Ranking the prevalence of construction cost overrun risk factors in completion of public-private partnership projects: A case of the Sondu-Miriu hydro-electric power project in Kenya

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ABSTRACT

The purpose of the study was to identify and rank the prevalence and severity of risk factors construction cost overrun in Public-Private Partnership projects using a case study of the Sondu-Miriu Hydroelectric Power Project in Kisumu County, Kenya. This study adopted a descriptive design and collected quantitative data analyzed quantitatively using descriptive statistics. In total, 85 persons were identified to have taken part in the management and implementation of the study from whom a sample size of 71 participants was obtained. Questionnaires were emailed to the participants providing details of the study and requesting their participation. The study ranked the risk factors based on prevalence and severity from most prevalently severe to least prevalently severe as design changes, emerging tasks affecting delivery, construction task breakdown structure, design variations, and failure of contractors to complete different tasks. Thus, stakeholders should participate fully in the project from design to avoid design changes leading to cost overrun. During implementation, the contractor and construction manager should devise mechanisms to anticipate changes in the political environment as such changes determine government policies and decisions affecting the project funding, design, and scope.

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Introduction

Due to the existing exponential rate of urbanization witnessed in the world, there has been a corresponding increase in construction projects as the cornerstone of urbanization (Li, et al., 2005; Ichimura, 2003). The large number of construction projects required by the developing sectors and initiated by governments in developing countries has resulted in constraint on financial resources leading to a shortfall (Zhu, 2004; Wu, 1999). This has led to emergence of innovative practices to fund and deliver such projects among them Public-Private Partnerships (PPPs). Public-private partnership (PPP) model integrates the strengths and advantages of government structure and goodwill with the technical prudence of the private investors and efficiency in service delivery (Koppenjan & Enserink, 2009).

Through PPPs, the service providers target sustainable solutions in project provision and maintenance to achieve best quality, highest level of satisfaction, timely delivery and cost effectiveness. Thus, the governments are able to derive innovation from the implementers, eliminate negative impact, ensure acceptable environmental management while delivering the required public project (Agarchand & Laishram, 2017; Anastasopoulos *et al.*, 2010; Kwak, Chih&Ibbs, 2009). However, adopting PPP has a strategy has the potential to introduce risks, some of which are not in other forms of contracting practices. Using principal-agent theory, practitioners and scholars acknowledge the risks of involving different stakeholders by understanding their motives within the wider scheme of project implementation through PPP (Shrestha *et al.*, 2019).

Despite the acknowledged success of PPP projects, failures due to emerging risks have been witnessed attributed to financial management, political environment and rejection of the project by the host community (Zou *et al.*, 2008). As such, due to the number of stakeholders involved, the divergent interests and the emerging risks, PPP projects suffer legal wrangles, political disputes and

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culture dynamics (Abdel Aziz, 2007). A vivid example of conflict, dispute, failure and recourse is that is cross cutting across the projects is presented by Bird's Nest Project of Beijing, which was repossessed by Assets Supervision and Administration Commission (ASAC) in 2009 citing statements that the implementing company failed in its functions of instituting control mechanisms, made numerous design mistakes and faults which resulted into more costs (Bird's Nest Stadium Project, 2009). Such conflicts have the potential to drag over a long time while seeking to find solutions. The delay will result into running costs and failure to realize the economic value of the project (Doloi, 2012), and even the overall failure of the project (Wang, Liu, Xiong & Song, 2019).

Risks can increase losses by increasing costs, undermining the quality of projects, and even delaying delivery of designed works. Osipova (2008) noted that construction-related risks significantly impact the construction projects in the country because it affected the quality, time and costs of those projects. Findings showed that there was no iterative method of managing risks among the companies and concluded that partnership ensures cooperation between stakeholders through shared risk allocation during project execution.

Completion of PPP projects entails the comprehensive delivery of the project within the boundaries of the planned time, budgeted costs, and without unresolved labour issues. PPP projects are aimed at finding solutions to public problems by taking advantage of resources in the hands of public sector. It thereby combines the strengths in public and private sectors to solve problems that members of public face. Thus, international organizations, governments, and private developers have appreciated and embraced the cost benefits of such arrangements hence their popularity.

One of the main challenges of PPP approach in project implementation is cost overrun given the expectation is high from the beneficiary group. Usually, where governments are involved, the people or the population demand projects which meet their unique needs and high levels of accountability based on geographical or social differentiation (Bordat et al., 2004). Identifying the determinants of cost overrun and their severity in PPP is potentially valuable when implementing such projects. This has resulted in increased research regarding cost overrun (Frimpong et al., 2003; Flyvbjerg et al., 2004; Kyte et al., 2004; Bhargava et al., 2010). However, previous researchers have identified numerous factors for cost overrun without ranking and quantifying the magnitude of their effects on cost overrun. The studies model the factors to lead to overrun without actually presenting the ones with significant effects. It presents a bleak scenario where all activities present one of the limitations of past research is the assumption (typically due to data limitations) that cost overrun, along with other cost characteristics, behaves the same across different contract approaches (Gransberg et al., 2007, Gransberg & Riemer, 2009; Anastasopoulos et al., 2011; Choi et al., 2013). A study of cost overrun by PPP contracting approach would ideally identify the corresponding influential factors, thereby establishing relationships that enable more accurate predictions of cost overrun likelihood and amounts/rates that are approach-specific.

Research on the risk associated with PPP projects has focused on risk identification, risk evaluation, and risk allocation, as well as the exploration of methods for identifying factors related to the success or failure of PPP projects (Cui, Liu, Hope & Wang, 2018). However, there is little work concerning the severity and significance of each risk. Ranking the risks based on magnitude of influence on completion is important if managers are to focus on the aspect of cost management while maximizing on quality and the available resources of time and labour.

The purpose of the study was to identify and rank the prevalence and severity of risk factors construction cost overrun in Public-Private Partnership projects using a case study of Sondu-Miri Hydroelectric Power Project in Kisumu County, Kenya.

This study adopted a descriptive design and collected quantitative data analyzed quantitatively using descriptive statistics. In total, 85 persons were identified to have taken part in the management and implementation of the study from whom a sample size of 71 participants was obtained. Questionnaires were emailed to the participants providing details of the study and requesting their participation. The study ranked the risk factors based on prevalence and severity from most prevalently severe to least prevalently severe as design changes, emerging tasks affecting delivery, construction task breakdown structure, design variations, and failure of contractors to complete different tasks.

Literature Review

There is no doubt that almost all significant projects involve some level of risk because of their complexity and expected longer investment period (Lyons & Skitmore, 2004). Further, variations in PPP projects in developing countries might occur due to variations in their constraints and risks. Cost overrun occurs when projects incur more than the budgeted amounts of money. Sometimes, it is referred to as excess cost above budget ceiling (Zhu and Lin, 2004). Koushki, AL-Rashid and Kartam (2005) examined rising costs and time overlap in the developments of private residential units in Kuwait. They established that excess costs and time overlap proportionately related to total costs. Lack of financial resources and inappropriate time allocation were some of the factors that contributed to this relationship.

Frimpongs, Oluwoye and Crawford (2003) evaluated about 26 factors that caused cost overruns and established that difficulties in obtaining monthly payments from project owners were the main factor that caused project delays. Similarly, Mweresa (2013) investigated the impact of high prices in construction projects. The population of the study consisted of contractors, consultants, and clients. Purposive sampling was used to select forty respondents. It showed that eight factors, namely work definition, bureaucracy

in government, risk allocation; timeliness; requirements' interpretation, resource planning, inefficient preparation and contractors' inabilities had notable impacts on overruns.

Tipili and Ilyasu (2014) on performance criteria within Nigerian construction industry noted that most important performance indicators for evaluating project performance were quality of the construction work when completed, cost incur to complete the project and time taken in the delivery of the designed project in successive order.

According to consultants, setbacks in decision making; poor planning and supervision; poor communication; lack of skills among consultants; a lot of time wasted as contractors wait for sample materials and drawings to be approved are some of the factors that delay projects. Further, researchers have shown that contractors fail to make use of risk analysis techniques and instead depend on own judgments as they estimate cost and time. A study by Mousa (2005) in Tanzania has shown that project owners and consultants tend to lack innovative methods of preventing and mitigating risks.

Research and Methodology

This study adopted a descriptive design and collected quantitative data analysed quantitatively using descriptive statistics. The independent variable was the construction costs with the dependent variable being completion of PPP project. The participants were members of the management team of the completed the Sondu-Miriu Hydroelectric Power Project. This was a completed PPP project in Kisumu County Kenya which had faced traditional and unique challenges leading to delays of more than five (5) over the project completion date, increased costs nearly 25% beyond the initial cost estimates and the eventual failure to deliver auxiliary components to the main project.

The top management involved in this study comprised members of project owners (government), the funding organization and the contractor. In total, 85 persons were identified to have taken part in the management and implementation of the construction of SonduMiriu Hydro Electric Power Project. A sample size of 71 participants was obtained. Questionnaires were emailed to the participants providing details of the study and requesting their participation. The questionnaires identified five items contributing to cost overrun which frequently dominated literature on construction projects. Calls were made to the sampled participants to provide reminders and urge them to participate. After a period of 1 month, a total of 39 questionnaires were received and analysed.

Model of the Study

The study is modelled showing stakeholders, risk factors they presented in completion of PPP projects and the aspects of cost overrun they lead to as presented in Fig. 1.

Figure 1: Conceptual Framework

The government as the main stakeholder determines the nature of the project. As such, the government constant introduces new tasks, proposes changes to design and recommends variation in design of individual components. On the other hand, other stakeholders including the contractors and financier may failure to complete tasks as scheduled including timely financing the project activities. Moreover, breakdown in tasks or bundling together is done whose effect is felt on rising costs. The cost overrun result from increased labour needs, increased material needs, increased cost of materials due to delays and inflation costs, need for more experts and logistics and sub-contracting costs due to repackaging of project tasks.

Results and Discussions

The five (5) items identified to contribute to cost overrun were contractor's failure to complete tasks, additional tasks emerging during construction process, changes in design during construction, design variation necessitating additional experts and the challenge of task breakdown for implementation. The participants rated the prevalence and severity of the cost increase components on a five (5) level scale where 1 was least prevalently severe with 5 being most prevalently severe. Data obtained from the 39 complete questionnaires represented a return rate of 54.9% which was acceptable considering that the respondents were members of the top

management. The data was analysed to determine mean score for each factor and the corresponding standard deviation (SD) which was used for ranking the prevalence of the risk factors towards cost (see Table)

Table 1: Risk Factors Contributing to Cost Overrun

Statement	N	Mean	SD	Rank
Contractor's failure to complete tasks lead to cost overrun	39	3.87	1.17	5
Tasks emerging during construction contribute to cost overrun	39	4.00	1.05	2
Design changes during construction resulted in cost overrun	39	4.18	1.05	1
Design variation necessitating additional experts resulted in cost overrun	39	3.97	1.14	4
Construction Task breakdown structure increased the overall cost	39	3.97	0.99	3
Composite mean	39	3.97	0.124	

The findings also showed that changes in design during construction resulted into additional costs thus raising the overall project cost as indicated by the item line mean (Mean = 4.18, SD = 1.05) which is higher than the composite mean (Mean = 3.970, SD = 0.124). This emerged as the most prevalently severe risk factor in implementation of PPP projects. The changes that occur have significant impact on project execution resulting in an overall effect of increasing the project costs. The challenge of design changes is prevalent due to the nature of government, there are prevailing political reasons and changing policy direction and visions desired by the government at the time of design. These visions and policies change with changing administration as well as political alliances. As governments continue to be key stakeholders in PPP projects, the aspect of design changes will persist and with the severity of such changes on the project cost, contractors and construction managers should dedicate resources and allow for flexibility to adjust to such changes.

Emerging tasks during the project were found to influence positively the timelines leading to increased project cost as indicated by the item line mean (Mean = 4.00, SD = 1.05) which is higher than the composite mean (Mean = 3.970, SD = 0.124). This shows that the problem of emerging tasks emerged frequently during project execution. During construction, when tasks which were not initially foreseen come up, the cost of completing the project increase. Such tasks including putting up temporary structure to mitigate against the effects of weather and emerging demands due to changing client needs. Such tasks will eat into the time allocated for other tasks, necessitate additional labour and require additional materials. Out of the five items, emerging tasks ranked high as the second most prevalently severe risk factor to construction risks. Similarly, Okeyo, Rambo and Odundo (2015) established that delays in payments affected project completion by reducing efficient processes and production (71.8%); increasing time attributable costs (71.8%); re-scheduling works (69.2%); extending time (69.2%); and preventing projects from completing before allocated time (53.8%).

Similarly, design variation resulted in the need for more experts hence raising the overall project costs as indicated in the item line mean (Mean = 3.97, SD = 1.14) which is the same as composite mean (Mean = 3.970, SD = 0.124). Prevalence severity of design variation was ranked fourth (4) out of the five items listed in the scale hence being significantly severe. Whereas in some cases, the entire project design might not change, design variations for individual components may necessitate inclusion of special stakeholders with an overall effect of increasing the project cost. Contractors should critically and comprehensively analyse the design variations to minimize the effect of cost overruns. The results agree with those of Mweresa (2013) who revealed that there were eight factors that acted as underlying ones to overruns.

The study results also indicated that work breakdown structure during the project necessitated the involvement of many sub-contractors leading to increased project cost as indicated by the item line mean (Mean = 3.97, SD = 0.99). The challenge was found to be occurring significantly in comparison to composite mean, (Mean = 3.970, SD = 0.124). This implies that based on the magnitude of the project, there was a need for breakdown to facilitate completion. However, the breakdown implied the need for more sub-contractors hence increased costs. When the lead contractor has to bring on board sub-contractors to accomplish certain tasks, there is a challenge of classifying the tasks and determining the units or blocs for sub-contracting. This coupled with the time duration for negotiating terms of engagement and logistics will result into cost overrun affecting the entire project.

The study found that the effect of contractor being constrained to complete certain project parameters resulting into outsourcing some services was considerable although relatively low as indicated by the line item mean (Mean = 3.87, SD = 1.17). This was lower than the composite mean (Mean = 3.970, SD = 0.124). This shows that having a contractor who is not capable of completing various tasks components required to deliver a PPP project will ultimately lead to cost overrun. The contractor outsources the expertise from sub-contractors who were not part of the initial negotiations thus might be incapable of achieving the timelines and working within the cost framework. Contractor's failure to achieve project tasks ranked the lowest out of the five items indicating less prevalence despite

occurrence and the potential effect. Overall, it was found that there were costs overrun resulting from delays, design changes, use of sub-contractors as well as emerging tasks (Mean = 3.970, SD = 0.124).

Conclusions

Outsourcing services result in additional costs in documentation as well as equipment. Similarly, as the tasks emerged during the project execution, additional costs were incurred, thus ultimately resulting in increased project costs. Further, changes in design during construction result in additional costs while the need for work breakdown to facilitate completion necessitated the use of more sub-contractors hence increased costs. Overall, the study concludes that costs overrun result from delays, design changes, use of sub-contractors as well as emerging tasks affecting delivery.

Project stakeholders should minimize the number of contractors by vetting and prequalifying contractors with capability to deliver the services. This will prevent outsourcing and minimize cost overrun to ensure the project is completed as designed. Moreover, stakeholders should participate fully in the project from design to avoid design changes leading to cost overrun. During implementation, the contractor and construction manager should device mechanisms to anticipate changes in the political environment as such changes determines government policies and decisions affecting the project funding, design and scope.

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