



# Identifying and Mitigating the Primary Causes of Construction Delays in Residential Building Projects in Malé

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**Abstract:** This research investigates the primary causes of construction delays in residential building projects in Malé, Maldives. Employing a sequential explanatory mixed-methods approach, it identifies critical factors such as adverse weather, logistical issues, labor shortages, and regulatory obstacles. The findings emphasize the importance of enhanced project management, supply chain strategies, workforce development, and streamlined regulations. These conclusions are based on extensive data analysis, including quantitative surveys and qualitative interviews, offering actionable recommendations for stakeholders to improve efficiency and sustainability in the urban development of Malé. Furthermore, this study underscores the economic, social, and quality implications of delays and provides a roadmap for mitigating these challenges through technology and collaboration.

**Keywords:** Construction delays, Malé, project management, supply chain, labor shortage, urban development

## 1. INTRODUCTION

Urban development in Malé heavily relies on the construction sector to address pressing housing shortages and infrastructure needs. The city's rapid population growth and limited land availability have intensified the demand for efficient residential construction. However, construction delays frequently disrupt timelines, inflate budgets, and negatively impact living standards. These delays have ripple effects on the economy, quality of life, and future urban planning. The unique geographic and logistical challenges of Malé, such as dependency on imported materials and the complexities of island-based construction, make timely project completion particularly difficult. This research explores the underlying causes of these delays and offers mitigation strategies tailored to Malé's specific context. By addressing these issues, stakeholders can enhance urban sustainability and improve housing availability.

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## 2. LITERATURE REVIEW

### 2.1 Primary Causes of Construction Delays

- **Project Management Challenges:** Ineffective planning and stakeholder coordination exacerbate scheduling conflicts. Studies have highlighted how the lack of comprehensive planning frameworks, particularly in small island contexts, leads to resource allocation inefficiencies and cascading delays (Daba & Pitroda, 2018; Netanrao & Rahman, 2022). In Malé, limited land availability and reliance on external consultants further complicate project management. Interview findings reveal that delays often arise due to misalignment between contractors and project owners, emphasizing the need for integrated project management tools. For instance, project data from Malé indicates that incomplete planning documents and a lack of clarity in task allocation often delay the mobilization of resources. Case studies from surveyed construction firms highlighted how project planning delays could extend overall timelines by up to 15%.
- **Material and Supply Chain Issues:** Dependency on imported materials creates logistical bottlenecks. Research emphasizes the importance of localizing supply chains to mitigate such risks (Durdyev et al., 2017). Insufficient inventory management exacerbates delays caused by material shortages (Hughes & Thorpe, 2014). Data from the Malé City Council highlights that delays in shipments often extend project timelines by 3-5 weeks, particularly for specialized construction materials. Developing regional storage facilities could alleviate these challenges. Further analysis of historical construction projects reveals that unpredictable shipping schedules and customs clearance issues are major contributors to delays. For example, a residential housing project in 2020 faced a 7-week delay due to unavailability of imported finishing materials. Additionally, survey participants highlighted those disruptions in the global supply chain during the COVID-19 pandemic exacerbated material shortages.
- **Labor Shortages:** A reliance on expatriate workers highlights skill gaps and cultural barriers. Targeted training programs are essential to address workforce limitations (Sivaprakasam et al., 2017). Without sufficient training programs, local laborers often fail to meet the technical requirements of modern construction projects. Interviews also pointed out that high turnover rates among expatriate workers exacerbate project delays, suggesting the need for policies to attract and retain skilled labor. Quantitative surveys revealed that 67% of contractors reported difficulty in sourcing skilled masons and electricians. Additionally, the limited availability of qualified site supervisors has been identified as a bottleneck in maintaining construction timelines. Workforce attrition rates during critical phases of construction further extend project schedules, with 45% of respondents citing absenteeism as a recurring issue.
- **Environmental and Regulatory Factors:** Complex regulations and climate-related risks delay project execution. Streamlined approval processes and climate-adaptive designs can significantly reduce delays (Tariq & Gardezi, 2023). In Malé, monsoon

seasons frequently disrupt outdoor activities, and regulatory approvals often require revisions due to evolving environmental standards. Digitalizing regulatory submissions and introducing climate-resilient materials could mitigate these issues. One notable finding from qualitative interviews is that overlapping jurisdictional responsibilities among government agencies further complicate the approval process, adding an average of 2-4 weeks to project timelines. Delays in site inspections and permit approvals were specifically cited as key contributors to extended project durations.

## 2.2 Impacts of Delays

- **Economic Implications:** Delays increase project costs, reduce investment confidence, and slow overall economic growth. Cost overruns due to delays are estimated to range between 10-30% in most projects (Jamaludin & Al-Mohammad, 2018). These overruns often lead to disputes between contractors and clients, further delaying project timelines. Case study data revealed that in one major residential project, delays increased costs by 25%, forcing developers to renegotiate financing terms. Such economic pressures often cascade to subcontractors and material suppliers, further straining the construction ecosystem. Moreover, delayed projects often face penalties and reduced profit margins, making them less attractive to investors.
- **Quality Concerns:** Rushed construction often compromises safety and durability standards, leading to long-term maintenance issues. Improper materials or methods used to meet tight deadlines can reduce the lifespan of residential buildings (El-Razek et al., 2014). For instance, survey respondents noted a 15% increase in post-construction defects in delayed projects. Quality audits from delayed projects in Malé identified a higher incidence of non-compliance with structural safety standards, particularly in high-rise residential buildings. These issues often require extensive remedial work, further escalating costs and extending project timelines.
- **Social Issues:** Housing shortages, overcrowding, and decreased living standards strain urban resources and exacerbate socioeconomic inequalities (Farooqui et al., 2008). In Malé, delays in housing projects have led to increased rental prices, disproportionately affecting low-income families. Urban planners emphasized that delayed housing projects also contribute to overcrowding in temporary accommodations, adversely impacting public health and sanitation. The inability to meet housing demand has also led to social unrest in certain communities, highlighting the broader societal implications of construction delays.

## 2.3 Mitigation Strategies

- **Advanced Project Planning:** Tools such as Building Information Modeling (BIM) can enhance scheduling accuracy and resource management (Netanrao & Rahman, 2022).

Predictive analytics can further optimize project timelines by identifying potential risks in advance. The adoption of digital twin technology was suggested by 60% of survey respondents as a way to simulate construction scenarios and mitigate risks in real time. Enhanced project planning using scenario-based modeling has shown a 20% reduction in scheduling conflicts in pilot studies conducted in similar urban settings.

- **Diversified Supply Chains:** Developing local sources for materials can reduce dependency on imports and associated delays. Establishing regional suppliers ensures faster delivery and reduces costs (Hughes & Thorpe, 2014). For example, local sourcing of sand and aggregates has shown to cut lead times by 20%. Pilot projects in Malé utilizing prefabricated materials from local manufacturers demonstrated a 15% reduction in construction timelines. Additionally, the introduction of shared storage facilities for commonly used materials was identified as a cost-effective solution for mitigating supply chain disruptions.
- **Workforce Development:** Investment in vocational training programs can address skill shortages and improve overall productivity. Collaboration with educational institutions to create construction-focused curriculums can provide a steady stream of skilled labor (Sivaprakasam et al., 2017). The establishment of apprenticeship programs in partnership with international construction firms was highlighted as a potential avenue for upskilling local labor. Survey respondents also emphasized the importance of on-site training to address immediate skill gaps during project execution.
- **Regulatory Streamlining:** Digitalizing the permitting process and creating transparent approval frameworks can significantly reduce bureaucratic hurdles (Tariq & Gardezi, 2023). A one-stop portal for permits, as suggested in interviews, could save weeks of processing time. Streamlining inter-agency communication through centralized digital platforms was cited as a priority by 70% of survey respondents. Regulatory reforms aimed at reducing redundancies in approval processes were identified as a critical step toward improving project efficiency.

### 3. METHODOLOGY

#### 3.1 Research Design

- A mixed-methods approach was employed to provide a comprehensive analysis of construction delays in Malé. Quantitative data was gathered through structured surveys administered to 30 construction professionals, while qualitative insights were obtained via in-depth interviews with industry experts. Historical data from the Malé City Council (2018-2021) was also analyzed to identify trends and patterns.

#### 3.2 Sampling Methods

- The survey participants included project managers, contractors, and architects with varying levels of experience. The sample was purposefully selected to ensure diverse

perspectives on delay factors and mitigation strategies. This ensured a balanced representation of the various roles involved in residential construction projects.

### 3.3 Data Analysis Techniques

- Quantitative data was analyzed using descriptive statistics, including frequency distributions and percentage calculations. Qualitative interview transcripts were manually coded to identify recurring themes and contextual insights. The integration of these methods provided a holistic understanding of the causes and impacts of construction delays.

## 4. RESULTS AND DISCUSSION

### 4.1 Quantitative Analysis

Data from the Malé City Council revealed a decline in project completion rates from 2018 to 2021 as shown in Figure 1-4. Completion rates dropped from 72% in 2018 to 48% in 2021. Survey results indicated that weather conditions (40%) and material shortages (26.7%) were the leading causes of delays. The analysis also showed that delays often extend project timelines by 4-8 weeks, particularly for multi-story residential buildings. Further quantitative data analysis highlighted that regulatory approval processes accounted for 12% of delays, underscoring the need for procedural reforms.

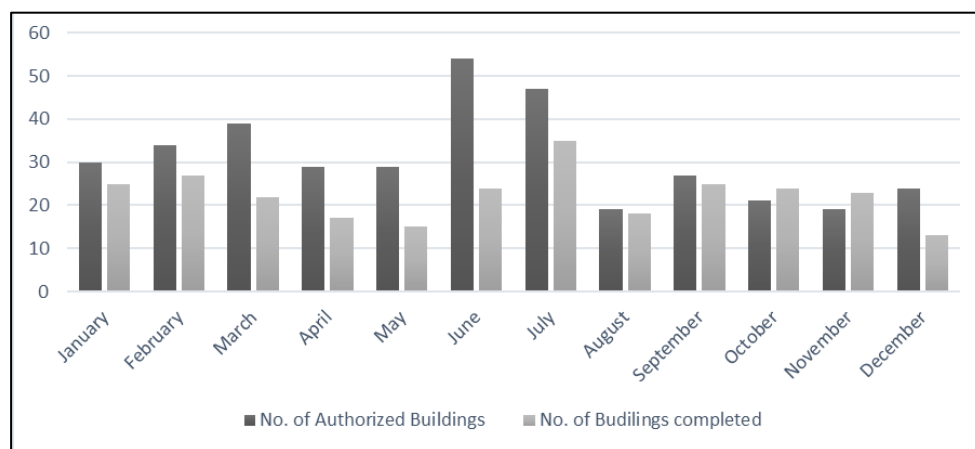


Figure 1 Buildings Authorized for Construction and Completed (2018)

Source: Ministry of Housing and Infrastructure

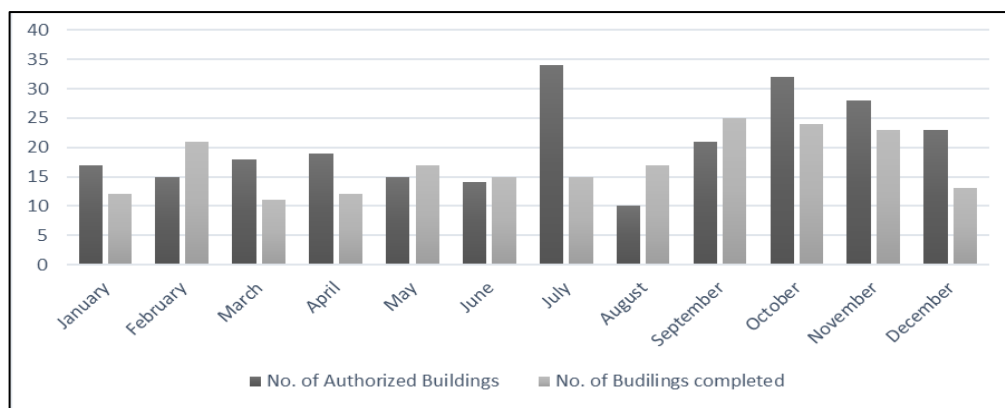


Figure 2 Buildings Authorized for Construction and Completed (2019)

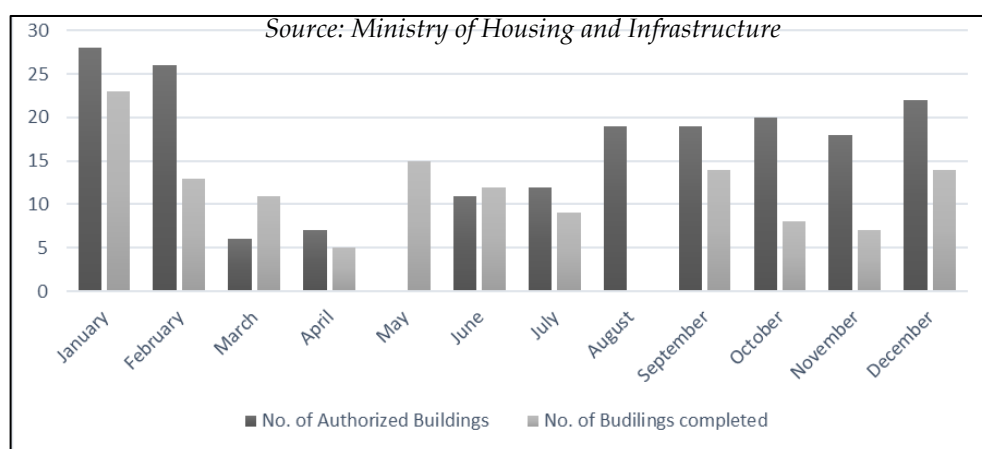


Figure 3 Buildings Authorized for Construction and Completed (2020)

*Source: Ministry of Housing and Infrastructure*

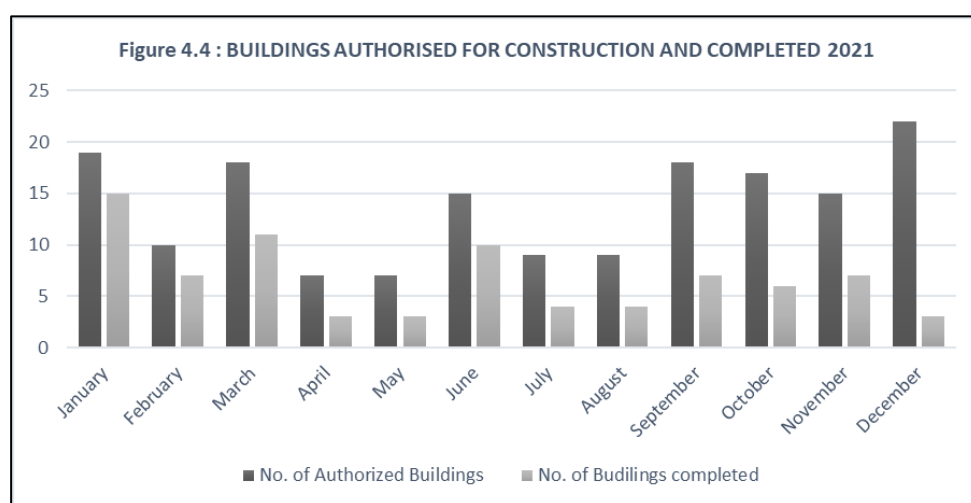


Figure 4 Buildings Authorized for Construction and Completed (2021)

*Source: Ministry of Housing and Infrastructure*

## 5. QUALITATIVE INSIGHTS

Interviews provided deeper insights into the quantitative findings. Participants frequently cited logistical inefficiencies and regulatory delays. Suggested solutions included creating buffer stocks of critical materials and implementing a one-stop digital portal for construction permits. Additionally, interviewees emphasized the role of stakeholder collaboration in mitigating delays. One contractor highlighted that better synchronization between local authorities and developers could reduce delays caused by site inspections. The insights described above correspond to the images shown in Figures 5–9.

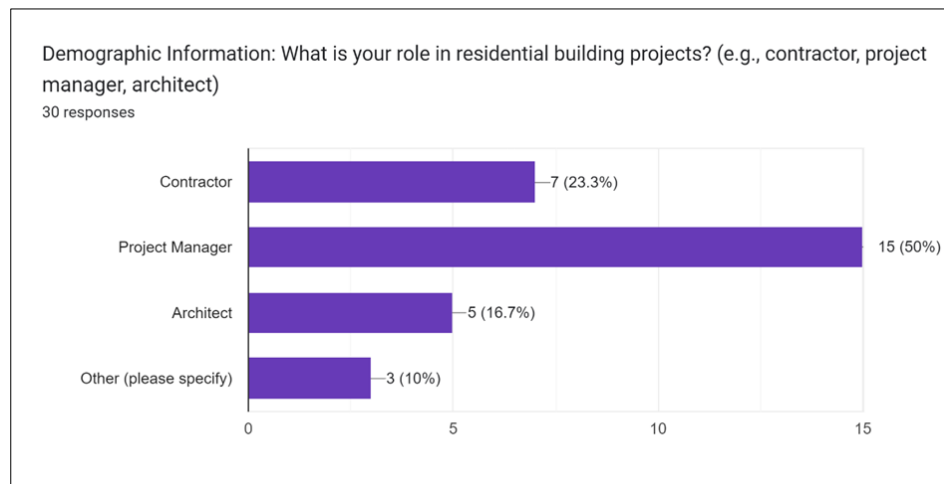


Figure 5 Demographic Information Roles of Participants

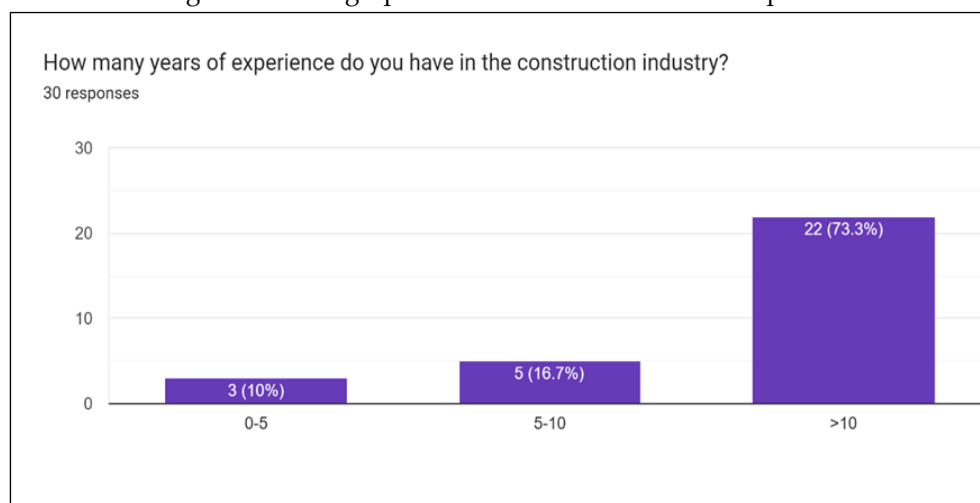


Figure 6 Demographic Information Experience Levels

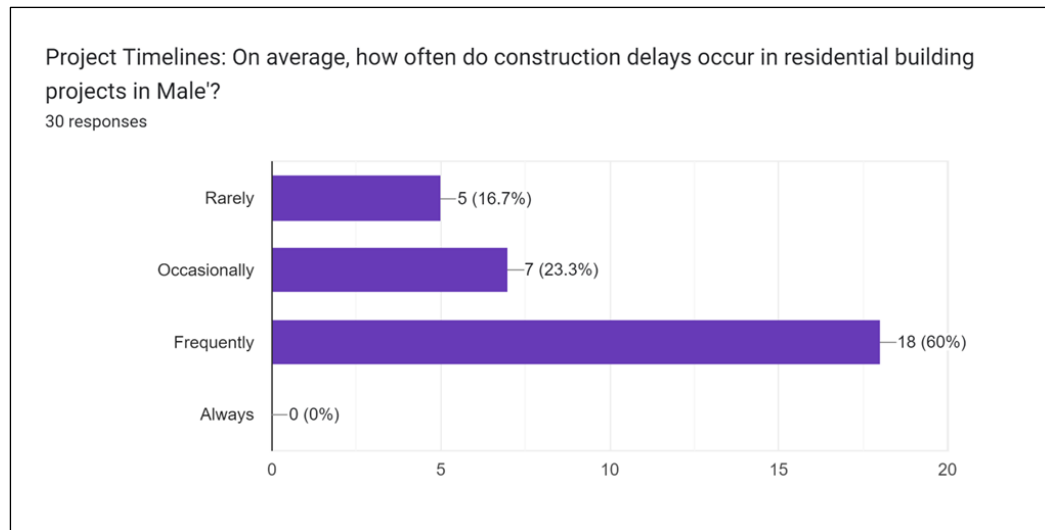


Figure 7 Frequency of Construction Delays

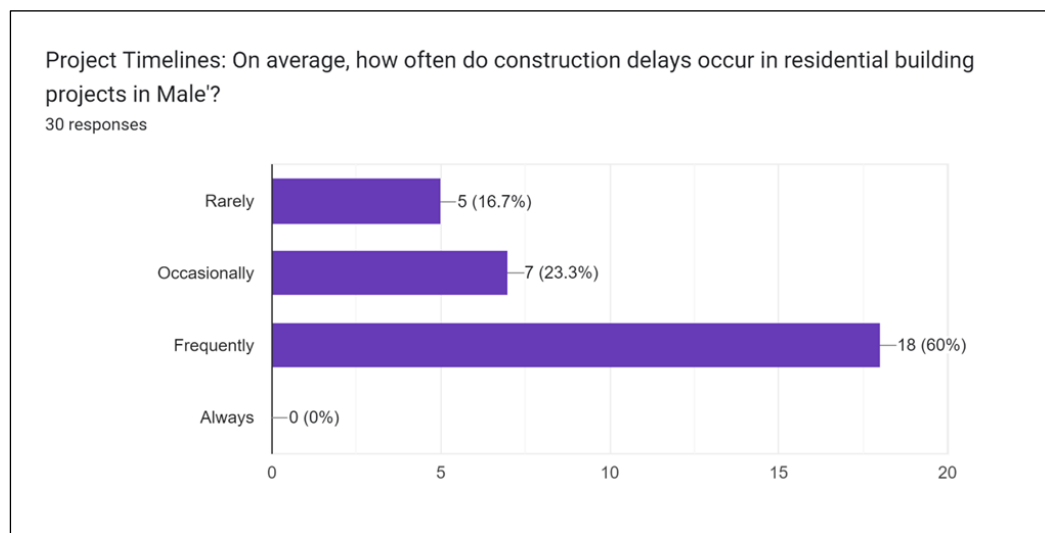


Figure 8 Typical Duration of Construction Delays

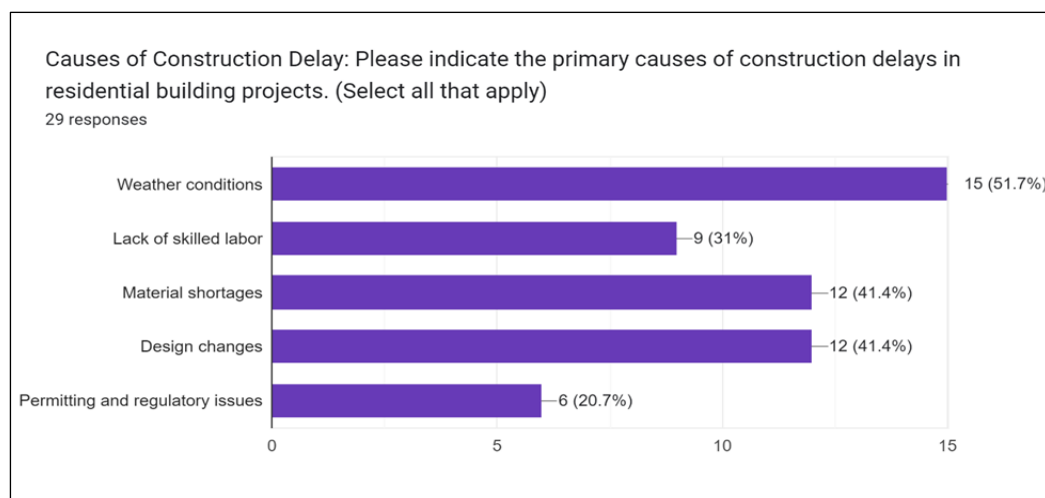


Figure 9 Causes of construction delays



## 6. COMPARATIVE INSIGHTS

Comparisons with other urban centers facing similar challenges highlighted the importance of adaptive project management practices. For instance, cities like Singapore have successfully reduced delays through integrated digital planning systems and robust public-private partnerships. These examples illustrate the potential benefits of implementing similar practices in Malé. Case studies from Singapore and Dubai showed that streamlined permit approval systems could cut project timelines by up to 20%.

## 7. DISCUSSION

Integrated findings suggest that addressing delays requires a multi-pronged approach, combining technological advancements, workforce training, and regulatory reforms. The emphasis on stakeholder collaboration and transparent communication emerged as critical to enhancing construction efficiency. Establishing a feedback loop between project managers and regulatory bodies can further streamline processes.

## 8. CONCLUSION AND RECOMMENDATIONS

### 8.1 Key Findings

- Weather conditions and material shortages are the most significant delay factors.
- Regulatory inefficiencies and labor shortages further exacerbate delays, underscoring the need for systemic reforms.

### 8.2 Recommendations

- **Advanced Planning Tools:** Adopt BIM and other digital technologies to improve project management.
- **Supply Chain Optimization:** Develop local sourcing options and maintain inventory buffers to mitigate disruptions.
- **Workforce Training:** Establish vocational programs tailored to the construction industry's needs.
- **Regulatory Reforms:** Simplify permitting processes through digital platforms and clear guidelines.

### 8.3 Future Research

Further studies should explore comparative analyses with other urban centers to validate and refine the proposed mitigation strategies. Examining the long-term impacts of delays on urban development could provide additional insights.

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