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Critical Characteristics Review for Research and Development Facilities Construction Project in Malaysian

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Abstract:- In Malaysia, the construction industry plays a crucial role in driving economic growth. However, in modern times, it has become a highly competitive and risky sector, facing numerous unprecedented uncertainties. The Malaysian government's objective is to enhance the industry's productivity, organization, and caution. Despite efforts to improve construction productivity, including Research and Development (R&D) facilities, statistical data and researchers' studies show limited evidence of success. The effective characteristics of the construction industry significantly influence its performance. These characteristics encompass the involvement of both public and private sectors, construction corporations, consultants, agreement procedures, labor force, Construction Industry Development Board (CIDB), and adherence to Malaysia's master plan. This paper seeks to enhance understanding of these construction industry characteristics, particularly in relation to Research and Development facilities, and provide insightful analysis of associated challenges. The primary focus of this paper is to conduct a literature review and analyze key characteristics of Malaysia's construction industry. It is worth noting that the existing practices in the Malaysian construction industry have led to significant barriers and complexities. Some of these challenges include fragmentation, heavy reliance on unskilled immigrant labor, poor utilization of technology, and impediments to policy implementation. Addressing the issues identified through this literature synthesis will be crucial for future studies on the Malaysian construction sector. By tackling the problems highlighted in this review, there will be an opportunity to enhance the success of Malaysian efforts to construct Research and Development facilities, thereby fostering growth and development in the construction industry.

Keywords:- *Research and Development Facilities; Construction.*

I. INTRODUCTION

In 2023 the Gross domestic product or GDP in Malaysia growth approximately 4.5%, with the support of the nation's strong macroeconomic fundamentals, robust domestic demand, and effective implementation of the 12th Malaysia Plan (12MP), the economic outlook is promising. The fiscal deficit is projected to further consolidate to 5.0% of GDP, amounting to -RM93.94 billion, down from -RM99.48 billion recorded in 2022. Budget 2023 has been revised upwards to RM386.14 billion from the previous RM372.3 billion, making it the largest allocation in Malaysia's history. Of the allocation for Budget 2023, 74.8% will be utilized for operating expenditure while the remaining 25.2% is for development expenditure (Malaysia Madani - Developing a Civil Malaysia; Budget 2023). The construction industry in Malaysia is anticipated to experience steady growth over the next four quarters. This growth momentum is expected to persist throughout the forecast period, with a Compound Annual Growth Rate (CAGR) of 5.9% projected for the period spanning 2022 to 2026. The construction output in Malaysia is forecasted to reach MYR 228,680.8 million by the year 2026. The primary sectors in the Malaysia construction market include commercial construction, industrial construction, infrastructure construction, energy and utilities construction, institutional construction, and residential construction. According to the report, the construction industry in Malaysia is projected to grow by 6.6% and reach MYR 193,552 million in the year 2023. Even though certain construction sectors may face near-term challenges, the overall medium to long-term growth story in Malaysia remains intact. The uptick in the approval of residential projects is expected to further support the growth of the construction industry in Malaysia in 2022. While the construction sector is expected to recover and conclude on a positive note in 2022, it is important to note that construction firms in Malaysia are facing pressing challenges related to supply chain issues and labor concerns. These issues may impact the industry's ability to fully capitalize on the projected recovery and could pose obstacles to its growth in the short term. According to

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Olanrewaju et al. (2017), over the next 10 years, Malaysia will need approximately one million construction workers to meet the demands of the growing construction industry and its various projects. Indeed, as mentioned by Olanrewaju et al. (2017), one of the significant challenges faced by the Malaysian construction industry is the shortage of skilled labor. This scarcity of skilled workers can pose obstacles to the industry's growth and development, especially when trying to meet the increasing demand for construction projects in the country. According to Mustafa Kamal et al. (2012), the construction industry in Malaysia continues to grapple with numerous challenges, including issues related to low quality, low productivity, a shortage of skilled labor, project delays, inadequate maintenance practices, lack of compliance, and high rates of on-site accidents. These problems highlight the need for concerted efforts and improvements to enhance the overall performance and efficiency of the construction sector in the country.

The rising material costs are also expected to affect the profit margins of construction players in the country from a short-term perspective. The Master Builders Association of Perak, Melaka, and Johor, along with the Penang Master Builders and Building Materials Dealers Association, have jointly urged the Malaysian government to conduct a comprehensive review of the construction industry's regulations. This appeal reflects their concerns and aspirations for potential improvements and adjustments to the existing regulatory framework in order to address industry challenges and promote its growth and development. Notably, the construction industry in Malaysia is confronting significant challenges, including a shortage of labor, high operational costs, and stringent regulations. These hurdles can impede the industry's progress and competitiveness, making it crucial for stakeholders to address these issues through effective measures and strategic planning to ensure the sustainable growth of the sector. In their joint statement released in August 2022, the associations appealed to the Malaysian government to contemplate providing private construction projects with a similar variation of price treatment as that granted to government projects. In addition to advocating for equal price treatment, the associations further recommended that the government take steps to address the labor shortage issue in the construction industry. To do so, they called for simplification and easing of the foreign workers' application process for construction projects. Given the lack of interest among domestic workers in the sector, facilitating the recruitment of foreign workers could help bridge the labor gap and ensure the continuity of construction projects in Malaysia. This measure seeks to provide a practical solution to the labor challenges faced by the industry. As of the current situation, there is a substantial shortage of 550,000 to 600,000 construction workers in Malaysia. Labor scarcity is indeed one of the most pressing challenges confronting the Malaysian construction industry. As pointed out by Najib et al. (2019), the nation heavily depends on a substantial foreign labor workforce to meet the demands of the construction sector. This overreliance on foreign workers has resulted in limitations and constraints for the industry, necessitating a reevaluation of labor policies and strategies to ensure a more sustainable and balanced workforce composition in the construction sector. According to Hussain et al. (2020), the low-skilled labor participation in the construction industry is affected by several common problems, unfair salary, poor safety, lack of career paths, diminishing skilled labor training programs and delay in the schedule of work onsite. A significant portion, estimated to be around 60 to 90% of the building work in Malaysia was being carried out by foreign laborers, including those who were working illegally (Lingard, 2013). It was reported that approximately half a million foreign workers were present in Malaysia without proper working permits or visas. This heavy reliance on foreign and undocumented laborers highlights the challenges and complexities faced by the construction industry in managing its workforce and ensuring compliance with labor regulations. Indeed, the heavy reliance on foreign and undocumented laborers in the construction industry in Malaysia has led to significant challenges, including delays in the completion of both private and government projects. In response to the challenges faced by the construction industry and the issues with the labor force, the Master Builders Association has requested the government to postpone the implementation of the Employment Act 2022, which was initially scheduled to take effect on September 1, 2022. The delay is likely sought to allow more time for the industry to adjust and prepare for the new regulations and requirements introduced by the Act. This measure aims to alleviate the burden on construction firms and ensure a smoother transition to the updated employment regulations.

II. MALAYSIAN CONSTRUCTION INDUSTRY CHARACTERISTICS

This section provides a literature review that focuses on exploring the distinctive characteristics of the Malaysian construction industry. The first topic discussed is the construction performance, with a focus on the roles and participation of the public and private sectors in construction projects. The section also covers aspects related to construction corporations, consultants, and agreement procedures. Additionally, it delves into the issue of labor shortage in the industry, exploring its impact and potential solutions. The role of the Construction Industry Development Board (CIDB) in Malaysia's construction landscape is also examined, along with an analysis of the Malaysian master plan for the industry's development.

A. Construction Performance

As per Figure 1, the Construction sector in Malaysia maintained its positive momentum during the first quarter of 2023, with the value of work done experiencing a significant expansion of 9.4 per cent, amounting to RM32.2 billion. This growth indicates a robust performance of the construction industry in the given period. (Department of Statistics Malaysia, DOSM).

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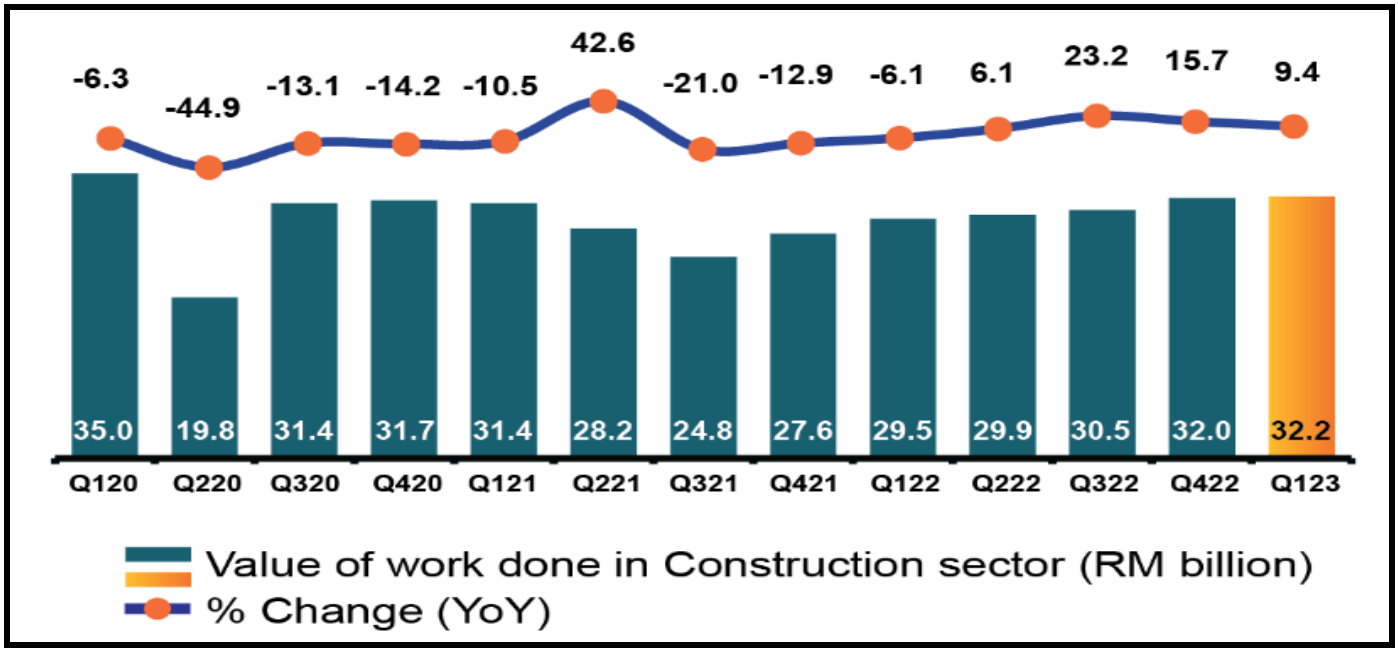

Fig 1: The Value of Work Done in Construction Sector from Q1 2020 to Q1 2023

According to Alaloul, Altaf. M (2021), the construction sector holds significant importance as it directly impacts the prosperity, health, and overall quality of life for a country's citizens. It is considered the backbone of economic growth, influencing all sectors on various levels within an economy (Alaloul, Musarat 2021). The Department of Statistics Malaysia, as shown in Figure 2, reported that the value of work done in the first quarter of 2023 saw remarkable expansion, primarily driven by a substantial increase in Civil engineering (17.2%). Following this, the Non-Residential buildings sub-sector and Special trade activities also experienced considerable growth, increasing by 9.6 per cent and 9.0 per cent, respectively. This growth across different sub-sectors demonstrates the positive impact of the construction sector on Malaysia's economic landscape during that specific period.

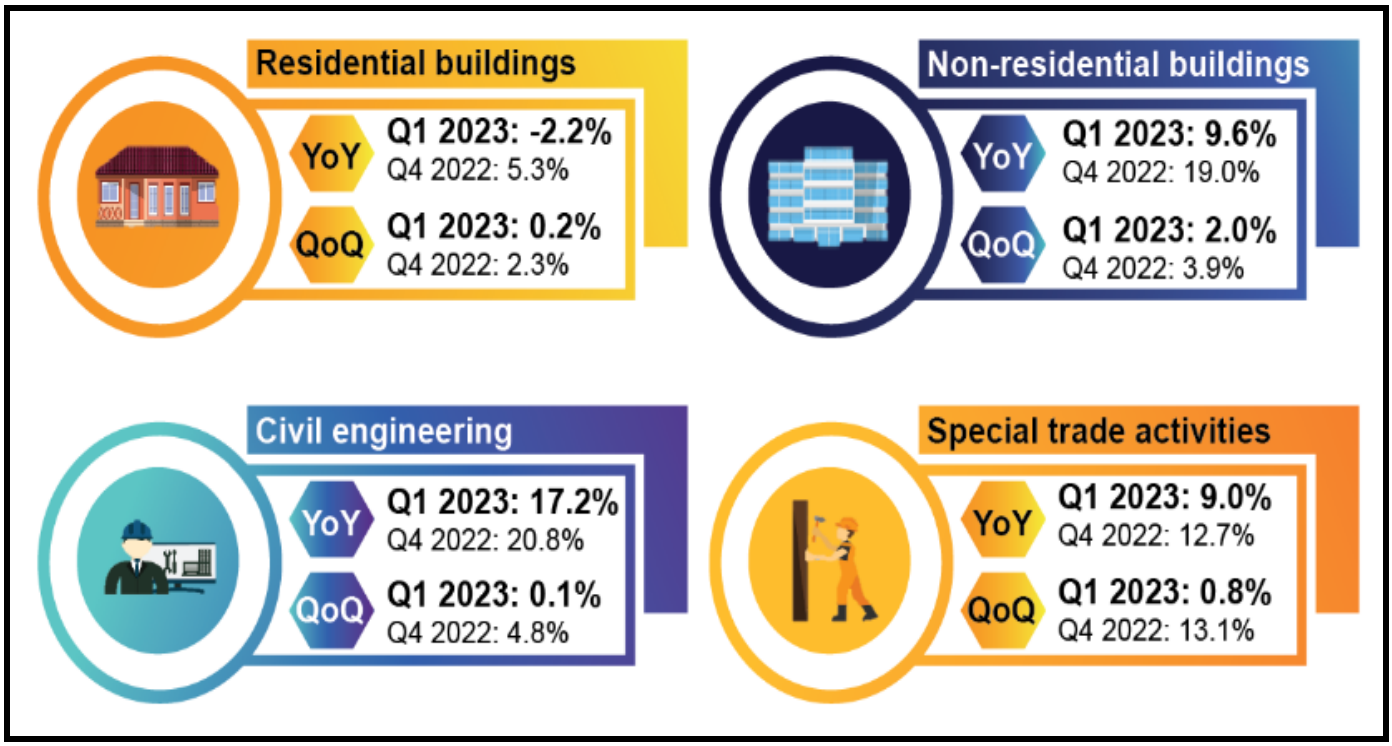

Fig 2: Expansion of Value of Work Done in First Quarter of 2023

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During the reported period, the Residential buildings sub-sector in the Malaysian construction industry witnessed a decline of 2.2 per cent in the value of work done, which stands in contrast to the growth of 5.3 per cent observed in the previous quarter. Nevertheless, when comparing with the preceding quarter, all sub-sectors exhibited growth. Notably, the Non-residential buildings sub-sector registered the most significant increase of 2.0 per cent, followed by Special trade activities (0.8%), Residential buildings sub-sector (0.2%), and the Civil engineering sub-sector (0.1%). The construction sector's direct influence on social and economic development is vital, particularly concerning money circulation. The absence of adequate building infrastructure can result in undergrowth across various sectors, an underdeveloped economy, a substandard level of living, and imbalanced income distribution, all of which contribute to a country's economic struggles (Gaal O.H, Afrah N 2017). On the other hand, effective management of the construction sector leads to an improved quality of life, including enhanced tourism, a sustainable environment, increased money circulation, and job creation throughout the country (Musarat M.A, Alaloul 2020). These positive outcomes contribute to the overall growth and prosperity of the nation.

B. Public and Private Sector

The Malaysian construction sector (MCS) is grappling with various challenges, including shortages of manpower, environmental concerns, issues related to work quality, and low productivity, which have posed significant problems (Alfan E, Zakaria Z 2013). As depicted in Figure 3, the private sector continued to be the primary driving force behind the growth in the first quarter of 2023, experiencing an increase of 10.6 per cent (compared to 23.5% in Q4 2022). The total value of construction work done by the private sector accounted for 61.4 per cent. In contrast, the public sector's value of work done represented 38.6 per cent of the total, witnessing a rise of 7.4 per cent in this quarter (compared to 4.7% in Q4 2022). These figures highlight the private sector's prominent role in contributing to the growth of the construction industry, with a considerable share of the total construction activities. However, it is essential to address the challenges mentioned earlier to further enhance the productivity and sustainability of the construction sector in Malaysia.

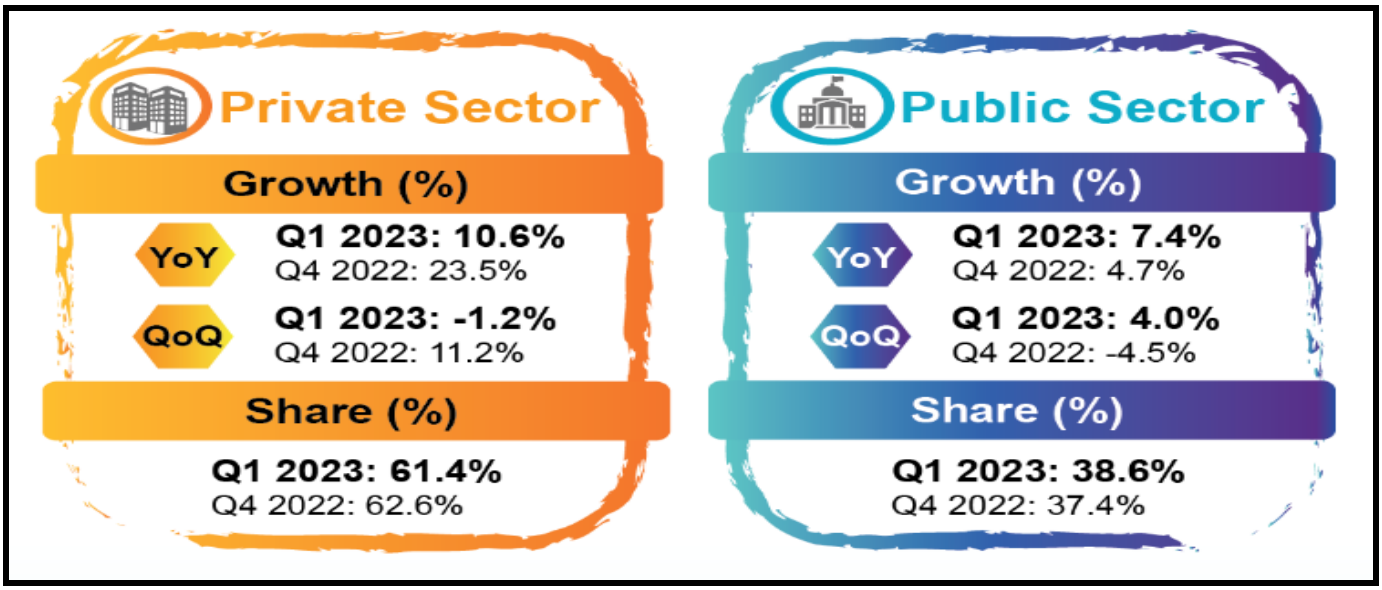

Fig 3: Private Sector Remains as the Main Impetus to the Growth of the Construction Sector in Q1 2023.

Public and private partnerships have gained popularity in developing countries as a means of involving the private sector in the development of public infrastructures (Javed et al., 2013). These partnerships possess unique characteristics such as competitive bidding processes, private sector innovation and expertise, and risk sharing between the public and private sectors (Cheung and Chan, 2011). However, public and private sector projects entail a higher risk profile compared to traditional delivery methods due to factors such as long lead times, high capital expenditures, and long-lived assets with limited value in alternative uses (Chan et al., 2015). Hence, public-private partnerships are recognized as collaborative endeavors between government and private entities, established with the purpose of accomplishing both social and commercial goals through cooperation. This cooperation involves sharing the risks associated with estimated costs and expected returns, as highlighted by Loosemore and Cheung in 2015. Despite their benefits, public and private partnerships also face challenges arising from differences in interests, corporate culture, and risk perception among the involved parties, which lead to diverse approaches and tools for dealing with risk (Liu et al., 2018; Song et al., 2018). Managing these differences and aligning the interests of the public and private sectors is crucial for the successful implementation of public and private partnerships projects in the construction industry.

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C. Construction Companies

The Malaysian Construction Company is witnessing significant growth both in the domestic market and on the global stage (Raza et al., 2014). In Malaysia, companies are categorized as either Bumiputera or non-Bumiputera. To be classified as Bumiputera, a company must have at least 51% of its shares owned by Malays/Bumiputera and have the majority (at least 51%) of its workforce consisting of Malays/Bumiputera. Before engaging in any construction tendering activities and commencing operations, all construction companies in Malaysia, regardless of their Bumiputera or non-Bumiputera status, as well as whether they are local or foreign contractors, are required to register with the Construction Industry Development Board (CIDB). In addition to registration, companies must meet specific requirements related to their paid-up capital as part of the registration process. The contractor grades of registration set by the CIDB are presented in Figure 4.

Gred / *Grade*	2014	2015	2016	2017	2018	2019	2020	2021
G1	33,941	33,744	35,149	35,347	36,604	42,173	56,866	65,540
G2	10,639	12,097	16,253	17,402	22,128	24,148	24,366	24.154
G3	8,874	9,246	10,628	12,510	15,415	16,406	17,206	18,539
G4	3,103	3,341	3,896	4,112	4,759	5,031	5,282	5,426
G5	4,294	4,656	5,101	5,455	6,073	6,220	6,370	6,713
G6	1,526	1,557	1,703	1,803	2,018	2,128	2,105	2,010
G7	5,788	6,066	7,084	7,402	9,000	8,752	8,841	8,739
Jumlah / *Total*	68,165	70,707	79,814	84,031	95,997	104,858	121,036	131,121

Fig 4: Number of Registered Contractors by Grade

As of June 2021, the contractors' registration records showed that a total of 131,121 contractors were registered with the Construction Industry Development Board (CIDB) in Malaysia. Out of this total, 65,540 contractors were classified as small and medium-sized companies. Notably, only around 13% of the registered construction companies in Malaysia fell under the category of large companies. This distribution indicates that a majority of the construction firms in the country are relatively smaller in size and likely play a significant role in the construction industry.

D. Construction Professionals

Based on the Figure 5. 2021 statistics, there are 6,841 Site Supervisor and 106,717 registered Project Manager in Malaysian construction industry (CIDB 2021).

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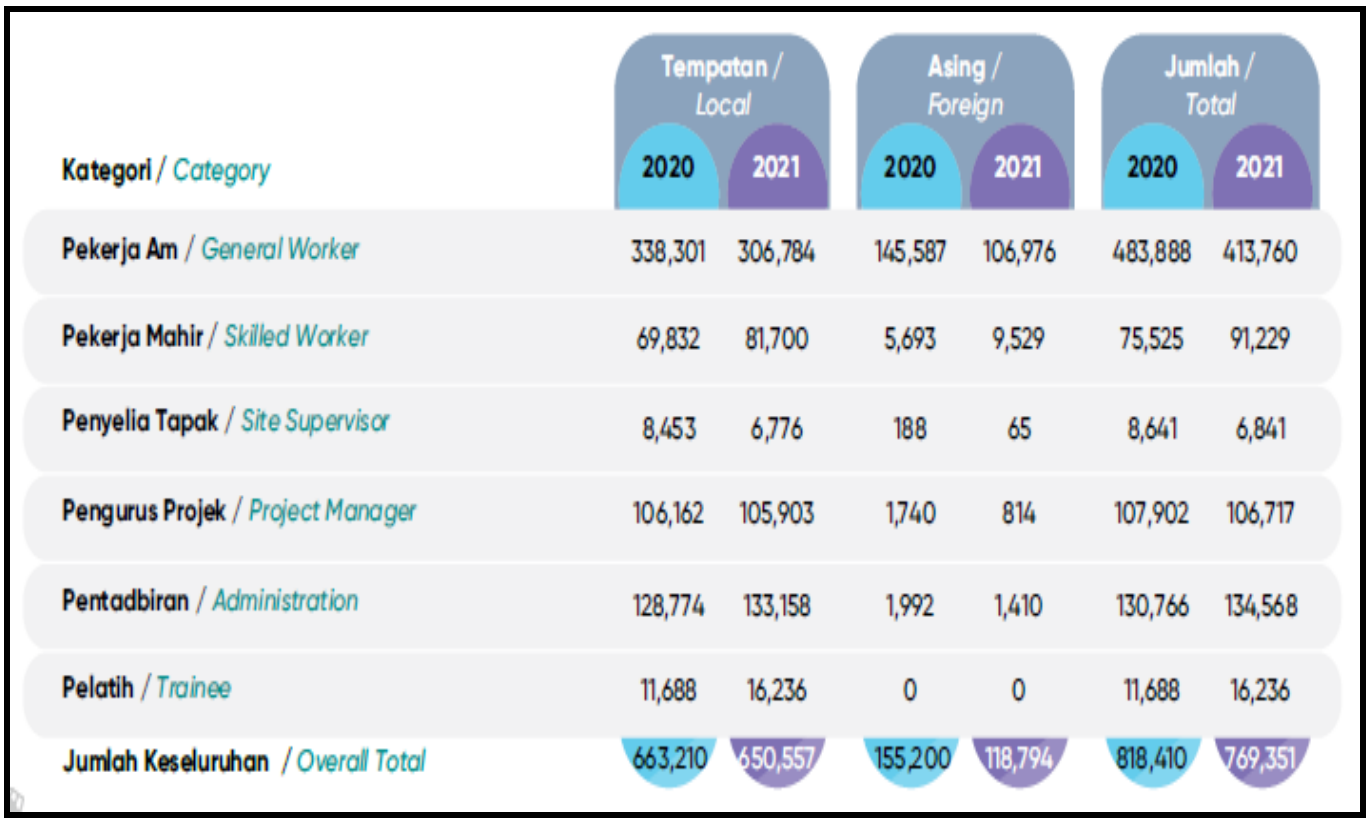

Kategori / *Category*	Tempatan / *Local*		Asing / *Foreign*		Jumlah / *Total*	
	2020	2021	2020	2021	2020	2021
Pekerja Am / *General Worker*	338,301	306,784	145,587	106,976	483,888	413,760
Pekerja Mahir / *Skilled Worker*	69,832	81,700	5,693	9,529	75,525	91,229
Penyelia Tapak / *Site Supervisor*	8,453	6,776	188	65	8,641	6,841
Pengurus Projek / *Project Manager*	106,162	105,903	1,740	814	107,902	106,717
Pentadbiran / *Administration*	128,774	133,158	1,992	1,410	130,766	134,568
Pelatih / *Trainee*	11,688	16,236	0	0	11,688	16,236
Jumlah Keseluruhan / *Overall Total*	663,210	650,557	155,200	118,794	818,410	769,351

Fig 5: Number of Registered Construction Personnel by Category

Improving the construction industry largely depends on the presence and development of skilled construction professionals. To achieve this, it is crucial to maintain up-to-date information about skilled labor in the construction sector. Having a clear understanding of the current scenario will enable authorities to take concrete and targeted steps to enhance the performance and efficiency of the Malaysian labor force (Najib et al., 2019). The lack of skilled labor poses a significant challenge to the country's economic growth and progress. Without an adequate number of skilled workers, the economy may struggle to move up the value chain and attract substantial investments in resources (Saieed, 2016). The government's efforts to improve the skill levels of Malaysian laborers have yielded mixed results, revealing a significant disparity between the proposed plans and their actual implementation, as reported by the International Labor Organization in 2018. This emphasizes the importance of effective implementation and monitoring of skill development initiatives to bridge the skill gap. The construction industry, in particular, relies heavily on skilled workers to meet the demand for construction projects. Therefore, investing in skill development and ensuring a steady supply of skilled labor is vital to support the growth and development of the construction sector in Malaysia. By addressing the skill shortage and providing adequate training and development opportunities, the industry can improve its performance and contribute to the country's overall economic progress.

E. Labour Stortage

A construction company need to recruit an extra workforce when the labor shortage to carry out work tasks as required by the construction job specifications. Indeed, the term "labor shortage" can encompass two different scenarios in the context of the labor workforce. In one sense, it refers to an "absolute shortfall" in the number of available workers compared to the demand for labor in the market (Rahim et al., 2016). This shortage occurs when the number of job openings exceeds the available workforce, leading to difficulties in finding enough workers to fill all the vacant positions. Therefore, if there is a situation where a job site without sufficient labor or human resources to perform various work tasks, other resources would not be able replaced, utilized, and converted into productive use (Muhamid 2013). Yusoff et al., (2021) in an opinion that hiring foreign labors is one of the fast and immediate solutions to managing labor shortages. Salleh et al., (2014) suggested that the fastest and cheapest way to fill the vacancies in the workforce and reduce the problem of a labor shortage is to fill the vacancy with foreign workers. According to MOHR (2019), the estimated number of active foreign labors in the Malaysian construction industry as mid of 2019 was about 435,000 people, constituting up to 21.7% of total documented foreign labors. The sustainability of human resources in the MCI was directly disrupted due to the over-dependence on foreign labor (Rahim et al., 2016). The influx of unskilled foreign labors too had worsened the situation of the existing shortage of skilled worker market (Marhani et al., 2012; Hamid et al., 2013). Construction is labor intensive industry that is

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commonly regarded as a major investment component which is highly dependent on human labor. Other than those who are involved in project management, most of the workers are low-skilled workers. The current global growth in the construction industry required a massive number of labors, therefore, the shortage of skilled labor has become a crucial issue in most countries. The consequences of labor shortage had contributed to the higher costs and poor quality of project performance. It also delayed the delivery of projects and harmed the successful completion (Juricic et al., 2021).

According to Statista in 2022, approximately 1.38 million people were employed in the construction industry in Malaysia. This figure represents a decrease in the number of employees compared to 2015 when the industry had 1.5 million people employed, as depicted in Figure 6. This decline in the workforce over the years indicates a change in the employment trends within the construction sector in Malaysia. The reasons behind this decrease could be influenced by various factors, including economic conditions, changes in construction demand, technology adoption, and workforce dynamics. Analyzing these trends can help understand the evolving labor market in the construction industry and guide strategies to address any potential labor challenges.

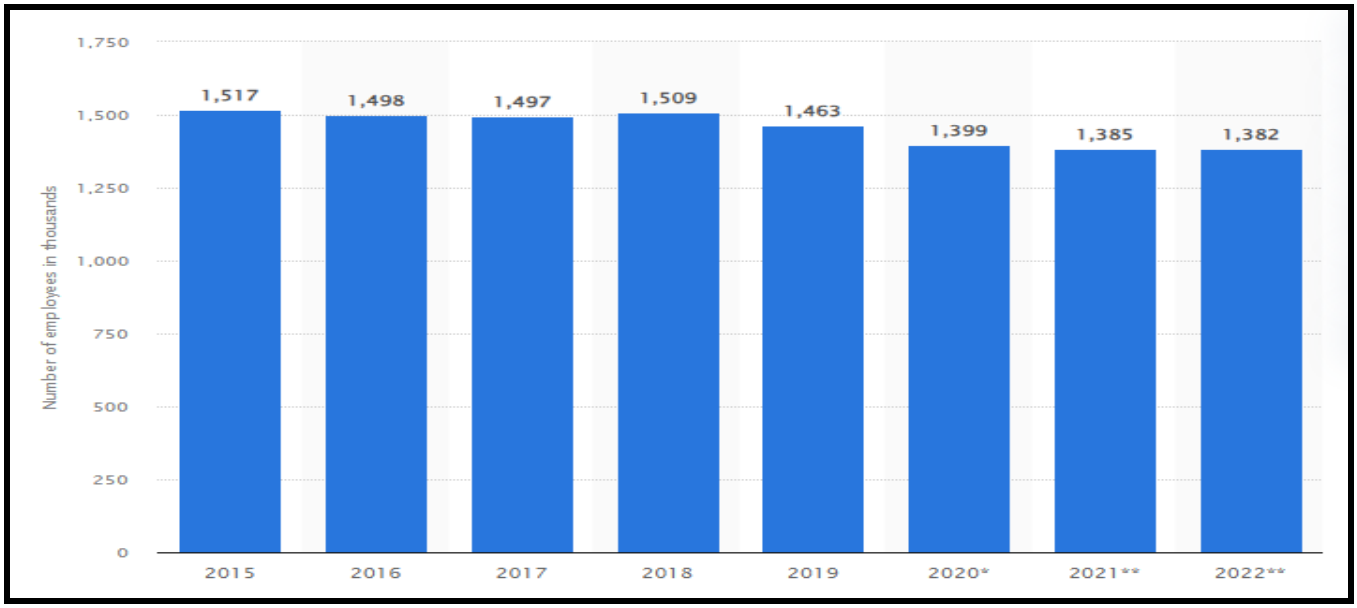

Fig 6: Number of People Employed in the Construction Industry in Malaysia 2015 to 2022

To perform effectively in construction projects, labor is an essential key factor in successive project management. Many construction projects have failed and been unsuccessful due to the labor factor (Rahim et al., 2016). An estimated shortage of 400,000 workers for the construction industry is yet to solve. To solve the problem, CIDB is closely working with the construction industry's stakeholders and the Ministry of Human Resources (MOHR) to effectively resolve the issue (Bernama, 2022).

F. Malaysian Construction Industry Development

The Construction Industry Development Board (CIDB) was established in 1994 under the Construction Industry Development Board Act 1994 (Act 520) with the objective of regulating, developing, and facilitating the construction industry in Malaysia to achieve global competitiveness. The board plays a vital role in advising the Federal and State Governments, as well as other stakeholders, on matters related to the construction industry. In the CIDB master plan, several challenges affecting the construction industry in Malaysia are identified. Some of the challenges faced by the Malaysian construction industry include project delays, low productivity, a negative industry image, economic volatility, manpower shortages, and insufficient data and information. The low productivity in the construction industry is attributed to various factors, such as limited technology usage, ineffective project site management, a lack of skilled labor, high input costs and inaccurate duration estimations, shortages of construction manpower, high construction wastage, poor maintenance practices, noncompliance with regulations, and a hazardous working environment leading to accidents. The poor image of the industry results in frequent accidents, lack of job security, poor management practices, low wages for high-risk jobs, and limited opportunities for career development. Additionally, Ansah et al. (2016) also pointed out some weak points in the Malaysian construction sector, particularly in planning and architecture disciplines. Addressing these challenges and weaknesses is crucial for the continuous improvement and development of the construction industry in Malaysia. Effective measures and strategies are needed to enhance productivity, safety, and the overall performance of the sector, ultimately contributing to its growth and success.

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G. Malaysian Construction 4.0 Strategic Plan 2020 – 2025

The Construction 4.0 Strategic Plan (2021-2025) is designed to be in alignment with various key national initiatives and policies in Malaysia (Figure.7). These include the Shared Prosperity Vision 2030 (SPV 2030), the implementation of the National Policy on Industry 4.0 (Industry4WRD), the National Internet of Things (IoT) Strategic Roadmap, the Malaysia Smart City Framework, and the Digital Economy Blueprint, among others. By aligning with these national initiatives, the Construction 4.0 Strategic Plan aims to ensure harmonious concordance between the vision and mission of the construction industry stakeholders and the broader national development goals. This strategic alignment is crucial for fostering cooperation and collaboration between different sectors and stakeholders in Malaysia, facilitating the adoption of new technologies, enhancing digitalization, and promoting sustainable practices in the construction industry. By integrating with the broader national plans, the Construction 4.0 Strategic Plan seeks to contribute to the overall development and progress of Malaysia's economy and society, as outlined in the Shared Prosperity Vision 2030 and other national policies. The harmonious alignment with these initiatives helps ensure that the construction industry plays a significant role in achieving the nation's long-term goals and remains competitive on the global stage during the Industry 4.0 era and beyond.

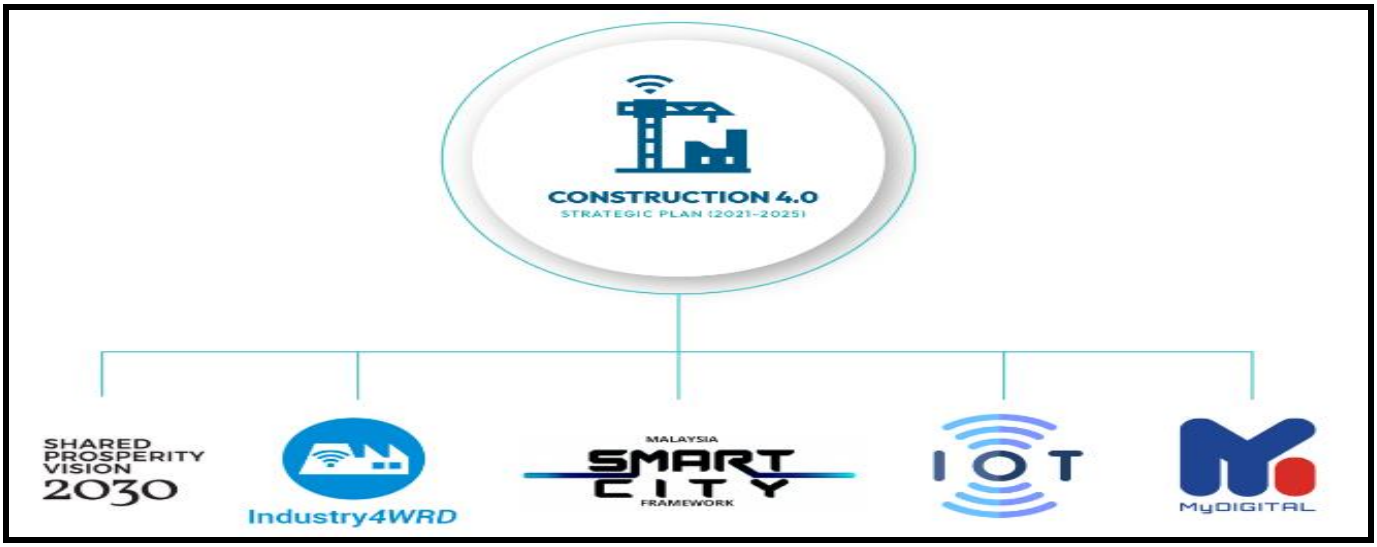

Fig 7: The Harmonious Alignment of the Construction 4.0 Strategic Plan (2021-2025) of the Vision and Mission of the Industry Stakeholders

III. MALAYSIAN CONSTRUCTION INDUSTRY ISSUES AND PROBLEMS

In 2022, the global economic starts to recover slowly. However, global construction industries are still facing several issues including manpower shortage, construction cost increase and consumer spending behavior changing. The review underscores the scarcity of research conducted by academics and practitioners on the challenges confronted by Malaysia's local construction industry. However, Table 1 provides an overview of the problems identified in the Malaysian construction sector, gathered from both local and international journals, conferences, and conventions. Table 1 shows the challenges in the Malaysian construction industry in project completion delays (Abdul Rahman et al., 2006), adverse impacts on clients and developers due to project delays (Abdul Rahman et al., 2006), economic repercussions of project delays on the industry (Abdul Rahman et al., 2006) The study carried out by Abdul Rahman et al. (2006) revealed that project delays constituted a significant concern in Malaysia's construction industry, with 45.9 percent of projects experiencing delays during their initial stages. These delays not only affect individual clients and developers but also have broader implications for the entire industry's contribution to the country's economy. Although the available literature on specific issues faced by the Malaysian construction industry is limited, these findings underscore the crucial problem of project delays. Further research and attention from academics and practitioners are necessary to comprehensively address the challenges and explore viable solutions for promoting sustainable growth and development within Malaysia's construction sector.

The construction industry is one of the industries which has a high demand for manpower to carry out the work. However, the country lockdown has significantly reduced the number of foreign workers. Although the recruiting of foreign workers has resumed in February 2022, the number of foreign workers in Malaysia is not sufficient yet in many industrial fields. This caused due to the slow government approvals, etc. Malaysia relies on foreigners for factory, plantation, and service sector jobs. The large number of migrants labor are consisting of those low skilled labors that are employed on a temporary basis (Al Tmeemy 2018). The distribution of resources, the changing preferences, the price (wages), the quantity (number of foreign labor), and the “invisible hand” will

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disrupt or affect the supply and demand (Rajib et al.,2021). The shortage of manpower slower down the work progress and increase the construction cost as the labor wages have increased tremendously. There are several reasons for the shortage of workers in the Malaysian construction industry. Firstly, the workers are reluctant to return to work due to the fear of contracting the disease. Secondly, many construction workers have lost their jobs because of the closure of their businesses due to the imposition of quarantine measures by the Government. Thirdly, many construction sites have been shut down owing to the increasing spread of the disease in the country. Finally, the lack of skilled workers in the industry is making it difficult to complete the projects on schedule. These are some of the reasons behind the shortage of workers in the Malaysian construction industry.

The lockdown affected the planning of all industries including logistics industry. In addition to the long-term lockdown in China, high gasoline prices, a lack of shipping containers and the shortage of manpower and restriction to enter the country had broken the global supply chain. The shortage of supply caused the fluctuation of material costs and increased construction costs eventually. According to Building Materials Cost Index December 2022 provided by DOSM, compared to yearn 2021, the average prices of steel and cement climbed by 10.2 percent and 9.0 percent respectively. A monthly analysis of construction materials and areas revealed an upward trend in the unit price index for certain selected materials, including cement, bricks and masonry, sanitary materials, and paints, across all regions in Peninsular Malaysia, Sabah, and Sarawak.

In December 2022, the unit price index for cement exhibited a growth of 1.5 percent when compared to the previous month, November 2022. This increase marked a consecutive growth for two months in a row. Nevertheless, the December 2022 unit price index for construction materials recorded year-on-year increases ranging from 1.8 to 11.8 percent. The unit price index for steel and cement increased by 1.8 percent and 8.4 percent year-on-year, respectively, in December 2022. In November 2022, the average price of cement (ordinary Portland cement) was RM20.88 per 50 kg. In December 2022, there was a slight increase of 0.3 percent, bringing the average price to RM20.95 per 50 kg. On the other hand, the average prices for aggregates and sand remained constant in December 2022, with aggregates maintaining a price of RM41.14 per ton and sand retaining a price of RM36.30 per ton, showing no change from the previous month. The Table 1 briefly highlighted the findings from previous research on Malaysian construction industry which able to corelated to research and development facilities construction project.

Table 1: Summary of the Previous Studies and Findings on Critical Characterization in Malaysia Construction Industry

No.	**Authors, Years**	**Participants**	**Methodology**	**Data Analysis Method**	**Findings/Variables**
1	Arditi et al., 2017	Contractors, engineers, managers, and directors	Questionnaire and interview	Statistical method	The research has revealed that there is a significant delay of 45.9 percent in completing construction projects during the construction stage.
2	Goh et al., 2013	Engineers, architects, contractors, developers	Questionnaire and interview	Statistical method	According to the findings, the emergence of financial and time risks in the local construction industry is primarily attributed to two key factors: frequent late payments and poor planning.
3	Ansah et al., 2016	Contractors	Semi structured interviews	RPN method	The key findings indicated that the highest risks in the industry were attributed to the following factors: the availability of labor, lack of technical know-how, reliance on outdated methodologies, inefficient dissemination of information, and changes in government regulations.
4	Ahmad Rahman et al., 2015	Project Manager	Interview	Ranking factor analysis	The study's results reveal that a significant proportion of construction projects in Malaysia do not employ risk management techniques.
5	Al Tameemy et al., 2018	Contractors and Managers	Questionnaire	Chi square (□²)	The results of the study reveal that there is a high demand for quality, cost, and training in the construction industry.
6	Raza et al., 2014	Contractors	Questionnaire	Ranking and factor analysis	The results highlight a potential gap in the expertise of site personnel, which can have a direct impact on the overall performance and efficiency of construction projects.
7	Sian et al., 2012	Project	Interview	Statistical method	Results on contractor’s improper planning

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		Managers	approach		
8	Javed et al., 2013	Contractors	Interview	Ranking and factor analysis	The special characteristics of public and private sector are competitive, innovation and expertise
9	Amran et al., 2014	Clients, consultants, and contractors	Questionnaire	Racking and factor analysis	The findings of the study indicate that Malaysian contractors perceive delays in payments and difficulties in resolving contractual issues as the primary impacts of construction risk.
10	Adnan et al., 2013	Main contractors and subcontractors	Questionnaire survey	Ranking factor analysis	Financial difficulties and manpower are the main issue on project delay

IV. SUMMARY

There is limitation in this study despite no previous research conducted specifically on Research and Development facilities construction project in Malaysia. However, the construction industry studies conducted in previous research able to pinpoint the critical characteristics review for research and development facilities construction project. The assessment was conducted to ensure thorough consideration of all the critical characteristics identified. Reviewing multiple studies conducted in Malaysia, it was found that various factors adversely affect the project outcomes in the construction industry (Siang and Ali, 2012; Javed, 2013; Ahmad Rahman, 2015; Ahmad and Arditi, 2017). Past literature highlights the current challenges faced by Malaysian construction projects, with factors such as changes in government policies, contractor competence, payment delays, contract resolution practices, financial difficulties, labor and equipment availability, material quality, and safety issues (Omar, 2009) playing significant roles. Based on the synthesis of the literature on the characteristics of the Malaysian construction industry, it is evident that the existing practices in the industry have led to serious problems. While the government plays an essential role in the industry, it has heavily relied on public sector investments for growth. The industry exhibits a high level of fragmentation, resulting in substantial disconnection among various stakeholders such as clients, consultants, main contractors, sub-contractors, and the on-site workforce. The large number of contractors operating in a small domestic market leads to strong competition and a prevalent sub-contracting culture. Different elements of projects are often outsourced to sub-contractors, and project awards are primarily based on competitive pricing. This situation leads to high variations in design, cost, and claims, resulting in disputes. These identified characteristics and practices in the Malaysian construction industry pose significant challenges, affecting project performance and overall industry efficiency. Addressing these issues may require collaborative efforts among stakeholders, improved project management, and a focus on enhancing industry standards to foster more sustainable and successful construction projects in Malaysia.

The Malaysian construction industry exhibits a high dependency on unskilled foreign labor due to their affordability, widespread availability, and flexibility. This reliance on cheap labor is evident in the current practices of many construction companies in Malaysia, especially small and medium-sized enterprises (SMEs), which continue to operate in a traditional manner. These companies often opt for inefficient, slow, and labor-intensive systems, relying on a low-wage, low-skill, and low-overhead approach to address cost concerns, as affordability is a critical issue in the industry. Moreover, many construction companies lack the capacity to adopt and integrate new technologies into their construction processes. They face challenges in absorbing and effectively utilizing advanced technology, which hampers their productivity and efficiency. Implementation of the government's policies, particularly those set out by the Construction Industry Development Board (CIDB), falls short in addressing these major issues faced by contractors. The guidelines and recommendations provided often do not sufficiently address the challenges faced during the construction phase, leading to implementation failures. Studies, such as those conducted by Kamal and Flanagan (2012) and Abdul-Rahman et al. (2015), highlight the low productivity in the industry, which is linked to the limited usage of technology. The current practices and processes do not adequately address how contractors can effectively adopt and benefit from available new technologies. There is a need for more comprehensive and practical approaches to address the challenges faced by contractors and facilitate the successful integration of technology into the construction process. To improve the industry's performance and productivity, it is crucial for the government and CIDB to consider the specific needs and capacities of construction companies, especially SMEs. This includes providing support and resources to help them adopt and implement new technologies effectively, as well as promoting a culture of innovation and continuous improvement within the construction sector. By addressing these issues, the Malaysian construction industry can enhance its competitiveness, efficiency, and overall quality of construction projects.

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V. CONCLUSION AND FUTURE DISCUSSION

In conclusion, this paper has successfully examined the distinct characteristics of issues and challenges in the Malaysian construction industry and their potential implications for research and development facilities construction projects. The literature synthesis has revealed a discrepancy between the aspirations of the government and policy makers for a more efficient and highly productive construction industry and the practical limitations faced by construction players and companies in delivering on these objectives. There exists a gap between the vision set forth by policy makers and the pragmatic realities within the industry. The identified issues and problems in the Malaysian construction industry, as presented in this paper, raise important questions about how the industry can enhance its performance and productivity. It also highlights the need for the industry to capitalize on available new technologies and implement them effectively. Moreover, it prompts consideration of the necessary measures to realize and align with the government's policy goals. These insights serve as a foundation for future research endeavors aimed at improving research and development facilities construction projects in Malaysia. By addressing the identified challenges and understanding the industry's unique characteristics, research efforts can be directed towards enhancing the overall efficiency, productivity, and quality of construction projects in the country. It is imperative for researchers, policy makers, and industry stakeholders to collaborate and work towards bridging the gap between vision and practice in the Malaysian construction industry, ensuring sustainable growth and development in the sector.

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