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RESEARCH ARTICLE

Effect of Mega Railway Projects on Small and Medium Construction Companies: Impact and Problems

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ABSTRACT - Railway mega-projects are typically enormous large-scale investment projects that require a long time to develop and build. However, compared to other types of transportation, the railway is a safe mode of land transportation. Therefore, development such as railway mega-projects positively impacts small and medium construction companies. This study aims to study the impact of railway mega-projects on small and medium construction companies and investigate the problems that small and medium construction companies experience involving railway mega-projects. This study used a qualitative method of open-ended interviews to collect data from small and medium construction companies. The collected data from twenty individuals were analyzed using the thematic analysis method. The results show that the challenges of mega railway projects are divided into technical and resources. Apart from that, job opportunities are the main factor contributing to the impact of mega railway projects. The study contributes by providing insights on the impact of mega railway projects on small and medium construction companies and the challenges involving mega railway projects.

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1.0 INTRODUCTION

In recent years, researchers in the field of construction management have been more interested in mega construction projects [1,2]. Due to their size, longevity, significant social and environmental implications, and vulnerabilities, mega construction projects face more significant difficulties than other types of projects. These issues are a result of the considerable number of parties involved, the contractual and technical complexities, and the vulnerability to changes in the microeconomic environment [1,3,4]. The small and medium-sized construction companies have had ample opportunities to contribute to improving the nation's public transportation system because of railway projects. The mega railway projects provide a platform for small and medium-sized construction companies to acquire the skills required to compete globally [5]. Their participation in such infrastructure development projects would allow them to expand their technological capabilities and enhance their skill sets. In addition to strengthening the public transportation system, the implementation of the railway project empowers small and medium-sized construction companies in the development industry [5]. The mega project provides the best opportunity for small and medium-sized construction companies to hone their skills and become competitive companies. Hence the study objectives are: 1) Study the impact of mega railway projects on the small and medium construction companies, 2) To investigate problems faced by the small and medium construction companies.

2.0 RELATED WORK

2.1 Importance of Mega Railway Project

Railways have played a vital role in the development of many sectors [6]. The railway is the country's principal economic artery and a vital piece of infrastructure. Railway building helps stabilize growth, restructure the economy, and improve people's lives, which serves both immediate and long-term interests. Railways bring value to society by facilitating large-scale, rapid changes to the built environment while mobilizing large sums of money and various capabilities [7]. In addition, railways provide more job chances for both skilled and unskilled workers. Multiple factors can contribute to the success of the railway project, although it entails several risks. It is widely acknowledged that railway projects generate significant high risks [8]. As a result, proper management would result in tremendous benefits and add value to the public and long-term economic growth. Rail projects were the most expensive among other infrastructure projects, with a 45 percent cost overrun. The impact of risk can be categorized into two types that are immediate and long-term. Risk impacts can be divided into two types: immediate and long-term. Immediate impacts happen right after a risk occurs and include things like disruptions, financial losses, and damage. Long-term impacts, however, last for a longer time and may include sustained effects on projects, changes in market positions, and lasting financial consequences. It's important to deal with both types by responding quickly to immediate issues and planning carefully for the lasting effects over time.

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2.2 Impact of Mega Railway Projects

The implementation of the railway project is not only to strengthen the public transport system but also helps to strengthen the ecosystem of small and medium enterprises (SMEs) in the development industry in the country [9]. It is important for the continued participation of private companies in infrastructure projects that it requires SMEs to invest in improving and diversifying skills with developments in technology involving equipment and automation [10]. It is also in line with the Construction Industry Transformation Program (CITP) by the Ministry of Works to increase industrial productivity under the P6 -Developing the capacity and capability of small and medium enterprise or Bumiputera initiatives [11]. It will positively impact the construction, manufacturing, and content services sectors [12]. This is because local contractors will offer development work related to the mega railway project. In addition, there will be demand for building materials such as iron, cement, stones, and professional services and energy skills such as engineers, architects, builders, and surveyors [13]. This will demand a high demand for skilled labor in the railway industry. Malaysia has many technical centers and polytechnics that can provide local skilled workers for the railway industry. The presence of more workers will provide opportunities for medium and small economies and further increase demand for food, housing, grocery stores, and consumption in the states that will get the railway alignment [14].

2.3 Problems of Mega Railway Projects

Mega railway projects face numerous challenges that hinder their successful completion and add to their complexity. A key issue is the widespread misinformation about project costs and benefits, leading decision-makers into a realm of heightened uncertainty and substantial risks. This misinformation often results in significant cost overruns, as seen in notable projects like the Channel Tunnel, the Central Artery/Tunnel project in Boston, and the underground subway system in Bangkok [15,16]. Another significant challenge is the profound disruption these projects cause to the intricate fabric of social reproduction. These infrastructure developments have the power to alter established mobility patterns, restrict access to essential facilities, and disconnect labor from prevailing transport systems and informal road economies [17]. This socio-economic upheaval not only complicates the project implementation process but also introduces unforeseen complexities in managing societal dynamics affected by these massive infrastructure undertakings. Additionally, the resilience management capability of engineering construction within the context of mega railway projects requires critical attention and enhancement. This capability, intricately tied to the adaptability of the construction system in times of crisis, depends on various factors such as the institutional environment, effective implementation, rigorous supervision, robust guarantees, constructive feedback mechanisms, stakeholder involvement, and meticulous design considerations [18]. Strengthening these aspects is crucial for fortifying the overall resilience of mega railway projects and ensuring their sustained success amidst the multifaceted challenges they encounter.

3.0 METHODOLOGY

3.1 Data Collection

The data collection method for this study is open-ended interviews. This approach has been used in other works in construction management research, including identifying COVID-19 impacts on construction and Factors, challenges and strategies of trust in BIM-Based construction projects [19-21]. The interviewees selected for in-depth interviews are from the Grade 1 to Grade 5 construction companies registered under Construction Industry Development Board (CIDB) in Malaysia. These grades represent a system for categorizing companies in terms of their ability to take on projects or tenders and their financial strength. The highest grade, G7, has no limit on the tender capacity, with a paid-up capital of RM 750,000. As we move down the grades, both the tender capacity and paid-up capital decrease. For example, companies in G6 can handle tenders up to 10 million with a paid-up capital of RM 500,000, while those in G1, the lowest grade, can handle tenders up to 200,000 with a paid-up capital of RM 5,000. This system helps in understanding the financial capabilities of companies, allowing for better matching of projects with companies of the appropriate capacity and resources. Two questions have been asked to the selected respondents. 1) How do mega railway projects impact small and medium construction companies? 2) What problems are small and medium construction companies facing in mega railway projects? The construction companies are categorized into small and medium-sized companies, and only twenty construction companies will be selected as samples. The construction company list was obtained from the CIDB website. The interviewees' appointments were made based on the interviewees' convenience. Then, with the interviewers' permission, all information provided by respondents throughout the interview part was captured using a notebook and a sound recorder so that the analysis could be more precise and productive. In addition, it aids in preventing the loss of any interviewee information [22].

3.2 Data Analysis

According to [23], data and trends are identified and evaluated based on the specifications. Following the stages of data collection, data analysis is performed to extract useful information. The analysis must provide a summary of the data, emphasizing the most significant trends and differences. The collected data were subjected to thematic analysis to uncover recurring themes in the interview data. Thematic analysis is a highly adaptable methodology that may be adjusted to the requirements of various research, producing a rich, deep, and intricate data account [24,25]. In addition, the data are analyzed to convert raw data into relevant information to reach the study's objectives and draw conclusions. There are six phases in the thematic analysis, as shown in Figure 1 [24]. The first stage begins by familiarizing the data with the first

ideas, reading, and re-reading. The next phase is to generate preliminary codes. The third and fourth phase is searching and reviewing the themes. Themes may be explored by collecting codes into probable themes and all data pertinent to each theme. After that, reviewing the themes includes checking if the themes work with the coded extracts and the whole data set and producing a thematic 'map' of the analysis. The fifth phase is to define and name the themes. The last stage of thematic analysis is producing the report. Phase six involves the final analysis and preparation of the report when the authors set fully developed themes. Within the domain of construction management research, resaerch papers frequently apply the themaitc analysis on analyzing qualitaive data such as literature and interviews [26, 27]. This method serves as a pivotal tool for exploring various dimensions of construction management. Notably, researchers adeptly utilize thematic analysis to uncover integrated applications of Building Information Modeling (BIM) in project cost management [28-30]. Its consistent application underscores its effectiveness in methodically revealing, categorizing, and interpreting key themes and patterns within the intricate landscape of construction management research. Thematic analysis is widely recognized and commonly employed for its ability to systematically explore and interpret complex themes, making it a cornerstone in this field of study.

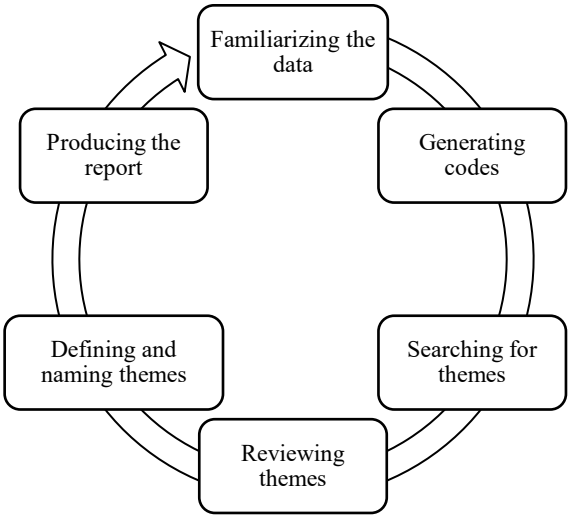

Figure 1. Thematic analysis steps

4.0 RESULTS AND DISCUSSCION

This section emphasizes the analysis of data collected through structured interviews. This chapter will present data collected from interview sessions with 20 construction companies and data analysis using thematic analysis techniques.

4.1 Impact on Mega Railway Projects

The impact theme of the mega railway project obtained from twenty respondents of construction companies in Malaysia is people and organization. According to interview data, the impact of mega railway projects on small and medium construction companies is job opportunities. The impacts of mega railway projects also include skills, suppliers, economy, and project opportunities, as shown in Figure 2. The details of themes and subthemes are discussed in the subsequent subsections.

4.1.1 Impact on people:

People play a critical role in the growth process. People play a crucial role in a nation's development efforts since everyone possesses unique talents, skills, and abilities beneficial to development. Two factors are identified related to the people: job opportunities and skills.

Job opportunities. This sector offers more opportunities for local small and medium construction companies to participate in this project. Examples of interviewees from the interview summary are the following:

"Mega-projects can help small and medium construction company to get opportunities this is because small and construction company play and an important role for providing product and services." (Respondent 20)

Skills. Having skill in doing the work is very important to ensure the work can be done perfectly. In construction projects, workers' skills can influence their performance of construction projects. Skills can be divided into two subthemes: communication skills and construction skills.

"Railways offer more job opportunities to both skilled and unskilled workers." (Respondent 3)

4.1.2 Impact on organization:

The organization has the second impact on mega railway projects to small and medium construction companies. Three factors from the organization are supplier, economic, and project opportunities.

Supplier. Suppliers provide the materials a company uses to produce its goods and/or services. Suppliers provide the transportation of those materials. Without a solid relationship with its suppliers, a company cannot offer its customers a consistently high-quality product or service. The respondent's response is as follows:

"Small and medium construction company important to help the mega projects in certain activities which could be better supplied by a small and medium construction company." (Respondent 12)

"Small and medium construction company play an important role in relation to larger companies as suppliers and distributors…." (Respondent 19)

Economic. The construction industry plays a vital role in the economy of any country. It uses the most significant number of labor, materials, and financial resources. Therefore, the construction industry is an important sector that contributes more to the country's economic growth. The construction industry's contribution to economic development and economic activities significantly affects the country's development. Examples of interviewees from the interview summary are the following:

"Having developments such as mega railway projects had a positive impact on the country's economy and local SMEs to play their part in developing the country's public transportation system." (Respondent 1)

Project opportunities. The construction of mega-projects has provided significant opportunities for small and medium construction companies to develop and strengthen the country's public transportation system. The responses based on the interview summaries are as follows:

"The implementation of these mega railway projects provides opportunities for the local small and medium construction company to get involved in the rail industry." (Respondent 9)

"This sector provides more big opportunities for the local small and medium construction company to contribute to this project." (Respondent 18)

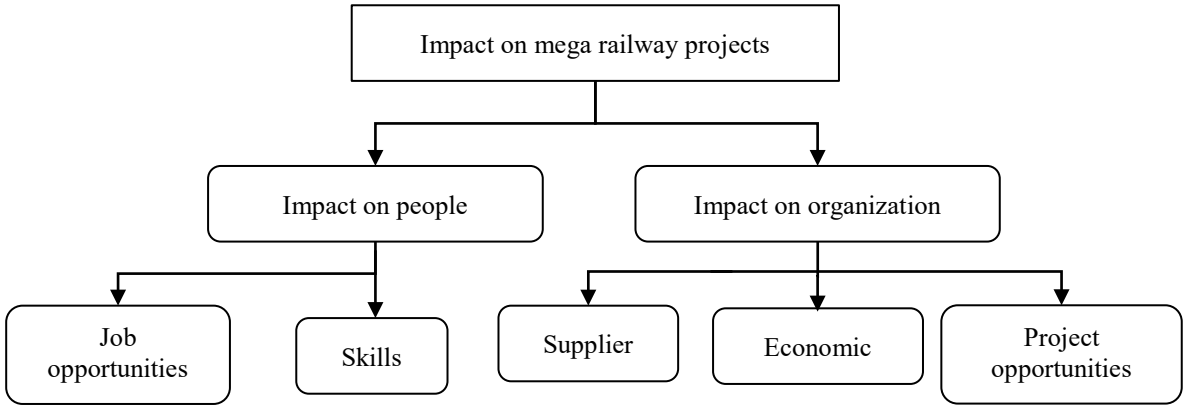

Figure 2. Impact of mega railway projects

4.2 Problems Faced by the small and Medium Construction Companies

This section summarizes the themes and subthemes of problems the small and medium construction companies face. These factors are stakeholder engagement, management, poor performance, lack of construction skills, lack of construction equipment, and lack of construction materials. The themes are grouped into technical and resources. The problems faced by the small and medium construction companies are represented in Figure 3.

4.3 Technical

Technical requirements are essential for the successful completion of a project. They include aspects such as performance, reliability, and availability. In this study, technical shortcomings in construction projects are one of the challenges.

Stakeholder engagement. Most mega construction projects involve several stakeholders whose diverse interests affect the progress of the projects positively or negatively. The complexity and type of construction projects sometimes determine the number of stakeholders involved. According to [31], more complex construction projects will require more stakeholders when compared to small-scale projects, thereby increasing the stakeholders' uncertainties associated with such projects.

"Mega-projects usually have a challenge that is weakness in organizational design and capabilities. This is because there are many entities or multiple stakeholders involved in building megaprojects." (Respondent 2)

Management. The construction industry cannot run well without a good management team. The study found that one of the most important consequences of poor project management is project cost overruns. If appropriate project management skills cannot be applied, the estimations will not be accurate. Therefore, project management must estimate the project

schedule carefully. Also, monitor and control it to complete the project on time. Examples of interviewees from the interview summary are the following:

"Project delays due to poor site management, the contractors have weaknesses in site planning, implementation, and control. Better site management project schedule performance can be significantly improved." (Respondent 8)

Poor performance. Poor performance has a significant impact on a construction project, such as the loss to the company in terms of cost, time, quality, and reputation. Many construction projects experienced poor performance, namely extensive delays, exceeding initial time, and cost estimates. Contractors who obtain a contract to carry out a project pose the most significant risk in a large-scale construction project [32]. The responses based on the interview summaries are as follows:

"Excess costs and additional inputs due to project construction not being completed within the stipulated time." (Respondent 6)

4.4 Resources

One of the problems that small and medium construction companies face is resources. These companies face problems divided into three categories: Lack of construction skills, lack of construction equipment, and lack of construction material.

Lack of construction skills. Lack of construction skills is one of the challenges involving mega railway projects. Some foreign workers lack construction skills because they never undergo construction training before working in the construction industry. Other than that, their productivity is low because the employer assigned them to do only one job. Therefore, lack of skills is a significant issue that significantly impacts the time it takes to complete tasks, the cost of labor, and the quality of the products produced [33]. The responses based on the interview summaries are as follows:

"The challenges of the megaprojects are the lack of a construction workforce; this is because the workforce in developing countries usually comes from those living in rural areas then construction companies in cities may have difficulty recruiting workers." (Respondent 17)

Lack of construction equipment. Lack of equipment is one of the common problems associated with the construction industry, especially in developing countries. Examples of interviewees from the interview summary are the following:

"Typically, mega construction projects use a lot of machinery; the machinery helps the workforce handle heavy work on the site. Therefore, a shortage of the basic equipment and plant required for the execution of the project may into project delays." (Respondent 17)

Lack of construction material. Since Malaysia has developed into an upper-middle-income developing country, demand has often exceeded supply, and this has caused the price of building materials in the market to increase. As a result, the contractor acts to delay the purchase of building materials until the cost of the material decreases. Shortage and delay of construction materials were the leading causes of project delay. This is because not all the materials imported from overseas manufacturers are 100% produced.

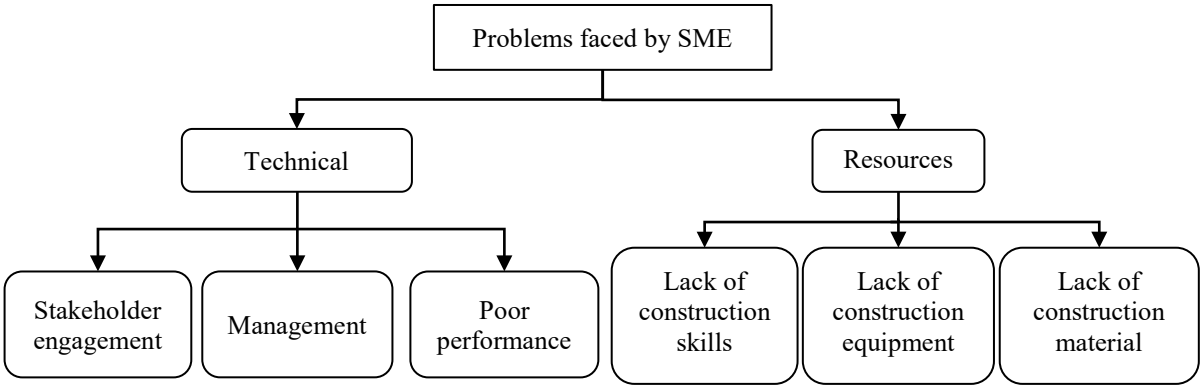

Figure 3. Problems faced by the small and medium construction companies

5.0 CONCLUSION

This study focuses on the impact of mega railway projects on small and medium construction companies. The study aims to identify the problems faced by small and medium construction companies. The study summarizes the impact of mega railway projects into two themes: people and organization. The people included job opportunities and skills, while the organization included supplier, economic, and project opportunities. Furthermore, the problems faced by small and medium construction companies have been determined into two themes: technical and resources. The subtheme of technical is divided into three categories: stakeholder engagement, management, and poor performance. Then, the resources are lack construction skills, lack of construction equipment, and lack of construction materials.

From the data collected, the implementation of mega railway projects provides opportunities for small and medium construction companies to get involved in the railway industry. This is because job opportunities are the main factor contributing to the impact of mega railway projects. Small and medium construction companies are essential to help the mega projects in certain activities, which could be better supplied by small and medium construction companies. The study could aid Managers and policymakers in having a better overview of small and medium construction companies, which will lead to better planning and development countermeasures to overcome current problems that companies face. The impact of the mega railway on SMEs would help authorities and stakeholders to better understand the enormous benefit of the projects. The identified themes could help develop plans to adapt more projects for SMEs. The problems faced by SMEs were pointed out in a step toward solving the current struggles. The sub-themes could help managers and authorities to take countermeasure in facing these problems.

6.0 CONFLICTS OF INTEREST

The authors declare no conflict of interest.

7.0 AUTHOR CONTRIBUTIONS

Saffuan Wan Ahmad: Conceptualization, Methodology, Supervision

Nurul Atiqah Ab Hakim: Data curation, Writing- Original draft preparation

Saffuan Wan Ahmad: Visualization, Investigation

Abdelrahman M. Farouk.: Writing- Reviewing and Editing

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9.0 DATA AVAILABILITY

Some or all data, models, or code generated or used during the study are proprietary or confidential in nature and may only be provided with restrictions (e.g., anonymized data).

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