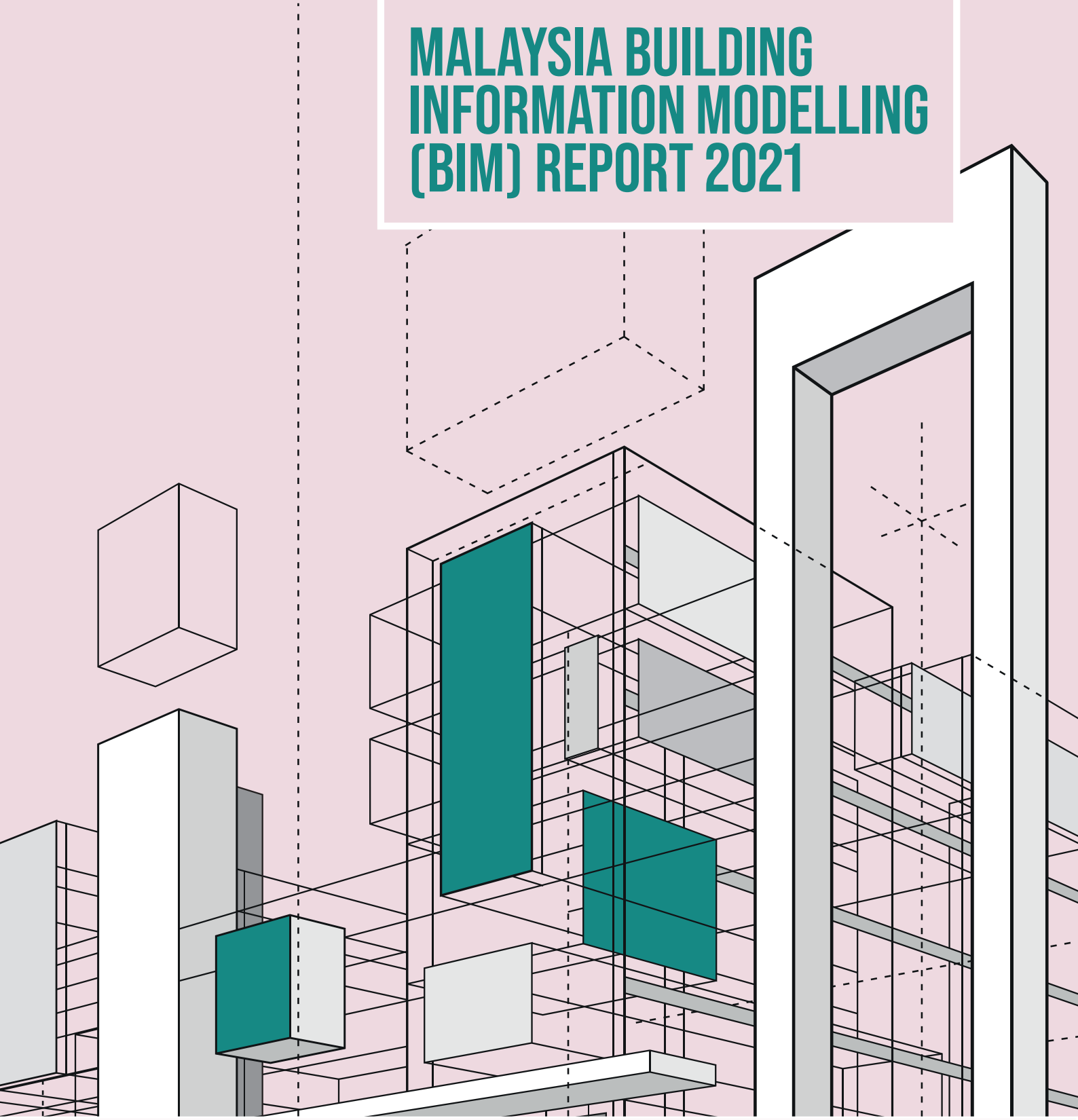
MALAYSIA BUILDING INFORMATION MODELLING (BIM) REPORT 2021



CIDB MALAYSIA

MALAYSIA BUILDING INFORMATION MODELLING (BIM) REPORT

2021

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Perpustakaan Negara Malaysia Catalogue-in-Publication Data
ISBN No: 978-967-xxxx-xx-x

CONTENT

EDITORIAL BOARD

This report has been prepared by Construction Industry Development Board (CIDB) Malaysia and supported by the Construction Research Institute of Malaysia (CREAM). Sincerely thanks and grateful to those who contributed directly or indirectly to make this report succeed.

PREFACE

For decades, the construction industry has remained among the least digitized industries. Most organizations in the industry prefer to use cumbersome practices and methods instead of investing in digitization. The emergence and rapid spread of COVID-19 have had an unprecedented impact on industries all around, including the construction industry. Eventually, the pandemic drives organizations in the construction industry to digitize and employ technology to ensure worker safety and productivity.

Digitization represents a change from traditional analog methods. As a result of digitalization, construction organizations can level up their businesses by enhancing processes and systems to make workers more productive, lowering overall costs, and increasing profitability. In addition, the digitization of fundamental construction processes will set the path for the future application of more advanced technologies and allow construction organizations to be more efficient and competitive in global target markets.

Building Information Modeling (BIM) is a highly collaborative process that allows architects, engineers, real estate developers, contractors, manufacturers, and other construction professionals to plan, design, and construct facilities within a 3D model. Since 2015, organizations have used BIM to improve designs, encourage stakeholder collaboration, and streamline construction processes. Furthermore, the five-year Strategic Construction (CR4.0) strategy promotes BIM as an emerging technology that will increase effectiveness and ease of business. As a result, adopting BIM is one of the most efficient ways for organizations in the construction industry to make a digital breakthrough.

BIM adoption can help to overcome different construction difficulties at a lower cost. With the introduction of BIM, all aspects of the pre-construction and planning phases become easier to manage and faster to complete. One significant advantage of BIM is that it delivers accurate construction cost estimates well before the construction phase. Furthermore, BIM assists contractors in making better material choices and reduces human errors that may arise during construction.

The present level of BIM adoption in Malaysia has previously been examined to track its progression. The first and second BIM reports were issued in 2016 and 2019, respectively. Consequently, the third report will examine the progress of the BIM adoption level in Malaysia following the COVID-19 pandemic. Since 2019, public projects of RM 100 million or more have been mandated to use BIM, which has aided in BIM adoption in Malaysia. Furthermore, the Malaysian government has made significant national initiatives to improve industrial performance by advocating for the use of BIM.

CIDB will continue to make every effort to increase BIM adoption among construction industry stakeholders to improve the Malaysian construction industry at all levels of the supply chain. Furthermore, collaboration and assistance from industry stakeholders are required to advance the digitalization of the Malaysian construction industry.

Technology and Innovation Division (BTI)
Technology Development Sector
Construction Industry Development Board (CIDB)

EXECUTIVE SUMMARY

BIM facilitates the process of producing digital twins of a facility. The existing body of knowledge lacks an understanding of the criteria influencing project team members in adopting BIM in construction projects. BIM not only allows for digital design representation but also offers all the necessary information for every project before it is built. BIM is used to create and manage this data during the design, construction, and operation stage. BIM combines multi-disciplinary data to produce detailed digital representations that can be maintained in real-time on an open cloud platform.

According to the Malaysia BIM report published in 2016, the level of adoption stands at 17%. The level of adoption in 2019 stands at 49% is increase drastically as compared to 2016. While in 2021, the level of adoption of BIM increased to 55%. The respondent's interest in establishing BIM is consistently increased from 2016 until 2021. It can be seen that the adopters of BIM vary among organization sizes. It shows that 30% of large organizations have dominated the survey result, followed by small organizations at 25% and medium to large organizations at 23%.

In terms of the standard used in BIM adoption, most organizations adopt CIDB BIM guidelines as the main reference, followed by Malaysia's Public Work Department / Jabatan Kerja Raya (JKR) BIM guidelines. In addition, the respondents most referred to CIDB as the source of information on BIM.

According to the results, the top five strategies to enhance BIM adoption are;

a) Create BIM institutes for training young/fresh graduates

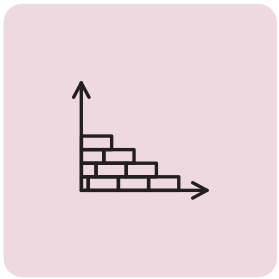
b) Provide financial aid to reduce the cost of adopting BIM

c) Develop BIM adoption guidelines

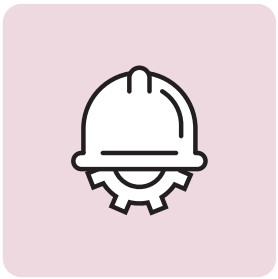
d) Develop programs to integrate BIM into education curricula and academia

e) Develop programs to increase BIM awareness and understanding

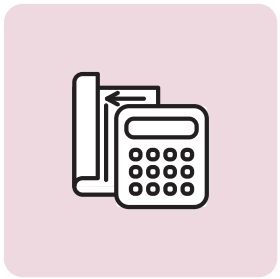
As COVID-19 impacted the construction industry, the findings show increased technology adoption since the unprecedented outbreak occurred. However, government response strategies are necessary to endure the impact due to many reasons, including but not limited to the following:



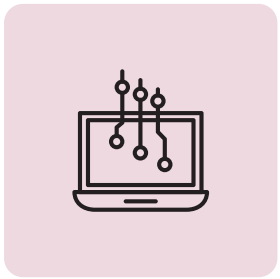
a)
Increase construction cost



b)
Shortage of labor



c)
Increase government support for financing



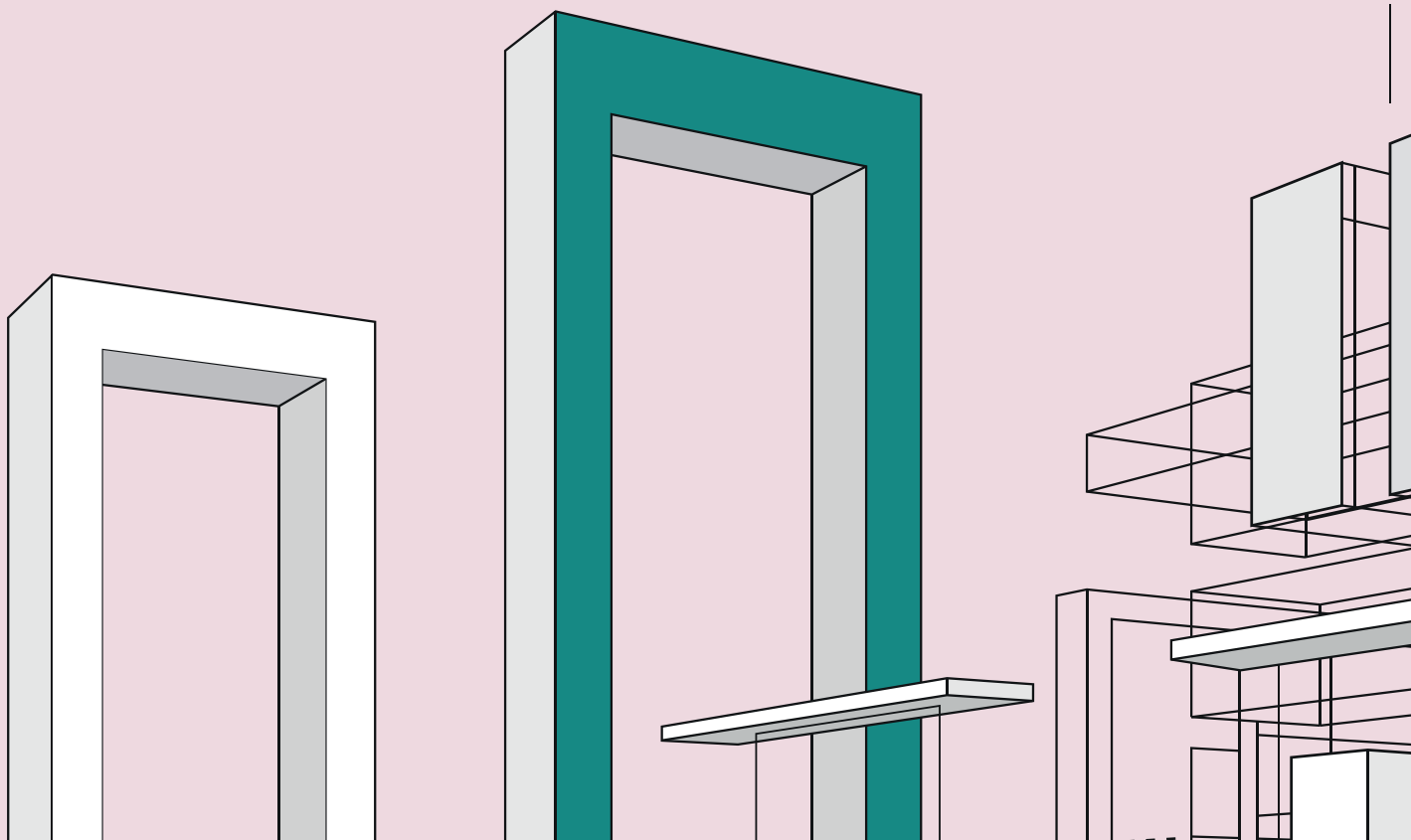
d)
Increase digital transformation

The result shows the top four challenges that remain yearly from 2016 until 2021: high cost of software, high cost of training, high cost of technology, and lack of BIM knowledge. CIDB has embarked on the Construction 4.0 (CR4.0) Tour across the country to excite and create a platform for industry players to get insight into digital technology and BIM. A new top challenge faced by the industry in adopting BIM is the lack of top management support for BIM.

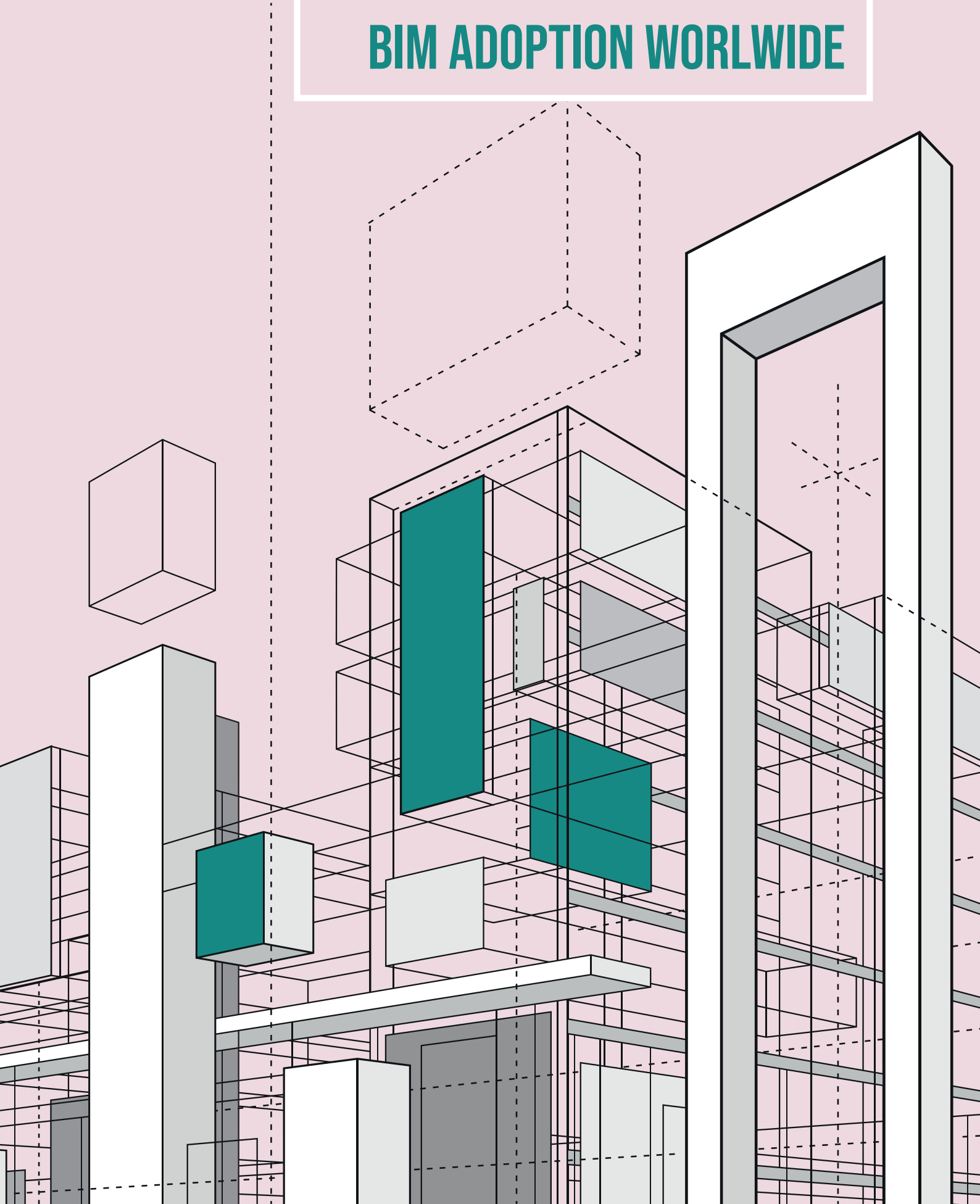
A key strategy to make BIN a norm in the construction sector is to ensure that the new construction workforce is highly skilled in BIM. Towards this end, the empowerment of satellite centers has to be strengthened. Furthermore, this time is now for the industry to pay greater attention to advanced technologies such as BIM. This is because adopting BIM is a key game changer to ensure that the construction industry maintains its competitiveness on the local and international fronts. Furthermore, BIM is important to the industry that has entered CR4.0 and the 4th Industrial Revolution (4IR).

Industry in support of the government has to put greater promotion and awareness efforts, the future uptake and adoption of BIM in the industry. The industry's adoption of BIM would only increase overall productivity.

01



BIM ADOPTION WORLWIDE



Section **01**

BIM ADOPTION WORLWIDE

1.0 BIM ADOPTION WORLWIDE

The BIM market was valued at USD 5.9 billion in 2021 and is projected to reach USD 10.7 billion by 2026. It is expected to grow at a compound annual growth rate (CAGR) of 12.5% during the forecast period. The rising adoption of remote working due to COVID-19, the rapid rise in urbanization globally, and growing government initiatives for adopting BIM are contributing to the growth of the BIM market. Rising trend of the internet of things (IoT) in the construction sector, the increasing trend of BIM, and the growing focus of organizations on introducing new standards in the BIM market act as growth opportunities for the market players.

A report by the World Economic Forum (2018) has highlighted the importance of BIM as a centerpiece of the industry by applying several technologies, such as prefabrication, automated equipment, and mobile applications. The adoption of BIM throughout the construction lifecycle needs a collaborative and integrated platform and support from the industry players.

It is imperative in a literature review to describe clear boundaries to limit the research (Seuring and Muller, 2008). BIM adoption means “the successful adoption whereby an organization, following a readiness phase, cross the ‘Point of Adoption’ into one of the BIM capability stages, namely, modeling, collaboration, and integration” (Succar & Kassem 2015). BIM adoption has significantly increased around the globe, particularly in developed countries, over the past years.

A report by McGraw Hill (2014) revealed that more than 30% of total projects are using BIM globally, although the number varies between regions. Globally, many reports on the level of BIM adoption have been published. However, in some cases, the reports only tabulated data for a specific year without including the data from other years. Meanwhile, the other published reports were starting to measure the level of adoption. In fact, until recently, the UK has been the only country measuring the annual level of BIM adoption starting from 2011 to 2019.

Table 1.1. indicates the BIM adoption rate in different countries. This table shows that Malaysia recorded a higher BIM adoption rate (55%) than Singapore, Japan, China, Poland, Estonia, the Czech Republic, and Russia. In addition, the adoption rate in Malaysia rose by 6% in 2021 compared to the previous report in 2019.

Table 1.1 BIM adoption rate in different countries

Country	Adoption rate	Year	(Source)
Malaysia	55%	2021	This report
US	80%	2021	Jiang
UK	73%	2020	NBS. 10TH Annual BIM Report
Canada			University of Toronto
Australia (architects)	76%	2021	Australian institutes of Architects
Germany	70%	2021	Planradar
Denmark	78%	2016	Malleson
Poland	43%	2021	Planradar
Estonia	51%	2015	Usesoft AS
Czech Republic	25%	2016	Malleson
Russia	12%	2021	Planradar
Japan	46%	2021	Statistica
China	52%	2019	Cheng and Lu
Hong Kong	75%	2020	Construction Industry Council
Singapore	50%	2018	BCA

The United States (US) is one of the pioneers in BIM development and adoption in the construction industry (Wong et al., 2010). The BIM adoption rate will reach 80% in the design industry by 2021, with a 98% adoption rate in large architectural organizations. In the US, the General Services Administration (GSA) 2003 launched the “National 3D-4D program” to form strategies to gradually adopt 3D, 4D, and BIM for all major public projects (Wong et al., 2010). In 2007, the GSA included BIM for spatial program validation for all its projects (Burgess et al., 2018). The US was the first to require mandatory use of BIM in 2007 (Jiang et al., 2022). In addition, the US established several BIM guidelines and standards, such as the National BIM Standard (NBIMS-US), BIM Guide Series 01 to 08, and NYC BIM Guidelines (Cheng and Lu, 2015).

In the UK, the government has mandated a minimum of Level 2 collaborative BIM on all publicly financed projects since 2016 (Burgess et al., 2018). The Scandinavian countries are at the forefront of BIM adoption (Smith, 2014). In the Netherlands, the Government Buildings Agency mandated using BIM for public projects in 2011 (Cheng and Lu, 2015). Research conducted in Germany, France, Brazil, and Austria showed that BIM is gaining wide adoption in these countries (Matarneh and Hamed, 2017). In Estonia, a survey was carried out among 297 organizations, revealing that 51 % of respondents are already using BIM or planning to adopt it over the next five years (Usesoft AS, 2016). Early BIM adoption and a mandate for adopting BIM in 2016 have been identified as the main factors contributing to the high BIM adoption rate. The UK has also provided opportunities for adopters through a global leadership role in BIM exploitation, BIM service provision, and BIM standards development (Paul, 2018). With government support, the UK has radically adopted a BIM strategy that has glorified the global image of UK designers, contractors, and other professionals. In April 2016, government-mandated BIM Level 2 on all public projects. UK's construction industry is one of the most technologically advanced and digitized industries. After the initiative taken by the UK government, reports suggest that 20% of the industry has adopted it successfully and has gained a 12% increase since 2017. This mandate was established by the Government Construction Strategy to move to BIM level 3. Despite not being the first country that adopts BIM, the UK is the only European country that proposed a clear BIM roadmap to illustrate a step-by-step BIM adoption (e.g., the Government Construction Strategy 2011–2016 and 2016–2020). Furthermore, some countries focused on the technical solutions for BIM and encouraged BIM research and business activities by providing reasonable funding. On the contrary, the UK government established specialized organizations for BIM, such as the BIM Task Group and the Centre for Digital Built Britain, to organize government efforts to promote BIM adoption. These organizations are established by BIM experts from academia and industry and are more capable of detecting problems in the construction industry and proposing specific solutions.

BIM was mandated in Germany in 2017 for projects worth over €100 million (Planradar, 2021). According to Design Technology in Architecture BIM (2021) Report, the adoption rate among Australian architectures is 76%. In Russia, BIM adoption is significantly lower than in other countries, with a 12% adoption rate (Planradar, 2021). BIM was recently mandated in March 2022 for all government-funded projects.

According to Yang and Chou (2018), the BIM adoption rate is less than 30 % in the Middle East. Gerges et al. (2017) state that BIM adoption is relatively low in Africa strategies to reduce these hindrances and further promote the use of BIM in the construction industry.

In ASEAN countries, the government of Singapore, through the Building Construction Authority (BCA), has initiated the Construction Productivity Roadmap to transform its construction industry (BCA, 2011b). In enhancing construction productivity, driving BIM

adoption has been seen as one strategic thrust (Teo et al., 2015). In 2011, a National BIM Steering Committee was set up to provide a governing framework to execute a BIM roadmap and led the development of Singapore's BIM Guide and BIM Particular Conditions (BCA, 2011a; BCA, 2013). BCA (2011b) has provided a series of initiatives to encourage BIM adoption in Singapore's construction industry. For example, BCA and building SMART Singapore developed BIM submission templates, a library of design objects, and project collaboration guidelines. In addition, in 2011, pilot projects with BIM were performed with public sector clients. Subsequently, the BCA of Singapore issued regulations to make it compulsory for practitioners to submit architectural, structural, mechanical, and electrical plans for building works for approval in the BIM format (BCA, 2015). Specifically, after 1 July 2013, all architectural and engineering plans of new construction projects with a gross floor area of more than 20,000 must be submitted in BIM format starting from July 2013 and 2014. After 1 July 2015, all plans of new building projects with a gross floor area above 5,000 must be submitted in BIM format. In addition to the regulations, BCA also set up the BIM Fund aimed at helping organizations establish BIM collaboration capability by covering the costs for training, consultancy services, and purchasing hardware and BIM software (BCA, 2014).

The BIM Steering Committee – Ministry of Construction (MOC) in Vietnam has signed a Memorandum of Understanding (MoU) to work towards Vietnam's 2021 goal of adopting nationwide BIM guidelines. The MoU was signed to acquire guidance on BIM global best practices and share its experience in engaging with governments worldwide on adopting BIM guidelines and mandates. The steering committee oversees three key phases laid out by the Prime Minister: raising awareness and encouraging organizations to explore BIM adoption by 2019; adopting and evaluating BIM in pilot projects by 2020; and Nationwide BIM roll-out by 2021 (Bui, 2018).

In Indonesia, policymakers have developed several regulations that promote the use of BIM in local construction projects, including PUPR Minister Regulation No. 22/2018 and Government Regulation No. 16/2021. In addition, Warmadewa University and Gianyar Public Works and Housing Office have also collaborated in human resource development to support BIM adoption (Sopaheluwakan1 and Adi, 2020). Thailand also developed the Thailand BIM Guideline, the first guideline stipulated by the Association of Siamese Architects under Royal Patronag (Ngowtanasawan, 2017).

In other Asian countries, the Japan Federation of Construction Contractors (JFCC) formed a BIM Specific section under its Building Construction Committee to promote BIM adoption (Jin et al., 2015). In addition, Japan's Ministry of Land, Infrastructure, Transport, and Tourism published the Guidelines for BIM Standard Workflows in 2020. Before that, the ministry developed guidelines for developing and using BIM models for government projects in 2014, which were revised in 2018. As far back as 2010, the start of pilot projects for BIM

use in public construction works was announced. The Ministry of Science and Technology of the People's Republic of China (MOST) announced BIM as a key national research and application project in 2011. China developed several BIM adoption guidelines, policies, and standards at national and provincial levels, with the highest number of policies (17) in 2017. However, the number of policies decreased in 2020 due to the COVID-19 pandemic (Xie et al., 2022). In Hong Kong, the government mandated using BIM in the design and construction phases of all public projects (Development Bureau Hong Kong, 2017). Hong Kong's Housing Authority set a target to apply BIM in all projects by 2014. It also developed a set of modeling standards and guidelines for effective model creation, management, and communication among BIM users (Cheng and Lu, 2015). South Korea mandated using BIM in all publicly funded projects in 2016 (Cheng and Lu, 2015).

The BIM journey in Malaysia started in 2007; JKR published BIM Standard Manual and Guidelines. In 2010, BIM Technical Committee was established in JKR. The following year witnessed the development of the first in-house BIM pioneer project. In 2013, BIM Training Centre was established. JKR continued its efforts by releasing BIM Work Process Manual. In addition, CIDB established the Construction Industry Transformation (CITP) Programme (2016-2020) to initiate a comprehensive strategy to achieve BIM level 2 by 2020. CIDB also released BIM Report 2016 and BIM Report 2019 to measure the progression of BIM adoption in Malaysia, its uses, and the challenges preventing its adoption (Sinoh et al., 2020). The results illustrate incremental progression toward BIM adoption in Malaysia. Although the speed has not significantly increased, the initiatives executed by the Malaysian government helped disseminate BIM knowledge and increase the technical expertise required for adoption. However, compared to leading countries in BIM adoption, Malaysia still has room for improvement to achieve a higher BIM adoption. As Malaysia moves towards a more comprehensive BIM adoption, the high BIM awareness rate indicates that most industry players are already aware of BIM. The improvement in the BIM adoption rate compared with the previous BIM Report 2019 paints an overall picture of the promising growth of BIM in Malaysia.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Private Working Space
Office
Pool
Co-working Room
Extra space for activities
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Nostrud exercitation
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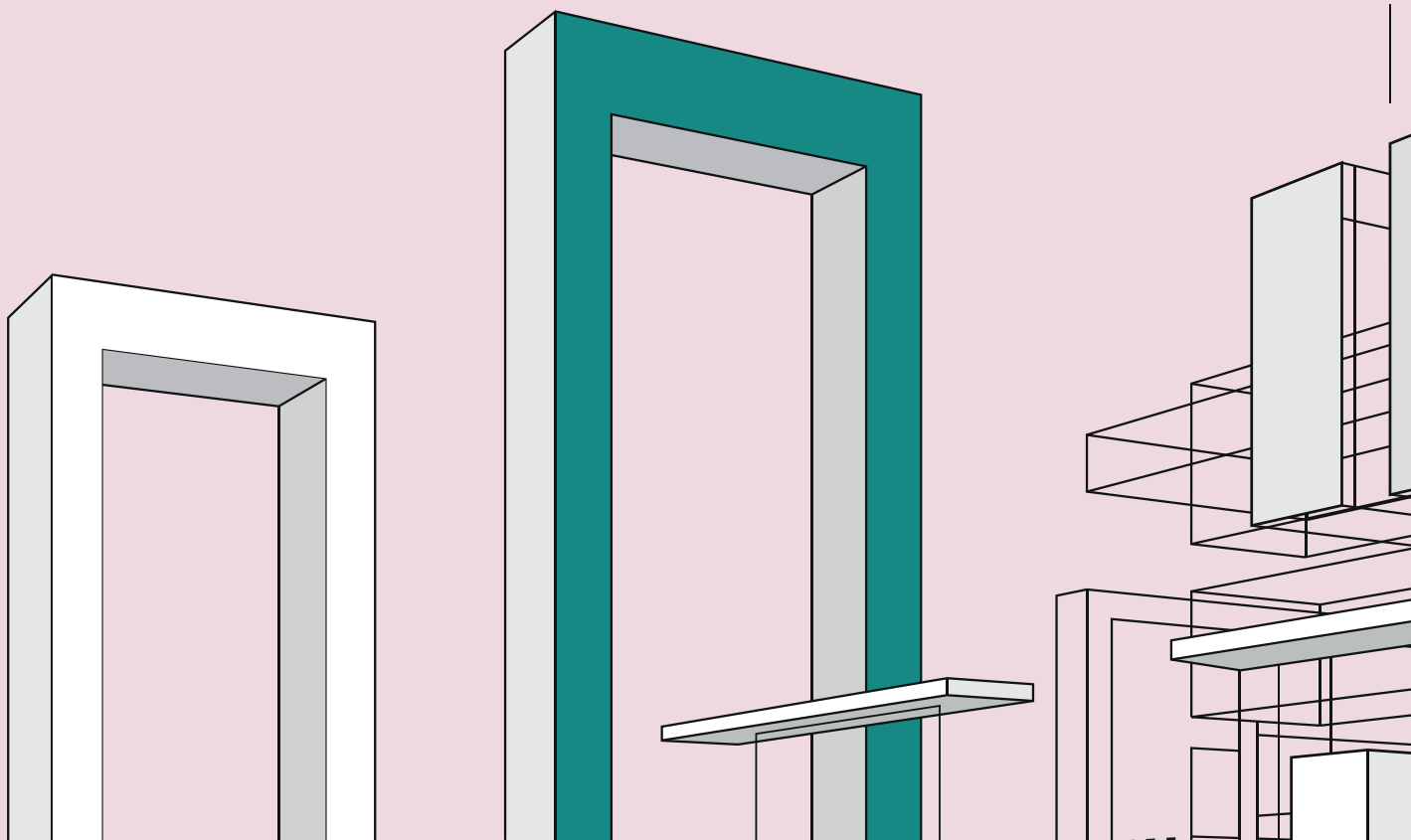
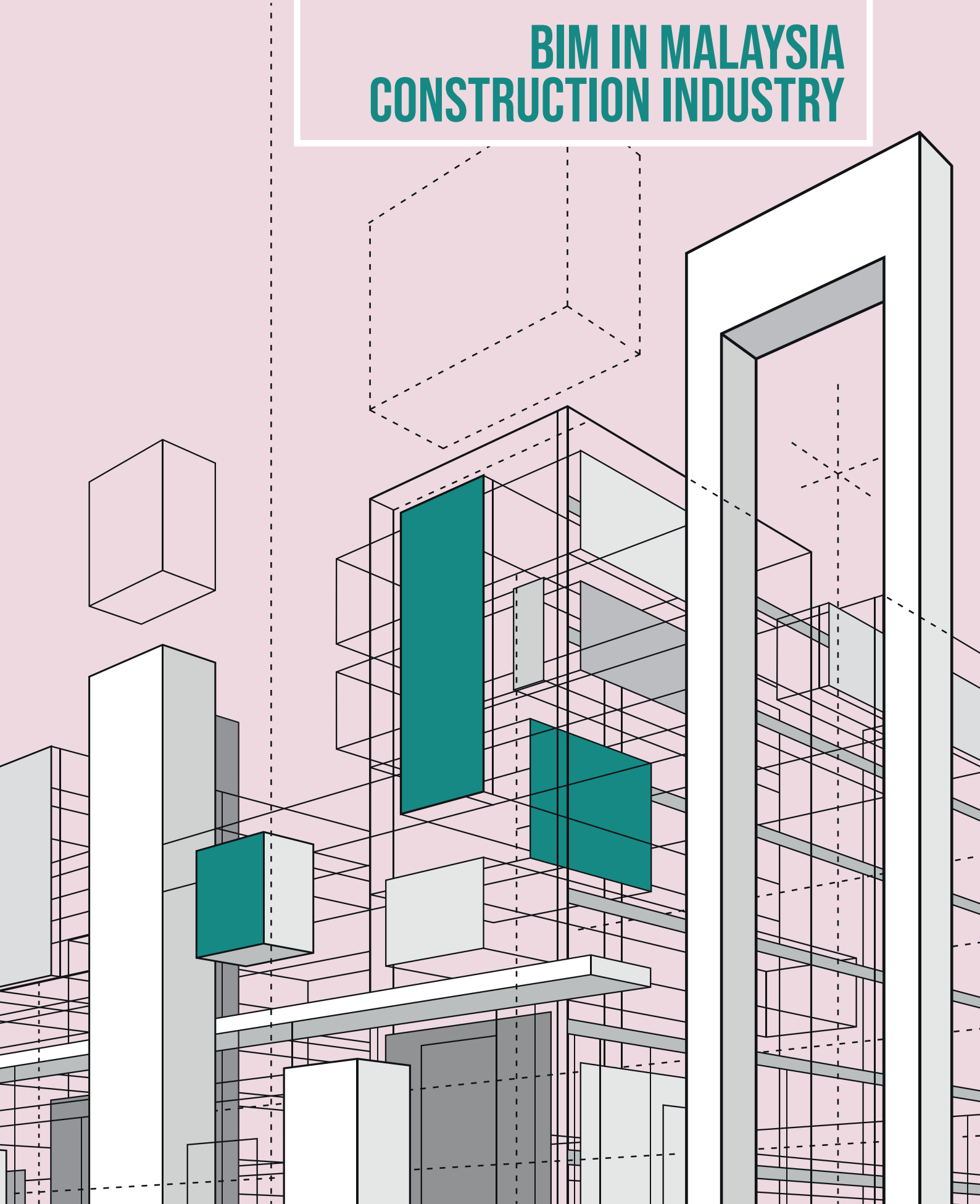


BIM IN MALAYSIA CONSTRUCTION INDUSTRY



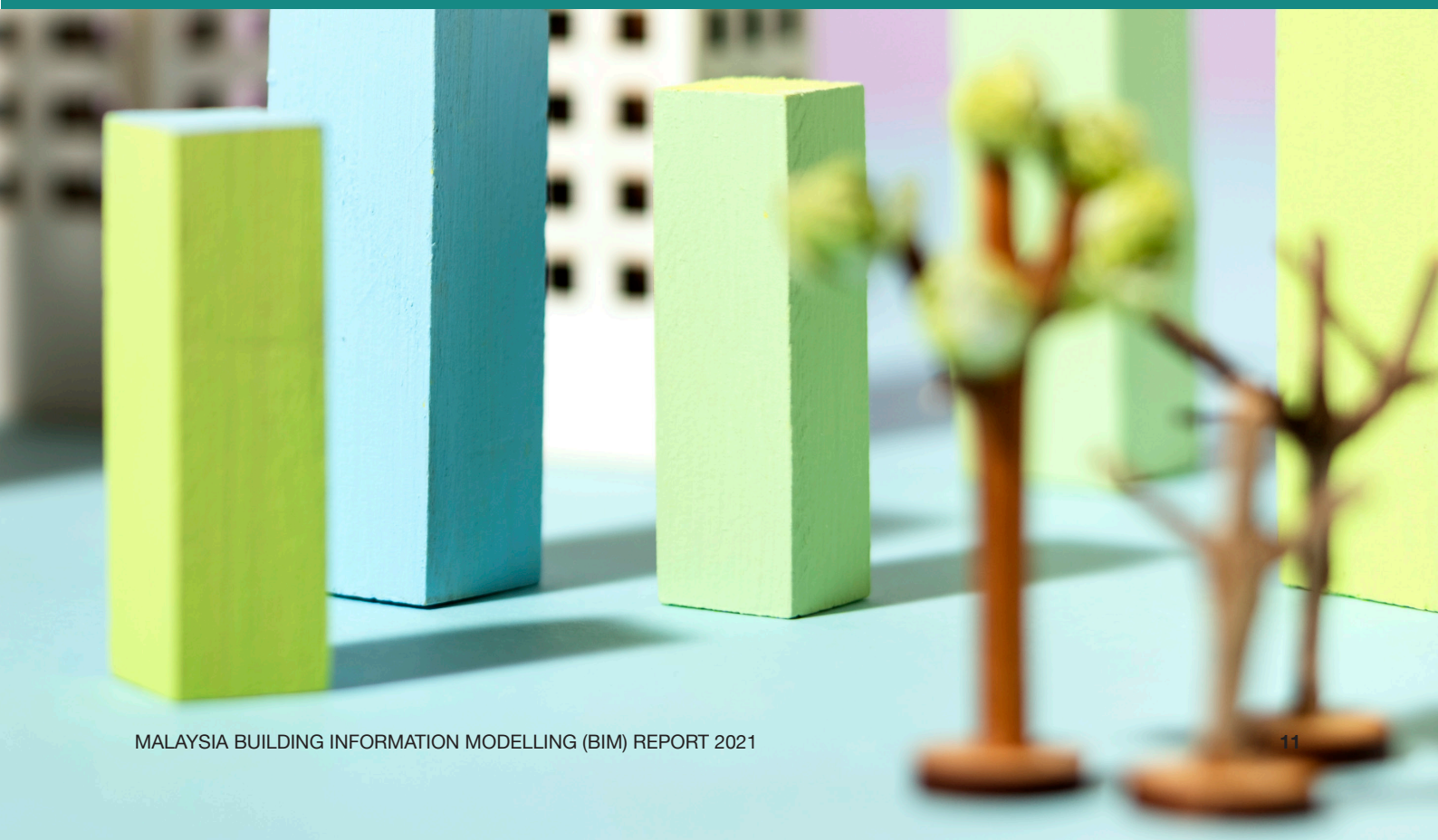
Section 02

BIM IN MALAYSIA CONSTRUCTION INDUSTRY

2.0 BIM IN MALAYSIA CONSTRUCTION INDUSTRY

A new wave of technology has already hit most of the global industries, including the ones in Malaysia. The advancement of digitalization has swept away most of the old working methods, leaving behind collaborative and integrated working environments. A report on Shaping the Future of Construction by the World Economic Forum (2016) highlighted the adoption of BIM along the construction lifecycle for better project outcomes and cost reduction. From the international to national level, the Ministry of Works (KKR) and CIDB have worked together to boost the productivity of the local construction industry. In addition, the Shared Prosperity Vision (SPV) 2030 on society highlights the importance of upskilling and reskilling workers for digitalization. Hence, BIM assumes its role as one of the centerpieces in the digitalization process.

Highlighted as one of the technologies under the Productivity Thrust in CITP 2016–2020, BIM acts as a platform to allow various stakeholders to collaborate in the planning, design, and construction of facilities using 3D models (Lorek, 2018). By zooming into CITP, we find several KPIs listed under the Technology Focus Area. The KPIs include BIM adoption for 100% of public building projects above RM 100 million by 2020 and 70% of private building projects above RM 10 million by Jan 2021 (CIDB, 2019a). Apart from that, the private sector has been encouraged to use BIM as the KPI to spread the transformation throughout the industry. Throughout the CITP, CIDB and its subsidiaries have carried out various BIM-related programs such as BIM day, BIM road tours, incentives, seminars, workshops, and others to empower the usage of BIM in the Malaysian construction industry. Currently, the Construction 4.0 Strategic Plan (2021–2025) encompasses the adoption of BIM together with the other eleven emerging technologies. The strategic plan targets more BIM adopters in the future, which will drive a more productive construction industry.



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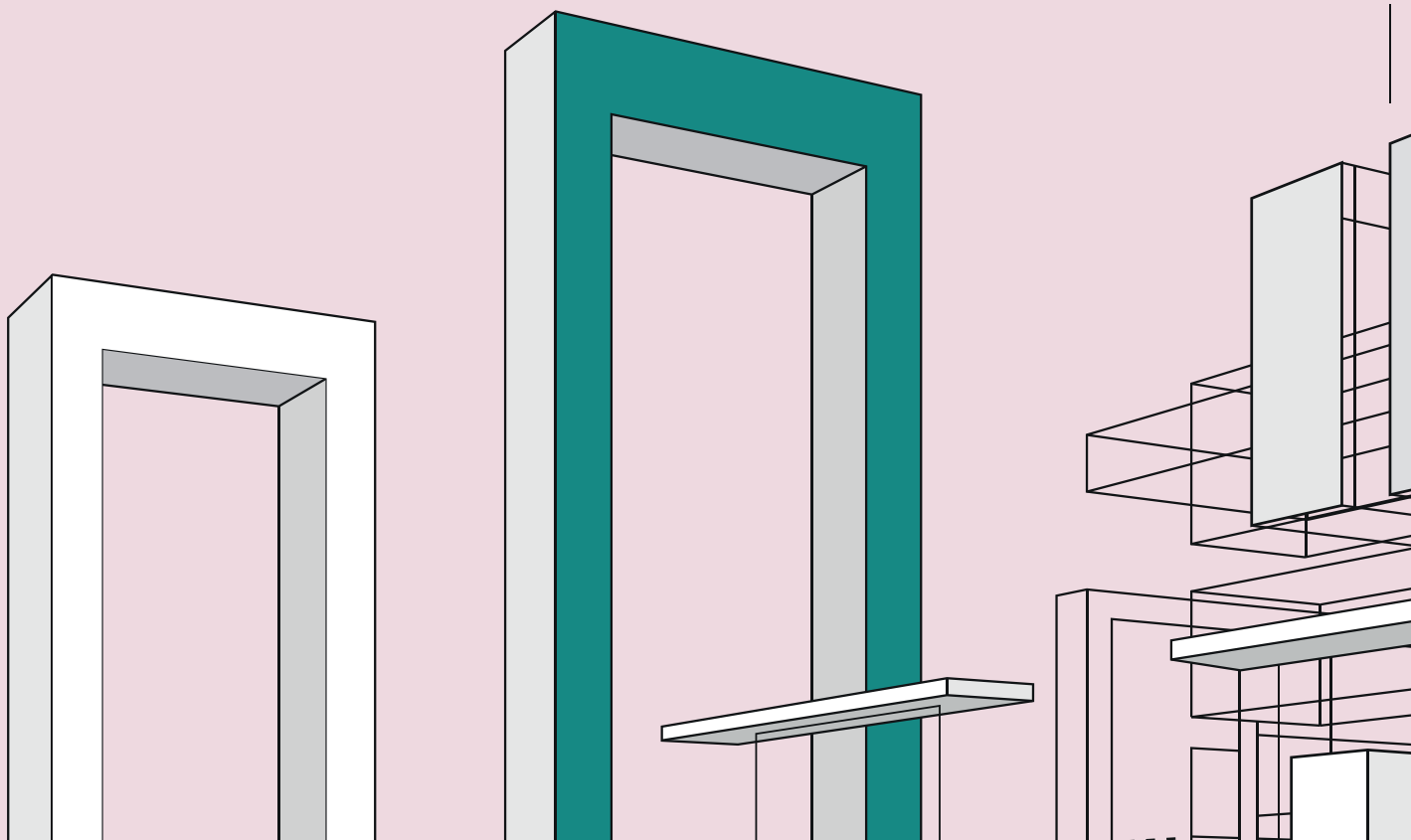
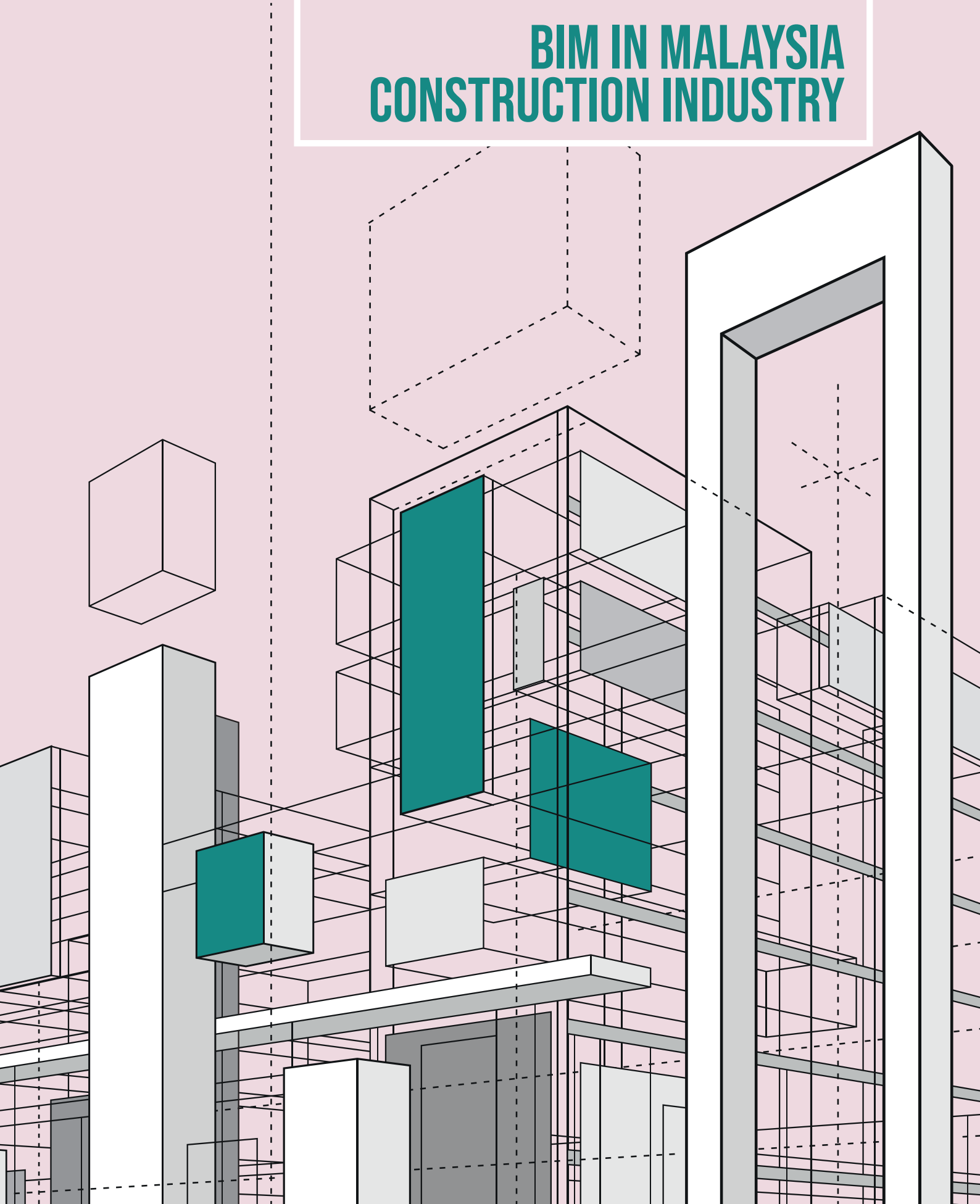


BIM IN MALAYSIA CONSTRUCTION INDUSTRY



Section 03

BIM SURVEY FINDINGS

3.0 BIM SURVEY FINDINGS

This survey has gathered respondents from various construction players, including government agencies, the private sector, professional bodies, academia, and others who produced results from different perspectives and viewpoints. The results indicate the level of BIM adoption in the Malaysian construction industry three years after the first National BIM Report was published. The survey was disseminated to the respondents from July 2022 until August 2022 through several platforms: online surveys, seminars, digital blasting, interviews, conferences, and meetings. Toward the end, the results were collected and analyzed in detail.

This report summarizes the analysis report for the CIDB BIM Report 2021 survey. In addition, the report summarizes results based on the project objectives: (1) awareness of construction industry stakeholders on BIM; (2) readiness of construction industry stakeholders for BIM; (3) current BIM usage in the local construction industry; (4) challenges faced by construction industry stakeholders in adopting BIM, especially during COVID-19; and (5) strategies for enhancing BIM industry in Malaysia.

3.1 RESPONDENT PROFILES

This section summarizes the respondent profile according to state, organization size, profession, and working experience to illustrate the 525 individuals involved in CIDB BIM Report 2021 survey. The survey respondents include contractors, manufacturers, architects, quantity surveyors, clients and developers, civil and structural engineers, and mechanical & electrical engineers.

3.1.1 Respondent by State

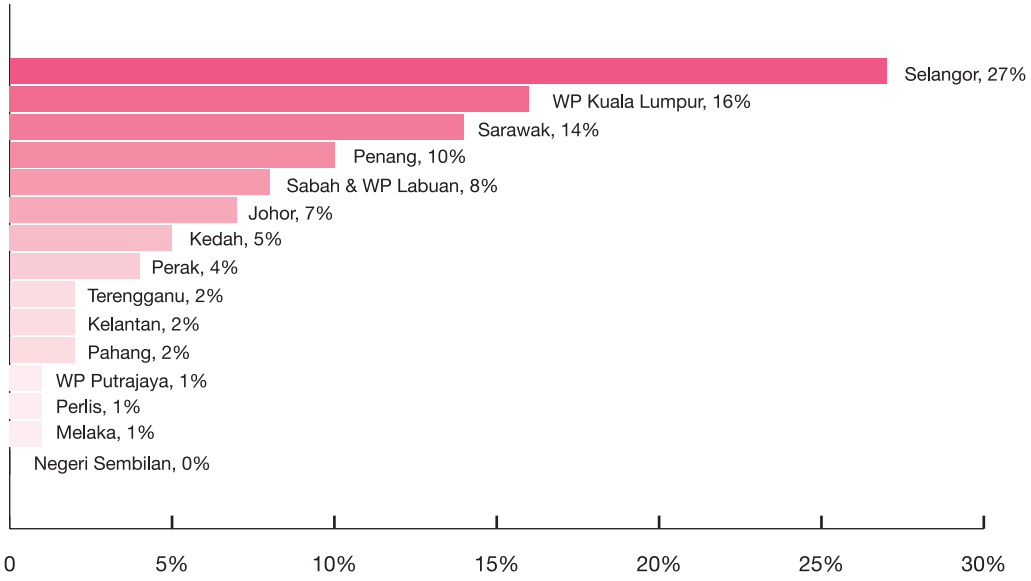


Figure 3.1. Distribution of respondents by state

The survey was distributed to the respondents in all states. The distribution of the respondents is shown in Figure 3.1. The highest distributions of respondents are from Selangor (27%), the Federal Territory of Kuala Lumpur (16%), Sarawak (14%), and Penang (10%). Selangor and Kuala Lumpur are projected to have the greatest response rates as metropolitan regions are home to a high proportion of the population. The states of Sabah and WP Labuan, Johor, Kedah, and Perak showed an average of 4%-8% respondent distribution. Meanwhile, few responses were collected from other states and showed almost even percentages of respondent distribution at 1%-2%.

3.1.2 Respondents by Organisation Size

Figure 3.2 reveals the organization's size according to the number of employees in each organization. The organizations of participants in the survey were almost evenly distributed. The result shows that respondents who came from small organizations dominated the number of respondents who answered the survey (31%), followed by 25%, 23%, and 21% for respondents who come from small to medium, large, and medium to large organizations. small-medium enterprises (SMEs) constitute a large portion of organizations in the Malaysian construction industry. More than 90% of registered construction organizations in Malaysia are SMEs. As a result, the characteristics of SMEs greatly impact the local industry.

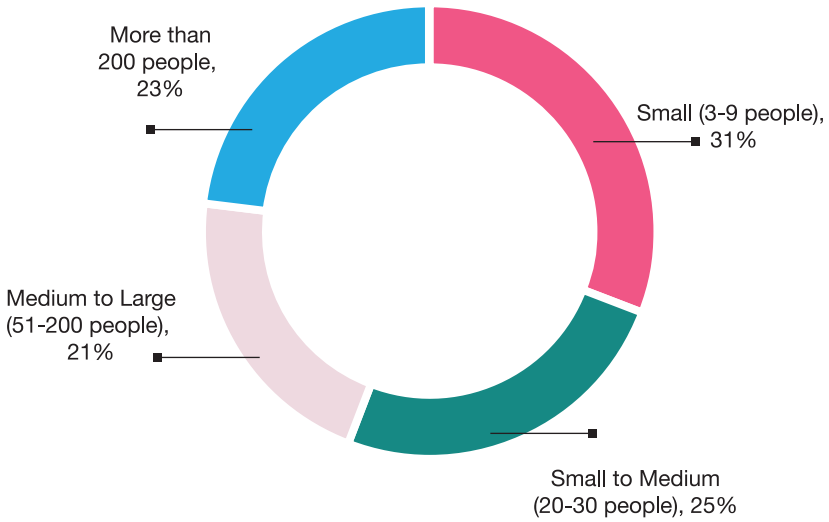


Figure 3.2. Distribution of respondents by organization size

3.1.3 Respondents by Profession

The most accountable group in a project is construction professionals. Hence, assessing the different professions using BIM is crucial for gauging BIM adoption in the Malaysian construction industry. The diverse perspectives of the respondents are essential in ensuring that the findings are thorough and adequate for all participants in the construction industry. Figure 3.3 illustrates the distribution of respondents according to their profession. Similar to the two previous reports, contractors dominated the number of respondents. This is followed by other professions such as civil & structural engineers (28%), mechanical and electrical engineers (11%), others (8%), clients and developers (7%), quantity surveyors (7%), architects (6%) and manufacturers (1%). The others profession include BIM consultant, data center engineering services, environmental auditor, environmental management, fabricator, government agency, integrated facilities management & engineering, interior design, planning & project management, plumbing works, precasters, project management, scaffolding services, specialists in aluminum and glass facade works, utility company and waste management.

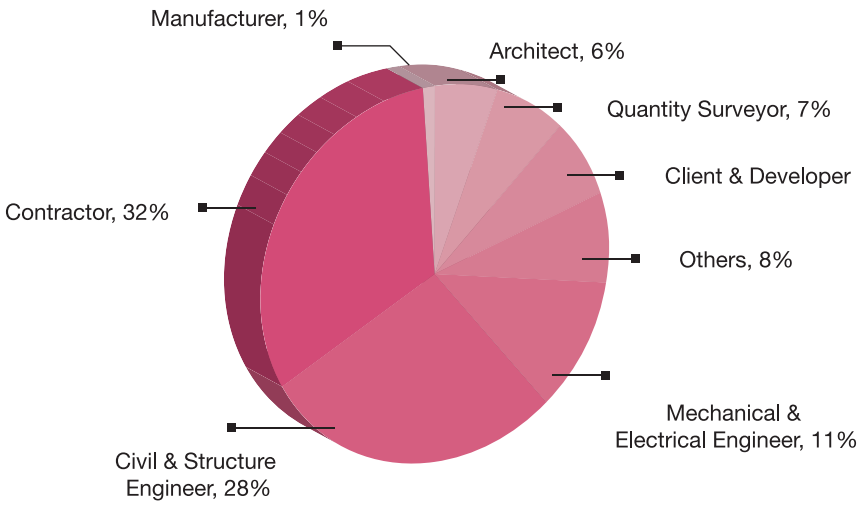


Figure 3.3. Distribution of respondents by profession

3.1.4 Respondent Working Experience

Figure 3.4 shows the respondent profile in terms of working experience. Respondents with less than five years of working experience made up the largest respondent distribution at 46%. Despite the survey having a significant percentage of young professionals participating, this offered a special possibility to comprehend the perspective of the younger generation of experienced industry professionals and gain a more in-depth comprehension of BIM in the Malaysian construction industry. This distribution is followed by respondents with 6 – 10 years, more than 20 years, and 11 – 15 years of experience at 20%, 14%, and 12%. Respondents with 16 – 20 years of experience had the lowest distribution at 12%.

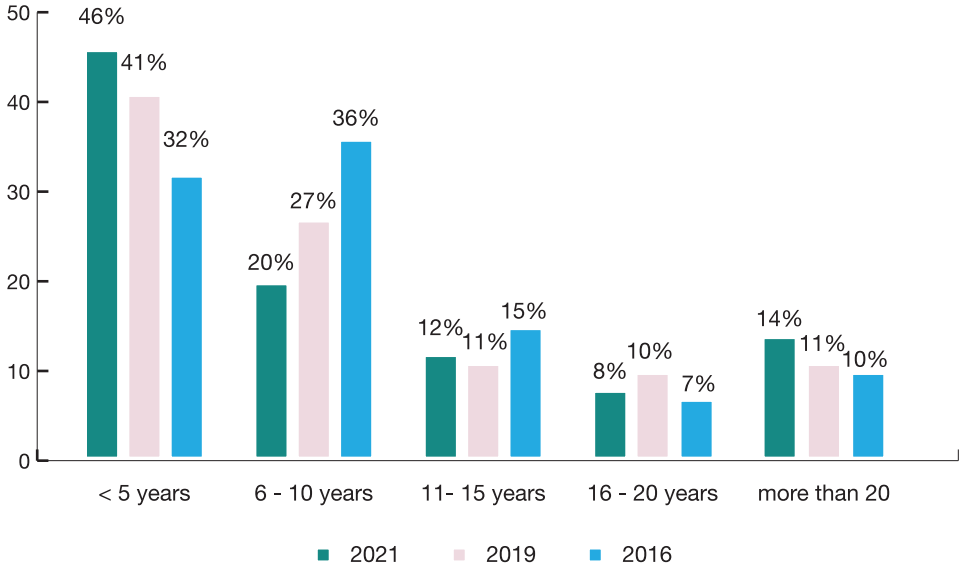


Figure 3.4. Distribution of respondents by working experience

3.2 AWARENESS OF CONSTRUCTION INDUSTRY STAKEHOLDERS ON BIM

This section summarizes the analysis results for survey questions related to the construction industry stakeholder awareness of BIM. The questions are related to respondent awareness of BIM, attendance for BIM programs, and BIM training provided by organizations.

3.2.1 Respondents Who Know About BIM

The application of BIM is gaining popularity among construction professionals globally (Olugboyega et al., 2020). BIM benefits the construction industry throughout the project lifecycle, during the design stage (Parn et al., 2018), the construction stage (Eastman et al., 2011), and the operation stage (Xu et al., 2014). As the Malaysian Government starts to encourage the adoption of BIM, it is important to investigate the current awareness among our construction industry players.

Based on Figure 3.5, in 2016, only 45% of the respondents answered Yes to knowing BIM, while 55% were unaware of BIM. On the other hand, the survey in 2019 revealed that 74% of respondents were aware of BIM, while only 26% did not. However, a survey in 2021 found a slight increase in respondents' awareness of BIM, where 78% of respondents answered Yes to knowing BIM while 22% answered No. The reason for the sudden jump and slight increase, as stated by the experts of the focus group discussions:
"So, we can say that the awareness of BIM increasing is increasing in particular 2021. It is increasing due to the movement control order (MCO). The professionals are taking the opportunity to upskill and reskill using BIM. There is much online content available during COVID-19. Furthermore, organizations provided internal training for workers due to project works required to stop during MCO restrictions." (Group 1)
"We conclude that the huge jump from 2016 to 2019 was due to organizations started adopting BIM due to demand, such as in all mega projects. However, the speed is decreasing as many projects are on hold due to the pandemic." (Group 2)
"We agree with the conclusion that it is increasing yearly and decreasing in speed. We believe it is due to the pandemic." (Group 4)

The sudden increase in BIM awareness in 2019 is due to BIM being mandated for any public project budgeted at RM100 million and above since 2018 (PWD, 2018). However, some challenges reported in adopting BIM in Malaysia include poor knowledge, cost, lack of awareness, and difficulties shifting from traditional practices (Othman et al., 2021). Therefore, to increase the adoption of BIM in Malaysia, strategies need to be established related to institutional governance, change accommodation, technical environment, cooperation, and resources (Ma et al., 2020).

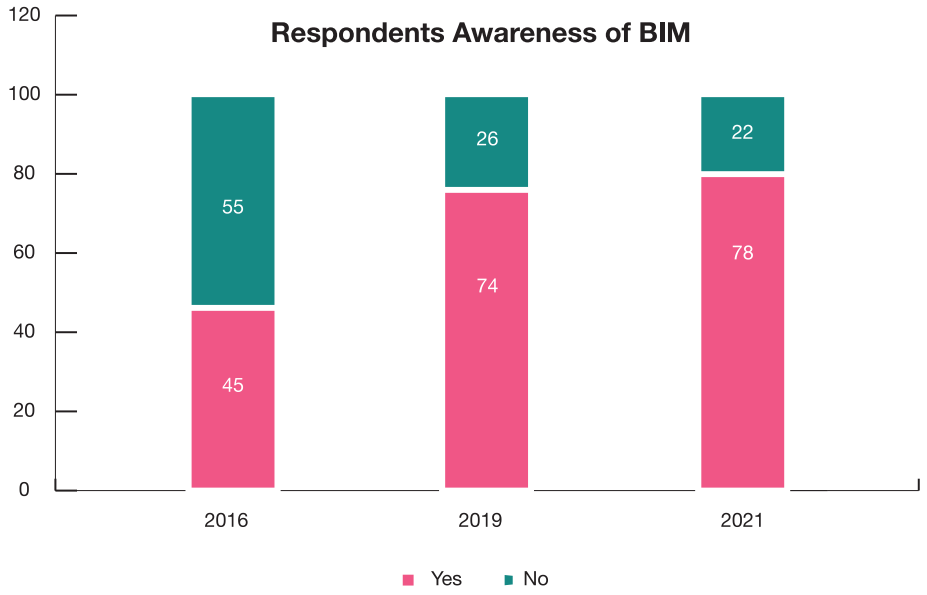


Figure 3.5. Respondent awareness of BIM

3.2.2 Attending BIM Programs

Figure 3.6 shows the percentage of BIM awareness in BIM program attendance. The results revealed a rise in BIM program attendance from 55% to 66% of respondents. However, the percentage decreased in 2021 to 62%. Nevertheless, the percentage is still higher than in 2016 (55%).

This trend is primarily due to pandemic survival, as even in the face of a pandemic, industries must continue to operate, so it is more in survival mode. Online training is also beneficial as individuals can enroll to get information on BIM. Although the pandemic has limited many training programs, industries continue to believe that face-to-face training is always more effective than online training.

"Training was always face-to-face. It is better than online. Also, we believe that this trend mainly happened because of the survival mode during the pandemic because by hook or by crook, we still need to do our job." (Group 1)

"During the pandemic hit, there were a lot of online courses, so even students could enroll in all of the online courses" (Group 2)

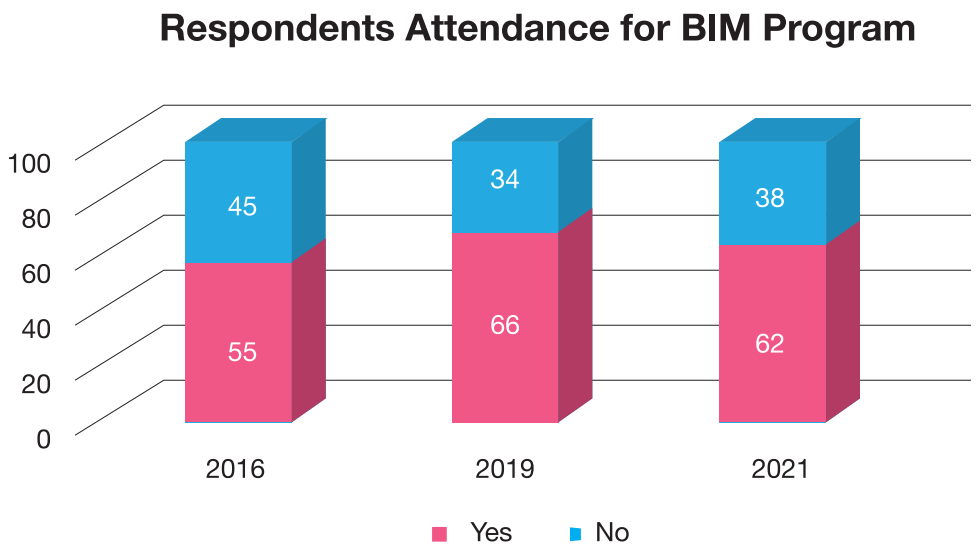


Figure 3.6. Respondent attendance for BIM programs

3.2.3 BIM Training Provided by Organisation

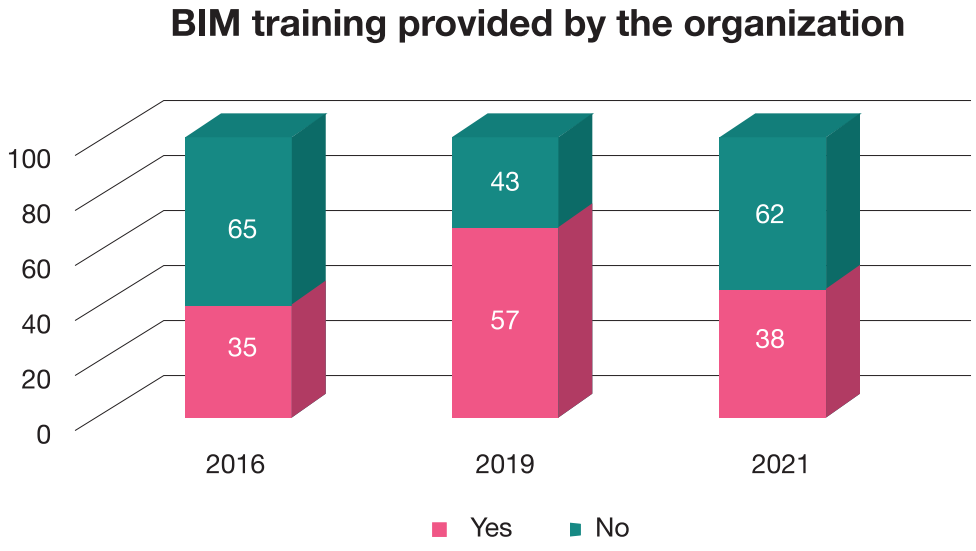


Figure 3.7. BIM training provided by the organization

To guarantee the competence of participants in the construction industry, training is one of the fundamental skills that every employee in every organization must possess. However, CIDB (2016) highlighted the lack of skilled talent to prepare plans in BIM and integrate them with the other stakeholders across the value chain. Therefore, BIM personnel training at accredited training organizations must be consistently conducted to overcome this issue.

As awareness of BIM increases over the years, there is some correlation with awareness of BIM at the organizational level, as shown in Figure 3.7. The increase in BIM training, as evidenced by the increase from 35% to 57% in the survey responses, proves that the organizations are aware and willing to change their BIM adoption approach. However, the percentage decreased in 2021 to 38%. Nevertheless, the percentage is still higher than in 2016 (35%). According to Rick (2020), The assessment of training requirements must be closely scrutinized as the lack of appropriate training is one of the most significant impediments to BIM adoption. It is especially true for organizations with limited staff with experience in BIM.

These results can be associated with the results for 'attending BIM programs' as training provided by organizations is also affected by COVID-19. Training increased significantly between 2016 and 2019, but the pandemic caused it to decline. The need for BIM specialists, particularly in the mechanical and electrical fields, expanded significantly in 2019, which led to a large increase in job possibilities. The industry is aware that individuals will pursue these BIM-related positions. Therefore, more training is provided to them.

On the contrary, some industry experts have a different view. They concurred that if this number includes external training, the outcome for 2019 will be lower because offering external training requires additional expenses, which they wished to avoid when assessing the COVID-19 impact. However, certain organizations provide internal training. Therefore, the results for 2019 are probably lower because physical attendance was not authorized throughout the pandemic. Moreover, given the rise in individuals who are already familiar with BIM, there are probably going to be fewer newcomers who need the training, as stated by the experts:

"We agree with this as COVID-19 affected the training provided. From 2016 to 2019, training was a lot, but because of COVID-19, it decreased back down. Also, back in 2019, the demand for BIM skills increased a lot because there were many skyscraper projects, and the demand for BIM specialists, especially in mechanical and electrical, shot up a lot. So, there were many job opportunities. So, the training needs to be done. Organizations made opportunities available as people will go for BIM for jobs. So, they provided more training for them." (Group 1)

"We partially agreed if this result is for external training. This is because there will be extra costs when organizations provide external training. When COVID-19 hit, all organizations need to cut costs. Also, most organizations are already providing in-house training. So, we conclude that external training should decrease while internal in-house training should increase." (Group 2)

"Agree with the assumption that physical attendance was not allowed during the pandemic. Also, because individuals who know BIM increased. Therefore, there is a probability for fewer newcomers." (Group 4)

3.3 READINESS OF CONSTRUCTION INDUSTRY STAKEHOLDERS FOR BIM

This subsection provides the results on the readiness of construction industry stakeholders for BIM. The results include individual interest in establishing BIM, belief that BIM would benefit project adoption, willingness to change for adopting BIM, and investment in BIM. The survey also includes questions on organizational financial allocation for BIM and policies for adopting BIM.

3.3.1 Respondents Who Know About BIM

The respondents' knowledge of BIM demonstrates the baseline of how industry players' awareness competes with the current development of the construction technology industry. Figure 3.8 reveals that the level of interest from the respondents was high. More than 85% of the survey respondents were interested in establishing BIM in their projects. There was a decrease between 2016 and 2019 from 95% to 88%. However, there is a slight increase between 2019 and 2021 from 88% to 89%.

The increase in respondents' interest in establishing BIM correlates with the increase in BIM awareness. During the MCO restriction, professionals used BIM to upskill and reskill their knowledge. Furthermore, as the project work had to be halted due to MCO restrictions, some organizations provided internal training for employees. However, respondent interest has slightly increased because many projects have been on hold, as stated by the experts:
"So, we can say that BIM awareness is increasing, particularly in 2021. It is increasing because of MCO. The professionals are taking the opportunity to upskill and reskill using BIM. Organizations did provide internal training for workers due to project works required to stop during MCO restriction." (Group 1)
"We conclude that the huge jump from 2016 to 2019 was because the organization has started to adopt BIM due to the demand of the project, such as all the mega projects and sort, but we can see the speed is decreasing, maybe due to like many projects have been held on because of the pandemic and anything, so can see the speed is decreasing." (Group 2)
"We agree with the conclusion that it is increasing yearly and decreasing in speed. We believe it is due to the pandemic." (Group 4)

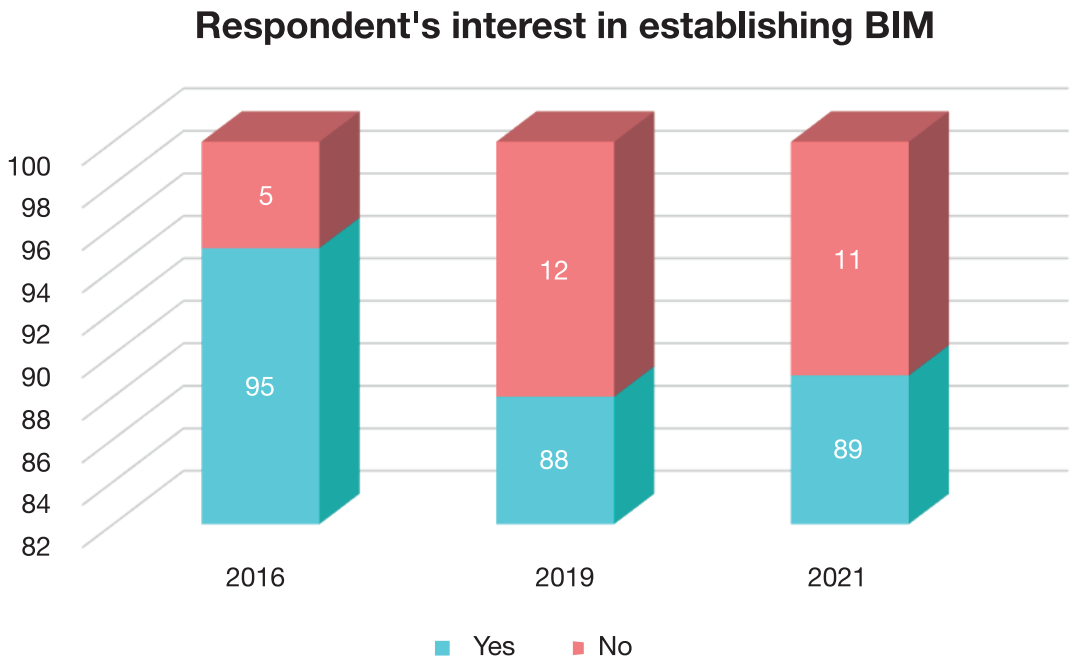


Figure 3.8. Respondents' interest in establishing BIM

3.3.2 BIM Provides Benefits

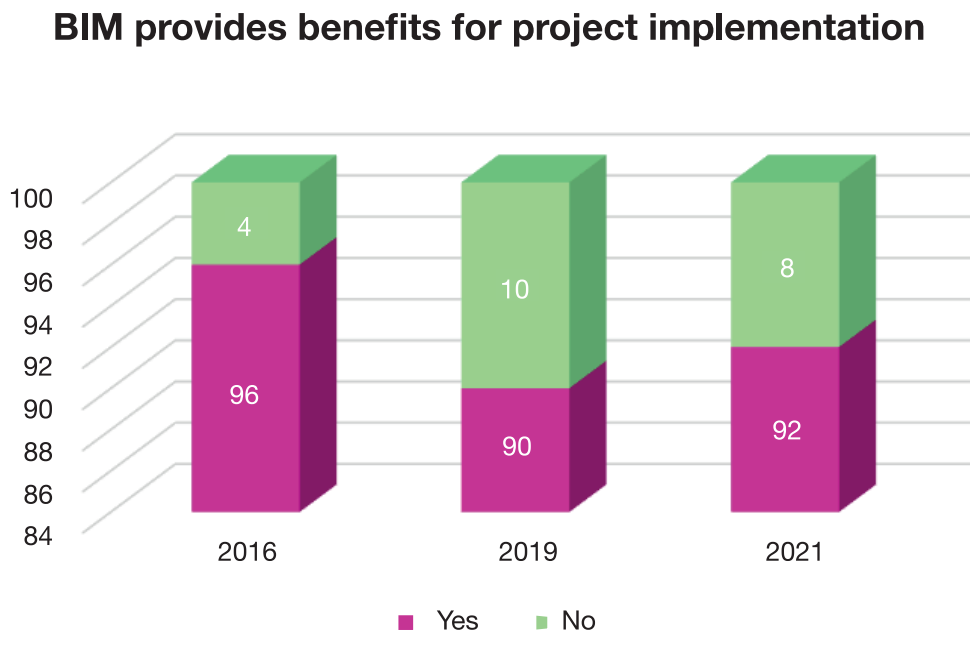


Figure 3.9. BIM provides benefits for project adoption

In measuring the benefits of BIM, three main criteria need to be considered to see whether they have a positive or negative impact on the individual or organization. Time, cost, and quality are the three crucial criteria affecting the BIM project adoption. Figure 3.9 displays the percentage of benefits provided by BIM for project adoption. There was a decrease between 2016 and 2019 from 96% to 90%. However, there is a slight increase between 2019 and 2021 from 90% to 92%. In other words, more than 90% of the respondents agreed that BIM could provide good benefits for their project adoption as it caters to the time, cost, and quality criteria.

Individually the industry players have believed and understood that BIM provides benefits. During 2016, there were many projects, and BIM started to be widely adopted that year. However, due to negative experiences with previous projects, the trends slowed in 2019. When the pandemic struck in 2021, virtual meetings increased because all coordination work could be done virtually. As a result, they must adjust their workflow. Some of them believe that the individual's statement is unimportant and that they should instead focus on the organizations' readiness to accept BIM. While the majority believe BIM has benefits, some believe BIM is not for them after learning or using BIM, as stated by the experts:
"So, we can see the trend here is all above 90%. So, it is good. So, it meant that we do believe, and we understand that this BIM gives more benefits." (Group 1)
"And 2019 was reduced due to bad experiences with previous projects. From my experience, during 2016, there were many projects, and then BIM started to be widely adopted in 2016. Most organizations may have faced failed adoption in their project. Furthermore, we can see a decrease in 2019. However, when the pandemic hit, it increased in 2021 as many virtual meetings and all coordination could be conducted virtually. So, they have to change their workflow." (Group 2)
"The majority think BIM provides benefits, but some believe BIM is not for them after learning or using BIM, maybe." (Group 4)

3.3.3 Willingness to Change for BIM Adoption

People, process, technology, and policy are the four main pillars that contribute to the improved performance of the construction industry. People are always associated with a change in mindset from the old way of working to the new working style. Here, Figure 3.10 illustrates the willingness of the respondents to change BIM adoption. All respondents show a positive willingness to change for BIM (84% in 2016 and 72% in 2019 and 2021). These numbers are good indications of BIM advancement in the future.

The demand for BIM projects was undoubtedly high in 2016. However, in 2019, when the industry actively adopted BIM, it was clear that BIM required a significant cultural transformation that began with resources, training, personnel, software, and hardware. The decreased number during 2019 happened as they discovered that it is not a straightforward

process and needs more to learn. Additionally, they are also concerned about the transition from physical submission to online submission and digital signatures, as stated by the experts:

"So back in 2016, there was a high on BIM. However, in 2019, when you want to adopt BIM, you understand that BIM is a huge cultural shift starting from the financial, training, people, software, and hardware. I think they realized that adopting BIM is not easy."

"Submission of drawings needs to be digitalized, the signature needs to be digitalized, and then there is the issue of whether your signature is authentic. Is it not? What is the data that you have in your signature? This issue contributes to whether you are willing enough to shift from, you know, physical submission to online submission." (Group 1)

"And for 2016, the peak, same reason as individual interest in establishing BIM and individual believe BIM provides benefits and for 2019 and 2021 same." (Group 2)

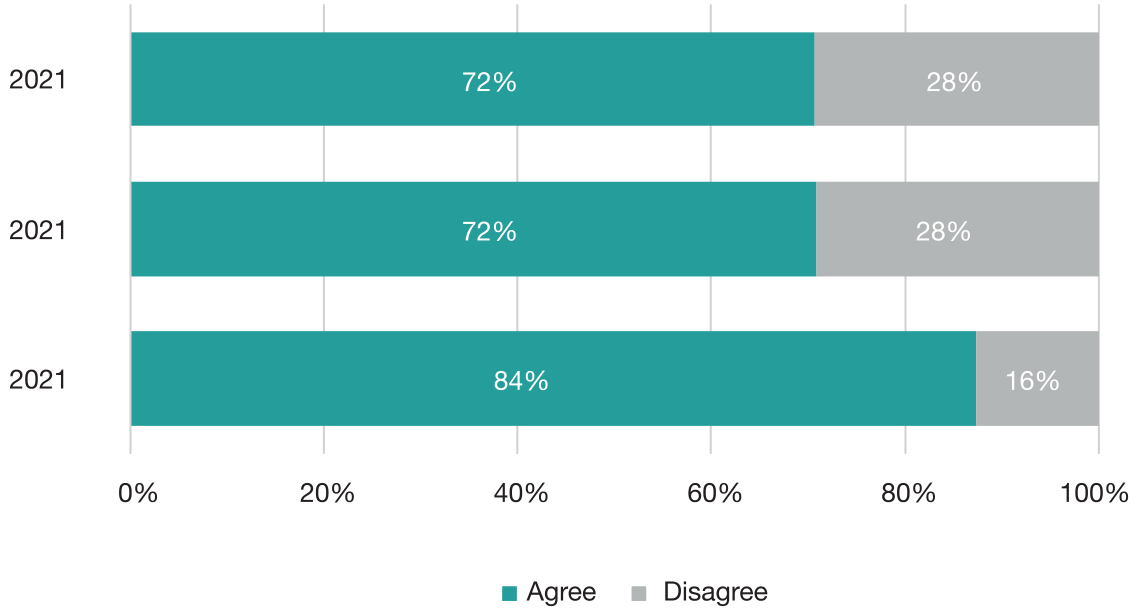


Figure 3.10. Willingness to change for BIM adoption

3.3.4 Investment in BIM

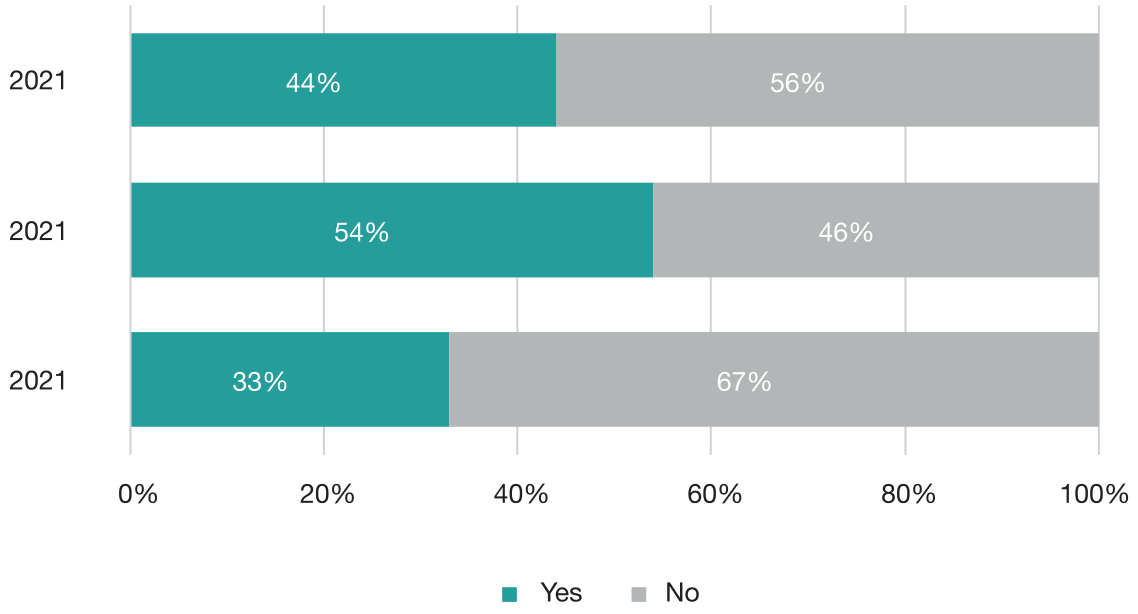


Figure 3.11. Investment in BIM

Figure 3.11 illustrates an interesting figure to consider in BIM adoption. From 2016 to 2019, the respondents showed an increase in BIM investment from 33% to 54%. However, investment in BIM decreased from 54% to 44% between 2019 and 2021. Nevertheless, the percentage is still higher than in 2016 (33%). According to Rahman (2014), BIM is a relatively potential technology, particularly in Malaysia, and individuals will likely be hesitant to embrace it. The expense of BIM training is one of the major roadblocks to its uptake. Cost is one of the most immediate issues for construction organizations on BIM adoption in the industry. The initial investment costs cover a variety of items, including new software, hardware, and employee training.

The investment depends on how much an individual is willing to study BIM and how much an organization is willing to spend on BIM, as the software is costly. The industries feel that the reason why 2019 increased was to meet the CITP's KPI. They also agreed that before 2019, the government had already provided subsidies for SMEs to pay for training and software. However, after that, CIDB stopped providing these subsidies, and the trend started to decline.

"These three years is lesser than 50%, but 2019 is 54%, but again I believe that this 2019, it shoots up because of the CITP's KPI, so I think that is why it shoots up back, but it goes down back, so quantity investment it is it depends of how much the individual is willing to learn BIM and also how much an organization willing to spend of BIM because as you know, BIM software is not cheap" (Group 1)

"And then, regarding the organization's investment in BIM, we agreed that before 2019, the local government had already subsidized training and software for SMEs. After that, I think there will be no more subsidies. As a result, we can see that the trend is going down. And then, for 2021, the situation is becoming more stabilized than 2019 as the new workforce is equipped with BIM knowledge, and organizations can have in-house training." (Group 2)
"Increased in 2019 but decreased in 2021 for organization investment in BIM. Most probably, the percentage is decreased due to the post-pandemic impact on the industry." (Group 4)

3.3.5 Organisation Financial Allocation for BIM

Along with the investment into BIM in the organization, the financial allocation for BIM is also important to measure the readiness level of BIM adoption in Malaysia. Figure 3.12 shows that in 2019, 43% of the respondents agreed with their organizations allocating some financial expenditure to improve or kick-start the BIM working environment. However, that percentage decreased to 34% in 2021. Nevertheless, the percentage is still higher than in 2016 (28%). BIM training can be done in-house or outside the organization (Pena, 2011). Because BIM experts such as BIM managers can conduct training, organizations with experienced individuals in BIM are more likely to conduct in-house training. According to prior research, organizations that use their trainer for in-house training can help organizations with customized training (Green, 2007).

Most industry players have the same view on these results. The trends for financial allocation and organizational investment are correlated with each other. However, some industry players prefer that the measurements be divided by organization size to understand that small, medium, or large have different capacities to invest in.
"The trend is the same. Financial allocation and organizational investment correlate with each other. (Group 1)
"We prefer that the measurements are separated by organization size, so we know that small, medium, or large has different capabilities to invest in. (Group 3)
"Increased in 2019 but decreased in 2021. Also, we believe this is due to pandemic and development trends." (Group 4)

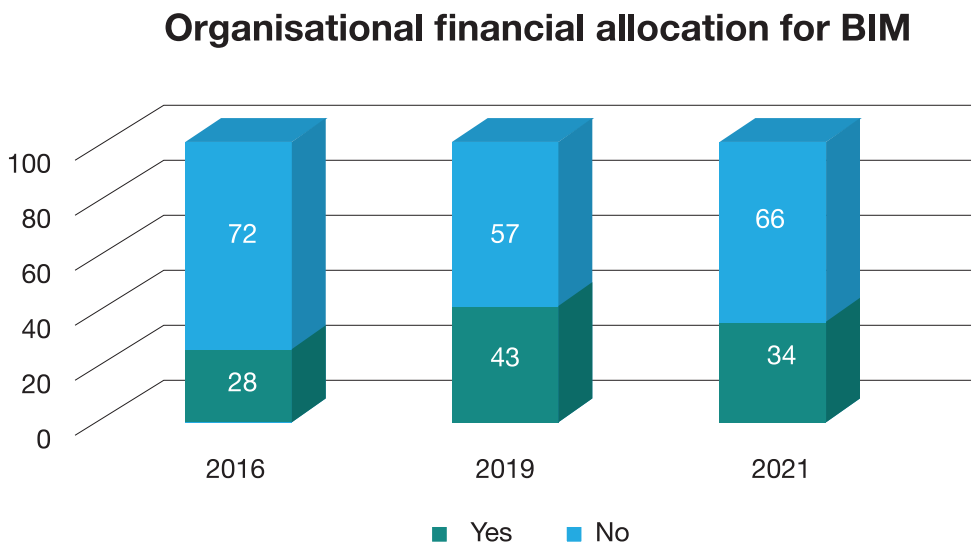


Figure 3.12. Organisation financial allocation for BIM

3.3.6 Clear policies to support BIM Adoption

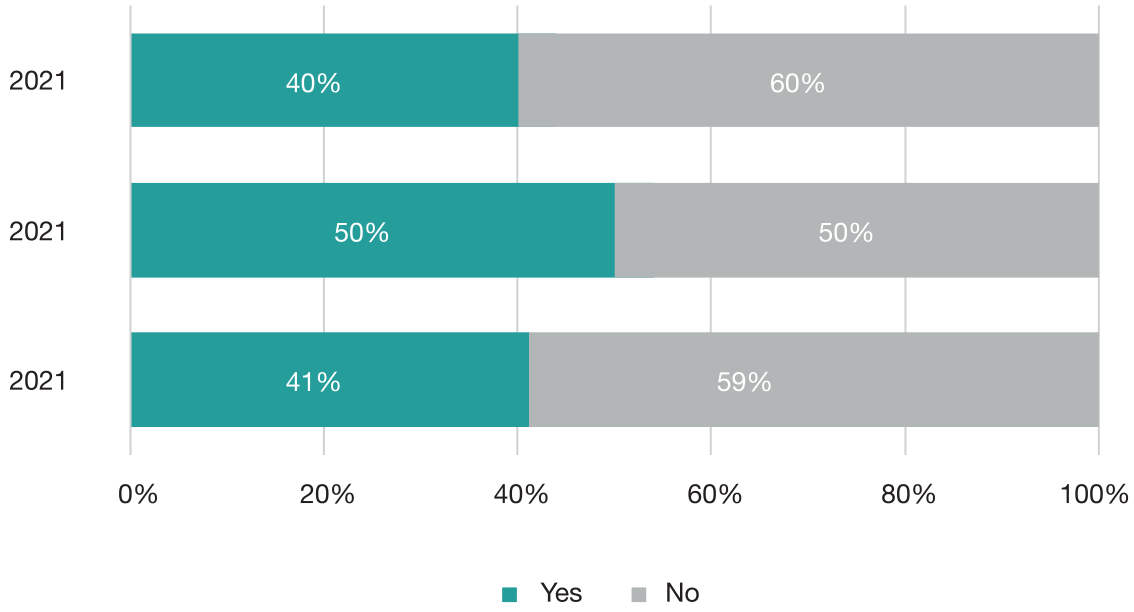


Figure 3.13. Policies on BIM adoption

As previously stated, having a policy is one of the main pillars that support BIM adoption. Unfortunately, most BIM adopters have difficulties in structured policy interventions to drive BIM adoption. Figure 3.13 shows that there has been an improvement in clear policies from the government or organizations to support BIM adoption. The number of respondents who answered in the affirmative rose from 41% in 2016 to 50% in 2019. However, that percentage decreased to 40% in 2019, which is slightly lower than the percentage in 2016. According

to Zakaria (2013), users create their guidelines without consulting a BIM specialist because there is no national BIM adoption guideline. Every organization develops its rules, resulting in a wide range of outcomes. As a result, construction players will be confused by all of these versions.

The industries find that having various standards amongst the authorities may have contributed to the outcomes. Particularly, this occurs while submitting documentation where each organization sets different standards. Therefore, by establishing a uniform standard, all stakeholders are expected to comprehend the BIM policy and can subsequently speed up documentation-related processes.

"I think when it goes there, the subject and matter, in the end, depends on you knowing your standard on how you want to deliver or submit files. However, we believe that if we all have the same standard, it will ease the submission works for all stakeholders." (Group 1)

3.4 CURRENT BIM USAGE IN THE LOCAL CONSTRUCTION INDUSTRY

The results include the overall BIM adoption rate and the rate by region, working experience, profession, and organization size. In addition to that, the survey also collected data on BIM uses in organizations, tools used for modeling, approaches for sharing information, individual involvement in BIM projects, standards used, BIM sources of information about BIM, models coordination between all disciplines, and level of confidence regarding knowledge and skill in BIM.

3.4.1 BIM Adoption Rate

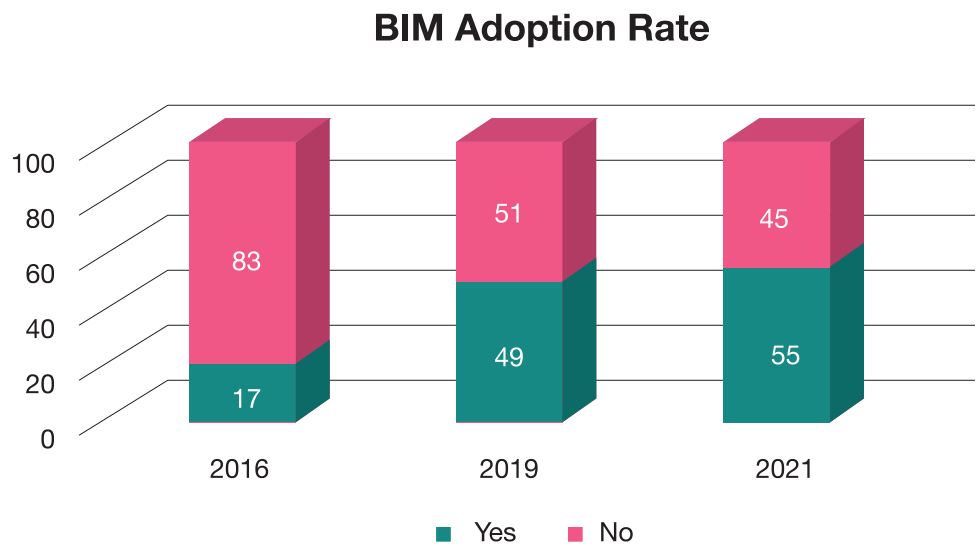


Figure 3.14. BIM adoption rate

The results of the BIM adoption rate are important for measuring the level of adoption among construction industry players in Malaysia. Figure 3.14 portrays the BIM adoption rate for 2016, 2019, and 2021 respectively. Previous reports on the BIM adoption rate showed that only 17% of the respondents had experience using BIM in 2016.

In 2019, a positive increment was recorded, with 49% of BIM adoption by respondents compared to 2016 (three years ago). The percentage of BIM adoption in 2019 showed a drastic improvement as it increased by almost triple the previous figure. The introduction of CITP, accompanied by relevant government policy, has guaranteed a better BIM adoption rate, especially in 2019. In addition, the increasing trend of project demand has increased the BIM adoption rate.

"This is because, again, CITP is all right and then also the government policy." (Group 1)

"On the BIM adoption rate, we agreed that it increased from 2016 to 2019 due to project demand." (Group 2)

Moving forward two more years in 2021, the BIM adoption rate is still increasing but with a minor increment and is recorded at 55%. However, between 2019 and 2021, the reduction of project demand due to the COVID-19 pandemic decreased the BIM adoption rate. Besides that, the development trends in the job market, including uncertainty or unavailability of BIM-related jobs, increase in material price, and labor shortage, have also affected the BIM adoption rate. Furthermore, the lack of BIM standards and guidelines adds to the trouble of BIM adoption in the construction industry. Due to a lack of understanding of BIM, construction stakeholders are unsure how, when, or where to begin adopting it (Zakaria, 2013).

"And for 2019 to 2021, many projects are on hold due to the pandemic, and then we conclude that project demand will be affecting the BIM adoption rate." (Group 2)

"Agreed, BIM adoption is increasing, but the speed is decreasing. We have decided that it is due to development trends. What development trends: first, because of uncertainty in jobs, there are no jobs for BIM, and also, the market increase the material price and shortage of labor." (Group 4)

3.4.2 Organisation BIM Use

Figure 3.19 shows the results of organizational BIM use. Coordination/clash detection has recorded the highest percentage at 73%, followed by visualization (65%) and project planning (60%). BIM uses percentages between 20% and 40% are estimating (36%), scheduling (35%), take-offs (31%), virtual mock-ups (28%), and selling/presentations (24%). Prefabrication (19%), facility management (17%), and value analysis (13%) are the BIM uses with percentages between 10% and 20%. Finally, code compliance and other uses are the only ones with percentages less than 10%.

Although most respondents agreed that coordination/clash detection represented the highest percentage of BIM use, that is only limited to specific construction stakeholders (i.e., consultants and contractors). From the client's point of view, the visualization and virtual mock-ups for BIM use are more crucial to representing the 3D façade view of the facilities. Moreover, BIM use, such as scheduling and project planning, including site logistics and project risk, are essential to construction stakeholders to provide better insight into the project. Lastly, the increase in BIM use in prefabrication can also lead to a higher BIM adoption rate.

"The strata of using this BIM change based on the client because now, when you deliver a file or a project to a client, it is not just... like have clash or not... it is not just that. It is more to visualization because now, we are at a point where when we submit drawings, we need to submit them together with the tone color of the concrete." (Group 1)

"… But it can be like scheduling and then for a site logistic, project planning. It can be fully used because by using scheduling and project planning. We can try to involve the project risk. We can use it for planning and scheduling for a certain project to have better insight into that project." (Group 2)

"Agreed BIM adoption in prefabrication should be increased. If BIM adoption in prefabrication should be increased, then BIM adoption will also increase." (Group 3)

Besides that, some BIM use falls under the same categories and is suggested to be combined; for instance, "estimating, "scheduling," and "project planning" can be grouped under "project planning."

"So, what we believe that here instead of making it individually, you can actually group up like "scheduling," sorry... "estimating," and "take-off" you can make it to one group and then "visualization" and "virtual mock-ups" (Group 1)

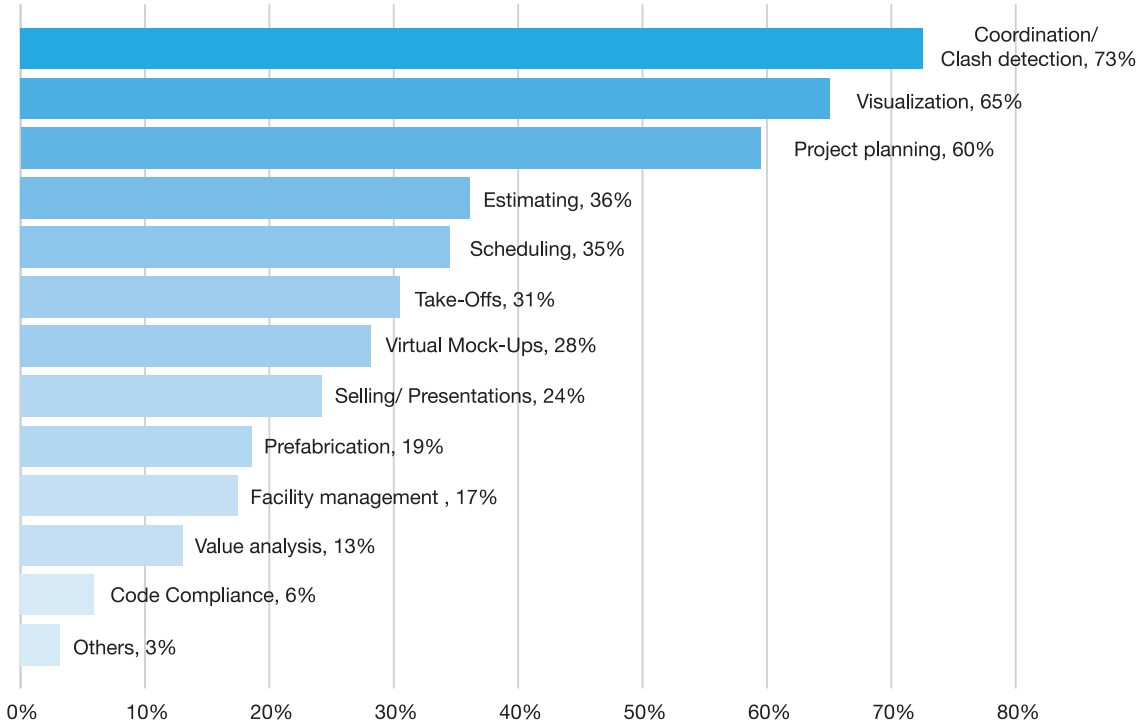


Figure 3.19. BIM use in organizations

3.4.3 Tools used for modeling in organizations

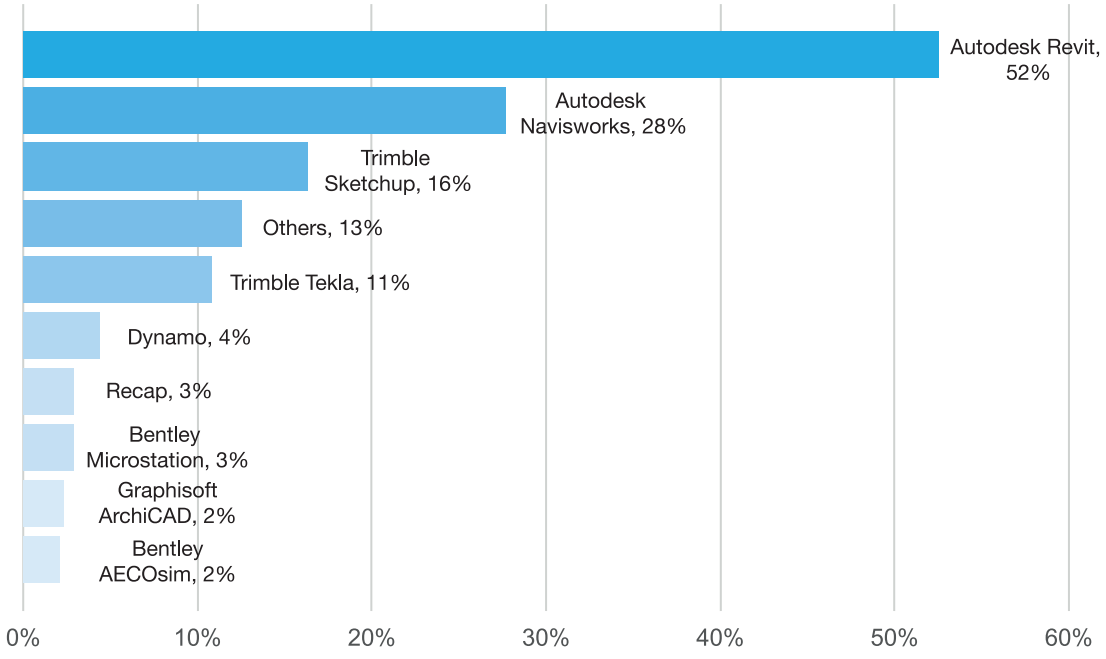


Figure 3.20. Tools used for modeling in organizations

Figure 3.20 shows the most common tools used for modeling in organizations. Again, Autodesk Revit is taking the lead as the most used software to produce informative models at 52%. Next, another product used for design and clash detection, Autodesk Navisworks (28%) and followed by Trimble Sketchup (16%), Timble Tekla (11%), Dynamo (4%), ReCap (3%), Bentley Microstation (3%), Graphisoft ArchiCAD (2%) and Bentley AECOsim (2%).

Several experts opined that the software Autodesk AutoCAD which produced 2D drawings should be the most used tool as 2D drawing is still a required document for submission to the relevant authority. However, the results are acceptable as many consultants have already used Autodesk Revit since the software was introduced. Other software such as Bentley Microstation and AECOsim have their advantages but are not popular compared to Autodesk software.

"I mean, 2D drawing is still a required obligatory document for you to submit documentation. It means the submission is still 2D, so that is why I think the tools used in models are still in AutoCAD." (Group 1)
"Consultants already use AutoCAD360 depending on project needs and requirements on what tools are used. I think this because the market has already introduced Revit as the main tool for BIM. However, some people still think BIM is a Revit, which it is not. Other software also has advantages, such as Bentley Microstation, AECOsim, and Civil 3D. However, it depends on the BEP itself." (Group 2)

3.4.4 Approach for sharing information

Figure 3.21 shows the results of approaches for sharing information. Following a naming convention for all shared information has the highest percentage at 66%, followed by clearly indicating what the shared information is suitable for (59%) and exchanging information in FIC format (43%). There is only one approach with percentages between 20% and 40%: highlighting named information through revision codes at 28%. Exchanging information in COBie format (7%), classified information using Unclass (6%), and others (4%) are approaches for sharing information with percentages less than 10%.

Most experts opined that all the shared information should have already been included in the BIM Execution Plan (BEP) before the project execution:

"I think this one is very straightforward. Every organization has its policy and standard of ISO." (Group 1)
"I think in BEP, normally we have some period to discuss on BEP based on what we agreed on the sharing information that we do for a certain project. Because in the end, BEP will conclude everything on what kind of information we will be sharing and then what platform, format, and everything. So normally, we use ISO, the BS, and everything, but some of the projects have their standard that they want to follow so that they will include them in the BEP." (Group 2)

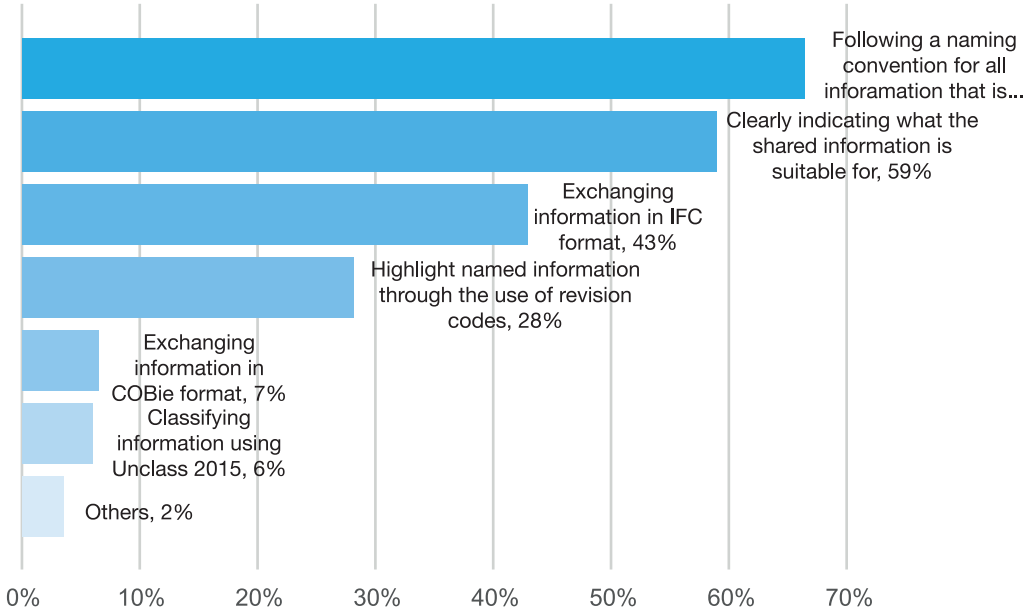


Figure 3.21. Approach for sharing information

3.4.5 Individual involvement in BIM Projects

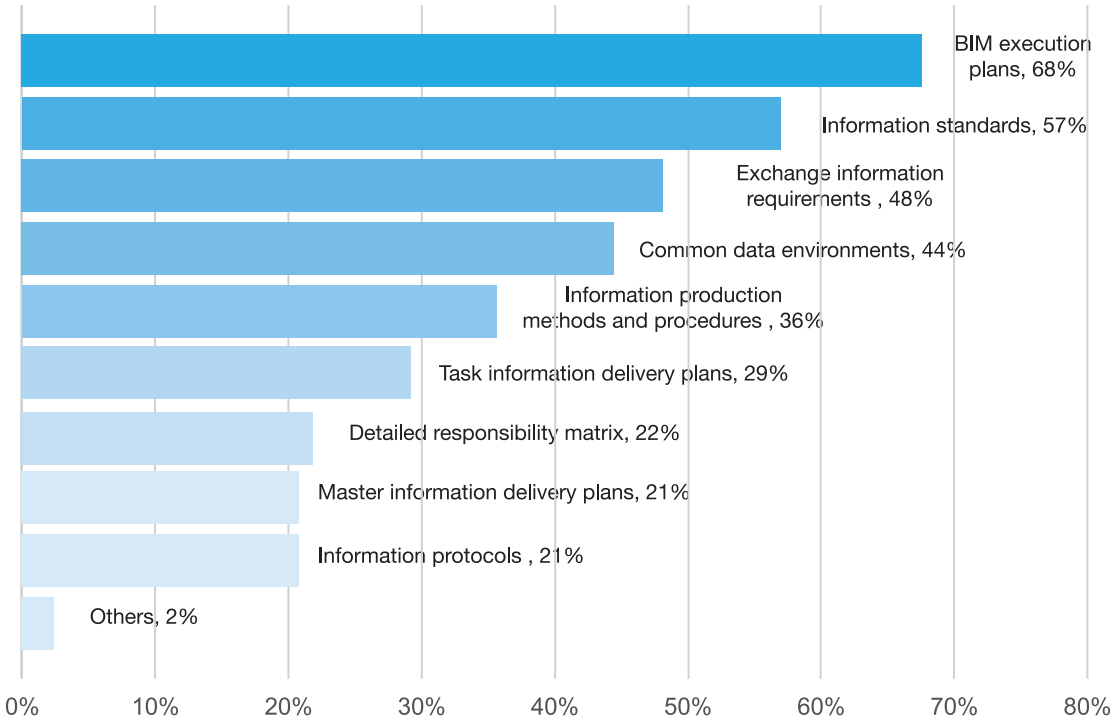


Figure 3.22. Individual involvement in BIM projects

Figure 3.22 shows the results for individual involvement in BIM projects. BIM execution plans have the highest percentage at 68%, followed by information standards (57%), exchange information requirements (48%), and common data environments (44%). Involvement with percentages between 20% and 40% are information production methods and procedures (36%), task information delivery plans (29%), detailed responsibility matrix (22%), and information protocols (21%). Only other involvement has percentages less than 10% at 2%.

For individual involvement in BIM projects, most experts agreed that a BEP should represent the highest percentage as it involves a lot of activities, including information standards and exchange information requirements. As a result, the other information should have been included in BEP, and there is no need to make a data comparison among them.
"It has its standard, but then we agree with the idea that BEP is involved a lot in these activities." (Group 1)
"BEP already concludes everything because BEP is the last stage of the process, even for standard information action, EIR, common data environment, everything already concluded in the BEP." (Group 2)

3.4.6 Standards and Sources Used

Figure 3.23 portrays the standards used in organizations. CIDB BIM guidelines have the highest percentage at 49%, followed by JKR BIM guidelines (48%). Standards used with percentages between 20% and 40% are organization BIM policy/strategy aligned with industry standards at 38% and BS EN ISO 19650 series at 25%. Industry standards that do not align with industry standards are the only standards used, with percentages between 10% and 20%. Standards with percentages lower than 10% re BS/PAS 1192 suite and MS 8536 soft loadings at 8% and 4%. Lastly, the results show that there are no other standards used.

In general, it is undeniable that the CIDB and JKR BIM guidelines represent the highest percentages, as both organizations have put much effort into promoting their guidelines to construction industry players. Also, the other standards, including organization BIM policy/strategy that aligns with industry standards and BS EN ISO 19650 series, are popular options for usage among private organizations if they fulfill the requirements of industry standards.

"We can see that the first and second place goes to CIDB and JKR. So, we have to highlight that all your effort is being taken. We highly appreciate it and acknowledge that you are doing a good job in adopting these BIM guidelines. So, hats off to CIDB." (Group 1)
"We agreed with the result depending on the project requirements and needs. Some private using ISO, the government, uses JKR standards, and then like my project, they are using BIM forum LOD specification, so that is fine. They need to specify the LOD matrices that we need to follow." (Group 2)

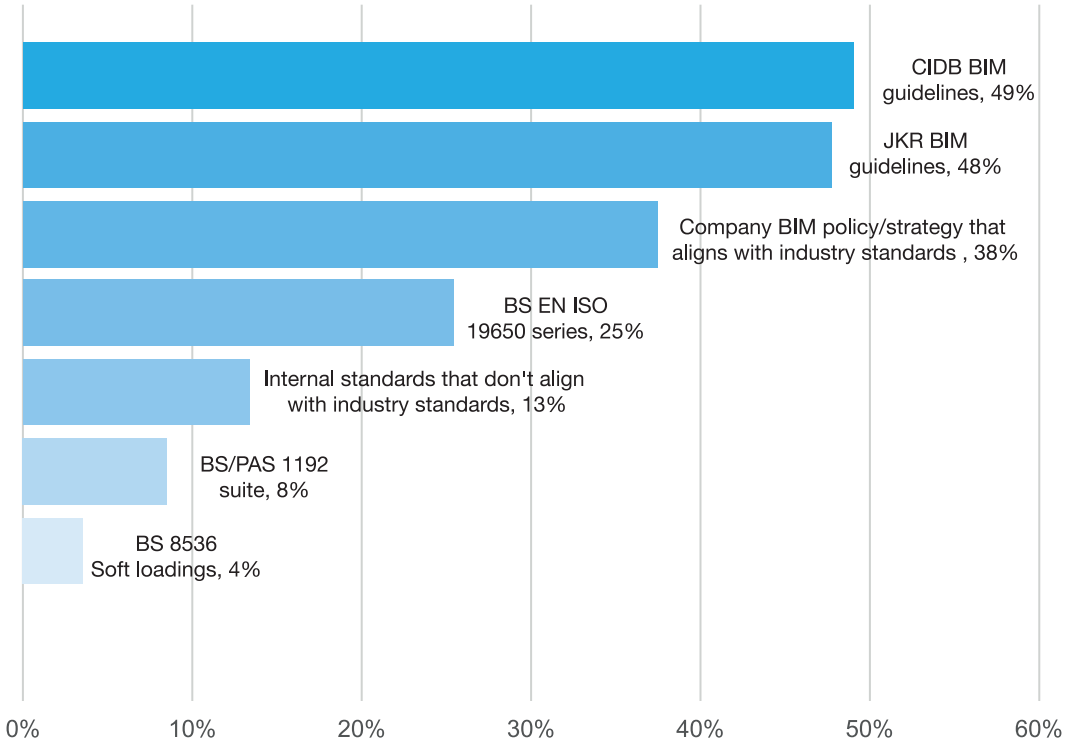


Figure 3.23. Standards used in organizations

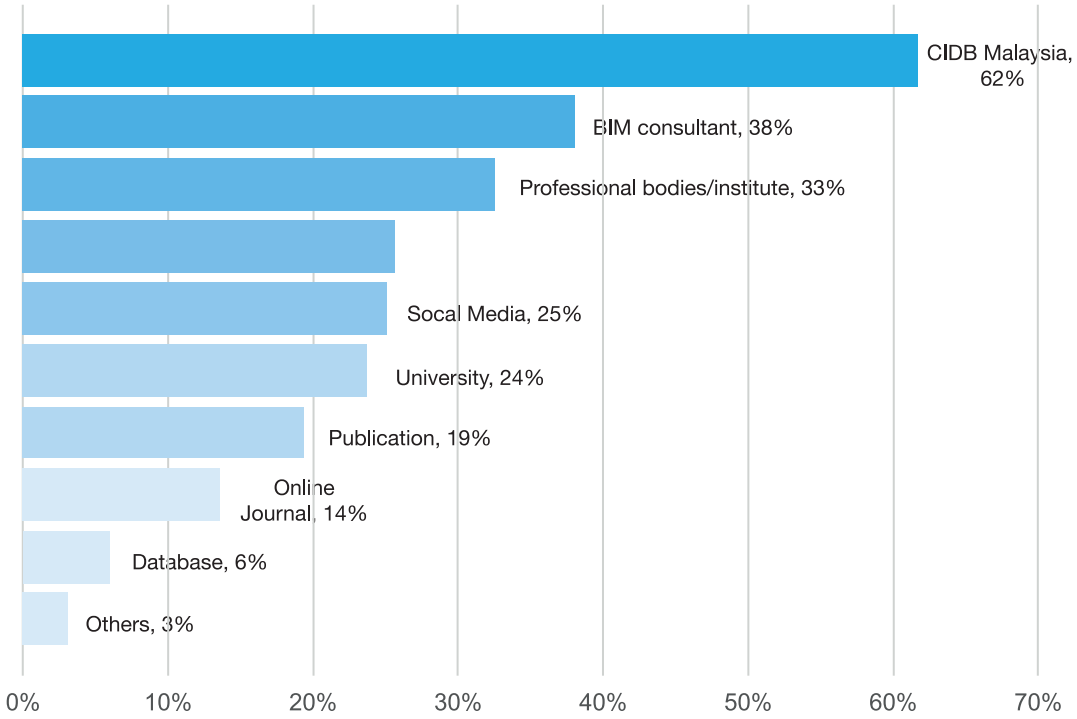


Figure 3.24. Sources of information about BIM

Figure 3.24 represents various BIM information sources. CIDB Malaysia was cited as the source of BIM information for most respondents (62%). BIM consultants were ranked second, with 38% of respondents citing them as sources of BIM knowledge. This was followed by professional bodies or institutes (33%), colleagues (26%), social media (25%), universities (24%), publications (19%), online journals (14%), and databases (6%).

3.5 BIM MODELS COORDINATION BETWEEN ALL DISCIPLINES FOR PROJECTS

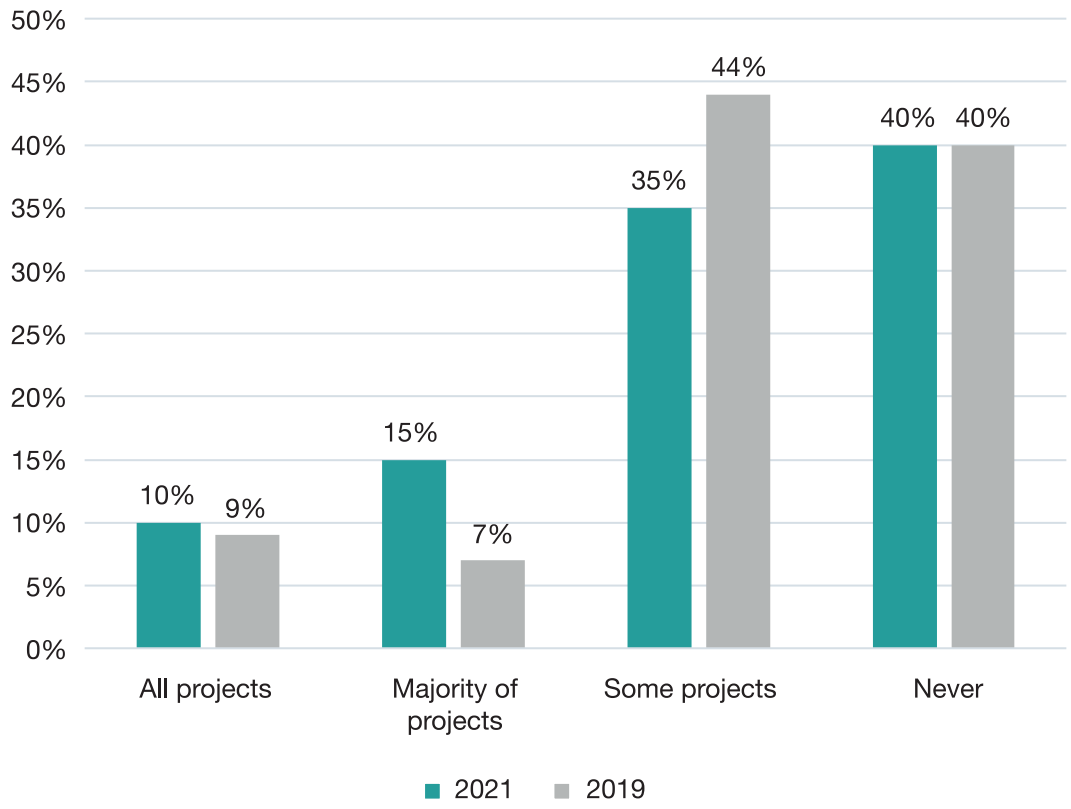


Figure 3.25. BIM models coordination for projects

Figure 3.25 illustrates the proportion of BIM model coordination for projects answered by the respondents. For 2021 and 2019, the percentage of respondents who answered never remained the same at 40%. From 2019 to 2021, there was a decrement in the percentage of respondents involved in BIM model coordination for some projects, from 44% (2019) to 35% (2021). Nevertheless, the results show a good sign as there is a hike percentage of respondents involved in BIM model coordination for the majority of projects. From 2019 to 2021, there was a significant improvement in BIM model coordination in the majority of projects, from 7% (2019) to 15% (2021), approximately an 8% increment. For BIM model coordination in all projects, there is a minor improvement from 9% (2019) to 10% (2021). Most experts agreed with the results and gave positive feedback, including but not limited to the following:

"So, we can see here that the percentages for the "never" categories are 40% and 40%. So, it means that some of the organizations are still practicing Level 1 BIM. It means that in a project team group, you may be doing BIM, but probably your M&E or you are structural. They are not doing BIM. So, regardless we cannot execute BIM. It goes vice versa." (Group 1)

"We agree with the data given and probably need to define the percentage of the majority; our group suggests that the majority of projects have a percentage, let us say, from 50% to 99%. Some projects changed from 99% to 1 % and never 0% so that we have a better definition of some projects and the majority of the projects. We also need a general note about 2020; for example, it is a year we have COVID-19, so it should affect some of the survey results." (Group 2)

"BIM model coordination between all disciplines for a project, we agreed because of increased usage for the organization that has adopted BIM. An organization that has not used BIM has not taken the first step to use BIM. That is why the 'never' percentage remains the same." (Group 3)

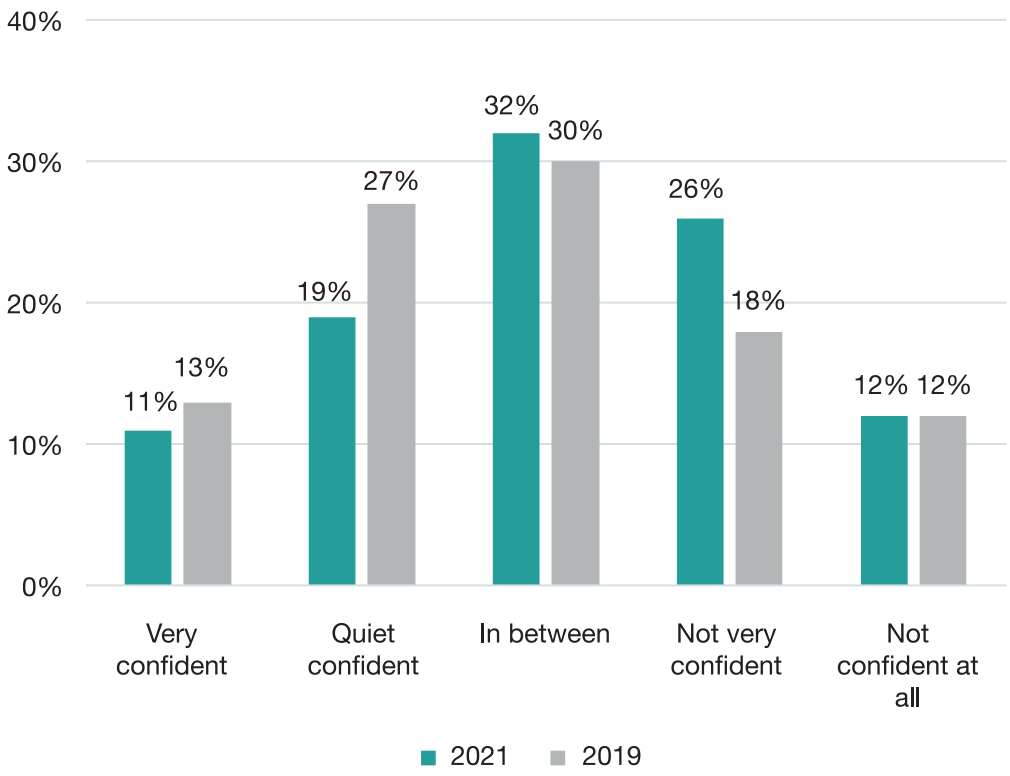


Figure 3.26. Level of confidence in using BIM

Figure 3.26 portrays the level of confidence in using BIM for the years 2019 and 2021. The result shows that the level of very confident and quite confident declined between 2019 and 2021, with the level of very confidence from 13% to 11% and quite confident from 27% to 19%. Some experts opined that the results could not represent the whole industry as the question leads to a more personal evaluation. In contrast, the level of in-between confidence and level of not very confidence has illustrated an upward trend from the year 2019 to 2021, level of in-between confidence from 30% (2019) to 32% (2021) and the level of not very confident from 18% (2019) to 26% (2021). Some experts agreed that a few groups of BIM users have less opportunity to apply their knowledge and skills in real projects. Also, some experts agree with the results as project complexity is growing even with the application of BIM. For the level of not confident at all, the percentage remains unchanged for both 2019 and 2021.

To increase the level of confidence in individual BIM skills and knowledge, it is important to have more training, seminars, and sharing discussions with industry experts. However, despite its long history, BIM is still in its infancy in Malaysia and has yet to be properly developed and refined to realize its full potential (Roslan, 2019).

"So, this is the reality we need to face that "in-between" you know ... the category "in-between" is the highest because less opportunity to apply the knowledge and skills in real projects and this thing that is going on, most of the BIM experts that we have in Malaysia they shifted to international projects. Alternatively, they are probably based in Malaysia but doing international projects. All right. So, I think this can be related to how are we, you know, going to further, how I would say this, retrench? Retrench? Not retrench. I would say maintain these skilled employees we have here. So, I think this is one thing we should note, so they do not go off, you know, other countries, you know." (Group 1)
"We agree confidence is decreasing while not very confident increasing because the complexity of projects increased." (Group 4)

3.6 CHALLENGES FACED IN ADOPTING BIM AND THE IMPACTS OF COVID-19

The results include the rankings for challenges in adopting BIM and COVID-19 impacts on BIM projects. The survey also provides insights into the impact of COVID-19 on BIM adoption, BIM investment, and BIM staff growth.

3.6.1 Challenges in Adopting BIM

Table 3.1. Ranking of challenges for adopting BIM

Challenges	2021	2019	2016
High cost of software	1	2	4
High training cost	2	3	2
High cost of technology	3	1	1
Lack of BIM knowledge	4	4	3
Lack of top management support	5	New	New
Lack of experience in coordinating the construction documents by using BIM	6	5	-
Lack of time for experimentation and adoption in a fast-paced project	7	10	6
No established contractual framework for working with BIM	8	7	-
Lack of organization familiarization with adopting BIM	9	9	14
Insufficient BIM training available	10	15	5
Reluctance to initiate new workflows for adoption of BIM	11	8	12
Lack of references/sources to assist in adopting BIM	12	13	7
Lack of direction of BIM in the industry	13	17	13
Lack of awareness of BIM benefits	14	12	18
The complexity of the new roles in BIM-based construction projects	15	New	New
Lack of BIM demand	16	New	New
Difficulty in adopting BIM coordination	17	20	-
Lack of clear policies that support BIM adoption	18	6	-
Inadequate information management processes for BIM	19	New	New
Lack of appropriate projects to adopt BIM	20	New	New
Resistance to change for new technology	21	16	17
Existing hardware is not capable of running basic BIM software	22	18	11
Lack of time to adapt	23	11	9
There is no BIM requirement/mandate in the industry	24	14	15
Lack of interoperability between software in exchanging information	25	New	New
The complexity of BIM software	26	-	16
The assumption that conventional methods are better than new processes	27	19	18

Table 3.1 shows the ranking of the challenges for adopting BIM for 2016, 2019, and 2021 reports. Additional challenges acquired through the survey include but are limited to:

- Software providers are monopolizing the market.
- The higher cost of BIM software support
- More training regarding BIM should be planned as there is a lack of awareness of BIM.
- Procurement processes are not tailored for BIM
- Lack of exposure and opportunity on BIM for fresh graduates
- Interoperability issues between BIM software and system-specific software (e.g., gas and chemical piping software)
- Clients are not willing to pay additional fees to purchase the necessary software licenses
- BIM is not seen as a priority by top management and decision-makers
- Lack of integration and readiness between all stakeholders for coordination
- Confusion on BIM at the earlier stages of the project
- Misconceptions about BIM
- Resistance to adopting BIM as it required changing from normal ways
- There were many trial project exercises, as there are no project references for benchmarking

The results show the top four challenges remain the same yearly: (1) high cost of software; (2) high training cost; (3) high cost of technology; and (4) lack of BIM knowledge. Additionally, in the 2021 report, a new challenge was discovered and ranked fifth: a lack of top management support. Most of the focus group participants agreed with the ranking. They quoted,
"We agree with the ranking of the issues." (Group 3)
"This one is a bit interesting because we agree on most of the challenges in the top five." (Group 4)

One of the challenges in adopting BIM, which ranked the highest, is the high cost of the software. Previous research confirmed that the high cost of software is the most regularly mentioned challenge in adopting BIM (Georgiadou, 2019; Jamal et al., 2019; Leśniak et al., 2021). Although there are huge benefits and cost savings associated with BIM adoption, BIM software costs are high (Juszczyk et al., 2015). Accordingly, the cost of adopting BIM software such as Revit, Tekla, ArchiCAD, and Naviswork is high compared to traditional design tools (Latiffi et al., 2014). This is often difficult to finance due to the lack of resources, particularly for SMEs. However, one of the participants of the focus group discussion stated that,
"I can say that cost is, in fact, an issue. It does not matter whether it is software or hardware. But you can say in the long term, right, it does save you much money." (Group 1)

Research confirmed that BIM had provided approximately 5–9% cost savings during construction by contributing to reduced change orders and rework (Fanning et al., 2015).

The challenge ranked second highest in the 2021 report is the high training cost. Previous research has confirmed the high cost of BIM training as one of the challenges in adopting BIM (Arunkumar et al., 2018; Sun et al., 2017). BIM training helps users to perform more efficiently, generating precise and accurate outcomes. This can reduce the rework required during construction, as projects are less likely to require any last-minute changes or encounter unforeseen issues. However, one of the participants in the focus group discussion disagree with this,
"This one is interesting because we agree on most of the challenges in the top five, except for the high cost of BIM training. We do not agree with the high cost of BIM training because, first, some BIM training and software costs have already come together. So, software, If you say that 30000 per subscription already includes 15% and 10% of training, we believe that is not that high. However, since 2016, CIDB has allocated funds and subsidies for training BIM software and its usage. Second, organizations have developed BIM training modules for their employees. However, advanced training for software costs is still high. For beginners is subsided, but advanced training is very high." (Group 4)

In addition, a lack of BIM knowledge is a challenge in adopting BIM. Gamil and Rahman (2019) found that one of the critical challenges to adopting BIM is the lack of BIM knowledge. The lack of knowledge regarding BIM has put a question mark on the construction practitioners on how, when, or what to start adopting BIM. Consequently, projects may suffer from inefficiency and loss of profits due to increased operating costs leading to the perception that BIM is hard to adopt.

The newly discovered challenge in adopting BIM, which ranked fifth place, is the lack of top management support. It is critical to ensure top management support for adopting innovation at the organizational level (Xu et al., 2014). More encouragement from the top management leads to greater benefits from BIM adoption (Xu et al., 2014). In addition, the commitment of top management bolsters an organization's ability to execute changes successfully in organizations.

BIM has effectively disrupted the way construction organizations operate. BIM has allowed the construction industry to create greater efficiency, which in turn leads to enhanced productivity, quality, and safety (Syed, 2019)

3.6.2 Impact of COVID-19 on BIM Projects

Table 3.2. Ranking of the impact of COVID-19 on BIM projects

Impact of COVID-19	Rank
Increase construction cost	1
Shortage of labor	2
Increase government support for financing	3
Increase digital transformation	4
Expedite schedule for constructing urgent emergency projects	5
Increase technology adoption	6
Changes in contractual terms	7
Reduce overhead cost	8
Higher rejection rate of project financing	9
Increase demands from local suppliers	10
Improve sustainable development	11
Changes in working behavior	12
Disruption in the supply chain	13
Shortage of materials	14
Reduced number of public projects	15
Reduced construction productivity	16
Reduced foreign investment in the construction industry	17
Downsizing of existing projects	18
Reduced demand for construction-related works	19
Reduced number of private projects	20
Increase infectious disease management practices	21
Termination of existing projects	22
Reduce morale among project team members	23

Table 3.2 shows the ranking of the impacts of COVID-19 on BIM projects in Malaysia. The other impacts are as follows:

- BIM applications remain in demand even though the country is entering the endemic phase
- Project delay and the reduction of the workforce
- Increased overhead cost and turnaround time
- Shortage of workforce resources (from management, supervision, support team, and physical workers) in the market

The top four impacts are: (1) increased construction cost; (2) shortage of labor; (3) increased government support for financing; and (4) increased digital transformation. These results illustrate that COVID-19 can positively and negatively impact BIM projects. The top negative impacts include increased construction costs and a shortage of labor. On the contrary, the positive impacts include increased digital transformation and technology adoption and increase digital transformation.

The COVID-19 pandemic has negatively affected the global BIM construction market, mainly due to the halt in international trade, prolonged lockdowns, and reduced construction activities globally (Roy, 2021). In this 2021 report, one of the top four impacts of COVID-19 that negatively affect the Malaysian Construction industry is increased construction costs. For example, changes in foreign exchange rates and rising demand for suppliers are driving up material prices. Furthermore, COVID-19 test procedures have cost the organization more money. As construction is a labor-intensive industry, it can be very expensive for organizations to ensure workers follow SOP. Examples of responses from the focus group discussion are as follows:
"Increased construction costs ranked at the top due to the shortage of labor, changes in working behavior, supply chain, shortage of materials, reduced number of not public projects, and increased technology adoption. So as a result of all these problems, it increases construction costs." (Group 4)

Another negative impact of COVID-19 on BIM projects in Malaysia is the labor shortage. Due to COVID-19, many foreign workers returned to their countries, leading to a labor shortage. In addition, foreign workers from outside Malaysia could not come to Malaysia because of the restriction enforced by the Malaysian government. Consequently, the lack of workers caused delays in construction work. Focus group discussion stated,
"With BIM or without BIM, labor shortage and material price increases are still the issues. So, this gives back to hidden social costs. Social hidden cost means that the Bangladeshi are going back to their country. The Indonesians are going back to their country back. Furthermore, the supply of materials, especially aluminum, has been increasing. So, with or without BIM, the price of a material is still an issue here, all right." (Group 1)

One of the positive impacts of COVID-19 on the Malaysian construction industry is increased government support for financing. For example, the government has provided PRIHATIN Economy Stimulus Package, where PRIHATIN Special Grant MYR3000 will be provided to businesses affected by the COVID-19 pandemic. Also, the government has provided PENJANA Micro Finance for Bumiputera SMEs affected by COVID-19, with funding of between RM100,000 and RM1 million for the SMEs involved.

Another impact of COVID-19 that positively affects Malaysia's construction industry is increased digital transformation.

"We agree with the increase in digital transformation. This means that from the paper, we go for paperless. From physical submission now to online submission." (Group 1)

"On the positive side is increased technology adoption and digital transformation." (Group 2).

During the COVID-19 lockdown measures, some construction organizations used devices to plan their workplaces and conduct walk-throughs to ensure social distancing was being adhered. For example, drones and Unmanned Aerial Vehicles (UAVs). These devices surveyed the land, provided aerial photography, and mapped tough-to-reach topography. Drones can also be used to inspect sites safely for hazards such as structural damage. Besides, construction workers can be equipped with wearable technology to help monitor site conditions, physical stressors, and site capacity to improve site safety and track worker productivity.

3.6.3 Impact of COVID-19 on BIM Adoption

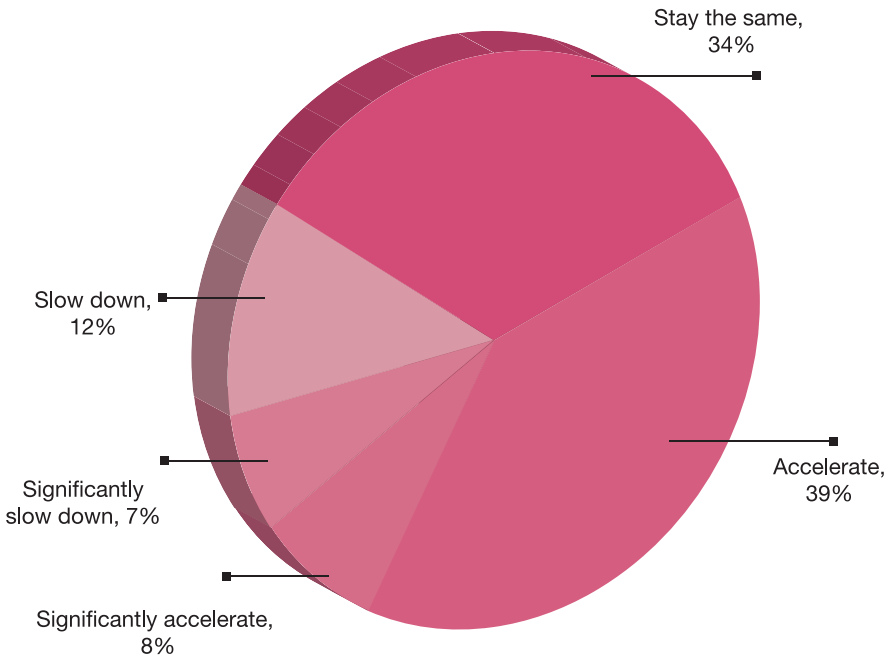


Figure 3.27. Impact of COVID-19 on BIM adoption

Figure 3.27 shows the impact of COVID-19 on BIM adoption. The results show that 39% responded that COVID-19 accelerated BIM adoption. Also, 34% responded that the adoption of BIM stayed the same despite the arrival of COVID-19. Finally, 19% responded that COVID-19 slowed and significantly slowed BIM adoption at 12% and 7%. Participants in focus group discussions stated that they agreed with the survey result. Some of their responses are as below:
"We agree with "accelerate." "Stay the same" is because of survival mode, as explained before. All right, before the "stay the same" because with a pandemic or without a pandemic, some organizations already have BIM. Some organizations do not have BIM. So, even with or without a pandemic, it just rather "stays the same." (Group 1)

Participants of the focus group discussion stated that COVID-19 does not affect BIM adoption for SMEs because they were in survival mode and trying to sustain business and remain resilient during the pandemic. SME owners are fighting battles on multiple fronts, including supply chain disruptions, reduced local and overseas demand, workforce shortages, and other challenges. Therefore, SMEs did not try to adopt BIM during the pandemic. On the other hand, COVID-19 has accelerated BIM adoption in big organizations. During the pandemic, big organizations could establish strategies for adopting BIM. For instance, to help overcome travel restrictions, training related to BIM was conducted online. Some of the responses from participants of the focus group discussion are as below:
"In Malaysia, most are SMEs. So, for 'accelerate,' I think it depends on the organization's nature based on the respondents and demographic. So, for 'remain the same,' I think for SMEs, okay, because during COVID-19 and after the post-COVID-19, the respondents say stay the same because I think most of them are trying to sustain the organization. Furthermore, for 'accelerate,' I think most of it comes from a big organization. So, they try to develop a more efficient workflow for BIM. So, there is a learning curve." (Group 2)
"Agreed because there is a relationship between BIM training and its adoption. Due to COVID-19, most BIM training was done online-based, not physically." (Group 4)

3.6.4 Increased BIM Investment as A Result of COVID-19

Figure 3.28 shows the impact of COVID-19 on increased investment in BIM. The results show that 72% disagree that the pandemic has increased investment in BIM. Only 28% of the respondents agreed that COVID-19 had increased BIM investment. This result indicates that the pandemic has not increased investment in BIM to support its adoption. Some of the responses from focus group discussions:
"So, we disagree with this. I think we adopt BIM, not because of COVID-19. We adopt BIM because it is a government policy that is necessary. So that is why we adopt BIM. It is not because of COVID-19." (Group 1)

Participants of the focus group discussions stated that COVID-19 does not affect BIM investment because organizations adopt BIM due to policies enforced by the Malaysian government.
"It depends on the size of an organization. For some SMEs, sustained cash flow of staff means they want to maintain their organization to stabilize it because of COVID-19, and then for 'yes,' I think that one is only applicable for a big organization." (Group 2)

Moreover, participants of the focus group discussion stated that investment in BIM depends on the size of the organizations. Thus, SMEs did not invest in BIM because they sustained cash flows during the pandemic.
"Experts agree with the results. Employees have time to go for BIM. The problem is no BIM projects to be adopted. You have time, no projects." (Group 4)

Additionally, experts in focus group discussions revealed that, although organizations have adopted BIM, there were no projects during the pandemic. Hence BIM could not be adopted, leading to reduce in BIM investment.

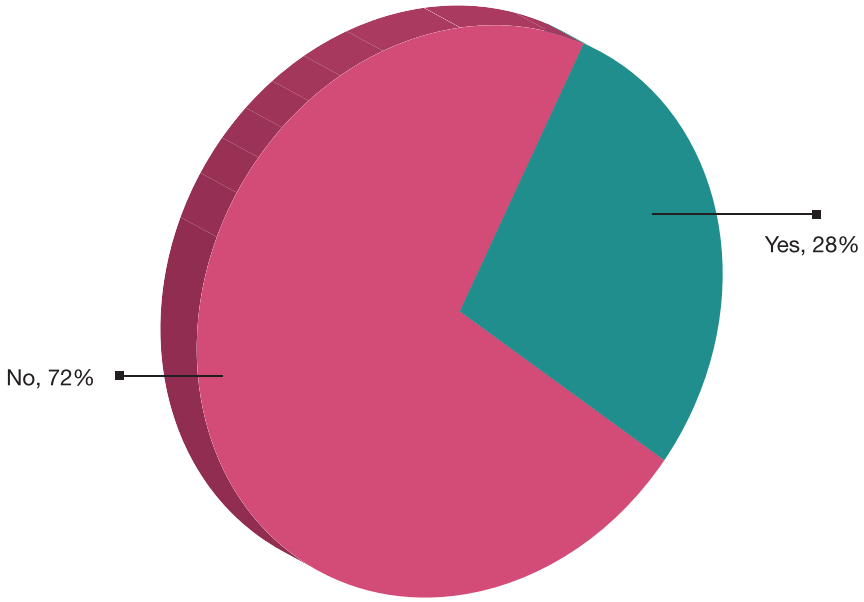


Figure 3.28. Increased BIM investment as a result of COVID-19

3.6.6 BIM Staff Growth as A Result of COVID-19

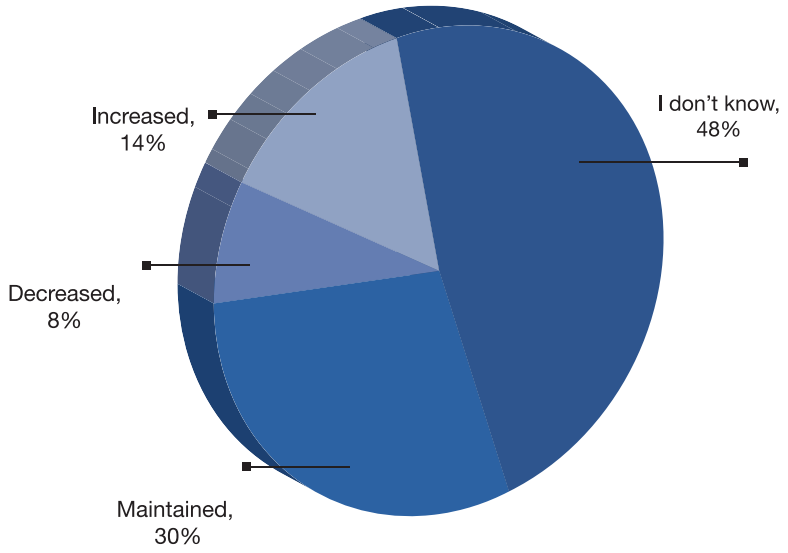


Figure 3.29. BIM staff growth as a result of COVID-19

Figure 3.29 shows the results of the impact of COVID-19 on BIM staff growth. The results show that 48% responded, "I do not know." On the contrary, 14% and 8% responded that COVID-19 has increased and decreased the growth of their BIM staff. In addition, 30% of the respondents responded that their BIM staff growth was maintained due to COVID-19. Participants of the focus group discussions agreed with the results:

"We say not relevant as the recruitment has been frozen. Actually, during the pandemic, in 2020, most organizations had already frozen their recruitment. Then they opened back once they saw the opportunity to enhance their workflow and there was a demand from clients. However, this does not represent the whole industry because it depends on the respondent's background." (Group 2)

"Agreed that most respondents selected "I do not know." However, we assume "I do not know" means uncertainty with reasons due to material cost increase, no BIM projects forecasted, shortage of labor, and others." (Group 4)

Participants of the focus group discussions stated that most construction organizations had adopted a hiring freeze because of COVID-19. Hiring freezes occur when an organization detects that recruiting new employees will result in a budget deficit for a specific fiscal period. As a result, the organization will refrain from hiring new employees until the organization's financial position has improved.

3.7 STRATEGIES FOR ENHANCING THE BIM INDUSTRY IN MALAYSIA

This sub-section summarizes the results of strategies for enhancing Malaysia's BIM industry. The results include ranking strategies for enhancing BIM adoption and individual awareness of BIM as part of the national agenda, future use of BIM in Malaysia, readiness to adopt BIM, adequacy of resources to assist BIM adoption, and mandating the usage of BIM in the future.

3.7.1 Government Strategies for Enhancing BIM Adoption

Table 3.3. Ranking of strategies for enhancing BIM adoption

Government strategies	Rank
Create BIM institutes for training young/fresh graduates	1
Provide financial aid to reduce the cost of adopting BIM	2
Develop BIM adoption guidelines	3
Develop programs to integrate BIM into education curricula and academia	4
Develop programs to increase BIM awareness and understanding	5
Foster market demand for BIM	6
Develop a digital transformation strategy for BIM	7
Develop BIM standards	8
Develop BIM-related contractual frameworks	9
Initiate pilot projects to exploit evidence-based benefits of adopting BIM	10
Mandate BIM adoption in the construction industry	11
Develop programs for improving BIM competencies	12

Table 3.3 shows the ranking of government strategies for enhancing BIM adoption.
Other strategies for enhancing BIM adoption acquired from the survey include but not limited to:

- Activate BIM *Perantis & Prihatin* Programme. The program has assisted many organizations and individuals in adopting BIM. It also would reduce the challenges of having a multi-disciplinary technical BIM Coordinator in the market.
- Some projects would be required to adopt BIM in full application
- Compulsory for all government and local authority projects to adopt BIM
- Every project of government must procure BIM software to fasten the project and avoid clashes with any services
- Federal policy and state adoption create a two-tier system, and a lack of skills cascades down when dealing with 13 independent entities. Ensuring a commonality of approach will be a huge challenge, with so little competence likely to be found within each state.

- Government should standardize the system and provide sufficient resources to the organizations
- Include BIM in the project cost
- BIM as one of the requirements for government projects
- Impose mandatory to include BIM pricing in government tender
- Offer rebates to organizations that successfully adopt 100 % BIM
- Engage with more experts, either local or international, to impart knowledge of advanced BIM
- Higher pay to professionals that can work with BIM
- Introduce and integrate BIM into the university syllabus (construction-related programs) - as a stand-alone subject
- Make it mandatory for all departments in government to use BIM. If only architects agree to adopt it, but engineers and quantity surveyors are reluctant to use it, it will be challenging.
- Please mandate it as a module subject for all universities.
- Introduce basic BIM in colleges or secondary schools to expose young generations
- To incorporate all the related government agencies using BIM and ensure all the stakeholders are using standardized structured BIM execution plans

The top government strategies are: (1) create BIM institutes for training young/fresh graduates; (2) provide financial aid to reduce the cost of adopting BIM; (3) develop BIM adoption guidelines; (4) develop programs to integrate BIM into education curricula and academia; and (5) develop programs to increase BIM awareness and understanding.

Create BIM institutes for training young/fresh graduates. The effective use of BIM needs substantial investment in training. Training young school leavers can help overcome the challenges of the unavailability of BIM personnel. Graduates, through training, can be equipped with sufficient BIM knowledge and necessary skills to work at the industry level. In so doing, construction professionals are more motivated and willing to adopt BIM and use its tools if the BIIM professionals are within their reach. One expert mentioned that:

'we agree, where government needs to continue the BIM training center for tertiary. All right, because coming to my background, I mean certain tertiary education are not exposed to BIM. They are very foreign to the name BIM. So, when they graduate, they have this mindset that BIM is software. If you do 3D things, it is BIM, not just that. It is your planning, your scheduling, and your logistic. Everything involved a cultural shift. So, when we have the initiatives to train them from the ground up, I think they would have more value and added skills for fresh graduates.'

Providing financial aid to reduce the cost of adopting BIM. The cost of BIM adoption, including the initial cost of software and hardware and BIM training, is a notable constraint

globally. Since 2016 CIDB has allocated funds and subsidies for BIM software training and its usage, especially for beginners (CIDB, 2016). Moreover, organizations have developed initiatives by providing training modules for existing staff to maintain competitiveness. However, the cost of advanced BIM training is still high. Financial aid from the government can reduce the financial burden on organizations, especially SMEs.

Develop BIM adoption guidelines. BIM adoption guidelines should be developed as part of the BIM adoption strategy. CIDB and JKR have made great efforts in providing direction for using BIM. Malaysia published BIM standards and guidelines in 2014 and BIM Work Process Manual in 2015 (Sinoh et al., 2020).

Develop programs to integrate BIM into education curricula and academia. As BIM becomes one of the uptrends in the construction industry, the demand for skilled BIM professionals increases steadily. Hence, educational institutions must include BIM in their curriculum. Graduates can then possess an adequate education level that ensures their knowledge and skills are appropriate and suited for successful adoption. Adopting BIM into curriculums is viewed as difficult, so better alignment between the educational industry and professional bodies can ensure the right BIM content and necessary BIM skills are developed by the curriculum (Rogers et al., 2015).

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Develop programs to increase BIM awareness and understanding. It is common for construction professionals to have a varying understanding of BIM. Inconsistencies in the understanding are due to the lack of awareness of BIM and its benefits, uses, and capabilities (Rogers et al., 2015). The Malaysian government is actively promoting BIM in the construction industry, evidenced by the increasing number of BIM seminars, workshops, and publications (CIDB, 2019). These initiatives would eliminate the misunderstanding over BIM and expose construction professionals to BIM capabilities over the entire project lifecycle can maximize the benefits for stakeholders.

3.7.2 Individual Awareness of BIM

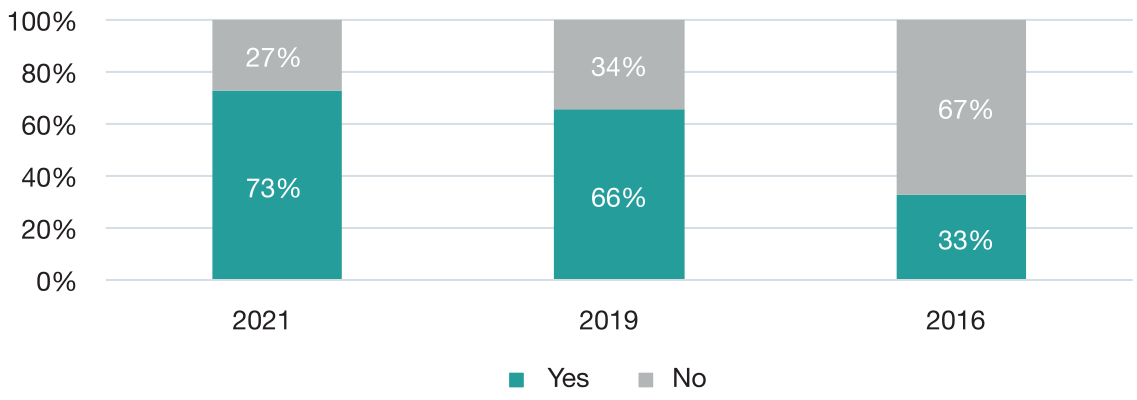


Figure 3.30. Awareness of BIM

Figure 3.30 shows a doubling of BIM individual awareness of BIM as part of the national agenda from 33% in 2016 to 66% in 2019. Furthermore, this awareness increased to 73% in 2021. In other words, individual awareness of BIM as part of the national agenda is increasing.

Throughout the CITP, CIDB and its subsidiaries have carried out different BIM-related programs, such as BIM Day, BIM Road tour, incentives, seminars, and workshops to enhance BIM adoption in Malaysia. CIDB also provides hands-on training for BIM adoption and certification for BIM personnel. Online classes were also provided to overcome the physical attendance limitations due to COVID-19. One focus group member said:
'We conclude that the huge jump from 2016 to 2019 was because the organization has started to adopt BIM due to the demand of the project, such as all the mega projects and sort, but we can see the speed is decreasing, maybe due to like many projects have been held on because of the pandemic and anything, so can see the speed is decreasing.'

3.7.3 Mandating Usage of BIM In the Future

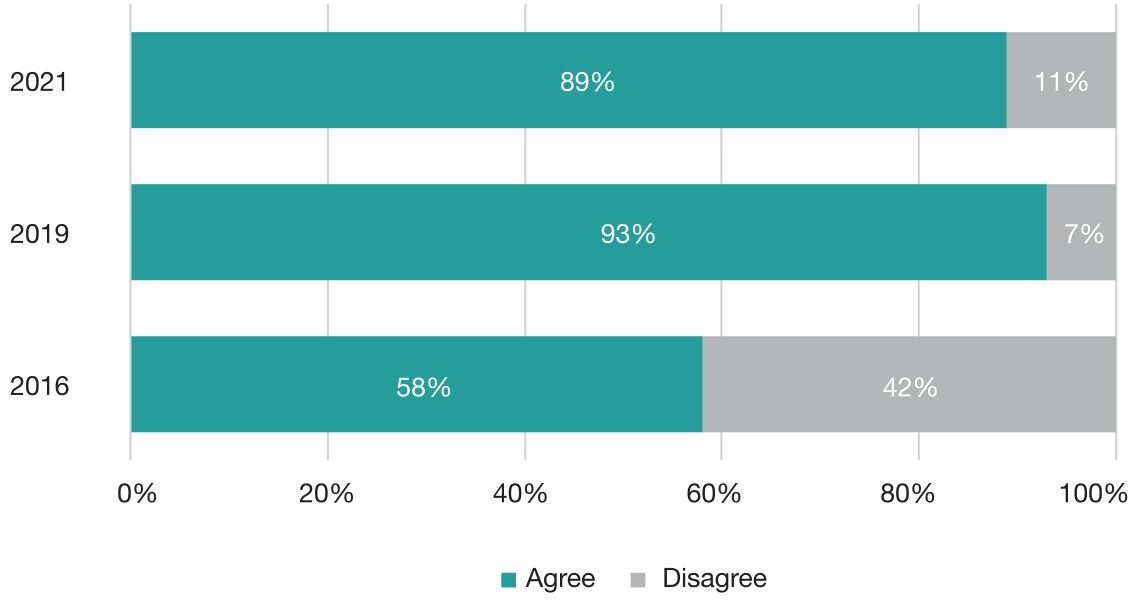


Figure 3.31. Mandate usage of BIM

Figure 3.31 shows the results of individual belief in mandating the usage of BIM in the future. The number of respondents who believe BIM should be mandated rose from 58% to 93% between 2016 and 2019. However, the percentage decreased to 89% in 2021 but is still significantly higher than in 2016.

Currently, the BIM mandate is only for government projects budgeted over RM10 million. Moreover, due to the development trends and technological advances, more focus was given to emerging technologies rather than BIM. Therefore, there is a need to look up to future development and performance rather than the adoption itself. One focus group member stated:

'[….] the reason why it decreased after 2019 is that we understand that CITP adopted it from 2016 until 2020. Yes, that is good. However, from 2019 onwards, CIDB introduced this one called CR 4.0. So, when they introduced CR 4.0, this CITP became less prominent in the BIM long term planning. So, I think we believe that it will decrease back in 2021.

3.7.4 Adequacy of Resources to Assist BIM Adoption

Figure 3.32 shows the respondent's opinion on the adequacy of resources to adopt BIM. The number of respondents who agreed that there are adequate resources to adopt BIM rose from 54% to 59% between 2016 and 2019. However, the percentage decreased to 52% in 2021, lower than in 2016 and 2019.

In 2021, the demand for BIM became less. This is likely due to COVID-19, which affected most organizations, especially SMEs. Several organizations have grappled with the negative impacts of the COVID-19 pandemic, with much of the burden falling on SMEs. Due to the changing environment and uncertainty, more attention was paid to coping with the pandemic (Xie et al., 2022). As a result, BIM investment and allocating adequate resources, including funds, infrastructure, and BIM consultancy, became challenging.

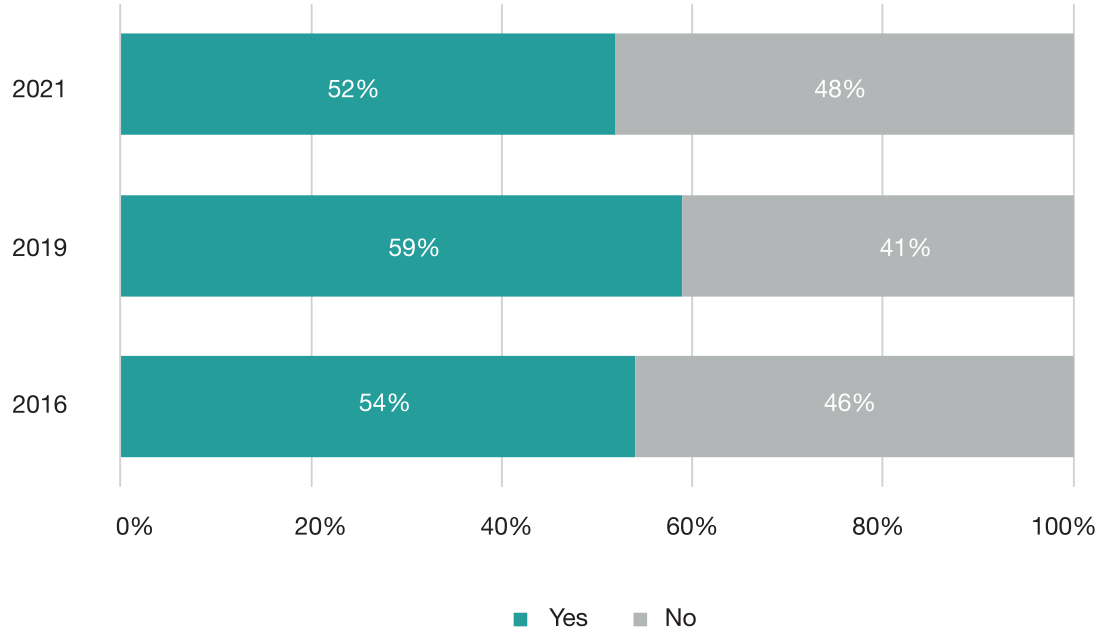


Figure 3.32. Adequacy of resources to assist BIM adoption

3.7.5. Readiness to adopt BIM

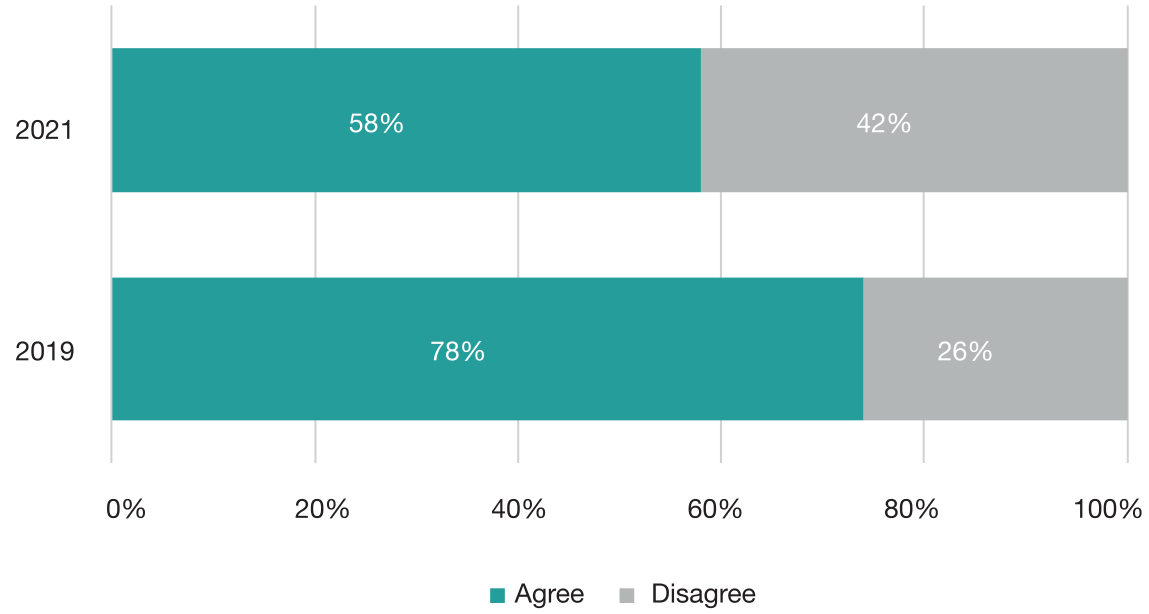


Figure 3.33. Readiness of organization

Figure 3.33 shows the agreement of respondents on the organizational readiness to adopt BIM. The results show that 74% of the respondents agree that their organization is ready to adopt BIM in 2019. However, that percentage decreased to 58% in 2021.

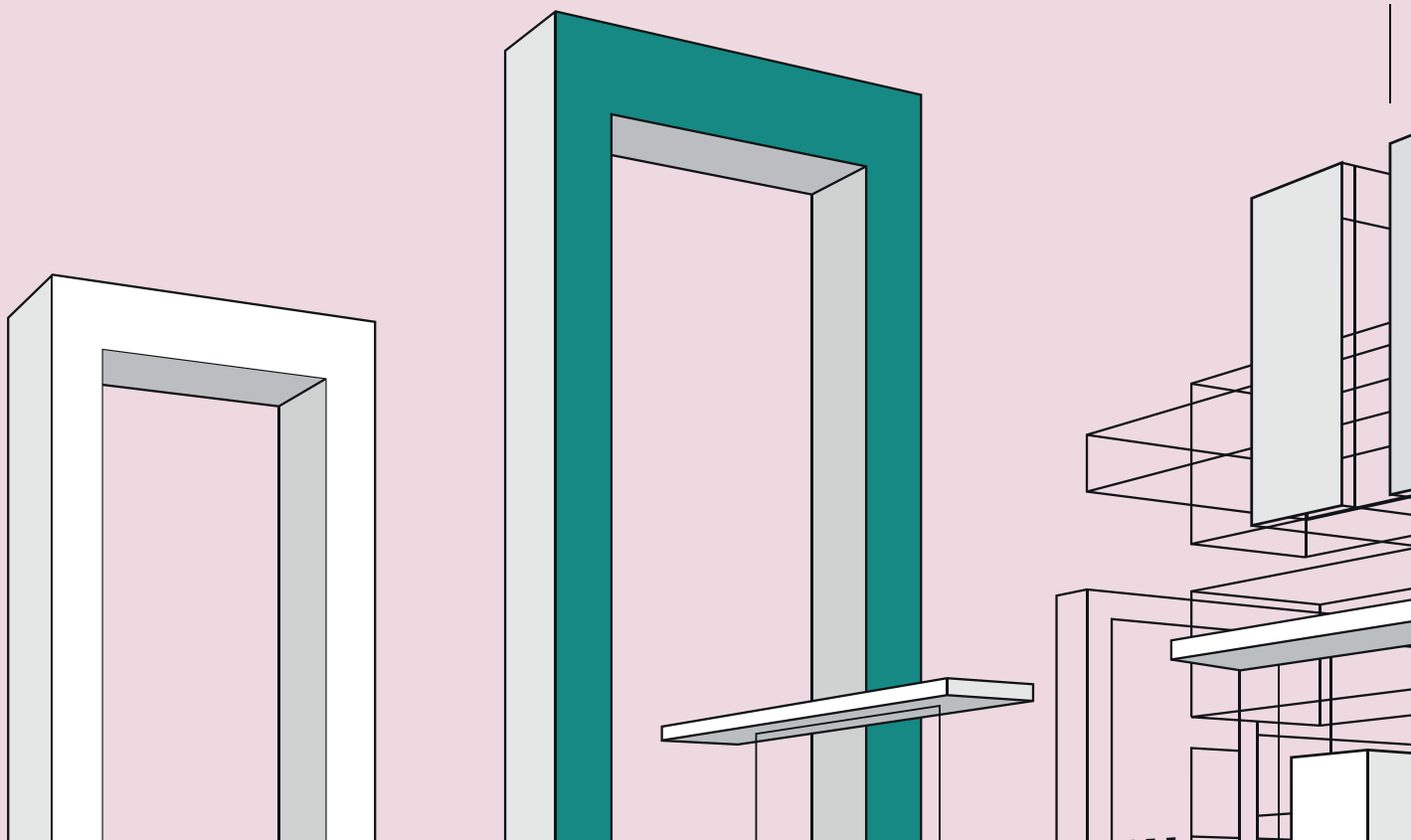
BIM PROFICIENCY TRAINING

1	BIM CONCEPT & THEORY
2	BIM MODELLING OF ARCHITECTURE
3	BIM MODELLING OF STRUCTURE
4	BIM MODELLING OF ELECTRICAL
5	BIM MODELLING OF MECHANICAL & PLUMBING
6	BIM MODELLING OF INFRASTRUCTURE (ROADS & HIGHWAYS)
7	BIM COORDINATOR PART 1: SETUP
8	BIM COORDINATOR PART 2: COORDINATION
9	BIM COORDINATOR FACILITIES MANAGEMENT
10	BIM MANAGER PART 1
11	BIM MANAGER PART 2
12	BIM PROJECT QUANTIFICATION

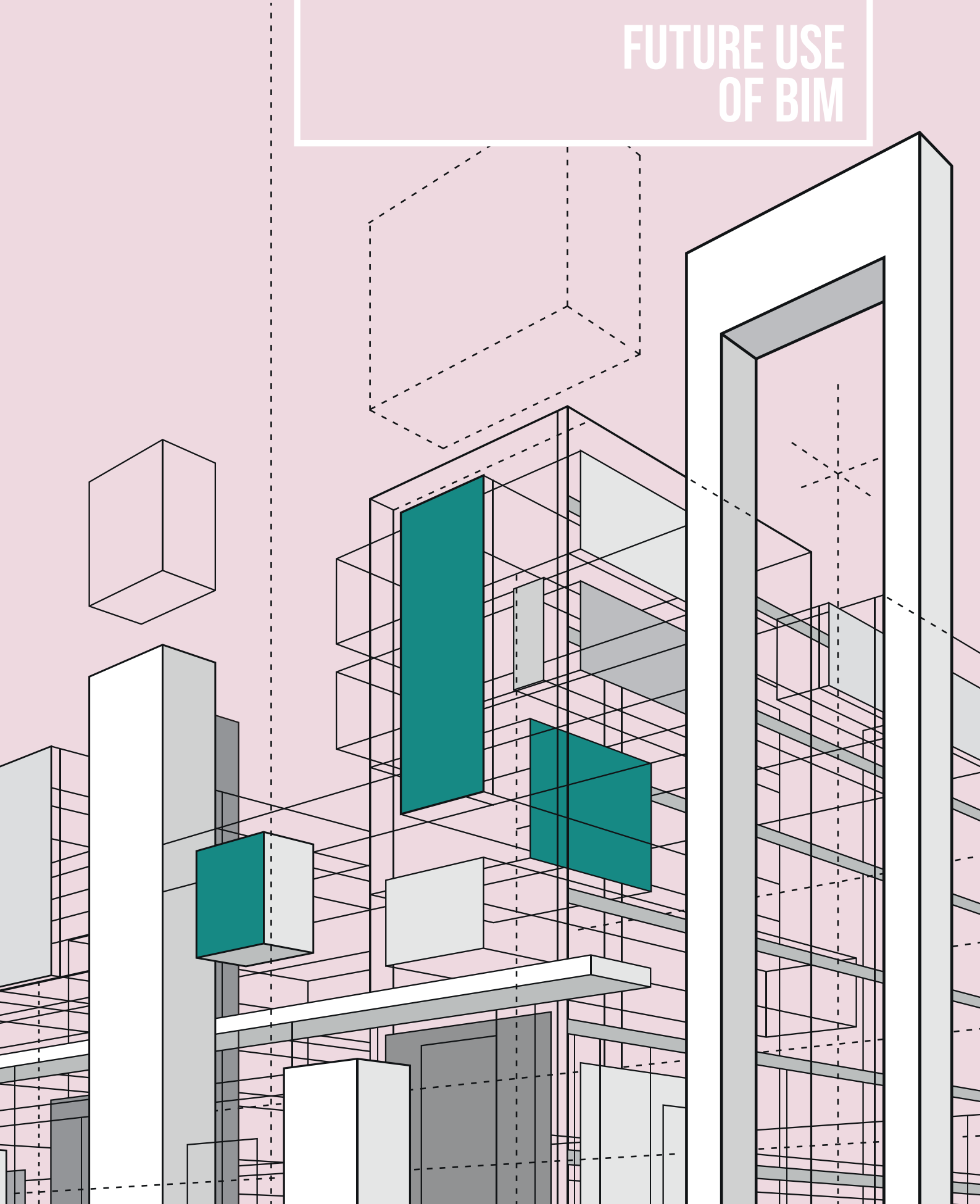
FOR MORE INFORMATION:

Contact No: 03-4040 0399
Website: mybim.cidb.gov.my
Email: training@econstruct.com.my
Location: myBIM Centre, 11th Floor, Menara Sunway Putra,
100, Jalan Putra, 50350 Kuala Lumpur
HRDF claimable and CCD points approved

04



FUTURE USE OF BIM



Section 04

FUTURE USE OF BIM

4.0 FUTURE USE OF BIM

The construction industry contributes significantly to the economies of both developed and developing countries. Despite the fact that it is one of the largest industries in the world, the adoption of new technology is lagging behind other industries. However, the COVID-19 pandemic changed the industry by increasing digitalization levels in some areas. To adapt to the challenges posed by the COVID-19 pandemic, construction organizations have digitized and employed technologies such as BIM to ensure worker safety and productivity.

BIM revolutionized the industry by streamlining project lifecycles. It is an intelligent 3D model-based process that gives construction professionals the insight and tools to plan, design, construct, and manage buildings and infrastructure. Some benefits of adopting BIM are improving coordination and clash detection, reducing risk, and enhancing scheduling. In addition, organizations adopting BIM can easily incorporate project changes that the pandemic has brought into their models and schedules. This enables stakeholders to remotely track their projects' progress and performance in nearly real time.

Stakeholders will consider digital project management to be critical for project monitoring and decision-making in the future. Thus, BIM adoption is critical for the construction industry's survival and growth, allowing projects to continue in a digital and virtual environment while minimizing the risk of team members meeting and working together. The government is also leading the way in adopting BIM and providing resources to help it become widespread. For instance, CIDB has built myBIM Centre as a central hub for BIM-related information, tools, and services. Regular technical training is also provided, and partnerships have been formed with many educational institutions to prepare the workforce of the future better.

Eventually, the time has arrived for the industry to pay closer attention to advanced technologies like BIM. BIM can assist organizations in mitigating risks and providing solutions. Organizations that have not yet digitally transformed must rethink and evolve quickly. Evidence has shown that digital technologies are aiding the industry in keeping things running even during the pandemic. With BIM, project stakeholders may use a centralized 3D model to plan, interact, and make real-time decisions from any location. Therefore, stakeholders need to embrace BIM as the way of the future to maintain resilience as the world's digitization and decentralization increase.

5.0 CONCLUSION

BIM is a tool that would contribute to **boosting productivity** in the construction industry. Over the years, there has been much resistance from construction industry players when it comes to embracing technology. According to Malaysia Productivity Corporation (MPC) National Productivity Report 2020, construction productivity has also fallen below overall results. The use of BIM not only transformed a project's productivity level but would also potentially increase the **ease of doing business**. While the construction industry grew year by year, it is still lagging behind other major economic industries. Adopting BIM is one of the most effective ways for organizations to make the digital leap.

Using BIM in construction is somewhat producing **digital twins** of facilities which enables tracking and managing all facets of the project life cycle. The BIM would help resolve and identify problems virtually at **no cost implications**.

Overall, the BIM usage level in 2021 has increased to 55% compared to 49% in 2019 and 17% in 2016. The level of BIM awareness also increased in 2021 to 78% from 74% in 2019 and 45% in 2016. The participation of the respondents in the BIM program decreased by 66% in 2019 compared to 62% in 2021. However, it increased in 2016 from 55% to 66%. BIM training decreased from 57% in 2019 to 38% in 2021. Respondents agreed to apply BIM in the organization despite being affected by the COVID-19 pandemic in the Construction industry.

Investment in BIM is decreasing from 54% (2019) to 44% (2021). This is due to the COVID-19 pandemic that hit the country in 2019 and harmed the construction industry. It involves high costs that have to be borne by the contractor/developer so that BIM users are unable to bear the cost of using BIM in the organization. Finances provided for BIM applications decreased from 43% (2019) to 34% due to operating costs and resources used during the COVID-19 pandemic.

BIM adoption in the local construction industry increased by 49% (2019) to 55% (2021). Information (sources) about BIM is high compared to other sources, which is 62%. This situation shows that the industry well receives the information presented by CIDB. Strategies are recommended to increase the use of BIM in the construction industry, including creating BIM institutions for young people and graduates. It encourages knowledge about BIM to develop among graduates and young people early. BIM can detect clashes, perform accurate assessments, and becomes a reliable basis for decision-making even in the early stages of construction. In addition, another strategy is to establish financial assistance to reduce the cost of using BIM. In addition, BIM guidelines need to be developed to use BIM in Malaysia more parallel and standardized.

ACKNOWLEDGEMENT

The Construction Industry Development Board Malaysia (CIDB) would like to acknowledge the individuals and organisations for their invaluable contributions and insights in designing the journey of this research.

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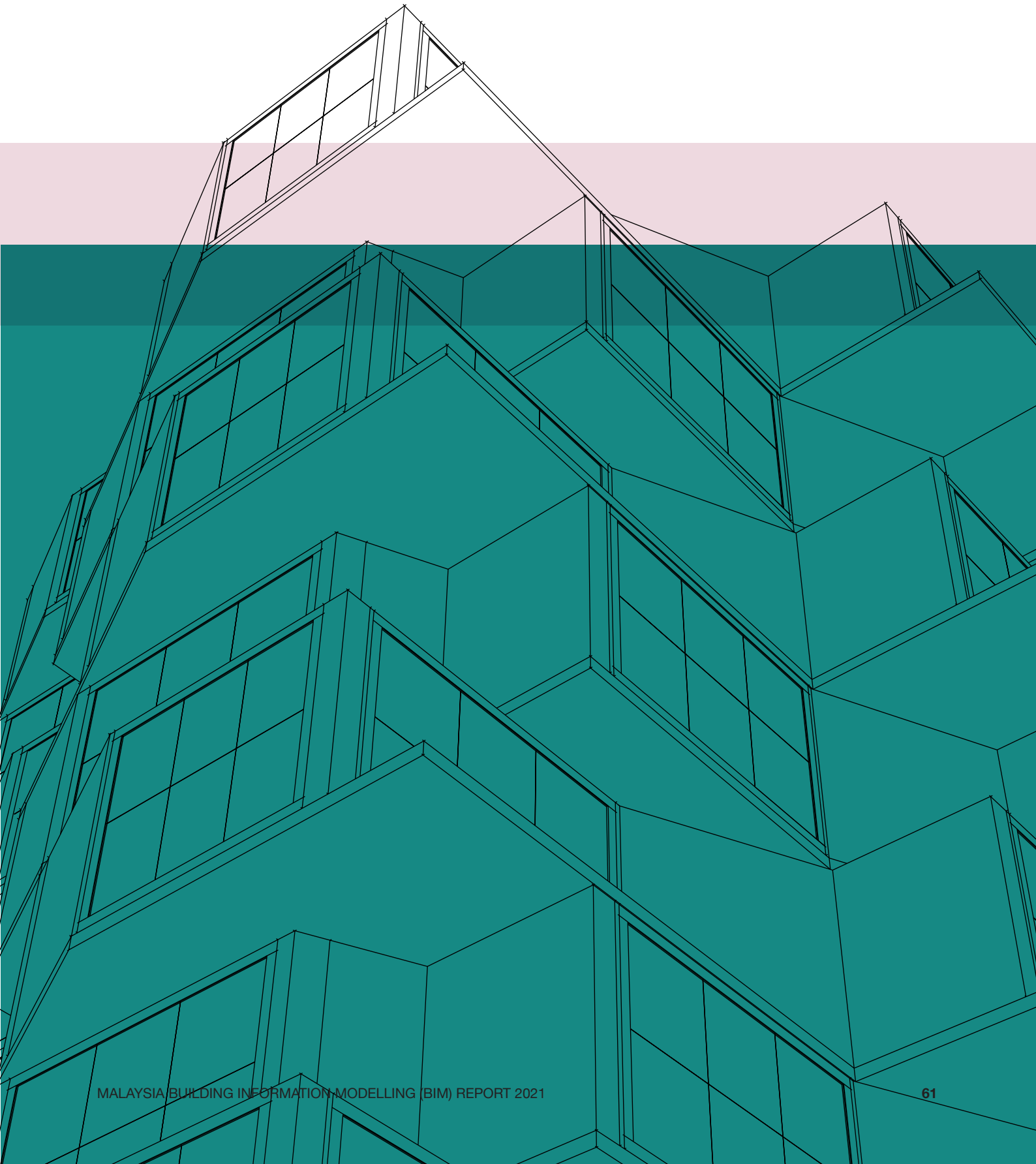

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APPENDIX A

CONSTRUCTION INDUSTRY DEVELOPMENT BOARD (CIDB)

SURVEY ON ADOPTION OF BUILDING INFORMATION MODELLING (BIM) IN MALAYSIA 2021

As an industry professional in the construction industry, we invite you to participate in a study on BIM adoption in the Malaysian construction industry. This study is being conducted to help policymakers, industry practitioners, and researchers improve the success of BIM adoption in Malaysia.

Your participation is purely voluntary. Your responses will be kept confidential, and only aggregated results will be published in reports and publications. By submitting your responses, your consent to participate in the study is implied. You may withdraw your consent at any time by not submitting the survey.

Your time and cooperation are greatly appreciated. If you have any questions, please feel free to contact us.

1.0 SECTION A: RESPONDENT BACKGROUND

1. Designation & Position:
   ----

2. Working experience in the construction industry:

☐ < 1 year	☐ 1 – 5 years	☐ 6 – 10 years
☐ 11 – 15 years	☐ 16– 20 years	☐ > 20

3. Personally, have you ever heard about BIM?

☐ Yes (if Yes, please proceed to Question No. 4) ☐ No (if No, please proceed to SECTION B)

4. Personally, have you ever handled a BIM project?

☐ Yes (if Yes, please proceed to Question No. 6)
☐ No (if No, please proceed to SECTION B)

5. Working experience in using BIM:

☐ None
☐ < 1 year
☐ 1 – 5 years
☐ 6 – 10 years
☐ 11 – 15 years
☐ 16– 20 years
☐ > 20

6. Future use of BIM in Malaysia:

☐ In five years' time, we will use BIM
☐ In three years' time, we will use BIM
☐ In one year's tiyear use BIM
☐ Not interested in adopting BIM

2.0 SECTION B: ORGANISATION BACKGROUND

7. Nature of business:

☐ Architect
☐ Civil & Structure Engineer
☐ Mechanical & Electrical Engineer
☐ Quantity Surveyor
☐ Developer
☐ Contractor
☐ Manufacturer
☐ Supplier
☐ Client
☐ Others (please specify): _____

8. Grade of Contractor (Please proceed to the next question if not applicable):

☐ G1
☐ G2
☐ G3
☐ G4
☐ G5
☐ G6
☐ G7

9. State:

☐ Selangor
☐ Negeri Sembilan
☐ Melaka
☐ Perlis
☐ Sarawak
☐ Pahang
☐ Johor
☐ Perak
☐ Penang
☐ Kedah
☐ Sabah & WP Labuan
☐ Kelantan
☐ Terengganu
☐ WP Kuala Lumpur
☐ WP Putrajaya

10. Size of organization:

- ☐ Small (3 - 19 people)
- ☐ Small to Medium (20 - 50 people)
- ☐ Medium to Large (51 - 200 people)
- ☐ Large (> 200 people)

11. How does your organization use CAD?

- ☐ No CAD
- ☐ 2D only
- ☐ 2D and 3D CAD
- ☐ 3D only

12. Is your organization aware of and adopting BIM?

- ☐ Aware and adopting
- ☐ Aware but not adopting
- ☐ Unaware

13. Organization working experience in using BIM:

- ☐ None
- ☐ < 1 year
- ☐ 1 – 5 years
- ☐ 6 – 10 years
- ☐ 11 – 15 years
- ☐ 16– 20 years
- ☐ > 20

3.0 SECTION C: RESPONDENT BIM KNOWLEDGE

14. How confident regarding your knowledge and skills in BIM?

- ☐ Very confident
- ☐ Quite confident
- ☐ In between
- ☐ Not very confident
- ☐ Not very confident at all

15. What types of tools do you mainly use when producing models/drawings?

- ☐ Autodesk Revit (Architecture/Structure/MEP)
- ☐ Autodesk Navisworks
- ☐ Graphisoft ArchiCAD
- ☐ Bentley AECOsim
- ☐ Tekla
- ☐ Vico
- ☐ Autodesk AutoCAD LT
- ☐ Autodesk AutoCAD
- ☐ Trimble Sketchup
- ☐ Bentley Microstation
- ☐ Others (please specify):_____

16. How likely are you to turn to the following sources of information about BIM?

- ☐ CIDB Malaysia
- ☐ E-Construct Services Sdn Bhd
- ☐ Professional bodies/institute
- ☐ Publication
- ☐ Social media
- ☐ Database
- ☐ Colleagues
- ☐ BIM consultant
- ☐ University
- ☐ Online journal
- ☐ Journal
- ☐ Others (please specify): _____

17. Have you attended any seminar or program on BIM? (e.g., Roadshow, BIM day, Professional talk/ Seminar/ Program related to BIM adoption) [BIM AWARENESS]

☐ Yes ☐ No

18. Are you interested in establishing or using BIM within your organization?

☐ Yes ☐ No

19. Do you think BIM will provide benefits to your organization?

☐ Yes ☐ No

4.0 SECTION D: BIM IN ORGANISATION

20. Does your organization currently provide training for staff in BIM tools and workflows? [BIM AWARENESS]

☐ Yes ☐ No

21. Did your organization already invest in BIM hardware and Software? [BIM READINESS]

☐ Yes ☐ No

22. Does your organization allocate any financial incentive for using BIM? [BIM READINESS]

☐ Yes ☐ No

23. Does your management have clear policies that support BIM adoption? [BIM READINESS]

☐ Yes ☐ No

24. Do you use BIM Models coordination between all disciplines for projects?

- [ ] All projects
- [ ] Majority of projects
- [ ] Some projects
- [ ] Never

25. If you plan to adopt BIM, do you have adequate resources to assist BIM implein mentation in your organization?

- [ ] Yes
- [ ] No

26. Do you believe that the industry is ready to adopt BIM?

- [ ] Yes
- [ ] No

27. Do you believe that the government should mandate the usage of BIM in the future?

- [ ] Yes
- [ ] No

28. How is your organization using BIM?

- [ ] Coordination / Clash detection
- [ ] Visualization
- [ ] Project planning
- [ ] Prefabrication
- [ ] Virtual Mock-Ups
- [ ] Take-Offs
- [ ] Selling / Presentations
- [ ] Estimating
- [ ] Scheduling
- [ ] Compliance
- [ ] Value analysis
- [ ] Facility management
- [ ] Others (please specify):

29. Thinking about the projects where you have adopted BIM, which of the following approaches has your organization adopted with respon concerning information?

- [ ] Following a naming convention for all information that is shared
- [ ] Exchanging information in IFC format
- [ ] Clearly iIndicating shared information is suitable for (e.g., for information, for review, as a record)
- [ ] Highlighting manded information through the use of revision codes
- [ ] Classifying information using Uniclass 2015
- [ ] Exchanging information in COBie format
- [ ] None of these
- [ ] Don’t know

30. Thinking in more detail about BIM, in the last 12 months, which of the following things have been involved with, in some way, on BIM prcts you have worked on?

- ☐ BIM execution plans
- ☐ Common data environments
- ☐ Information standards
- ☐ Exchange information requirements
- ☐ Information production methods and procedures
- ☐ Information protocols
- ☐ Detailed responsibility matrix
- ☐ Task information delivery plans
- ☐ Master information delivery plans
- ☐ None of these
- ☐ Don't know

31. Which (if any) information management/BIM standards does your organization use and base internal process processes(**multiple choice question**)?

- ☐ BS EN ISO 19650 series
- ☐ BS/PAS 1192 suite
- ☐ Internal standards that don't align with industry standards above
- ☐ Company BIM policy/strategy that aligns with industry standards
- ☐ BS 8536 Soft loadings

5.0 SECTION E: CHALLENGES TO BIM ADOPTION IN AN ORGANIZATION

Please rate the level of criticality of the following challenges to BIM adoption based on your general experience using a five-point Likert scale: (please tick one box in each row).

1 - not critical 2 - less critical 3 - neutral

4 - critical 5 - extremely critical

Challenges	Level of criticality				
	1	2	3	4	5
1. Lack of clear policies that support BIM adoption					
2. Lack of awareness of BIM benefits					
3. Lack of BIM knowledge					
4. Insufficient BIM training available					
5. Reluctance to initiate new workflows for adoption of BIM					
6. No established contractual framework for working with BIM					
7. Resistance to change for new technology					
8. Lack of experience to coordinate the construction documents by using BIM					
9. Fast-paced					
10. Lack of direction of BIM in industry					
11. The Lack of time to adopt					

12. The assumption that conventional methods are better than new processes						
13. Lack of organization familiarization to adopt BIM						
14. Lack of references/sources to assist in adopting BIM						
15. There is no BIM requirement/mandate in the industry						
16. Existing hardware not capable to run basic BIM software						
17. High cost of technology						
18. High cost of software						
19. High training cost						
20. Difficulty in adopting BIM coordination						
21. The complexity of BIM software						
22. Lack of top management support						
23. Lack of BIM demand						
24. Lack of interoperability between software in exchanging information						
25. Lack of appropriate projects to adopt BIM						
26. Inadequate information management processes for BIM						
27. The complexity of the new roles in BIM-based construction projects						

For other challenges (if any), please write in:

6.0 SECTION F: GOVERNMENT STRATEGIES TO PROMOTE BIM ADOPTION IN AN ORGANIZATION

Please rate the level of criticality of the following government strategies to promote BIM adoption based on your general experience using a five-point Likert scale: (please tick one box in each row).

1 - not critical 2 - less critical 3 - neutral

4 - critical 5 - extremely critical

Government strategies	Level of criticality				
	1	2	3	4	5
1. Develop programs for improving BIM competencies					
2. Provide financial aid to reduce the cost of adopting BIM					
3. Develop BIM standards					
4. Develop a digital transformation strategy for BIM					
5. Mandate BIM adoption in the construction industry					
6. Develop programs to increase BIM awareness and understanding					
7. Foster market demand for BIM					
8. Initiate pilot projects to exploit evidence-based benefits of adopting BIM					
9. Develop programs to integrate BIM into education curricula and academia					
10. Develop BIM-related contractual frameworks					
11. Develop BIM adoption guidelines					
12. Create BIM institutes for training young/fresh graduates					

For other government strategies (if any), please write in:

7.0 SECTION F: IMPACT OF COVID-19

32. As a result of COVID-19, do you believe that BIM adoption in the construction industry will accelerate, stay the same or slow down?

☐ Significantly slow down ☐ Slow down ☐ Stay the same
☐ Accelerate ☐ Significantly accelerate

33. As a result of COVID-19, has your company increased overall investments to adopt BIM?

☐ Yes ☐ No

34. Please indicate how much BIM staff growth over the last year of 2020 until 2021.

☐ Maintained ☐ Increased
☐ Decreased ☐ I don't know

35. Please rate the criticality of the following COVID-19 impacts on your BIM projects.

1 - not critical 2 - less critical 3 - neutral
4 - critical 5 - extremely critical

COVID-19 impacts	Level of criticality				
	1	2	3	4	5
1. Higher rejection rate of project financing					
2. Shortage of labor					
3. Reduced number of public projects					
4. Downsizing of existing projects					
5. Reduced morale among project team members					
6. Disruption in the supply chain					
7. Termination of existing projects					
8. Shortage of materials					
9. Reduced number of private projects					
10. Reduced construction productivity					
11. Reduced demand for construction-related works					
12. Reduced foreign investment in the construction industry					
13. Changes in working behavior					
14. Increased infectious disease management practices					
15. Increased technology adoption					
16. Increased digital transformation					
17. Changes in contractual terms					
18. Improved sustainable development					
19. Increased government support for financing					
20. Increased construction cost					

21. Increased demands from local suppliers					
22. Expedited schedule for constructing urgent emergency projects					
23. Reduced overhead cost					

For other COVID-19 impacts (if any), please write in:

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ISBN 978-967-2971-41-2