, they might have built the capacity and capability for the BIM approach through the professional BIM course, hiring the BIM personnel workforce, buying and upgrading the capable hardware to cope with the advancement of software and proper BIM workflows in their organisations. However, even with these existing resources, an organisation can still be inadequate to cater for BIM implementation, and these reasons are the reasons why:

CHAPTER 4

THE SUCCESS STORY OF BIM IMPLEMENTATION IN MEGA PROJECTS

CIDB MALAYSIA

A CASE STUDY
THE STORY BEHIND CONSTRUCTION OF

KLCC LOT L, M, N

OVERVIEW

KLCC has been known for quite a while for its iconic status as Twin Tower in Malaysia. However, the construction of new development, KLCC Lot L,M,N will change the whole Malaysian landscape for iconic skyscraper. The main contractor, KLCC Projeks Services Sdn Bhd has shared their insight of BIM technology adoption in their construction projects.

BIM FACILITIES & CAPABILITIES

The right amount of investment that has been made is hard to be justified as a lot of factors and variables need to be considered along with the projects. But it will involve the resources, including personnel, facilities, equipment, and software. About 1-2% of BIM resources from the total project cost will suit the BIM implementation.

ISSUES & CHALLENGES

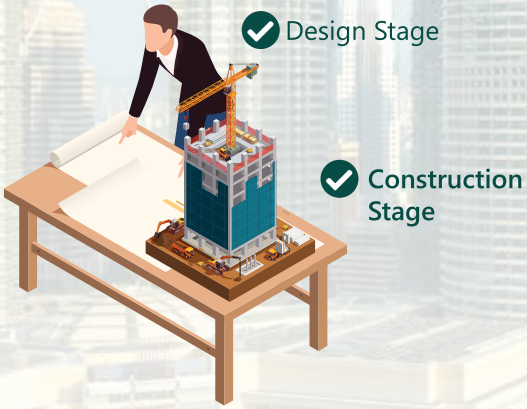
Several issues and challenges have been faced during the BIM implementation, for example the software limitation that contributes to work delays, etc. Furthermore, a proper coordination among stakeholders involved will rise during the design and construction stage. Currently, the consultants only need to design until LOD 200 during the design stage, but after the tender stage, they faced a lot of issues regarding the coordination of the 3D model. Moreover, the cost issue for the BIM hardware, software, and renewal are quite costly which affected their projects and organization where it become a stumbling block for our local contractor to maintain and renew the license every year as the renewal cost.

BIM INTEGRATION APPROACH

To ensure the competency of the staff, KLCC Projeks Services will send almost all of their staff to attend for the BIM professional courses, at least with some basic knowledge of BIM to ease the process of implementing BIM throughout the projects. In terms of work, the use of BIM360 has become a crucial part where all stakeholders involved can access, review, and check the BIM documents. Moreover, the use of online meeting platforms such as Microsoft Teams and Google Meet for daily and weekly meetings with the stakeholders involved regarding the clash analysis and resolved technical issues have helped to ease the project integration and collaboration. As for building the capabilities and capacities of BIM experts, they would engage with an external well-known consultant to deliver the training to their staff.

"In our organisation, the management would send almost all of us for the BIM professional courses starting from design up until facilities management. The KLCC employees must have at least some basic knowledge of BIM to ease the process of implementing BIM throughout the projects"

BIM IMPLEMENTATION PROJECTS LIFE-CYCLE



WHO ARE THE BIM DRIVERS IN THIS PROJECT?

Organisation Initiatives

APPROACH TO COUNTER ISSUES & CHALLENGES?

To counter on these issues, KLCC Projeks Services tries to ensure the local sub-contractor implements the BIM by engaging with international contractors that are already aware and have quite good knowledge about BIM. Later, these international contractor will collaborate and engage with the local sub-contractors to produce their model, run the clash detection analysis and assisted in terms of submission and inspection at the site. To achieve better coordination and collaboration, the consultants need to have BIM personnel ready and strong knowledge of BIM to deliver the outcome well. A qualified BIM competency personnel should well equip with the BIM knowledge, high knowledge to design and producing the model and drawing as well as familiar with the BIM process workflow.

DIRECTION OF BIM IN CR4.0

The progress of CR4.0 technology adoption might be slow, but it is already being implemented and gaining its pace from time to time. In fact, the implementations have been practised implemented in the industry, for example, Industrialised Building System, QR Code, Virtual and Augmented Reality, wireless sensor, and others.

COMMENTS & FEEDBACK OF BIM IN CR4.0

The digital information will fit into every phase of the project lifecycle because it enhances site collaboration and coordination. The launching of CR4.0 will benefit our construction industry to a wider level. Maybe, in 2025, the local contractor will have opportunity to embark on their project outside Malaysia. They believe this strategic plan will elevate the quality and standard of the local contractor to meet the level of international contractor standards.

"For future projects, we need to explore more tools and software that suit the projects because every project will require different kinds of software for the implementation of BIM and comply with Project Information Requirements (PIR).

MOTIVATION TO IMPLEMENT BIM

- Increase capability & capacity of BIM professional in organisation
- Exposure to the staff at least with basic professional BIM course

WAY FORWARD OF BIM

- Embark BIM at the design stage
- Explore more tools and software that suit the project requirements
- Expose our consultants and employeesto the international standard and ISO BIM certification

SPECIAL THANKS:

KLCC Projeks Services Sdn Bhd
Lot LMN & Infrastrucutre Mixed Development Project Office
9th Floor, Menara Atlan
161B, Jalan Ampang,
50450 Kuala Lumpur

A CASE STUDY

THE STORY BEHIND CONSTRUCTION OF

MRT

PUTRAJAYA LANE

OVERVIEW

The construction of the integrated public transport, Mass Rapid Transit (MRT) Putrajaya Line has brought significant impact to the country's construction industry. The project developer and asset owner, Mass Rapid Transit Corporation Sdn Bhd (MRT Corp) has shared their insight into BIM technology adoption in their construction projects.

BIM FACILITIES & CAPABILITIES

MRT Corp has become the first infrastructure developer in the region to achieve BIM Level 2 accreditation according to international standards.

MRT Corp has also become the recipient of many awards due to their technological advancement in BIM and GIS. Their awards include Asia Geospatial Excellence Awards, Be Inspired Awards 2017 – BIM Advancements in Rail and Transit, GeoInnovation Awards 2018 and Special Achievement in GIS (SAG) Award 2019.

MRT Corp also has established BIM in Rail Academy (BIRAC) training program for the MRT Putrajaya Line Project with the aim of promoting awareness and upskilling project related personnel with BIM knowledge. The strategic partnership between CIDB's myBIM Center has enabled MRT Corp to utilise myBIM Center and delivered BIRAC training program to 1,300 participants over a three-year period.

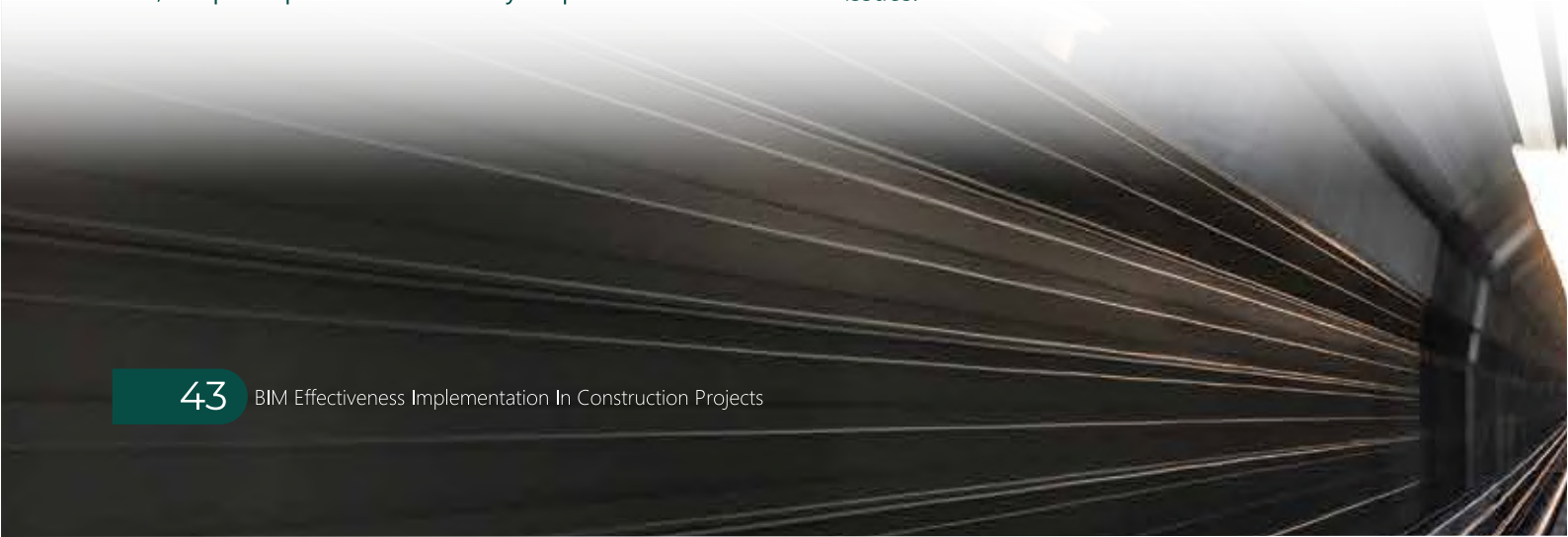
"The use of BIM in MRT Putrajaya Line Project has significantly improved productivity at the design stage and reduced abortive works in the construction phase. For example, about 1,000 conflicts were identified for each MRT site and resolved prior to construction commencing, saving on time and expensive recovery."

EMERGING TECHNOLOGIES

The project also leverages the augmented and virtual reality technology using the creation of the BIMAR app. The BIMAR app allows real-world visualisation of 3D building designs from BIM model using a mobile device during site inspections. Other emerging technologies such as Geographic Information System (GIS), drones and 3D laser scanning have also been widely used in this project. The GIS is used to store all project data such as building plans, imagery, topographical, geological, structural and environmental data. As for drones, it provides a bird's-eye view of the monthly construction site progress in reality models. The 3D laser scanning was used to validate design tolerance of the construction against the design using BIM models.

ISSUES & CHALLENGES

There are many challenges faced in the construction of a megaproject with a scale of the Putrajaya Line. The two main issues are the complexity of the construction works due to the multi-disciplines involved and information exchange to ensure that all disciplines receive real time information on the project. The risk of mismanaging these issues can lead to major design discrepancies, delays in design submission and on-site clashes that can lead to cost increase and delay in project delivery. MRT Corp has taken a bold step in mandating the use of BIM even from the early stages of the project to minimise the issues.



"MRT Putrajaya Line Project has embarked on the digital transformation of its engineering, design and construction process that saw the adoption of Building Information Modelling (BIM) throughout the design, construction and operational stages of the project."

APPROACH TO COUNTER ISSUES & CHALLENGES

MRT Corp has mandated BIM implementation for the Putrajaya Line project including 3D photogrammetry for verification at critical milestones to improve design collaboration, construction feasibility and accuracy of as-built information.

MRT Corp also implemented a cloud-based Common Data Environment (CDE) which enables true data mobility on this complex project, enabling all project members to retrieve the latest design information anywhere and anytime. This allows all parties of the project to view and access project drawings, models and documents from other disciplines and work collaboratively. The ease of information exchange of multiple disciplines provided by the CDE addresses the issue of data exchange and accessibility faced by the project.

BIM technology is able to federate multiple models from different disciplines such as structural, architectural and MEP models together to be reviewed by the engineers to minimize on-site clashes. Any issues that are found in the review sessions are addressed immediately during the planning stage to avoid any on site clashes. The 3D models also become the 'source of truth' when it comes to the drawings because the models are used to generate 2D drawings.

WAY FORWARD OF BIM

- As the Putrajaya Line project progresses to the operational phase, MRT Corp continues to exploring innovative solutions to exploit BIM for the asset operation and asset management tasks.
- MRT Corp is also exploring on the practical use of emerging technologies for the future MRT line as outlined in Construction 4.0 Strategic Plan as BIM is seen as a catalyst to the adoption of emerging technologies in the construction industry.

SPECIAL THANKS:

Mass Rapid Transit Corporation Sdn Bhd
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50490 Kuala Lumpur, Malaysia

CIDB MALAYSIA

A CASE STUDY

THE STORY BEHIND CONSTRUCTION OF

THE SIGNATURE TOWER EXCHANGE 106

OVERVIEW

The construction of The Signature Tower (Exchange106) has become a new futuristic skyscraper in Malaysia. Their main contractor,China State Construction Engineering(M) Sdn Bhd has shared their insight of BIM technology adoption in their construction projects.

BIM FACILITIES & CAPABILITIES

China State Construction Engineering has upgraded all their facilities including hardware & software to cater to the BIM works. To ensure the competency of the staff, they have conducted and organised trainings every two weeks as well as developed the operation manual to be adopted throughout the whole construction phase and as a guide and reference to everyone involved.

BIM INTEGRATION APPROACH

The application of cloud system enables all stakeholders to view the model anytime and anywhere and check in a real-time for the latest changes or amendments in the cloud. They have developed an integrated Revit BIM cloud system that was able to upload the information regarding the design and model including the problem arise during the construction.

"To ensure the competency of the staff, we have conducted and organised trainings every two weeks. The BIM system needs to be easily operated, and we will focus on how to use the system throughout the project."

ISSUES & CHALLENGES

The construction of mega projects will surely face a lot of issues and challenges during the development. For this project, they face several issue such as the coordination and cooperation among all stakeholders involved, competency of the personnel in terms of good software operation ability and deep understanding of the site construction.

From the management perspective level, the issue and challenges faced by their organisation is the motivation to implement BIM in construction projects. It is important to change our mindset and mind to start using BIM. As for China State Construction Engineering, they are close to fully implementing BIM throughout the construction life cycle, but there is still a long way to go.

BIM IMPLEMENTATION PROJECTS LIFE-CYCLE

- Design Stage
- Construction Stage

WHO ARE THE BIM DRIVERS IN THIS PROJECT?

- Client Requirement

- Organisation Initiatives

"The existing policy should mandate the use of BIM for certain project values and incur some BIM costs in the contract to assist BIM implementation throughout the projects"

APPROACH TO COUNTER ISSUES & CHALLENGES?

The core lies in the competent personnel whereby they need to train their personnel to use the BIM in real project applications, instead of learning the professional knowledge. On the other hand, the capacity of BIM personnel should be balanced with the project deliverable; as in their context, there are only four design engineers that were responsible for the BIM model, which is far from enough. If more personnel can participate in the projects, it will reduce the work pressure, and in fact, a greater number of BIM personnel will lead to more discussions and problem-solving of the projects.

DIRECTION OF BIM IN CR4.0

Industrial Revolution 4.0 originated from Germany whereby Construction 4.0 is a subset of IR4.0. As BIM is one of the listed technologies in the CR4.0, however, the implementation level in the Malaysian construction industry is still low. To enforce the use of BIM more, the direction of BIM in CR4.0 must be compulsory to be implemented for mega projects.

COMMENTS & FEEDBACK OF BIM IN CR4.0

The application of CR4.0 technologies, for instance, cloud computing, BIM, AI, prefabrication, and others, is good as it can improve the efficiency of the construction projects. However, the facilities, such as software and hardware, need to be upgraded to cope and suit the current demand and situation, so that it can deliver the outcome well.

MOTIVATION TO IMPLEMENT BIM

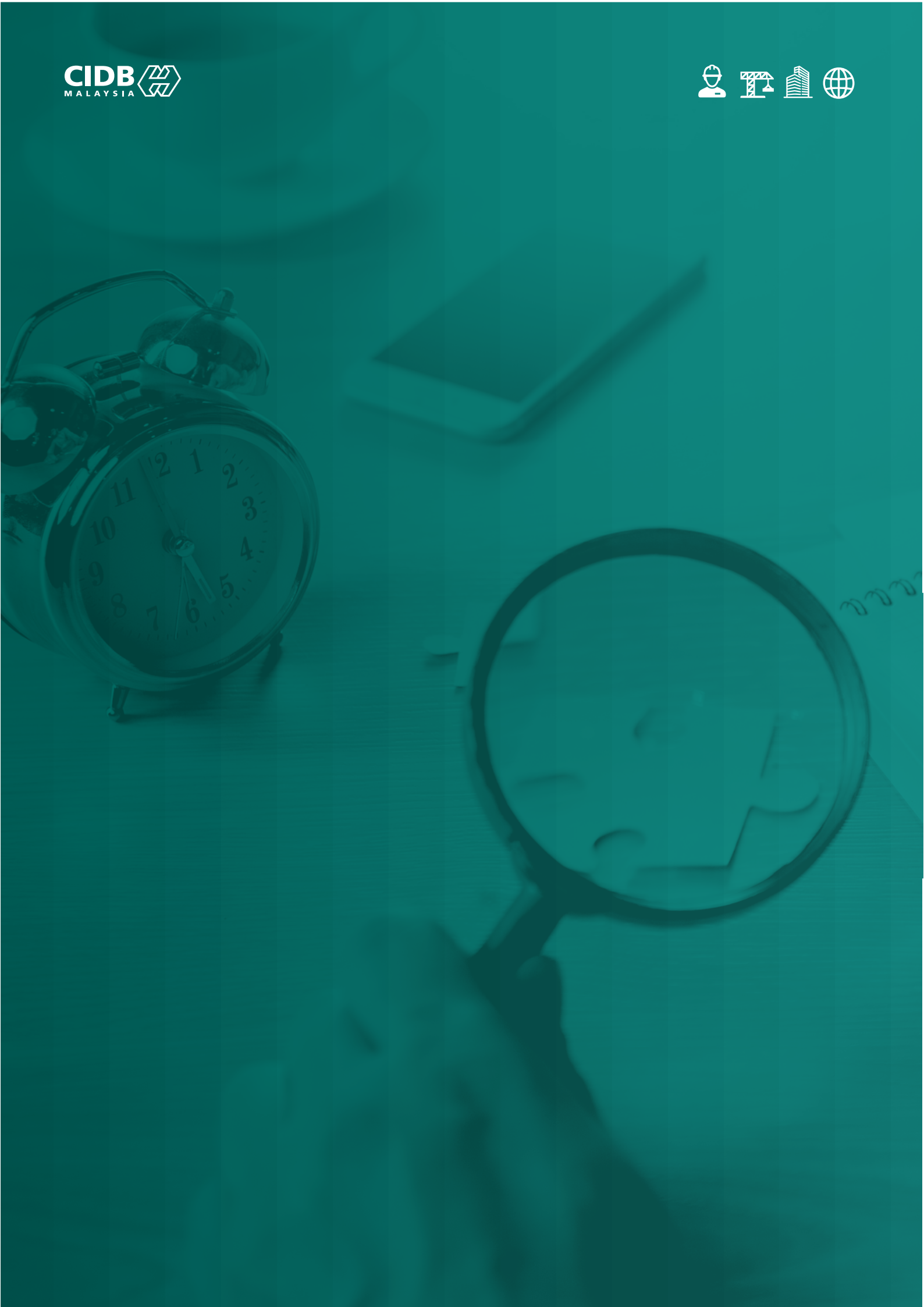
- Embark BIM at the design stage
- Explore more tools and software that suit the project requirements
- Expose our consultants and employeesto the international standard and ISO BIM certification
- Expose our consultants and employeesto the international standard and ISO BIM certification

WAY FORWARD OF BIM

- Suggestion to mandate on use of BIM in policy/ contract
- Financial performance of BIM in project
- Incur BIM cost in project value
- Government requirement to use BIM
- Build internal BIM capabilities and capacities through training and exposure to the new personnel

SPECIAL THANKS:

China State Construction Engineering (M) Sdn Bhd
Suite A-13A, Level 13A,
Hampshire Place Office, 157 Hampshire,
No. 1, Jalan Mayang Sari,
50450 Kuala Lumpur



CONCLUSION & RECOMMENDATIONS

CONCLUSION & RECOMMENDATIONS

The world is changing right now. The advancement of technology has transformed most of the industry into digitalisation, including construction. The construction industry should adopt and adapt to these transformations to cope with the current construction demands. In the Malaysian construction industry, a lot of initiatives and strategies can be implemented to enhance and encourage the use of technology, especially BIM, in construction projects. This report has given the first outlook on the level of BIM adoption among construction projects. Twenty-nine percent of Malaysian construction projects have adopted BIM, either in design, construction, or post-construction phases; whereas the highest use of BIM (29.6%) has been adopted throughout all construction life cycles, starting from design to post-construction stages.

To cope with the current technological advancements and rapid developments, our industry must be able to build the capacity and capability of skilled workers, or in this context, the competent person for BIM to deliver the project outcome well. The reskill and upskill of industry players must be enhanced to ensure more productive and effective project outcomes will be delivered in future construction projects. However, the industry players, especially the government sectors, should play a vital role in soaring the adoption of BIM by mandating the use of BIM for suitable project costs. This is because encouragement has been quiet since 2013. Not to be forgotten, the SMEs must take challenges to transform their organisation into a more technology- dependent organisation as more than 70% of the industry players are the SMEs. Incentives that were previously given by the government to the SMEs should be continued as it brought a lot of benefits and advantages in assisting the SMEs. In the future, more incentives could be given to them by looking into certain criteria, for example, to deliver the government projects, or based on the project value as this will boost their motivation for digital transformations.

Adopting BIM as a single technology without integrating it with other technologies could be the factor that causes low productivity. Silo-working environment needs to transform by using BIM as integrated and collaborative platform. The use of BIM should be integrated with other technologies, for example, cloud computing, Internet of Things (IoT), prefabrication, 3D laser scanning, drones, and other suitable technologies could bring more benefits and advantages not only to the user, but to the whole construction supply chain. CIDB will continue to support and assist the industry players to speed up the adoption of Construction 4.0 through the strategic initiatives and collaboration with the expert in creating the demands and competency of BIM in the Malaysian construction industry.

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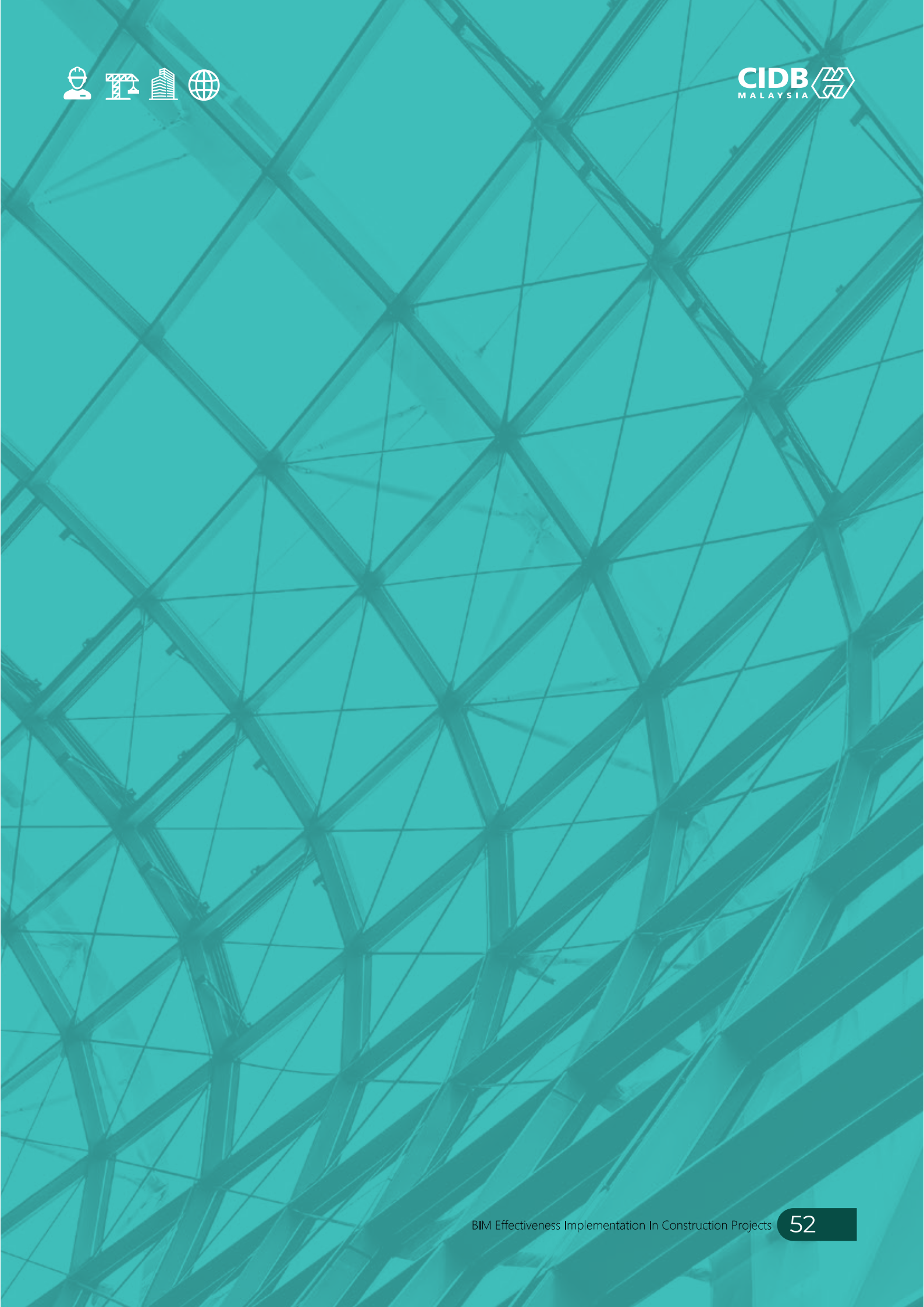

CIDB MALAYSIA

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Jimmy Zeng	China State Construction Engineering (M) Sdn. Bhd.

CIDB MALAYSIA

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INDUSTRY DEVELOPMENT
BOARD MALAYSIA