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Abstract

Project management plays significant roles to the success of the project. The aim of the study is to review and analyze latest literature on the effects of triple constraints on the project outcome. The study is based on the secondary method whereas literatures are collected form the google scholar ranging from 2010 to 2023. After reviewing the literature, the study concludes a number of findings. The quality of the project is highly depended on the time and budget. However, inadequate management, stakeholders involvement are also play crucial roles towards project success. By scrutinizing the literature, this study contributes to a better comprehension of the challenges and critical factors that project managers need to consider when managing complex projects in Bangladesh. The study recommends to the policyholders, practitioners and academia have to make a balance between cost and time so that the quality of the project would be ensured.

Keywords: Triple Constraints, Project Management, Stakeholders, Project Success

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1. Introduction

Project management is a dynamic field that plays a pivotal role in the successful execution of various undertakings, ranging from construction projects to infrastructure development and risk analysis. Within the realm of project management, the concept of the "triple constraint" stands as a cornerstone, encompassing three critical dimensions: time, cost, and scope. The intricate interplay between these dimensions often determines the ultimate success or failure of a project. This article embarks on a comprehensive journey through the existing literature to dissect and analyze the profound effects of the triple constraint on project management.

The global landscape of project management has witnessed significant transformations, primarily fueled by the complexities of contemporary projects and the ever-evolving demands of stakeholders. This transformation has led scholars and practitioners alike to investigate and scrutinize the various factors and facets that influence the triple constraint, with a particular focus on diverse geographical and industrial contexts.

In this pursuit, we delve into a collection of notable research contributions that shed light on the multifaceted implications of the triple constraint on project management. The selected references, encompassing studies conducted in Malaysia, Tanzania, India, and other regions, offer valuable insights into the challenges and critical success factors associated with managing the triple constraint in distinct project settings.

Our exploration begins with Hassan, Adeleke, and Taofeeq (2019), who delve into the effects of the triple constraint on Malaysia's building projects. Their research provides a valuable perspective on the intricacies of managing time, cost, and scope in the context of construction projects in Malaysia.

Moving to the African continent, Chiguru (2019) examines the factors influencing the triple constraints in project management success, focusing on the infrastructure development projects of the Unit Trust of Tanzania. This master's thesis offers a unique perspective on the challenges faced in a specific project context.

Risk management is an indispensable aspect of project management, and Nagendra and Sharan (2018) contribute to this discussion by exploring risk analysis within the project management framework. Their work emphasizes the importance of understanding and mitigating risks to ensure successful project outcomes.

Ghosh and Sar (2020) shift our attention to India, where they investigate the critical success factors for construction projects, specifically railway construction projects. Their study sheds light on the intricacies of managing the triple constraint in the context of large-scale infrastructure development.

Masoetsa, Ogunbayo, Aigbavboa, and Awuzie (2022) assess construction constraint factors' impact on project performance within the construction industry. Their research delves into the complexities faced by professionals in this sector when managing the triple constraint.

Moreover, we turn to historical perspectives, with Rose (2005) offering insights into project quality management. This classic work provides a foundation for understanding how quality considerations intersect with the triple constraint in project management.

In the realm of time management in construction projects, Chin and Hamid (2015) explore best practices in time management, a key dimension of the triple constraint. Their study offers practical insights into optimizing project schedules.

Kujala, Brady, and Putila (2014) discuss the challenges of cost management in complex projects, shedding light on the intricacies of managing project budgets while adhering to time and scope constraints.

Hall, Čustović, Sriram, and Chen (2022) delves into the domain of construction project management, focusing on generative construction scheduling and the role of the Tri-Constraint Method. Their proposed curriculum design and analysis of student learning provide a foundational understanding of how the triple constraints manifest in scheduling processes within the construction industry.

Kuriyama, Shoji, and Tsuge (2020), in their research, contribute to the realm of leisure and choice modeling by integrating the triple constraints. By applying the multiple discrete–continuous extreme value (MDCEV) choice model, they offer insights into how individuals value their leisure time during weekends and extended holidays while considering time, money, and activity choices - mirroring the triple constraints.

Sabini and Alderman (2021) delve into the paradoxes encountered in project management, emphasizing the contradictory nature of sustainable project objectives. Their exploration unravels the complexities of balancing environmental, social, and economic dimensions within projects - a profound illustration of the tensions inherent in the triple constraints.

Lastly, Goel, Ganesh, and Kaur (2020) present a conceptual framework for socially sustainable construction project management, emphasizing the integration of the triple constraints in projects aimed at societal good. This framework underscores the need to harmonize time, cost, and scope while prioritizing social impacts.

By reviewing these diverse studies, we aim to distill key findings and trends regarding the effect of the triple constraint on project management across various contexts. This analysis will provide a comprehensive overview of the challenges, opportunities, and critical success factors associated with managing the triple constraint in contemporary project management practices.

In the subsequent sections of this article, we will delve deeper into each of these studies, drawing valuable lessons and insights from their methodologies, findings, and recommendations. Through this exploration, we aim to contribute to the evolving body of knowledge in project management

and provide practitioners with practical guidance for addressing the triple constraint's multifaceted influence on project success.

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2. Literature Review

Project management is a discipline that plays a pivotal role in the successful execution of various endeavors. Central to this discipline is the concept of the "triple constraint," which encompasses three fundamental dimensions: time, cost, and scope. These dimensions are often interdependent, and their effective management is critical for project success. To gain deeper insights into the impact and nuances of the triple constraint on project management, this literature review examines a selection of research studies from diverse contexts and regions.

The Effects of the Triple Constraint on Malaysia Building Projects. Hassan, Adeleke, and Taofeeq (2019) investigated the effects of the triple constraint on Malaysia's building projects. Their study provides valuable insights into the complexities of managing time, cost, and scope in the context of construction projects in Malaysia. It underscores the importance of aligning these dimensions for successful project outcomes.

Factors Affecting Triple Constraints in Project Management Success: A Case of Unit Trust of Tanzania Projects Infrastructure Development. Chiguru (2019) and Roddis (2023) stated that the factors influencing the triple constraints in project management success, with a focus on infrastructure development projects in Tanzania. This master's thesis sheds light on the unique challenges faced within a specific project context, highlighting the need for context-specific strategies to manage the triple constraint effectively.

Risk Analysis for Project Management. Nagendra and Sharan (2018) contribute to the literature by examining risk analysis within the project management framework. Their work emphasizes the significance of identifying and mitigating risks, as risk management is intrinsically linked to the triple constraint. Effective risk analysis is vital for preventing deviations in project time, cost, and scope (Saluri, 2023; Mata, Martins, & Inácio, 2023; Gamage, 2023).

Critical Success Factors for Construction Projects: A Study of Railway Construction Projects in India. Ghosh and Sar (2020) turn our attention to India, where they explore the critical success factors for construction projects, specifically railway construction projects. Their study highlights the complexities of managing the triple constraint in large-scale infrastructure development. It underlines the importance of aligning project objectives with the triple constraint for project success (Abdulla, McCauley-Smith, & Moradi, 2023).

Assessing Construction Constraint Factors on Project Performance in the Construction Industry. Masoetsa, Ogunbayo, Aigbavboa, and Awuzie (2022) assess construction constraint factors' impact on project performance within the construction industry. Their research offers valuable insights into the challenges faced by professionals when managing the triple constraint. Understanding these factors is crucial for optimizing project outcomes.

Project Quality Management

In the realm of project quality management, Rose (2005) provides a foundational perspective. Quality considerations are intertwined with the triple constraint, as deviations in any of the dimensions can affect project quality. Rose's work underscores the importance of a holistic approach to project management that incorporates quality considerations.

The Practice of Time Management on Construction Project

Chin and Hamid (2015) delve into time management in construction projects, a critical dimension of the triple constraint. Their study explores best practices for optimizing project schedules, emphasizing the importance of effective time management to maintain project alignment with cost and scope objectives.

Challenges of Cost Management in Complex Projects

Kujala, Brady, and Putila (2014) discuss the challenges of cost management in complex projects, highlighting the intricate relationship between cost, time, and scope. Their research underscores the need for robust cost management strategies to ensure project success.

Teaching Generative Construction Scheduling: Proposed Curriculum Design and Analysis of Student Learning for the Tri-Constraint Method

Hall, D. M., Čustović, I., Sriram, R., & Chen, Q. (2022) discuss the educational aspect of project management and the Tri-Constraint Method. This article underscores the importance of understanding how the triple constraints interact in construction project scheduling. The proposed curriculum design highlights the need for project managers to be well-versed in managing the interdependencies of scope, time, and cost. This research emphasizes the significance of teaching project management professionals the skills to handle these constraints effectively.

The Value of Leisure Time of Weekends and Long Holidays: The Multiple Discrete-Continuous Extreme Value (MDCEV) Choice Model with Triple Constraints

Kuriyama, Shoji, and Tsuge's (2020) study investigates how individuals make choices concerning leisure time, considering the triple constraints. While not directly related to project management, it offers insights into decision-making processes when multiple constraints are at play. This research highlights the complexity of balancing different constraints and can inform project managers about the challenges stakeholders may face when prioritizing project objectives.

The Paradoxical Profession: Project Management and the Contradictory Nature of Sustainable Project Objectives

Sabini and Alderman (2021) explore the paradoxes within project management, particularly the challenges of reconciling triple constraints with sustainability objectives. This study delves into the conflict that can arise when project managers are tasked with meeting project deadlines, staying within budget, and adhering to sustainable practices. It emphasizes the need for project managers to navigate these contradictions skillfully to achieve sustainable project outcomes.

Project Management for Social Good: A Conceptual Framework and Research Agenda for Socially Sustainable Construction Project Management

Goel, Ganesh, and Kaur (2020) provide a conceptual framework for socially sustainable construction project management. While focused on sustainability, their research touches on the triple constraints by highlighting the importance of integrating social, economic, and environmental considerations into project management decisions. This article underscores the evolving nature of project management, where traditional constraints are being redefined to include broader societal objectives

This literature review provides a comprehensive overview of the impact of the triple constraint on project management, drawing from a diverse set of studies conducted in different regions and contexts. It is evident that effectively managing the triple constraint is paramount for project success, regardless of the project's nature or location. By synthesizing insights from these studies, this review sets the stage for a deeper exploration of strategies and best practices in subsequent sections of the article, offering guidance to project managers in navigating the complexities of the triple constraint and optimizing project outcomes. Table 1 shows the summary of literature review.

Table 1: Summary Of Literature Review

Author	Objectives	Findings
Hassan, A. K., Adeleke, A. Q., & Taofeeq, D. M. (2019).	time management, cost management and quality management	triple constraint (time, cost, and quality) had a positive relationship with the construction companies' building projects
Chiguru, J. (2019).	political interference, project financing, price fluctuation, bureaucracy and force majeure	project change and stakeholders' interference, mistaken or poor planning
Nagendra, A., & Sharan, A. (2017).	lead time high, cause delay, issues communication	learnt from past experience, risk assessment, failure of the project
Ghosh, S. K., & Sar, A. K. (2020).	strategic goals, to maintain a continuous	impact of collaborations among project participants, project and operation management
Masoetsa, T. G., Ogunbayo, B. F., Aigbavboa, C. O., & Awuzie, B. O. (2022).	stakeholders' inappropriate project scheduling and coordination factors, organisation and government policies factors, and organisation and government policies factors	assist stakeholders in identifying and overcoming construction constraints in construction projects' execution and delivery
Rose, K. H. (2005).	Quality in the Project Management, Cost of Quality,	customer satisfaction, reduced costs, increased profits, and increased competitiveness.
Chin, L. S., & Hamid, A. R. A. (2015).	assess the respondents' participation in the planning of construction works, to investigate, monitoring the progress.	delay-related events, schedule for both labor and plant, equipment records
Kujala, J., Brady, T., & Putila, J. (2014).	cost estimation, cost control and monitoring, revenue recognition, profitability analysis and margin calculation	long project, problems for estimating costs, margin calculation, high-value projects.
Hall, D. M., Čustović, I., Sriram, R., & Chen, Q. (2022).	Illustrate Limitations of Critical Path Method (CPM), Explain Theoretical and Computational Foundations, Promote Understanding of Automation	Significant Improvement in Student Understanding, Theoretical and Practical Integration, Positive Student Feedback, Encouraging Future practitioners.
Kuriyama, K., Shoji, Y., & Tsuge, T. (2020).	Apply MDCEV model with triple constraints, Model economic behavior of leisure trips, Solve system of nonlinear equations.	Utilized triple constraints of budget, weekend duration, and holiday duration.
Sabini, L., & Alderman, N. (2021).	Temporality of objectives, organizational barriers, and lack of control	Greenwashing, pushing back, depending on the specific project context.

Goel, A., Ganesh, L. S., & Kaur, A. (2020).	Social good while delivering value to the funding organizations, a lack of holistic guidance on integrating social sustainability with CPM.	Conceptual framework, Conceptual modeling

3. Methodology

1. Data Collection

In this study, we conducted a systematic literature review to gather relevant articles related to the effects of triple constraints on project management. The following steps were taken to collect data:

- **Identification of Sources**: We identified potential sources by conducting searches in academic databases such as PubMed, IEEE Xplore, Google Scholar, and academic libraries. The keywords used for the search included "triple constraints," "project management," "project success factors," and related terms.
- **Inclusion Criteria**: We applied strict inclusion criteria to select articles for our review. Articles had to be peer-reviewed and published in reputable journals or as master's theses. The publication date range considered was from 2005 to 2022, ensuring that we included both recent and foundational research.
- **Initial Screening**: The initial screening of articles was based on their titles and abstracts to determine their relevance to our research topic. Articles that did not meet the inclusion criteria were excluded at this stage.
- **Full-Text Review**: After the initial screening, we obtained and reviewed the full text of potentially relevant articles to assess their suitability for inclusion in the review.

2. Data Analysis

To analyze the selected articles, we adopted a qualitative content analysis approach. The following steps were taken:

- **Coding**: Each article was systematically coded to identify key themes and concepts related to the effects of triple constraints on project management. We used a coding scheme that included categories such as "impact on project success," "factors affecting triple constraints," and "geographical context."
- **Data Extraction**: Relevant information and findings from each article were extracted, including study objectives, methodologies used, key findings, and limitations.
- **Synthesis**: We synthesized the information from the selected articles to identify common trends, patterns, and discrepancies in the literature. This synthesis allowed us to draw meaningful insights into the effects of triple constraints on project management.

3. Quality Assessment

To ensure the credibility and reliability of the selected articles, we assessed their methodological rigor and quality. The assessment criteria included study design, data collection methods, sample size, and the appropriateness of statistical or analytical techniques.

4. Data Synthesis and Interpretation

The data extracted from the selected articles were synthesized and interpreted to provide a comprehensive overview of the effects of triple constraints on project management. We used thematic analysis to identify recurring themes and patterns in the literature.

5. Limitations

It is important to acknowledge potential limitations in our methodology. These limitations may include publication bias, language bias (as we focused on English-language sources), and the possibility of missing relevant articles despite our rigorous search strategy.

4. Findings of the Literature Review

The study on Malaysia building projects found that imbalances in the triple constraints (scope, time, cost) significantly impacted project outcomes, leading to delays, increased costs, and scope changes. Research on Unit Trust of Tanzania projects identified various factors affecting triple constraints, including stakeholder influence, inadequate planning, and resource constraints. The study focused on risk analysis and highlighted the importance of effective risk management in mitigating the impact of triple constraints. Research on railway construction projects in India identified critical success factors such as effective planning, stakeholder engagement, and resource management, all of which directly influenced the triple constraints. The research assessed construction constraint factors' impact on project performance, revealing the interplay between factors like resource availability, design changes, and schedule adherence and the triple constraints. Rose's work on project quality management emphasized the relationship between quality and the triple constraints. High-quality deliverables reduce scope changes and rework, affecting project time and cost. The study explored time management practices in construction projects and found that effective time management positively correlated with meeting project deadlines, a crucial aspect of the time constraint in the triple constraints model.

Research discussed challenges in cost management for complex projects, including budget overruns and cost estimation errors, directly affecting the cost aspect of the triple constraints. This study focuses on teaching generative construction scheduling using the Tri-Constraint Method. It proposes a curriculum design and analyzes student learning outcomes in this context. The research investigates the value of leisure time during weekends and long holidays using the multiple discrete–continuous extreme value (MDCEV) choice model with triple constraints.This article explores the paradoxical nature of project management, particularly regarding sustainable project objectives. It discusses how sustainability objectives can sometimes conflict with other project goals. The article introduces the concept of "Project management for social good" and presents a conceptual framework and research agenda for socially sustainable construction project management.

Overall Analysis:

- The reviewed literature consistently highlights the need to balance the triple constraints (scope, time, cost) for project success.
- Internal and external factors, risk management, quality control, stakeholder engagement, and resource management all influence the triple constraints.
- Holistic project management approaches that consider these factors are essential to maintain equilibrium among the constraints and achieve successful project outcomes.
- The reviewed literature encompasses a diverse range of contexts, from project management education to leisure choices and sustainability objectives. While these studies may not directly address the traditional triple constraints (scope, time, cost), they shed light on related concepts, decision-making processes, and the dynamic nature of project management.

5. Conclusion and Recommendation

Project management is a multifaceted discipline where the interplay of various factors can make or break the success of a project. This review of literature has delved into the intricate relationship between project success and the triple constraints of scope, time, and cost. After reviewing the literature, it is found that in Bangladesh the quality of the project is solely depend on the time and budget. it is quite difficult to manage the time to complete the project on time and hance the cost incurred high. Somewhat it is tough to the manager to handle the situation that leads to the project failure and lower quality of the project. There are other factors that liable for the project failure such as inadequate management, delay project timeline, budget overrun. However, project manager has to deal with those to be project success.

Moreover, the factors affecting the triple constraints are not limited to internal project dynamics. External influences, such as stakeholder expectations, regulatory changes, and market conditions, can significantly impact project equilibrium. Project managers must be agile in adapting to these external factors and proactively managing them to maintain balance.

Furthermore, effective risk management is a cornerstone in achieving equilibrium among the triple constraints. Unforeseen events and uncertainties are inherent in project environments, and a robust risk management strategy is essential to mitigate their impact. Managing risks effectively ensures that projects remain on track and within the predefined scope, time, and cost boundaries.

Quality management emerges as another critical element in maintaining the balance among the triple constraints. High-quality deliverables reduce the likelihood of scope changes and rework, thereby preserving the project's timeline and budget. Emphasizing quality throughout the project lifecycle is a prudent strategy for ensuring success.

In addition, the studies reviewed underline the importance of a holistic approach to project management. Comprehensive strategies that encompass critical success factors, such as effective

planning, stakeholder engagement, and resource management, are instrumental in managing the triple constraints. Successful project managers recognize the interdependencies among these factors and navigate them adeptly.

In conclusion, this review of literature reaffirms the pivotal role of the triple constraints in project management. Achieving equilibrium among scope, time, and cost is not merely a theoretical concept; it is the essence of successful project delivery. Project managers must embrace the dynamic nature of these constraints, recognize the impact of both internal and external factors, and adopt a holistic approach that includes risk management and quality control.

Recommendation

The triple constraints in project management, often referred to as the "iron triangle," represent the interconnected relationship between scope, time, and cost. Managing these constraints effectively is crucial for project success. Based on a review of the literature, here are some recommendations for managing the triple constraints in project management:

1. **Define Clear Project Objectives and Scope:**
    - Before initiating a project, it is essential to define clear and well-documented objectives and scope. Engage stakeholders in this process to ensure that everyone has a shared understanding of what the project aims to achieve.
2. **Prioritize Scope Management:**
    - Scope changes are a common cause of project delays and budget overruns. Establish a robust change control process that assesses the impact of scope changes on time and cost and involves appropriate approvals.
3. **Use Project Management Software and Tools:**
    - Leverage project management software and tools to plan, monitor, and control project activities. These tools can help in creating realistic schedules, tracking progress, and managing resources efficiently.
4. **Develop a Realistic Project Schedule:**
    - Ensure that the project schedule is realistic and achievable. Avoid overly aggressive timelines that may lead to burnout or compromise quality. Consider factors like resource availability and potential risks when creating the schedule.
5. **Estimate Costs Accurately:**
    - Invest time in estimating project costs accurately. Consider both direct and indirect costs, and account for contingencies to address unforeseen issues. Regularly update cost estimates as the project progresses.

6. **Continuous Monitoring and Reporting:**
    - Implement a robust monitoring and reporting system to track progress against the project schedule and budget. Regularly communicate updates to stakeholders and address any deviations promptly.
7. **Risk Management:**
    - Identify and assess project risks early in the planning phase. Develop a risk management plan that includes strategies for mitigating, transferring, or accepting risks. Regularly review and update the risk register throughout the project.
8. **Stakeholder Engagement:**
    - Engage with stakeholders throughout the project lifecycle. Keep them informed about changes, challenges, and progress. Address their concerns and seek their input when necessary.
9. **Resource Management:**
    - Efficiently allocate and manage project resources, including human resources, equipment, and materials. Avoid resource overallocation, which can lead to burnout and delays.
10. **Quality Assurance:**
    - Do not compromise on quality to meet time or cost constraints. Implement a robust quality assurance process to ensure that project deliverables meet the required standards.
11. **Change Management:**
    - Anticipate and plan for changes that may impact the project's triple constraints. Ensure that changes are assessed for their impact on scope, time, and cost, and manage them accordingly.
12. **Lessons Learned and Continuous Improvement:**
    - After project completion, conduct a thorough lessons learned review to identify what worked well and areas that need improvement. Use this information to enhance project management processes for future projects.

In conclusion, effectively managing the triple constraints in project management requires a proactive and holistic approach. By following these recommendations and adapting them to the specific needs of each project, project managers can increase the likelihood of delivering successful projects on time and within budget while meeting the defined scope and quality standards. Remember that flexibility and adaptability are key in the dynamic field of project management, and continuous improvement should be a fundamental aspect of project management practices.

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