Semarak International Journal of Modern Accounting and Finance

Journal homepage:
https://semarakilmu.my/index.php/sijmaf
ISSN: 3030-6329

Impact of Price Fluctuations on Construction Materials in Malaysia

Vincent Phen[1], Salihah Surol[1,*], Deprizon Syamsunur[1], Muhammad Noor Hisyam Jusoh[1], Moon Wei Chek[1], Nur Ilya Farhana Md Noh[2], Ng Jing Lin[2], Deddy Purnomo Retno[3]

[1] Department of Civil Engineering, Faculty of Engineering, UCSI University, 56000 Cheras, Kuala Lumpur, Malaysia
[2] School of Civil Engineering, College of Engineering, UiTM Shah Alam, 40450, Shah Alam, Selangor, Malaysia
[3] Department of Civil Engineering, Faculty of Engineering, Universitas Islam Riau, Pekanbaru, 28284 Riau, Indonesia

ARTICLE INFO

Article history:
Received 11 January 2025
Received in revised form 14 February 2025
Accepted 5 June 2025
Available online 30 June 2025

Keywords:
Construction materials; SDG 9

ABSTRACT

The post-pandemic period has significantly impacted construction material prices. Disruptions caused by the pandemic have affected the construction industry, leading to fluctuations in material costs. This study aims to investigate the effects of post-pandemic construction material price changes in Malaysia. The objectives of this study are to categorize the types of materials affected by price changes, identify the types of construction works impacted, and propose strategies to mitigate these effects as in Sustainable Development Goals (SDG 9) industry, innovation and infrastructure. Through surveys, respondents' opinions were collected and analysed by SPSS to assess the impact of material price fluctuations. Essential construction materials such as steel, cement, and lumber, which are widely used in various projects, have experienced significant price changes. Factors such as factory closures and transportation disruptions have led to material shortages, increasing demand and causing price volatility. These fluctuations have affected different construction sectors, including residential construction, infrastructure projects, commercial developments, and renovation works. The data collected revealed notable price variations resulting in cost overruns and challenges in budget management and project scheduling. To address these challenges, the construction industry needs to adopt effective strategies to navigate the financial and operational impacts of material price fluctuations.

1. Introduction

The Covid-19 pandemic which affected the entire globe has led Malaysia to introduce its own national restrictions based on Standard Operating Procedures (SOPs), including strict lockdown measures that significantly impacted Malaysia's economy, particularly the construction industry. The industry faced project delays as construction activities could not precede during the lockdown. Additionally, there was a shortage of raw materials since many companies relied on imported materials, and production was halted, as taken from Abbaspour *et al.,* [1].

* *Corresponding author*
E-mail address: salihah@ucsiuniversity.edu.my

https://doi.org/10.37934/sijmaf.5.1.111

Under SDG 9, the rising cost of construction materials affects infrastructure development, making it harder to build sustainable and resilient infrastructure. By implementing mitigation strategies such as innovative construction methods like 3D printing, prefabrication, and alternative materials, the industry can enhance efficiency while reducing reliance on volatile material prices.

From a previous studied by Ahmed *et al.,* [2] in the competitive global market, supply chain networks are carefully planned to meet customer demand. The Covid-19 pandemic affected most countries worldwide, leading to a drop in GDP from 3% to 15% which had a severe economic impact. Among the key factors influencing construction costs during the pandemic were supply chain disruptions and project completion delays. The supply chain, which connects manufacturers to consumers, was disrupted due to labor shortages caused by quarantines.

The price of construction materials fluctuates frequently, influenced by economic factors such as demand and supply. As a result, contractors must be vigilant and analyze material prices when tendering for projects. Typically, construction materials account for 60% of total project costs, making them a crucial factor in project success. The studied by Akanni *et al.,* [3] mentioned that unforeseen price changes can impact project schedules, and material prices vary over time due to factors such as demand, inflation rate, currency exchange rate, transportation costs, energy costs, importation fees, interest rates, and monetary policy.

Cost management is one of the major challenges in construction projects, as expenses often exceed initial estimates. Although cost overruns are common, affecting 90% of construction projects, they can be mitigated through effective cost estimation. This process, conducted in the early phases of a project, determines the overall budget based on market data. Since large quantities of high-cost materials are involved in construction, it is essential to estimate future price trends, especially in relation to inflation rates, to avoid unexpected cost overruns, as mentioned by Alsharef *et al.,* [4].

Following the Covid-19 outbreak, economic and financial markets were significantly affected, leading to volatility in natural resource prices. The studied by Al Mansoori *et al.,* [5] stated that the pandemic caused delays in industrial sector activities, including production, transportation, manufacturing, and other economic operations, all of which were temporarily suspended for public health reasons. In this context, forecasting construction material prices is crucial for effective project management, as the accuracy of these forecasts can have a significant impact on overall project costs, as discussed by Arof *et al.,* [6].

Despite the numerous studies on the effects of the Covid-19 pandemic on the construction industry, there remains a gap in understanding the long-term impact of these material price fluctuations on project sustainability and cost estimation in the Malaysian construction context. While previous research has primarily focused on the immediate disruptions caused by the pandemic, there is limited exploration of how these price changes affect future project planning, particularly in terms of forecasting and mitigating the risks associated with fluctuating material costs. Furthermore, there is a need for more comprehensive analysis that includes input from a diverse range of stakeholders, such as material suppliers, economists, and governmental representatives, to gain a holistic understanding of the broader implications for the industry. This study aims to fill this gap by providing insights into the challenges of managing material price fluctuations and offering strategies to enhance cost prediction and project resilience in the post-pandemic era.

2. Methodology

2.1 Concept

In this study, a quantitative method was used to collect numerical data through structured questionnaires. The questionnaires were designed to assess respondents' experiences and perceptions regarding the effects of post-pandemic construction material prices in Malaysia. The questions covered the types of construction materials that experienced price changes, the types of construction work affected by these changes, and strategies to mitigate their impact.

The research methodology began with selecting the research topic, followed by studying background information. A review of existing literature was conducted before developing a set of survey questions. These questions were distributed to respondents to gather their opinions on the topic. Once the data was collected, SPSS software was used to analyse and present the findings in charts and tables. The results were discussed in the later section of the report. Finally, a conclusion was drawn by summarizing the research findings and providing recommendations to complete the study thoroughly.

2.2 Survey Design

The sampling design involved selecting targeted respondents, designing the questionnaire, and conducting data analysis. The study focused on employees working in the construction industry. The questionnaire was created using Google Forms for convenience, with a target of more than 100 respondents. It was divided into five sections, covering the demographic profile of respondents, types of construction materials that experienced price changes, types of construction work affected, and strategies to mitigate the impact of price fluctuations. The questionnaire included multiple-choice questions, Likert-scale questions, and short-answer questions to align with the quantitative method.

The collected data was analysed using SPSS software, chosen for its efficiency. To ensure data consistency and credibility, a reliability analysis was performed using Cronbach's Alpha. This analysis was applied to a questionnaire containing Likert-scale statements related to the effects of post-pandemic construction material prices in Malaysia. A minimum Cronbach's Alpha value of 0.7 was required to ensure accuracy and reliability, helping to avoid the need for adjustments or exclusions of any variables.

3. Results

3.1 Demographic Profile

Descriptive statistical analysis was performed using frequency and percentage tests to identify, describe, and summarize the collected data. The figures in this section were derived from a summary of Google Form responses, while the tables were generated using SPSS software. The results showed that 89.3% of respondents were male, while only 10.7% were female, indicating that the construction industry remains male-dominated. However, this does not necessarily suggest gender discrimination, as the survey was open to all respondents regardless of gender.

In terms of age distribution, the majority of respondents (56.4%) were between the ages of 21 and 30, suggesting that the survey was primarily completed by individuals in their early to mid-thirties. Additionally, 32.7% of respondents were aged 31 to 40, indicating that a significant portion had experience in the construction industry. Furthermore, 9.1% of respondents were aged 41 to 50, while 1.8% was aged 51 to 60.

Regarding occupational background, the majority of respondents (40%) worked in the Site Engineering department, followed by 30.9% in Construction Management. Civil engineering students with internship experience accounted for 10.8% of respondents. Consultants made up 5.5%, while Contractors, Businessmen, Engineering Managers, and Project Planners each comprised 1.8% of the total respondents.

3.2 Types of Construction that Experienced Price Changes

The Malaysian construction industry plays a crucial role in the country's economic development, contributing significantly to the Gross Domestic Product (GDP). Over the past few decades, Malaysia's construction sector has experienced periods of growth, spurred by urbanization, infrastructure development, and government investment in large-scale public projects. However, it has also faced significant challenges, particularly in relation to the volatile prices of construction materials, which are subject to global supply chain fluctuations and local economic conditions.

Before the pandemic, material prices in Malaysia were relatively stable, with only minor fluctuations due to global market trends. However, since the pandemic began, the situation has changed drastically, with disruptions in supply chains, delays in shipments, and labor shortages leading to significant cost increases. The pandemic has highlighted the vulnerability of Malaysia's reliance on imported raw materials, such as steel, cement, and timber, which form a substantial portion of construction costs.

Since this section consists entirely of Likert scale questions, a reliability test was conducted using SPSS software to obtain a Cronbach's Alpha value. The reliability of the survey was 0.946. As shown in Figure 1, construction works involving steel and iron have experienced significant price changes, with a standard deviation of 0.7330. These materials are durable and ideal for supporting heavy loads, making them commonly used in the construction industry. However, price fluctuations have impacted construction projects. Cement and concrete had a standard deviation of 0.7594. These are among the most commonly used materials in construction due to their versatility in building various structures.

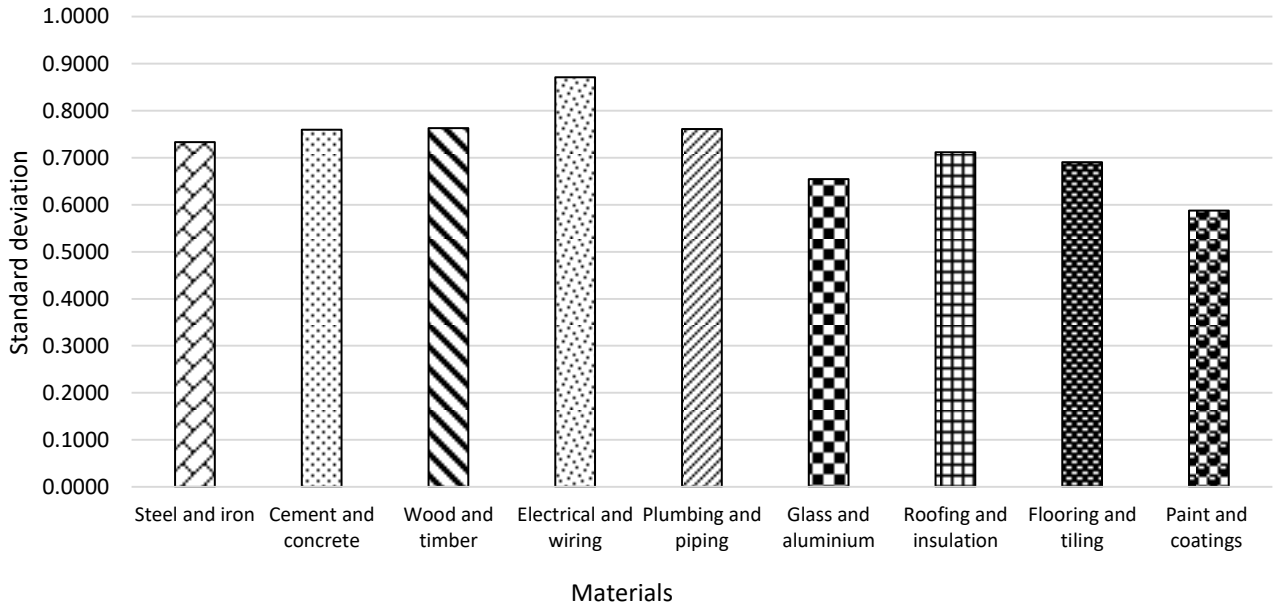

Fig. 1. Types of materials that experienced price changes

Wood and timber had a standard deviation of 0.7628. These materials are widely used in construction due to their strength, durability, and versatility. It is particularly common for formwork because of strong, lightweight, affordable, and eco-friendly. Electrical and wiring materials had a standard deviation of 0.8709. These materials are essential in modern buildings as it ensure the safe and efficient distribution of electricity. It provides power for lighting and household appliances and also used for communication purposes, such as telephone and internet access. Plumbing and piping materials had a standard deviation of 0.7609. These materials are critical for water distribution, flow control, and wastewater management in buildings.

Glass and aluminium materials had a standard deviation of 0.6544. Glass is widely used in doors, windows, and other applications, while aluminium is a lightweight, durable, and low-maintenance material that is resistant to corrosion and rust. Roofing and insulation materials had a standard deviation of 0.7115. These materials are highly durable and provide fire, pest, and water resistance. They are also energy-efficient, helping to keep buildings cool in summer and warm in winter, thereby reducing energy costs. Additionally, they can help to reduce noise levels, benefiting building occupants' well-being.

Flooring and tiling materials had a standard deviation of 0.6904. These materials protect the underlying structure, preventing water seepage that could cause damage to the foundation. It also enhances safety by reducing the risk of slips and falls and contributes to aesthetic appeal in building interiors. Construction works involving paint and coating materials had a standard deviation of 0.5875. Paint and coatings play a crucial role in protecting buildings from elements such as rain, UV rays, and chemicals, while also helping to prevent mold growth.

Most construction materials have undergone significant price changes due to the pandemic. The construction industry has been heavily impacted, particularly in terms of rising material costs. Essential materials used in all construction projects experienced price fluctuations due to supply chain disruptions, including factory closures and transportation delays. These challenges led to shortages and increased demand, ultimately causing price hikes.

3.3 Types of Construction Work that have been Impacted by the Changes in Construction Material's Prices

Figure 2 showing types of construction work that have been impacted by the changes in construction material's prices. Residential construction projects have a standard deviation of 0.7053. These projects encompass a wide range of building activities, from constructing small family homes to developing large apartment complexes. The increase in material costs can be attributed to several factors, with one of the most significant being the global pandemic's impact on manufacturing, transportation, and distribution networks. This disruption led to delays in production and delivery, creating material shortages and driving up prices.

Commercial construction projects have a standard deviation of 0.6838. These projects involve constructing buildings primarily for business purposes, ranging from small retail stores to large office buildings. The construction industry faced significant challenges during the pandemic due to government regulations, which disrupted material supply chains and caused shortages, leading to price increases. Additionally, manufacturing slowdowns increased the demand for construction materials, further contributing to rising costs. Another factor influencing material prices was the increase in energy costs, particularly for materials that require high energy consumption during production.

Infrastructure development projects have a standard deviation of 0.5741. These projects focus on improving essential facilities such as roads, sewers, and water supply systems, benefiting society

on both small and large scales. They play a crucial role in enhancing citizens' quality of life, stimulating economic growth, and creating job opportunities. However, during the pandemic, global supply chains faced unprecedented disruptions, including lockdowns, factory closures, and transportation issues. These challenges resulted in delays and shortages of construction materials, which in turn increased costs and impacted project budgets.

Renovation and remodelling projects have a standard deviation of 0.6113. These projects involve significant modifications or improvements to existing structures, properties, or spaces to enhance their functionality, aesthetics, or both. The shift to remote work during the pandemic prompted a greater demand for comfortable home spaces. As a result, many individuals chose to renovate and remodel their homes to better suit their needs. However, this surge in demand coincided with factory closures and labour shortages, severely limiting material production. Consequently, the supply of construction materials dwindled, further worsening the situation and driving up prices.

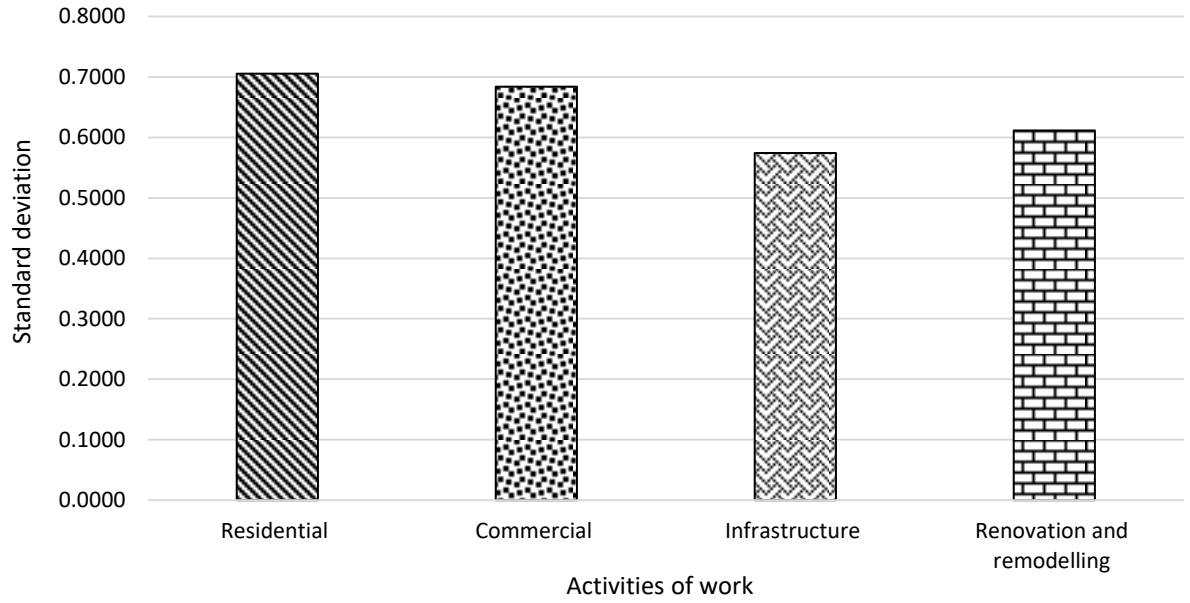

Fig. 2. Types of construction work that experienced price changes

3.4 Strategies to Mitigate the Effects of Changes in Construction Materials Prices

Price is a crucial factor to consider before purchasing construction materials, as it directly impacts a project's budget. An increase in material prices can lead to cost overruns. Various strategies to mitigate these overruns will be discussed in the following section. The second factor to consider is quality. The lifespan of a building heavily depends on the quality of the materials used in its construction. High-quality materials are more durable and likely to have a longer lifespan.

It can also withstand damage from weather, pests, and other external factors, reducing long-term maintenance costs. Availability and delivery time are also important considerations, as they can impact the timeline of a construction project. Delays in material delivery can disrupt the construction schedule, affecting overall project progress.

Brand reputation is a factor, though it does not always guarantee superior quality. While well-known brands may have a strong reputation, many lesser-known brands offer equally high-quality materials at a lower price.

3.4.1 Government policies and market reactions

The statement that government subsidies for construction companies can be an effective strategy has a standard deviation of 0.9473. However, most respondents disagreed with the idea that tax incentives should be provided to offset price increases. Their concerns include the potential reduction of funds for other industries and economic imbalances. Some also criticized the government's focus on the construction industry during the pandemic when health and safety were more pressing concerns, resulting in a standard deviation of 1.1519.

Regarding government-provided low-interest loans to address price increases, most respondents remained neutral, possibly due to a lack of information or a belief that other strategies would be more effective. This resulted in a standard deviation of 0.8692. A majority of respondents agreed with the statement that increasing import quotas could help mitigate price increases in construction materials. Higher import quotas can enhance the availability of materials, address supply shortages, and stabilize prices. By allowing greater imports, the government can reduce dependency on a single supplier and promote healthy competition.

3.4.2 Price and market fluctuations

Price has a standard deviation of 0.5925, highlighting its crucial role in construction projects, as it directly affects overall costs and budget allocation. Construction projects have faced delays or disruptions due to material shortages, with a standard deviation of 0.6816. The scarcity of construction materials has become a significant concern, especially following the pandemic and other unforeseen events that disrupted global supply chains. Factory closures, transportation challenges, and increased demand have all contributed to material shortages, leading to project delays. The post-pandemic environment has necessitated alternative sourcing strategies for construction materials, with a standard deviation of 0.6527. The pandemic exposed the risks of relying on a limited number of suppliers and regions, prompting respondents to explore new sourcing methods.

The pandemic further complicated the challenges faced by the Malaysian construction industry, exacerbating issues that were already present before COVID-19. The restricted movement control orders (RMCO) and lockdown measures implemented in 2020 led to major disruptions in the construction supply chain. Material shortages, due to halted production in key manufacturing countries, were compounded by delays in transportation and importation difficulties. These disruptions contributed to rising material prices, affecting both large-scale and smaller construction projects.

3.4.3 Innovative strategies for cost management

The use of innovative construction methods and technologies can help mitigate the impact of material price fluctuations, with a standard deviation of 0.7383. Advanced technologies such as prefabrication and 3D printing improve planning, visualization, and coordination, leading to reduced material consumption and minimized cost fluctuations.

Government policies have played a role in stabilizing construction material prices, with a standard deviation of 1.0805. However, the effectiveness of these policies varies depending on specific economic conditions and market factors. Adequate planning and forecasting can help prevent cost overruns in construction projects, with a standard deviation of 0.6873. Effective planning influences project timelines, resource allocation, and risk mitigation. Accurate forecasting

is equally essential, as it allows project teams to anticipate future cost trends, demand fluctuations, and market conditions, enabling informed decision-making.

Collaborative procurement methods can help mitigate the impact of material price changes, with a standard deviation of 0.7626. By working together, project stakeholders can negotiate better deals with suppliers, secure bulk discounts, and establish long-term partnerships that reduce costs. The use of alternative materials can help control construction costs during price fluctuations, with a standard deviation of 0.7133. Alternative materials offer cost stability and support local economies. Sustainable material substitution also promotes eco-friendly practices.

3.4.4 Sustainable and strategic approaches

Embracing sustainable practices can contribute to cost reduction in construction projects, with a standard deviation of 0.679. Sustainable methods enhance productivity, reduce accident risks, and minimize waste, leading to financial savings.

Additionally, compliance with environmental regulations through practices such as using recycled materials, conserving water, and reducing energy consumption can yield multiple cost-related benefits. Value engineering techniques can optimize material usage, with a standard deviation of 0.7241. These techniques reduce waste, promote sustainability, and ensure cost-effective project execution.

Effective risk management strategies can help mitigate the impact of material price fluctuations, with a standard deviation of 0.5618. Risk management involves closely monitoring market trends, diversifying supply sources, and having contingency plans, such as using alternative materials, to prevent unexpected cost increases.

Enhancing supply chain management can help manage material price fluctuations has a standard deviation of 0.75936. A well-structured supply chain enables construction projects to adapt to market changes by maintaining strong relationships with reliable suppliers and ensuring effective communication. This approach provides early insights into price changes and potential supply disruptions.

Early engagement with suppliers and contractors can help negotiate better material prices, with a standard deviation of 0.7115. Establishing early communication allows project teams to understand market trends, assess material availability, and anticipate price changes. This proactive approach helps in making informed purchasing decisions and comparing prices across multiple suppliers.

3.4.5 Monitoring and long-term strategies

Regular monitoring and evaluation of material prices can assist in cost control, with a standard deviation of 0.7053. Keeping track of price fluctuations allows project teams to anticipate changes and implement mitigation strategies. Using software tools and tracking material prices weekly, monthly, or quarterly can help maintain budget stability. Implementing long-term contracts with material suppliers can provide pricing stability, with a standard deviation of 0.894.

Long-term contracts ensure a consistent supply of materials at agreed-upon prices, shielding construction companies from market uncertainties and supply chain disruptions.

Continuous professional development for construction teams can enhance cost management skills, with a standard deviation of 0.7133. Specialized training and workshops help workers improve skills related to budgeting, resource allocation, and procurement. Equipping workers with up-to-date industry knowledge allows them to make informed decisions that optimize project costs.

The quality of locally produced construction materials in Malaysia is comparable to imported materials, with a standard deviation of 1.05683. Over the years, Malaysia's construction industry has made significant advancements in manufacturing and modern technology adoption, improving the quality of locally produced materials to compete with imported alternatives.

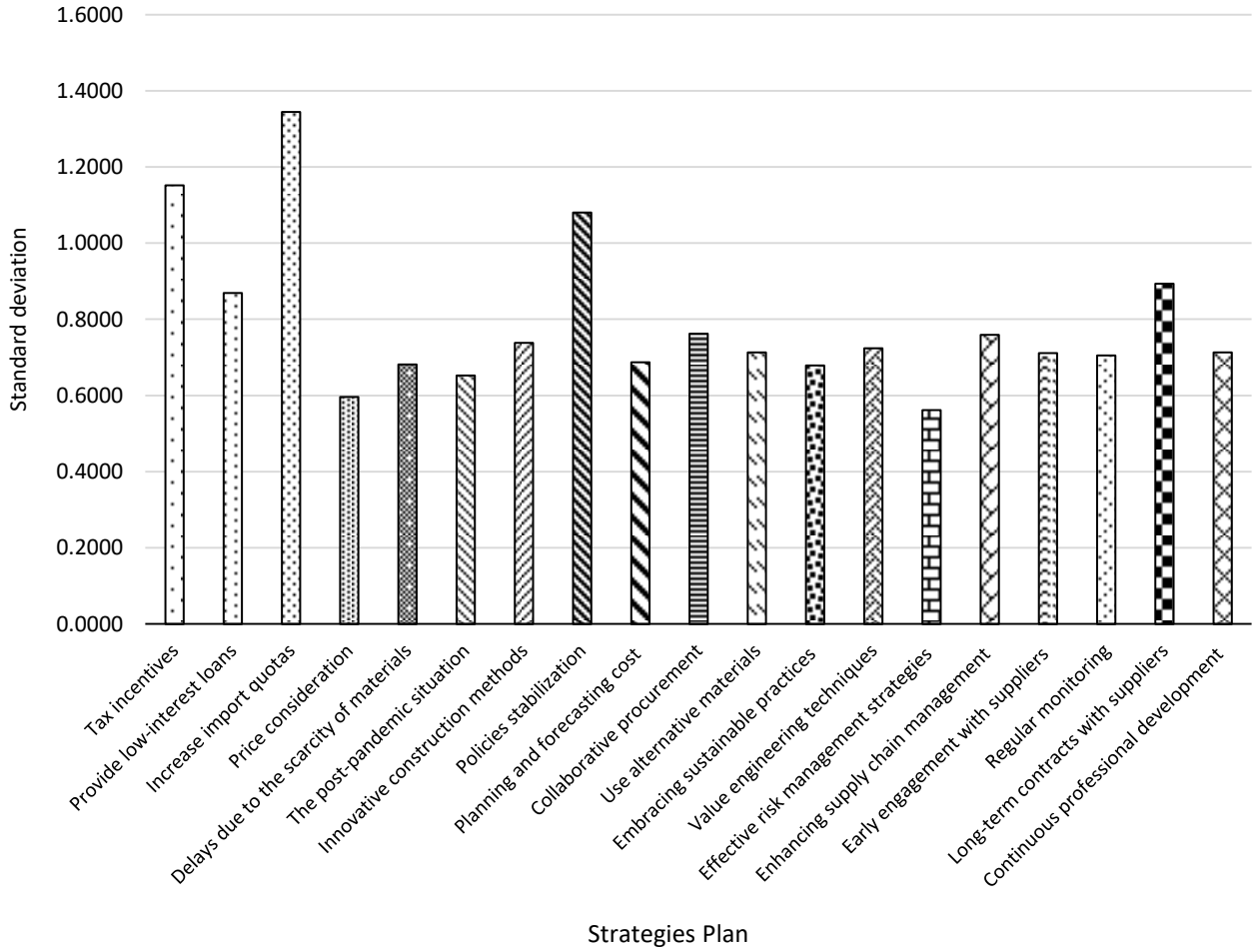

Fig. 3. Mitigation plan for price fluctuation

From the mitigation plans discussed, it has been shown that increasing import quotas, providing tax incentives, and implementing policy stabilization measures can effectively manage price fluctuations in construction materials. Increasing import quotas enhances market availability, reducing supply shortages and fostering competitive pricing. Tax incentives can alleviate the financial burden on construction companies, promoting investment and cost efficiency. Meanwhile, policy stabilization ensures a more predictable market environment, minimizing the impact of sudden price surges and supply chain disruptions. Collectively, these strategies contribute to a more resilient construction industry capable of adapting to economic uncertainties.

4. Conclusions

The research findings indicate that the prices of commonly used construction materials, such as steel, cement, and lumber, have undergone significant fluctuations, affecting various types of construction works and their budgets. These price changes have led to cost overruns, making budget management and project scheduling more challenging. Such volatility has forced

contractors to frequently revise their cost estimates and risk management strategies to accommodate unexpected market shifts. Moreover, small and medium-sized enterprises (SMEs) within the industry, which often operate on tight margins, are particularly vulnerable to the impact of these cost increases.

However, by adopting effective mitigation strategies, such as optimizing procurement processes, exploring alternative materials, and leveraging innovative construction technologies like 3D printing, prefabrication, and modular construction, the Malaysian construction industry can overcome these challenges. Strategic procurement, such as bulk purchasing or establishing long-term contracts with suppliers, can reduce the risk of price volatility. Meanwhile, alternative local materials may reduce reliance on imported resources, providing both economic and environmental benefits. Implementing these measures will contribute to cost-effective and efficient project execution, ensuring the successful completion of construction projects despite market uncertainties.

Furthermore, continuous monitoring of material price trends and integrating data-driven forecasting models can enhance the industry's resilience. Collaboration among stakeholders including contractors, suppliers, developers, and policymakers is also crucial to establish more stable supply chains and ensure better preparedness for future disruptions. By fostering a proactive and innovative construction environment, the industry can not only recover from the post-pandemic challenges but also build a more sustainable and adaptive future.

Acknowledgement
This research was not funded by any grant.

References

[1] Abbaspour, Solmaz, Amir Aghsami, Fariborz Jolai, and Maziar Yazdani. "An integrated queueing-inventory-routing problem in a green dual-channel supply chain considering pricing and delivery period: A case study of construction material supplier." *Journal of Computational Design and Engineering* 9, no. 5 (2022): 1917-1951. https://doi.org/10.1093/jcde/qwac089

[2] Ahmed, Mohammed Kamaruddeen, Mohd Noor Najihah, and Wahi Wahida. "Factors influencing the price of selected building materials in northern Malaysia." *Borneo Journal of Sciences and Technology* 2 (2020): 7-12.

[3] Akanni, P. O., A. E. Oke, and O. J. Omotilewa. "Implications of rising cost of building materials in Lagos State Nigeria." *Sage Open* 4, no. 4 (2014): 2158244014561213. https://doi.org/10.1177/2158244014561213

[4] Alsharef, Abdullah, Siddharth Banerjee, SM Jamil Uddin, Alex Albert, and Edward Jaselskis. "Early impacts of the COVID-19 pandemic on the United States construction industry." *International journal of environmental research and public health* 18, no. 4 (2021): 1559. https://doi.org/10.3390/ijerph18041559

[5] Al Mansoori, Hamdan Mohamed, Al Anoud Bandar Al Saud, and Harith Yas. "The Impact of Covid 19 on Increasing the Cost of Labor and Project Price in the United Arab Emirates." *International Journal of Pharmaceutical Research (09752366)* 13, no. 1 (2021). https://doi.org/10.31838/ijpr/2021.13.01.691

[6] Arof, K. Z. M., S. Ismail, and A. Latif Saleh. "Contractor's performance appraisal system in the Malaysian construction industry: Current practice, perception and understanding." *International Journal of Engineering & Technology* 7, no. 3.9 (2018): 46-51. https://doi.org/10.14419/ijet.v7i3.9.15272

[7] Esa, Muneera Binti, Farah Salwati Binti Ibrahim, and E. B. Kamal. "Covid-19 pandemic lockdown: The consequences towards project success in Malaysian construction industry." *City* 25, no. 2 (2020). https://doi.org/10.25046/aj0505119

[8] Hossain, Md Aslam, Dinmukhambet Raiymbekov, Abid Nadeem, and Jong Ryeol Kim. "Delay causes in Kazakhstan's construction projects and remedial measures." *International Journal of Construction Management* 22, no. 5 (2022): 801-819. https://doi.org/10.1080/15623599.2019.1647635

[9] Joslin, Robert, and Ralf Müller. "The impact of project methodologies on project success in different project environments." *International journal of managing projects in business* 9, no. 2 (2016): 364-388. https://doi.org/10.1108/IJMPB-03-2015-0025

[10] King, S. S., R. A. Rahman, M. A. Fauzi, and A. T. Haron. "Mechanisms for addressing the impact of COVID-19 on infrastructure projects." In *IOP Conference Series: Earth and Environmental Science*, vol. 682, no. 1, p. 012047. IOP Publishing, 2021). https://doi.org/10.1088/1755-1315/682/1/012047

[11] Mir, Mostafa, HM Dipu Kabir, Farnad Nasirzadeh, and Abbas Khosravi. "Neural network-based interval forecasting of construction material prices." *Journal of Building Engineering* 39 (2021): 102288. https://doi.org/10.1016/j.jobe.2021.102288

[12] Mohamed, Mohd Amizan Bin, Muhamad Fahim Hizami Bin Azmi, and Syahirah Intan Binti Mohd Sheffie. "COVID-19 pandemic: the impacts and prospects in the Malaysian construction projects." In *IOP conference series: earth and environmental science*, vol. 1067, no. 1, p. 012050. IOP Publishing, 2022. https://doi.org/10.1088/1755-1315/1067/1/012050

[13] Musarat, Muhammad Ali, Wesam Salah Alaloul, M. S. Liew, Ahsen Maqsoom, and Abdul Hannan Qureshi. "Investigating the impact of inflation on building materials prices in construction industry." *Journal of Building Engineering* 32 (2020): 101485. https://doi.org/10.1016/j.jobe.2020.101485

[14] Najib, Iskandar Zulkarnain Mohd, Rumaizah Mohd Nordin, Ezlina Mohd Ahnuar, and Khalida Mohd Sukor. "Malaysian as the component of labour force for construction industry in Malaysia." In *MATEC Web of Conferences*, vol. 266, p. 01007. EDP Sciences, 2019. https://doi.org/10.1051/matecconf/201926601007

[15] Omar, Ahmad Raflis Che, Suraiya Ishak, and Mohd Abdullah Jusoh. "The impact of Covid-19 Movement Control Order on SMEs' businesses and survival strategies." *Geografia-Malaysian Journal of Society and Space* 16, no. 2 (2020): 90-103. https://doi.org/10.17576/geo-2020-1602-11

[16] VU, Thong Quoc, Cuong Phu PHAM, Thu Anh NGUYEN, Phong Thanh NGUYEN, Phuong Thanh PHAN, and Quyen Le Hoang Thuy To NGUYEN. "Factors influencing cost overruns in construction projects of international contractors in Vietnam." *The Journal of Asian Finance, Economics and Business* 7, no. 9 (2020): 389-400. https://doi.org/10.13106/jafeb.2020.vol7.no9.389

[17] Taguchi, Naoko. "Description and explanation of pragmatic development: Quantitative, qualitative, and mixed methods research." *System* 75 (2018): 23-32. https://doi.org/10.1016/j.system.2018.03.010

[18] Salim, Naomie, Weng Howe Chan, Shuhaimi Mansor, Nor Erne Nazira Bazin, Safiya Amaran, Ahmad Athif Mohd Faudzi, Anazida Zainal, Sharin Hazlin Huspi, Eric Khoo Jiun Hooi, and Shaekh Mohammad Shithil. "COVID-19 epidemic in Malaysia: Impact of lockdown on infection dynamics." *medrxiv* (2020): 2020-04. https://doi.org/10.1101/2020.04.08.20057463

[19] Zamani, S. He, R. A. Rahman, M. A. Fauzi, and L. M. Yusof. "Effect of COVID-19 on building construction projects: Impact and response mechanisms." In *IOP conference series: earth and environmental science*, vol. 682, no. 1, p. 012049. IOP Publishing, 2021. https://doi.org/10.1088/1755-1315/682/1/012049

[20] Zhou, Yang, Xiaoxiao Wang, Rebecca Kechen Dong, Ruihui Pu, and Xiao-Guang Yue. "Natural resources commodity prices volatility: Evidence from COVID-19 for the US economy." *Resources Policy* 78 (2022): 102895. https://doi.org/10.1016/j.resourpol.2022.102895