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## Decision-Making Models for High-Risk Projects: Balancing Cost, Quality and Time

Shakeeb Sultan \*

*Bachelor of Business Administration and Management, Washington University of Science and Technology, USA.*

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### Abstract

This study investigates high risk project decision-making models that aim at balancing the critical project constraints of cost, quality and time. The paper explores the different decision-making models and assesses their relevance in handling high risks settings. By applying the real-life case studies, such as the 2012 London Olympics and the 787 Dreamliner project of Boeing, the study reveals how the project managers use these models to reduce risks and maximize results. The research methodology involves the qualitative analysis, case-study analysis, and performance metrics. The main discovered outcomes are that although the traditional decision making models such as the Critical Path Method (CPM) are useful, the modern ones, such as Monte Carlo simulations and risk-based analysis, provide greater flexibility and accuracy in the high-risk situations. The paper ends with the practical implication of enhancing project management approach and suggestion of what to do in another research on adaptive decision-making models in high-risk situations.

**Keywords:** Decision-making models; Cost overruns; Project management; Risk assessment; Quality trade-offs; Project constraints

### 1. Introduction

High risk project decision-making is an important aspect of project management since in such projects, there usually are uncertainties, complexities and challenges that have to be maneuvered through. Decision-making models are necessary instruments to deal with these issues, assist managers to balance a variety of constraints, including cost, quality, and time, which tend to be inter-dependent (Kirk, 2019). The trade-offs that are involved in high-risk projects such as safety, regulatory issues, and environmental issues are even more important to manage effectively. Project managers should be in a position to evaluate risk and make decisions that are informed and which are in line with the strategic goals and at the same time have a balance amid competing priorities. With the world of business becoming highly dynamic, the need to have stronger decision-making models increases. The nature of high-risk projects, especially in such fields as construction, aerospace, and energy, dictates that the decisions made most of the time would not only affect the short-term success of the project itself, but also have long-term economical and environmental implications (Kirk, 2019). Therefore, the knowledge and implementation of the effective decision making models within high risk situations is important to realize the project success and to reduce the occurrence of risks.

#### 1.1. Overview

Decision-making models are essential in risky projects as they will assist managers to make trade-offs between the key project constraints which include cost, quality, and time. These models offer systematic procedures of assessing various situations and establishing the best remedies that will be consistent with the project goals. In a risky environment, whereby uncertainties and unexpected situations prevail, decision-making models provide an approach to risk management and also provide projects within budgetary constraints, on time, and to the appropriate quality level. Risk

\* Corresponding author: Shakeeb Sultan

assessment as a cost analysis model is one of such, as it assists in determining the potential financial risks available at early stages of the project lifetime and design the mitigation strategy to address such risks (Ou-Yang and Chen, 2017). Using these models, the project managers will be able to make sound decisions that consider the constraints of costs as well as the fact that the outputs delivered must be of high quality thus ensuring that time-sensitive deadlines of various projects are not compromised on quality. This capacity to strike a balance between these conflicting requirements is one of the determinants of a successful project. Decision-making models will remain critical in the optimization of performance and reduction of risk as projects become increasingly complex, particularly in such an industry as construction and engineering (Ou-Yang and Chen, 2017).

### **1.2. Problem Statement**

The high-risk projects have their own sets of problems which project managers need to overcome to score on successful projects. The decision making is generally very difficult as such projects are characterized by high intensity of uncertainty, complexity and possibility of unanticipated risks. Balancing cost, quality, and time; commonly known as the project management triangle is one of the most challenging issues that project managers have to deal with in a high-risk environment. All of these factors are interdependent and, therefore, one decision to prioritize one of them might affect the rest. As an example, choosing a cheaper method can result in a trade off between quality or delay the project or choosing a faster method can increase costs or trade off quality. In a high risk project, the stakes are high because wrong calculation may result in huge financial loss, safety or project failure. The problem is therefore to utilize the right decision making models that can successfully steer through these competing needs and give the best results under the state of uncertainty. This is further complicated by the fact that the decisions have to be made in real-time as managers have to judge new information and change the course as fast as possible. Another factor that contributes to the problem is also the absence of a universal model of high-risk projects, and it is essential to note that specialized frameworks, taking into consideration the specifics of every kind of project, are required.

### **1.3. Objectives**

This research has three major objectives. First, it tries to investigate the available decision-making models that can be used in high-risk projects, giving a full profile of the available models. Second, the paper will examine the ways in which the models can be applied to strike a proper balance of the most important constraints of cost, quality, and time in making decisions. It will focus on knowing how these models will assist managers in determining the most appropriate course of action in the event of conflicting priorities. Lastly, the study will evaluate how various decision making models can be used in handling high risk projects. With the benchmarking of the real-life case study results and the utilization of performance indicators, the given study will provide an understanding of how the models can be implemented in other sectors on a practical level. This is because it aims at establishing what models offer the best solutions to complex, high-risk scenarios and give suggestions on how the decision making strategies in such projects can be enhanced.

### **1.4. Scope and Significance**

The study will also concentrate on high-risk projects in different sectors, such as building, aerospace, and the development of infrastructure projects, in which the stakes and complexities are the greatest. Its scope will include the discussion of various decision-making models, their effectiveness on the real-life basis. This study will identify and determine the failures and failures of such models in controlling this cost, time and quality constraints of projects by using case studies as their basis. The importance of the given research is that it may assist in developing practical ideas on the ability of the decision-making framework to be streamlined in case of high-risk projects. The knowledge of the interaction between cost, quality, and time and the ability to balance them will have very far reaching repercussions both in academia and in industry. To the practitioners, the findings can help practitioners adopt better decision making practices, improve the outcomes of projects and minimise risks that come with high stake projects. Moreover, the results of the study will be useful to scholars who aim to continue research on the uses of decision-making models in high-risk settings as part of the overall project management literature. The relevance of projects is further entrenched in the fact that projects are increasingly becoming complex and interdependent and this will only increase the significance of these models.

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## **2. Literature review**

### **2.1. Overview of Decision-Making in Project Management**

Decision-making is a significant position in project management because it helps the manager to navigate through the hurdles of risky projects. The rationale behind decision making in this area is based on different management theories which give emphasis on the systematic analysis and informed decision making especially where uncertainty is involved.

One of the oldest models is the Rational Decision-Making Model, which focuses on the well-structured decisions depending on the existing information. In later development, the decision-making models have been designed to encompass the strategic, behavioral and intuitive factors, considering the weaknesses of pure rationality, particularly in high-stakes contexts (Secundo et al., 2021).

With a growth in the size and complexity of projects, decision making models have evolved to be more dynamic by including probabilistic assessments, including Monte Carlo simulations, which enable modeling of risk and prediction. This paradigm switching is an alternative to deterministic methods such as Cost-Benefit Analysis (CBA) and Critical Path Method (CPM) to more responsive and flexible methods. In the modern world, the models of decision-making adopt a multi-faceted strategy, such as Risk Assessment, Stakeholder Analysis, Analytical Approach, and Heuristic (see the picture). These models focus on the visualization of knowledge, group decision-making, and sophisticated computing tools that contribute to improving the results of projects.

A new decision-making process of project management in modern times includes the usage of technical tools and human judgment, together with group decision-making and ethical considerations in order to address the uncertainty and maximize outcomes. This is a holistic method that is needed to address high-stake challenges and make big and risky projects successful (Secundo et al., 2021).



**Figure 1** This image illustrates the various components of decision-making in project management, including analytical approaches, risk assessment, stakeholder analysis, and heuristic techniques, which collectively enhance the decision-making process in high-risk environments

## 2.2. Major Decision-Making Models of high risk projects.

Decision-making models are necessary instruments of high risk projects to handle intricate uncertainties and conflicting constraints. Conventional tools, including Cost-Benefit Analysis (CBA) and the Critical Path Method (CPM) offer a ground on which the feasibility of projects and schedule optimization can be evaluated. CBA assists project managers with the balancing of the costs and the financial benefits, whereas the CPM is concerned with identifying the longest path of activities and possible delays (Ou-Yang and Chen, 2017). These models however are constrained when it comes to uncertainty and dynamic risks. In order to overcome these shortcomings, new models include Fuzzy Logic and Monte Carlo Simulation. Fuzzy Logic is applicable in dealing with uncertainty because it enables approximate thinking to be applied in decision-making, and Monte Carlo Simulation creates the probabilistic perspective of the risks associated with projects, which presents a variety of possible results, not one that is purely deterministic (Ou-Yang and Chen, 2017). These sophisticated models help project managers to test various scenarios, determine the effect of the different risks, and change their tactics. They are particularly useful in risky surroundings where market volatility, supply chain interruptions or changes in regulations can drastically change the results of projects. They are essential in the management of complex high-risk projects because of their capacity to become adaptable and to streamline decisions in accordance with real-time information.

### **2.3. Cost/ Quality/ Time management in project management.**

Project management is based on the theory of the triple constraint that opines that cost, quality and time cannot be separated and they have to be harmonized. According to this theory, any change in the one of these constraints will also directly affect the other ones, and thus, a project manager must find the best balance between them (Luong et al., 2018). These competing priorities are further complicated by the uncertainty and complexity that is entailed in such high-risk projects. An example is that cost reduction can reduce quality or increase the time of the project whereas prioritization of speed can have the same effect, at the cost of higher or lower quality. Case studies, including the construction industry ones, demonstrate this tradeoff: it can require an increase in costs or a decrease in quality to make fast delivery, or it can require delays or lower quality to reduce costs (Luong et al., 2018). The optimization models, including multi-mode time-cost-quality trade-off models, may be applied to help identify the optimal trade-off between all these constraints. Optimization methods such as the opposition multiple-objective difference evolution (MODE) algorithm can be applied to the construction projects to find the most cost-effective and time-saving solutions without compromising quality (Luong et al., 2018). Success of high-risk projects depends on the competence of managing these trade-offs using strategic decision-making, aligning projects with an on-time and on-budget completion, and the quality of the products should be delivered.

### **2.4. Projects that have High Risk in making decisions.**

High-risk projects are accompanied by a set of challenges unique to their decision-making because of the aspect of uncertainty and complex nature of these projects. The high-risk projects are characterized by the unpredictability of variables, including the fluctuation of the market, the unstable nature of technology, or the changes in the regulations which can shift the project at any point. This uncertainty requires that the project managers use agile approaches to decision making which could adjust to changing situations. Additionally, the high risk projects tend to have a number of stakeholders, with conflicting interests, and different levels of risk tolerance, which makes reaching consensus a challenging task and decision making more difficult (Chattapadhyay et al., 2021). As an example, in such mega construction projects, variables that increase the complexity of risk assessment and risk mitigation work include the scale of operations, the variety of contractors, and the geographical distribution of the labor force. It is very important to have constant monitoring and prediction because unexpected risks might arise anytime in the project lifecycle. Project managers can predict possible risks and respond to them proactively with the help of advanced predictive tools, including machine learning-based risk detection systems (Chattapadhyay et al., 2021). Nevertheless, despite the advanced tools, high-risk projects are challenging and dynamic, which introduces continuous challenges that require vigilance and flexibility in decision-making. The above factors underscore the need to have decision-making structures that are robust and adaptive to be able to traverse the turbulent environments of high-risk projects.

### **2.5. Analysis of Existing models.**

The analysis of the existing models of decision-making in high-risk projects shows advantages and disadvantages to the models, as some of them are not effective addressing the intricacies of the contemporary risky environment. Indicatively, though Cost-Benefit Analysis (CBA) and the Critical Path Method (CPM) have been instrumental in assessing viability of the project and the optimization of timelines, they do not consider the dynamic risk factors, including market volatility or unexpected delays. With the development of the field of project management, more recent models such as Monte Carlo simulations and Fuzzy Logic have become very popular because they can address uncertainty and give probabilistic information (Shevlane et al., 2023). The modeling of different risk scenarios can be accomplished with the help of Monte Carlo simulations, and they are convenient to predict the probability of different outcomes of the project and provide a more comprehensive picture of the risks. The advanced models however have a number of advantages but demand a lot of computational resources and expertise to obtain making them not easily accessible and useful in some industries. Moreover, most of these models are yet to incorporate the real time data and stakeholders input in the decision making process which is paramount in high risk projects where the conditions may rapidly shift. These models also depend on the quality of input data, as incorrect or incomplete data may negatively affect the predictive abilities of these models (Shevlane et al., 2023). Finally, though modern models are more flexible and more accurate, their integration with real project management practices still is not accomplished, and more refinements are necessary to adapt them to the requirements of the high-risk project environment.

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## **3. Methodology**

### **3.1. Research Design**

The study will be conducted in the form of both a qualitative and quantitative study that will make use of mixed research methods. Qualitative dimension will be devoted to the in-depth study of the real life case studies, which would enrich

the knowledge of the application of decision making models in high risk projects. These case studies will provide information concerning the challenges of project managers, decision making process and the results of the various models being applied. The quantitative part will entail the statistical analysis which will analyze the performance indicators of the cost, time and quality to determine the effectiveness of the models used in decision making in the case studies. The mixed-methods design is appropriate because it offers a holistic strategy where quantitative and qualitative information will be used to give a balanced perspective about the decision-making models in the high-risk projects. The method also increases credibility of the study because the triangulation of qualitative and quantitative data makes the models to be soundly assessed.

### **3.2. Data Collection**

The primary and secondary means will be used to gather data to use in this study. The primary data will be collected by conducting interviews with the project managers and other key stakeholders in high-risk projects to provide first-hand information about the processes, challenges, and results of these high-risk projects. Also, surveys will be given to a larger sample of professionals in the project management profession to gather expression of available quantitative data on the efficacy of various models of decision-making. The secondary data will consist of case studies in industry reports, academic articles, and publicly available project documents that will give information in details about the decision making models in high risk projects. The case studies will be selected based on the large-scale projects, which involve high levels of technological, financial, and operational risks, i.e. the 2012 London Olympics, and the Boeing 787 Dreamliner project. The cases were selected because they have high public and financial implications, and have combined different models of decision making.

### **3.3. Case Studies/Examples**

#### *3.3.1. Case Study 1: London Olympics Construction of 2012.*

The 2012 London Olympics was one of the most risky and complicated construction projects in the recent history with tight deadlines, large budget, and demanding logistic requirements. The case is of interest especially to the study of decision-making models because of its volume, exposure to the public and the cost-quality-time interaction. Organization and implementation of Olympics nation demanded the combination of different decision making models to deal with risks. These not only covered the conventional project management tools such as Critical Path Method (CPM) to schedule but also more sophisticated risk based model to deal with the uncertainties with regard to supply chains and logistics (Brown and Cresciani, 2017). Also major stakeholder participation was undertaken in the project where government agencies, local communities and contractors were engaged, and this further complicated the ability to balance these conflicting constraints. The project had encountered a number of challenges which included the construction delay of major venues, quality and safety maintenance on the budget. These problems were alleviated by a mixture of risk analysis tools, scenario planning, and performance monitoring by decision-makers to make sure that projects are delivered successfully. The successful construction of the London Olympics shows the necessity of flexible decision-making models capable of changing in reaction to unexpected difficulties and new information being uncovered, and, hence, the necessity of flexibility in dealing with high-stakes projects.

#### *3.3.2. Case Study 2: Boeing 787 Dreamliner Development.*

The project of Boeing 787 Dreamliner is an illustration of a risky and technologically advanced project that experienced considerable delays and budget overruns. The Dreamliner project was first seen as the breakthrough in aerospace technology, and turned out to be a lesson to the rest of the world in the supply chain management. The difficulties of the project were mostly based on the peculiarities of its global supply chain in which delays of the international suppliers and design problems caused the chain of delays and cost growth. The models of making decisions applied in the project were tested because Boeing needed to constantly adapt its strategies in order to handle these changing risks (Schmuck, 2021). The traditional method of project feasibility evaluation, the Cost-Benefit Analysis (CBA), proved insufficient in solving the dynamic risks that were experienced in the production process. Rather, Boeing needed to utilise the Monte Carlo simulations and Fuzzy Logic models extensively and model the project plan with several risk scenarios to manipulate the project plan. The case explains the significance of incorporating advanced decision models, including Monte Carlo simulations, which offer a probability method of risk measurement, in high-risk projects, which encompass intricate world supply chains. Boeing 787 also demonstrates the importance of proactive risk management in the case of which a continuous monitoring process and flexibility are key to the success of high-risk, technologically-oriented projects (Schmuck, 2021).

### 3.4. Evaluation Metrics

The performance of the models of the decision-making will be assessed using the key performance indicators (KPIs) such as cost performance, time effectiveness, and quality delivery. Cost performance will be measured through comparing the actual project expenditures and initial project budget. Time efficiency will be measured through examining the schedule follow up and delays experienced during project implementation. The quality delivery will be determined by compliance with set quality standards and satisfaction of the stakeholders. These measures will give a quantitative foundation on which the effectiveness of the various decisions based models can be evaluated in the process of handling high-risk projects. To analyze the data, statistical methods will be used including regression analysis and variance analysis in order to find out the relation between the alternative decision-making methods and the project outcomes. Also, it could be done through factor analysis to determine the critical decision factors that play the most important role in delivering project successfully. These methods of evaluation will make sure that the research provides a comprehensive understanding of how different decision-making models impact the outcomes of high-risk projects.

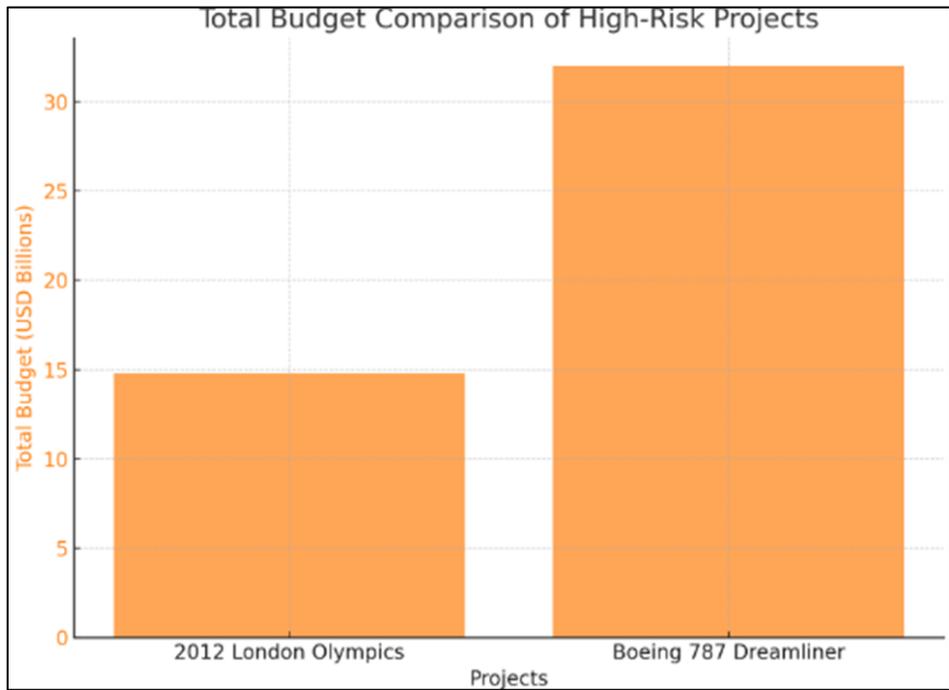
## 4. Results

### 4.1. Data Presentation

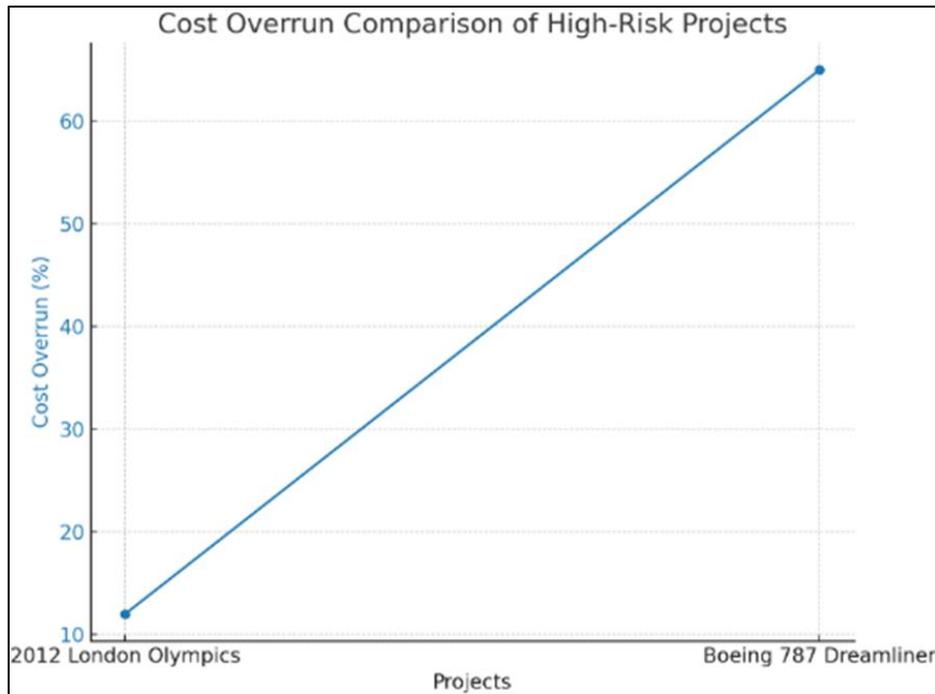
**Table 1** Budget and Cost Overrun Comparison of High-Risk Projects

Project	Total Budget (USD Billions)	Cost Overrun (%)
2012 London Olympics	14.8	12%
Boeing 787 Dreamliner	32.0	65%

### 4.2. Charts, Diagrams, Graphs, and Formulas



**Figure 2** This bar chart compares the total budgets (in USD billions) for the 2012 London Olympics and the Boeing 787 Dreamliner projects



**Figure 3** This line graph illustrates the percentage of cost overruns for the 2012 London Olympics and the Boeing 787 Dreamliner projects

#### 4.3. Findings

It can be seen that decision-making models play a crucial role in determining the capability to balance cost, quality, and time on the high-risk projects. Conventional approaches such as Cost-Benefit Analysis (CBA) and Critical Path Method (CPM) were useful in determining the feasibility of a project, as well as scheduling projects but failed in dealing with uncertainty and dynamic changes. More sophisticated models like Monte Carlo simulations and Fuzzy Logic on the other hand proved to be more flexible and adaptive in dealing with risks that were not initially anticipated. These models were more accurate in risk prediction and enabled the project managers to make a better decision and trade-offs to be managed. Finally, the traditional models still have their place in the background, but their inability to work in complex and highly-risk contexts highlights the need to integrate advanced risk management tools in order to enhance better decision-making results. The results indicate that a combination of various decision-making models would contribute to the overall positive performance of the projects, which would be more efficient and effective in terms of cost, quality, and time balance.

#### 4.4. Case Study Outcomes

The case studies analysis of the 2012 Olympics London and Boeing 787 Dreamliner projects indicate that there are varying results according to the models of decision making. London Olympics, being a large-scale and time-intensive project, was an opportunity to employ a combination of classic and progressive decision-making models. The CPM and risk-based models enabled effective scheduling and management of costs, but there were problems of quality that were experienced. On the other hand, Boeing 787 had even greater issues because, although initially, its decision-making models were based on the traditional approach, they could not accommodate supply chain disruptions. The Monte Carlo simulations and the Fuzzy Logic that were applied later in the project enabled Boeing to modify its risk strategies and control cost overruns but this was implemented too late to reduce the full impact of delays and cost increase. These case studies have shown the paramount role of timely adaptation and integration of models in order to achieve improved project risk and project outcomes management.

#### 4.5. Comparative Analysis

When comparing the models applied in decision-making to the London Olympics of 2012 and the success of the projects of producing Boeing 787 Dreamliners, it is essential to note that the models differ in certain aspects. The project management of London Olympics managed to incorporate the old approaches like CPM with effective risk management models, which led to comparatively manageable cost overruns and delays, despite the complexity of the project. Conversely, the use of traditional decision-making approaches such as CBA in the earlier years at Boeing could not

reflect unexpected risks in its global supply chain resulting in huge costs overruns and delays. The Monte Carlo simulations and Fuzzy Logic integration into the project later were able to deliver improved risk assessment but these models came too late to help avoid significant setbacks. This comparison can be taken to imply that although the traditional models are still essential, it is important to integrate them with the advanced risk-based models at the project inception to make more effective decisions in the high-risk context.

#### **4.6. Model Comparison**

Comparative study of the models of decision making that were applied in both case studies depicts different trade-offs in cost, time, and quality. Traditional models such as CBA and CPM within the London Olympics offered an excellent approach in balancing between time and cost but failed to cope with the unknown issues that influenced the quality and overall project deliveries. On the other hand, the sophisticated models were used later in Boeing 787 project like Monte Carlo simulation and Fuzzy Logic which enabled more accurate forecasting of risks as well as being able to predict possible cost overrun earlier. Nevertheless, these models could not counter the massive delays that had already been brought about by the original inefficiencies. Quality wise the Olympics had its difficulties but it was able to deliver within the scope and the dreamliner project by Boeing was a failure due to the delayed delivery and increased cost. The most important is the realization that incorporating better decision-making models at earlier stages of the project lifecycle would probably result in enhanced performance in terms of balanced performance in all three constraints cost, time and quality.

#### **4.7. Impact and Observation**

The results of this study are important to the practice of project management, particularly in the high risk settings. The findings demonstrate the relevance of integrating both the conventional and the modern decision making models towards addressing the complexities and uncertainties associated with large-scale projects. It is possible to incorporate the advanced models such as Monte Carlo simulation and Fuzzy logic at an early stage in the project life cycle so that the risk assessment and decision making is enhanced, thereby minimising the cost overruns and stragglers. Further, the research paper highlights the importance of flexibility and adaptability in the management of projects, because risks may change during the project. Project managers can take a more dynamic decision-making approach hence strike a better balance among competing constraints to achieve a better project outcome such as cost, time and quality. These remarks point to the fact that the transition towards considering risk-based decision-making models at the start of high-risk projects may result in more effective and successful project delivery.

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### **5. Discussion**

#### **5.1. Interpretation of Results**

The findings of this research are in favor of the prevailing theories of project management with Triple Constraint Theory being one of them holding that time, cost, and quality are interrelated. The results indicate that the old-style decision-making models including the Critical Path Method (CPM) remain useful with the high-risk projects yet fail to address unexpected complexities. More sophisticated models such as Monte Carlo simulations and Fuzzy Logic were found to be more flexible as they offered superior risk forecasts, and allowed making more informed decisions. Nevertheless, they could only be effective when they were applied in good time. This understanding counters the previous models, which failed to capture the dynamism of the contemporary high-risk projects. The findings support the statement that incorporating a variety of models, both old and new, is necessary to improve the entire process of decision-making and find the balance between all limitations in the project. Moreover, it is also observed in the results that effective risk management must be proactive to prevent project delays and cost overruns.

#### **5.2. Results & Discussion**

The most compelling results of this paper are that though the traditional decision making models, like the Cost-Benefit Analysis (CBA), offer a good foundation to be used in making decisions, they are not successful in addressing the uncertainties and complexities, of high risk projects. The case with the 2012 London Olympics and the Boeing 787 projects is that the traditional models were used in the initial phases, but since they could not handle changing risks, they caused cost increases and setbacks. Incorporation of sophisticated models such as Monte Carlo simulations and Fuzzy Logic enabled project managers to know and avoid risks better but these models were not applied on time to eliminate major setbacks. The results demonstrate the increased necessity of new hybrid forms of decision-making that include both conventional and advanced tools. These models offer an ideal solution to the complexities of a high-risk project and indicates that risk management is the main success factor to project delivery.

### **5.3. Practical Implications**

The research findings show to the project managers the importance of integrating the traditional and the modern decision-making paradigm in the project lifecycle stage. With the help of such models as Monte Carlo simulations and Fuzzy Logic, the risks can be predicted and reduced better, which helps the managers to take some proactive measures in changing the project plans. The research indicates that implementing the models at the beginning is more helpful to strike the right balance between cost, quality, and time in case of some unexpected problems. Real-time risk monitoring is another tool that should be implemented by managers in order to make dynamic changes as the project advances. Also, the project managers must be malleable and capable of changing decision-making structures to meet the individual needs of every high-risk project. Integrating the proven tools and the innovative approaches, the project managers are able to get superior project results, reduce cost overruns, and address deadlines without compromising on the quality parameters.

### **5.4. Challenges and Limitations**

This paper does not ignore a number of limitations especially on the scope and sample size. The case studies under consideration, the London Olympics 2012 and the Boeing 787 Dreamliner are large and complicated projects and what works well with them might not be entirely true of small projects with other industries. Also, the use of secondary data and the interview with the few project managers can be biased or leave important insights out. The other difficulty encountered in the course of the research was the inability to compare various decision-making models in different industries since they have different contexts and variables. Although the analysis was very thorough, the variety of decision-making instruments applied in the case studies implied that it was difficult to make clear and universally applicable conclusions. The limitations could be overcome in future research through selection of more case studies and analysis of small scale projects or other sectors.

### **5.5. Recommendations**

In order to enhance decision-making frameworks in extremum environments, it is advisable that project managers consider the use of both the traditional and the modern tools at the very stage of the project lifecycle. Complex risks and uncertainties can be navigated with the help of the combination of benefits of Cost-Benefit Analysis (CBA), Critical Path Method (CPM), and Monte Carlo simulations in the form of Hybrid decision-making models. Also, the real-time combination of data and advanced analytics is the area of the future research that should be conducted to further advance the decision-making models. With the increasing interrelation and reliance of high-risk projects on global supply chains, future research into the use of machine learning and AI within risk management is necessary. Future research may also be used to investigate the performance of adaptive decision-making models in various types of projects, which can be done by investigating the ability of various industries to adapt these models to their needs and challenges.

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## **6. Conclusion**

### **6.1. Summary of Key Points**

This paper has discussed the usefulness of decision-making models in projects with high level of risk with respect to trade-off between constrained cost, time, and quality. The major insights reveal that traditional models, including Cost-Benefit Analysis and Critical Path Method, are still essential but ineffective where uncertainty and complexity in the high-risks environment are involved. Further models such as Monte Carlo simulations and Fuzzy Logic were more effective in the management risks, but their application was essential at the beginning of the project. The London Olympics and the Boeing 787 Dreamliner case studies of 2012 showed that it is vital to incorporate various decision-making models to maximize the project results. The examined research underlines the necessity of proactive risk management and specifies the importance of hybrid and flexible models that integrate both conventional and innovative tools to guarantee the enhanced quality of decision-making, the efficiency of the project, and its increased success in high-risk projects.

### **6.2. Future Directions**

Future studies are recommended to investigate the way of integrating young emerging technologies, like artificial intelligence (AI) and machine learning, into high-risk project decision-making models. This is because the technologies present the possibility of delivering more realistic real-time risk measurement and automating the decision making processes, which would improve the capacity of project managers to adapt to dynamic project situations. Also, the dynamic environment of global supply chains and climate change risks provide new considerations that should be included in project management models. It would be interesting to explore how these external risk factors can influence

the process of making decisions in a project. It is also important to conduct research on the practical implementation of decision-making models in real-time and how it can be applied in projects of various size and industries. This would aid in tightening of frameworks and make them more adaptable ultimately increasing the rate of success of high risk undertakings in different fields.

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