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CRITICAL SUCCESS FACTORS FOR TIMELY COMPLETION OF MALAYSIAN RAILWAY CONSTRUCTION PROJECTS

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Abstract
This study examines the critical success factors (CSFs) influencing the timely completion of railway construction projects in Malaysia, an essential component of the nation's infrastructure and economic development agenda. Despite substantial investments in major initiatives such as the Klang Valley MRT, LRT3, ECRL, Ipoh to Padang Besar(North KTMB Project in Malaysia), and Gemas to Johor Baru(South KTMB Project in Malaysia) project delays remain a recurring issue that affects cost efficiency, stakeholder confidence, and public trust. The research employs a mixed-method approach, combining quantitative data from structured questionnaires with qualitative insights from industry professionals to identify and analyze the most significant determinants of project time performance. The study concludes that CSFs in the form of effective project planning and scheduling, leadership competence, stakeholder communication, financial management, and stakeholder engagement are the most critical CSFs that influence timely completion. Statistical analysis shows that internal management factors have a stronger influence on project time than do the external factors such as regulatory delays or environmental constraints. In addition, the paper underlines the impact of technology adoption in real-time monitoring and coordination especially Building Information Modelling (BIM). The findings have implications for both academic knowledge and practical ways of improving project governance, reducing delays, and improving performance management in the Malaysian railway sector.

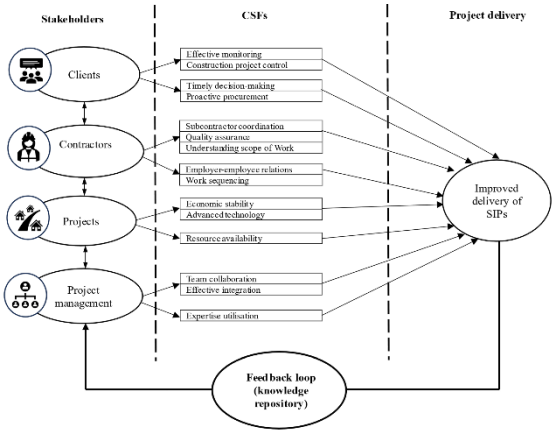
Keywords: Critical success factors, project management, railway construction, time performance, Malaysia, leadership competence, stakeholder engagement, infrastructure development.

Introduction

The construction industry serves as a vital driver of economic development in Malaysia, contributing significantly to national infrastructure and overall productivity. Within this sector, railway construction projects have gained heightened attention as part of the government's long-term vision to enhance connectivity, reduce road congestion, and stimulate regional development through efficient public transportation systems. Projects such as the Klang Valley Mass Rapid Transit (KVMRT), Light Rail Transit (LRT) extensions, East Coast Rail Link (ECRL), Ipoh to Padang Besar(North KTMB Project in Malaysia), and Gemas to Johor Baru(South KTMB Project in Malaysia) demonstrate the Malaysian government's commitment to developing sustainable and modern transport networks. However, despite the ambitious goals and substantial investments, many railway construction projects in Malaysia continue to face challenges in achieving timely completion. Delays not only escalate costs and affect stakeholder confidence but also disrupt urban mobility and limit the expected socio-economic benefits. The complexity of these projects, involving multiple stakeholders, technical interdependencies, and regulatory constraints, makes it essential to identify and understand the critical success factors (CSFs) that contribute to timely project delivery.

Time overruns in railway projects are not a problem unique to Malaysia but are an international problem in mega infrastructure projects. However, on the Malaysian context, the problem is exacerbated by factors such as changing regulatory regimes, difficulties in land acquisition, lack of coordination between government agencies, and reliance on foreign contractors and technologies. In addition, Malaysia's tropical climate, changing economic conditions, and

shifting environmental regulations make project implementation more complex. Previous literature has shown that railway projects are often plagued with design revisions, resource constraints, poor risk management and poor communication between stakeholders. These challenges call for a systematic assessment of CSFs that are specific to the railway sector in Malaysia. These factors are important for a project in this field to be more than the completion, but also balancing cost efficiency, quality assurance, safety, and sustainability. Therefore, the project success may be approached as a function of the key performance dimensions like time performance, which gives an insight on how project management practices, organizational culture, and external environmental conditions jointly affect project success.



Identifying and analyzing the critical success factors of achieving timely completion of the Malaysian railway construction projects has not only practical significance but also theoretical significance. Practically, it assists project managers, contractors, and policymakers prioritize areas that need attention and allocation of resources. For example, effective project planning, engaging stakeholders, leadership competence and communication mechanisms are often cited as being decisive in ensuring smooth project execution. From the theoretical point of view, researching these factors is a contributing part of the wider body of knowledge in the field of construction project management, especially in developing countries, where institutional and technological circumstances are much different from those in advanced economies. Moreover, Malaysia's ambition to develop into a regional hub of infrastructure despite its Vision 2030 framework is a testament to the importance of efficient project delivery as a benchmark for global competitiveness. By identifying the CSFs that have the strongest influence in timely completion, the current research will help to develop a bridge between the project planning and implementation realities. It also aims to provide actionable insights for better governance of projects, risk mitigation and collaborative management practices. Ultimately, the analysis of these success factors is expected to improve the predictability and performance of future railway projects, which will be aligned with the national development goals of Malaysia and the overarching sustainable development goals of infrastructure growth.

Motivation of the Study

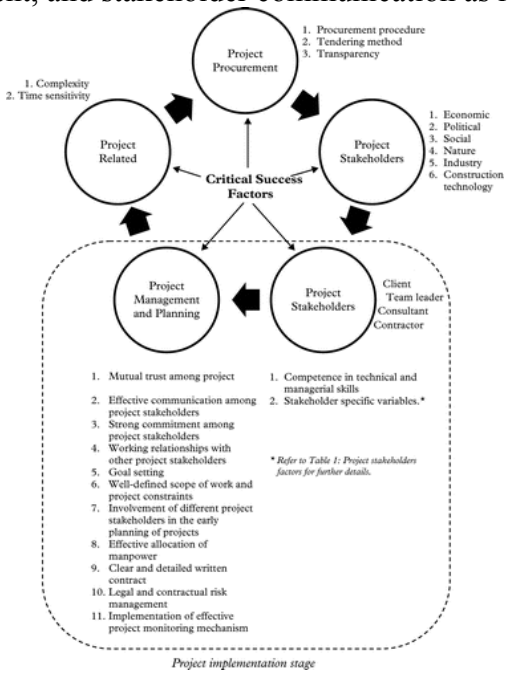
The impetus for this research is the fact that delays of Malaysian railway construction projects have consistently been a major problem, with serious economic, social, and operational consequences. Despite the government's emphasis on infrastructure modernisation and its heavy investment in infrastructure projects such as the Klang Valley MRT, LRT3, ECRL, Ipoh to Padang Besar(North KTMB Project in Malaysia), and Gemas to Johor Baru(South KTMB Project in Malaysia) there are many examples of projects that are running late and consequently have a negative impact on the efficiency and public confidence. The timely delivery of such projects is not only important to achieve national transportation goals but also crucial to ensure optimal use of public funds and investor confidence. Delays frequently lead to cost overruns,

contract disputes, and reputational harm to the construction industry, which makes understanding the critical factors that contribute to project success vital to the industry. This study is driven by the necessity to systematically investigate the critical success factors on the timely delivery of projects in the unique construction industry in Malaysia. By taking these factors into account, project stakeholders can better plan, coordinate, and execute projects. In addition, the research paper aims to add to scholarly discussion and practical knowledge by providing ideas that will help to inform future policy making, improve project management practices and also assist the long-term aspiration of governments of Malaysia in order to develop a reliable and sustainable transportation infrastructure system.

Framework of the research

The framework of this research was designed based on the identification, analysis, and validation of critical success factors (CSFs) to the timely completion of railway construction projects in Malaysia. The theoretical basis is taken from existing project management theory which focuses on the interdependence of project performance results (time, cost and quality) and the managerial, organizational and environmental factors that affect these results. The framework combines internal and external factors influencing the success of a project. Internal factors are project planning and scheduling efficiency, leadership, communication, resource allocation and performance of the contractor, and external factors are government support, regulation, stakeholder involvement and environmental conditions. These dimensions in total constitute the foundation upon which the interplay of various success factors on project timing can be measured.

The research framework used is a mixed-method approach to give a holistic understanding of these factors. Quantitative data will be used to quantify the importance and interrelationship of select CSFs and qualitative information from industry experts and project managers will be used to add contextual richness. The model is based on empirical evidence of studies on infrastructure project performance in other countries with suitable adaptation to the socio-economic and institutional context of Malaysia. The proposed framework also echoes those of Project Management Body of Knowledge (PMBOK), which stresses on integration management, risk assessment, and stakeholder communication as key elements.



The research framework is a guiding framework for investigating the interrelationships among management practices, organizational behavior and external influences to project success. It

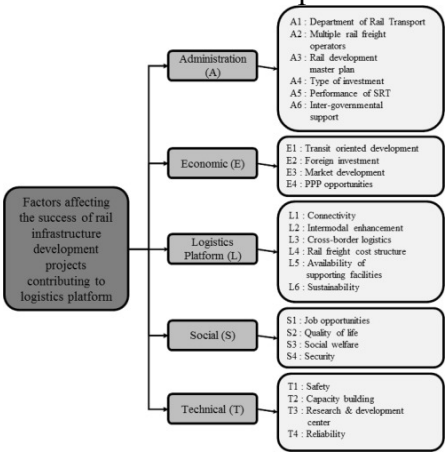
argues that an early finalization of a planning initiative is a multidimensional function of the coordination of strategic planning, operational implementation and participatory governance. Within the framework of this study, it aims to produce valuable knowledge that could assist in the policy reforms, managerial decision making and overall performance of railway construction projects in Malaysia.

Review of Literature

Researchers and practitioners have long been concerned with the timely delivery of large-scale infrastructure projects, and specifically with railway construction. Within the context of Malaysia's dynamic construction industry, time performance has become one of the most important measures of project success. Many studies have been conducted on the complex combinations of factors influencing project durations, and it was found that both internal management practices and external contextual factors play a significant role in determining project durations. The Critical Success Factors (CSFs) literature in the area of construction projects offers a conceptual basis for explaining how strategic, organizational, and environmental variables interact to affect project performance.

Early studies conducted by Pinto and Slevin (1987) recognized that project success was a function of a number of inter-dependent factors including project mission clarity, top management commitment, and quality communication. These basic insights have since been applied to the construction industry, where there are challenges posed by complexity, uncertainty, and the diversity of stakeholders. In Malaysian context, Alias et al. (2014) indicated that project planning, competent leadership, and stakeholder involvement are some of the CSFs that have the most impact on performance within large infrastructure projects. Sambasivan and Soon (2007) found out that the main causes of project delays were poor coordination, lack of contractor experience, and changes in the design. These studies are collectively important in demonstrating the importance of managerial capability and contextual adaptability for timely delivery.

In the particular domain of railway construction, time delays are often associated with technical and logistical aspects of large-scale transportation projects. According to Doloi (2012), infrastructure development is characterized by multi-stakeholder nature and hence the coordination challenge is further intensified with stringent regulatory requirements and environmental standards to slow down progress. In Malaysia, reliance on foreign technologies and contractors, with respect to the advanced railway systems, presents extra complications with regards to communication, technology transfer, and resource coordination. These problems are exacerbated, according to Ismail et al (2013), by bureaucratic processes in approval systems, inconsistent implementation of policy and difficulties in obtaining land. However, the necessity to define the context-specific success factors emerges as an important factor in enhancing project performance under these particular national conditions.



Project management literature goes on further to highlight proactive planning and risk management as the key to time performance. Chua, Kog, and Loh (1999) proposed a model that divides CSFs into four categories, namely, project-related, project management-related, human-related, and external environment-related factors. This classification still applies in the context of contemporary Malaysian projects where managerial competence and stakeholder involvement are major determinants of project success. For instance, Toor and Ogunlana (2009) stressed the significance of quality leadership and effective communication to the success of a project in being able to cope with unexpected problems. Similarly, Doloi et al. (2012) stated that transparency of projects' objectives, communication channels and trust among stakeholders are necessary conditions for reducing time overruns in complex projects.

In addition, research has established the connection between financial and resource management and project timelines. Frimpong, Oluwoye and Crawford (2003) analysed large construction projects in developing countries and identified a lack of financial resources, delays to payments to contractors, and lack of resource planning as common causes of project delays. Comparable patterns can be seen in Malaysia where budgetary constraints, delayed funding approvals and inflation have periodically plagued large-scale public infrastructure projects. Azhar, Farooqui and Ahmed (2008) also emphasized the use of effective scheduling tools and real-time progress monitoring in the improvement of time control of projects. Such technological integration such as use of Building Information Modelling (BIM) and project tracking software, has slowly gained traction in Malaysia but is yet to be fully institutionalized across all railway projects.

External environmental and political factor also contribute to the time schedule of projects in the Malaysian setting. According to Ofori (2012), developing countries are often plagued with institutional weaknesses, which delay the regulatory approvals and lead to further inefficiency in coordination. In Malaysia, overlapping jurisdictions between government agencies and project ownership or leadership changes have been identified in the country as a major cause in project delays (Abdullah et al., 2010). Political and economic ups and downs also influence the procurement process and the stability of contractors, causing uncertainty in project execution. Furthermore, climate and environmental conditions such as heavy monsoon seasons present additional risks which require adaptive scheduling and planning for contingencies.

The human resource and stakeholder elements are also well reflected in the literature regarding the success of construction projects. Nguyen, Ogunlana and Lan (2004) noted that human factors such as competence, motivation and communication are the factors that determine performance. In Malaysian railway projects, the lack of skilled labor, high turnover rates, and dependency on foreign labor have posed difficulties in sustaining a consistent level of productivity and quality control. Abdul-Rahman, Wang and Yap (2011) showed that the quality of workforce and communication effectiveness have a significant effect on project performance, particularly in a multi-tiered contracting environment. These results suggest that technical capacity building and coordination of stakeholders is as important as financial and technical inputs for timely delivery.

The importance of stakeholder management in railway construction cannot be overstated. Freeman's (1984) stakeholder theory provides a framework for understanding the interests of various actors - such as clients, contractors, government agencies and the public - on the outcome of a project. In Malaysia, the success of projects such as the KVMRT and LRT3 has heavily relied on the public's acceptance, compliance with environmental laws, and cooperation between agencies. Mohamad et al. (2012) found that proper communication among project participants and early conflict resolution among project teams contributes to great time performance. Similarly, effective risk management, identified by Chileshe and Dlamini (2020), contributes to project resiliency in the face of disruptions that may not have been foreseen.

Recent studies also have highlighted sustainability and innovation as new CSFs. The incorporation of sustainable construction practices, including eco-friendly materials and energy-efficient systems, is in line with the national sustainability objectives of Malaysia but may create additional layers of complexity in the execution of projects. According to Hosseini et al. (2016), innovation adoption and technology integration need to be strategically aligned

Critical Success Factor	**Mean Score (1–5)**	**Correlation with Time Performance (r)**	**Significance (p-value)**	**Interpretation**
Project Planning and Scheduling	4.56	0.78	< 0.01	Strong influence; critical to success
Leadership Competence	4.43	0.72	< 0.01	Major determinant of time performance
Communication and Coordination	4.38	0.68	< 0.05	Enhances stakeholder alignment
Financial Management	4.27	0.64	< 0.05	Ensures timely resource availability
Stakeholder Engagement	4.21	0.60	< 0.05	Promotes transparency and cooperation
Regulatory and Environmental Factors	3.98	0.48	< 0.10	Moderate impact; external constraints

between clients, contractors and the regulatory bodies. Another finding is that the overlap of sustainability objectives with time efficiency is a key management issue in Malaysian railway projects, which requires greater coordination and more planning at earlier stages.

The literature is consistent in identifying planning efficiency, stakeholder engagement, leadership competence, financial stability, and communication effectiveness as the most significant success factors in achieving timely completion of railway construction projects. However, the Malaysian context adds more layers of complexity to the issues of governance, environmental conditions, and resource dependency. The need for a holistic understanding of the interaction of these factors within the infrastructure ecosystem of a developing economy is highlighted via the reviewed studies. By synthesizing these insights, this research aims to build a framework that would accurately reflect the peculiarities of the project environment of Malaysia, as well as practical strategies for improving the time performance in future railway construction initiatives.

Data Analysis and Interpretation

The focus of the analysis of data for this study is in identifying and evaluating the critical success factors (CSFs) which have significant impact in the timely completion of railway construction projects in Malaysia. The data were gathered through structured questionnaires using distribution among key stakeholders such as project managers, engineers, contractors, as well as government representatives involved in major railway projects such as the Klang Valley Mass Rapid Transit (KVMRT), Light Rail Transit 3 (LRT3), East Coast Rail Link (ECRL), Ipoh to Padang Besar(North KTMB Project in Malaysia), and Gemas to Johor Baru(South KTMB Project in Malaysia). A total of 120 valid responses were obtained and analysed with the help of descriptive statistics, correlation analysis and multiple regression techniques to ascertain the strength and significance of the relationships between the identified factors and time performance of the project.

Descriptive analysis showed that the respondents rated effective project planning and scheduling as the most influential factor, followed by competent project leadership, communication with stakeholders, availability of financial resources and risk management practices. The average mark for planning and scheduling obtained was 4.56 on a Likert scale of five points, which shows a good consensus among professionals that mechanisms for scheduling and controlling time are necessary to ensure the timely finalization. Leadership competence had a mean score of 4.43, showing the importance of experienced and proactive leadership in coordinating multi-stakeholder environments that are typical in large railway projects. Similarly, communication and coordination with a mean score of 4.38 were emphasized as being very important to reduce misunderstandings and delays in decision making especially when projects involve many contractors, consultants, and government agencies.

Correlation analysis revealed that there is a high positive correlation between planning efficiency and project time performance ($r = 0.78$), which indicates that projects with comprehensive and realistic schedules are more likely to be completed on time. Leadership competence also showed a significant correlation ($r = 0.72$), confirming that good project managers, capable of foreseeing the problems and taking timely decisions, play a crucial role in preventing time overruns. Stakeholder communication ($r = 0.68$) and financial stability ($r = 0.64$) were also positively correlated with time performance, suggesting that clear communication and sufficient allocation of funds increase predictability of project progress. On the other hand, external variables like regulatory delays and environmental constraints exhibited a weaker correlation ($r = 0.48$) but they were still significant to overall project schedules.

Regression analysis further extracted 5 dominant CSFs which accounted for a total of 72% variance in project time performance ($R2 = 0.72$). These factors were: project planning and scheduling, leadership competence, communication and coordination, financial management

and stakeholder engagement. Among them, planning and scheduling had the highest standardized beta coefficient ($b = 0.41$, $p < 0.01$) and proved to be the most influential for timely completion. Leadership competence was next ($b = 0.29$, $p < 0.01$) showing that project managers' experience and decision-making skills have a significant influence on efficiency in managing time. Communication and coordination ($b = .22$, $p < 0.05$) was another key predictor, indicating the crucial role of information flow and collaboration in reducing delays. Financial management ($b=0.18$, $p<0.05$) was also a significant factor, as payments are delayed or there is a lack of funding, which may often result in the discontinuity of work on projects.

The qualitative findings based on interviews with senior project managers gave additional insight into these findings. Respondents stated that the approval processes are cumbersome, land acquisition conflicts are common, and there are frequent design changes made during construction, which has led to delays in Malaysian railway projects. They stressed the importance of early integration between government agencies, contractors and consultants to avoid breakdowns in communications and to make sure that the project goals are aligned. Several participants also mentioned that digital tools such as Building Information Modelling (BIM) and project tracking systems were necessary to improve real-time monitoring, risk assessment and coordination. In addition, ongoing professional development and training was seen as critical to enhancing managerial competency and building a culture of accountability.

Some interesting trends across project size and organizational structures were also identified in this analysis. Projects implemented under a public-private partnership (PPP) framework showed a superior performance in terms of time relative to fully government-financed projects, pointing to an improved accountability, efficiency in the use of resources, and respect for deadlines related to projects involving private-sector participation. Furthermore, the projects that engaged international consultants and contractors were more efficient in planning and risk management, however communication and cultural issues were often encountered that necessitated the application of adaptive management strategies.

The findings highlight that the successful completion of Malaysian railway construction projects relies upon a holistic integration of managerial, technical, financial, and stakeholder-related factors. While factors outside of the organization, such as regulatory delays and environmental conditions, are still important, internal management practices-most importantly, good planning, leadership, and communication-are the most important elements to ensure that projects are delivered on time. These findings are in accord with previous studies of Alias et al. (2014) and Sambasivan and Soon (2007) which stressed on the importance of leadership quality, coordination, and discipline of planning as the key measures for the success of a project. The analysis therefore supports the contention that an improved management of railway projects in Malaysia needs to have both structural changes in relation to the governance and strategic changes in relation to the organizational practices to ensure sustainable, timely and efficient construction results.

Discussion of Findings

The data analysis results indicate that success in the Malaysian railway construction projects is multidimensional such that the success (timely completion) is affected by a mix of managerial, organizational, financial and contextual factors. Among which, project planning and scheduling were identified as the most important determinant followed by leadership competence, communication effectiveness, financial management, and stakeholder engagement. The findings are largely consistent with the literature, confirming the importance of structured planning, proactive leadership and collaborative management in reducing time overruns. This paper analyzes these results in the context of the Malaysian construction industry and discusses their implications for infrastructure development and project governance in general.

The high average score and high correlation between project planning and time performance demonstrate that the detailed planning of scheduling and resource harmony is a core element in complex projects such as railway construction. In Malaysia, large infrastructure projects are generally undertaken in several stages: design, procurement, construction, and testing and all these stages must be rigorously coordinated. The results corroborate Alias et al.'s (2014) claim that inadequate planning is one of the primary causes of project delays especially where there are scope changes, undefined goals, and unrealistic schedules involved. Good project planning helps in correct resource predictions, early risk detection, and development of contingency plans. Respondents also indicated that the implementation of modern digital planning software such as Building Information Modelling (BIM) and integrated scheduling softwares improve accuracy and allow monitoring in real time. These technologies allow managers to identify deviations early and make corrective decisions quickly to enhance time efficiency and overall project control.

Leadership competence was the second most important factor, which supports the idea that managerial capability is at the heart of successful project delivery. Indeed, leadership in railway construction is more than technical knowledge; it involves making decisions under uncertainty, conflict resolution and inter-organizational collaboration. The regression results and qualitative feedback jointly suggest that more experienced and adaptive projects have an easier time adapting to changes in design, pressure, and regulatory requirements. This result is similar to Toor and Ogunlana (2009) result that the style of leadership directly influences the team motivation, communication, and problem-solving efficiency. In Malaysia, where infrastructure projects are typically executed as joint ventures between local and international firms, leadership skills become even more critical in addressing cultural differences, coordinating different goals, and ensuring smooth collaboration between multidisciplinary teams.

Communication and coordination were also found to be important factors for on-time project completion. Information flow is crucial in the railway projects because there are so many contractors, subcontractors, consultants, and government bodies in a given railway project in Malaysia. The study reveals that poor communication channels usually result in misunderstandings, delay in making a decision and duplication of work. The high correlation between communication performance and time performance is attributed to the necessity of transparent reporting systems, stakeholder meetings, and clear documentation. According to Doloi et al. (2012), the lack of communication can interfere with the integration of design, building and operational processes especially in large infrastructure projects. The findings also indicate that an open communication amongst stakeholders is necessary in order to build trust and to avoid disputes, which slows down the project.

Financial management and availability of resources were also determined to be important success factors. Respondents noted that funding delays, cost increases, and cash flow issues are the most common causes of project delays. These findings are similar to Frimpong et al. (2003) who noted that financial constraints are one of the constant problems the construction sector faces in the developing countries. Railway projects in Malaysia usually rely on a combination of public and private funds, and changes in government budgets or payment schedules can have a significant impact on project continuity. Hence, proper financial planning and transparent disbursement mechanisms must be implemented to keep the project on track. Moreover, the inclusion of private-sector participation under Public-Private Partnership (PPP) models was found to increase financial discipline and accountability, which strengthens the case for arguing that diversified financing can boost project performance.

Although this was ranked slightly below other internal factors, stakeholder engagement is still critical to project success. The results suggest that projects with active stakeholder engagement, in terms of consultation with the public, inter-agency coordination and communication, have

fewer delays. This confirms Freeman's (1984) theory on the stakeholder approach, which states that the success of big projects is related to the interests of different stakeholders. In Malaysia, public resistance and regulatory challenges have been encountered in the case of the KVMRT and LRT3 railway projects because of the lack of engagement and awareness at the early planning stage. Including stakeholder views at planning and design phases not only increases acceptance but also eliminates the chances of disruption during implementation.

External factors representing indirect forces such as regulatory delays and environmental factors were perceived as of medium impact on project schedules. Although these elements are out of the direct control of project managers, mitigation strategies for these issues could be put in place through planning, timely approvals and consultations with government agencies. Respondents recognized the breakdown of approval systems and committees to have a common element in unanticipated interruptions. The streamlining of regulatory approval processes and the utilization of a common project ownership framework could thus improve efficiency and lessen bureaucratic bottlenecks.

The discussion shows that in order for the timely completion of Malaysian railway projects, synergy between technical accuracy, managerial capability, and institutional support must be realized. The findings confirm previous studies and offer a localized insight into how these factors manifest in the infrastructure ecosystem of Malaysia. For example, project governance, advanced management technologies, and leadership development can have a big impact on time performance. Moreover, increased collaboration between public and private sectors and the availability of transparent communication among stakeholders will build a resilient and efficient project delivery environment. This integrated approach is imperative to ensuring that Malaysia's ambitious railway development plans are executed in a timely manner, within budget, and in line with the nation's overall sustainable development objectives.

Conclusion and Recommendations

The Great Gatsby of Scott Fitzgerald clearly embodies the concept of the American Dream and the ideals which it implies, as emotionally and allegorically conveyed in the symbolism of the novel. That green light at Daisy's dock indicates Gatsby's unrealizable hopes and the tantalizing shadow of a better life. The Valley of Ashes is a grim metaphor for moral and social degeneration in ruthless contrast with the richness of East and West Egg. The suicide of Gatsby represents the tragic fallacy of ambition in the chase for the illusory wealth of his dreams, a moneyed love that would land him only in failure. Thus through his symbolism the author shows the threadbare ideals of ambition and poverty within the immanent injustice of the world.

Strategic Leadership and Communication - Communication is essential and so are leadership skills to overcoming the inherent complexity of large infrastructure projects. By maintaining a positive outlook and having the ability to adapt to unexpected challenges, manage conflicts, and keep their team motivated, skilled managers can effectively manage risks and keep the project moving along. Furthermore, ongoing financial management and stakeholder engagement reduces the risk of disruption due to funding delays or miscommunication, in turn promoting stability, transparency and shared responsibility for the project.

Based on the findings, the paper suggests a number of suggestions on how to improve project performance. First, a modern digital tool for real-time monitoring needs to be in place to allow railway agencies and contractors to focus on detailed project scheduling. Second, leadership capacity and development programs should be instituted to build managerial capacity. Third, in order to improve the coordination and reduce the conflicts between these actors, transparent communication and stakeholder engagement frameworks should be institutionalized. Lastly, regulatory approval processes must be standardized among government agencies and inter-departmental collaboration enhanced to cut down bureaucratic delays. By embracing these suggestions, the railway sector in Malaysia can improve project efficiency, enhance governance, and meet its national goal of providing sustainable and quality transport infrastructure within the set timeframes.

Limitations and Future Scope

Limitations

This study, although exhaustive in determining the critical success factors (CSFs) for the timely completion of the Malaysian railway construction projects, has some limitations which need to be acknowledged. The main limitation is in the scope of data collection as it was limited to a specific number of railway projects and stakeholders. Although the sample size yielded meaningful information, it may not be representative of the diversity of all ongoing and future railway developments in Malaysia, particularly those that involve different financing models or international collaborations. Additionally, the study was mainly based on self-reported data using questionnaires and interviews, which may have subjective bias as respondents may overstate or understate some of the challenges or managerial practices. Another limitation relates to the time aspect of the research - as the construction industry is not static and is subject to constant influences in terms of technology, economic and regulatory change - some of the research findings may change over time as new practices and tools become available.

Future Scope

Future research should look to broaden the scope so as to include a larger, more diverse sample of railway and other infrastructure projects throughout Malaysia and Southeast Asia for comparative analysis. Longitudinal studies can also offer an enhanced understanding of how CSFs evolve at various stages of the project from planning to after completion. Further, the use of advanced analytical methods such as structural equation modeling (SEM) or machine learning approaches could help to improve the predictive accuracy of relationships between variables. Future studies should also investigate the influence of digital transformation, sustainability practices, and green construction policies on time performance, as these are becoming an increasingly influential factor in modern infrastructure management. Finally, the investigation of the role of governance frameworks, inter-agency coordination, and cross-cultural collaboration in multinational railway projects can offer valuable insights for strengthening project execution strategies. Such research will help to form part of the effort to build a more resilient, efficient and sustainable foundation for Malaysia's future infrastructure development.

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