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Dynamic Management of Cost Contingency: Impact of KPIs and risk perception

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Abstract

Risks are inherent in construction projects. In order to manage risks, contingency amount is set aside usually in an escrow account. Cost contingency can be a handsome amount that would get blocked during the execution of the project for further use, incurring constant opportunity cost. The stakeholders may wish to use this held amount for other endeavors during project execution. The managerial practices for dynamic contingency management are of extreme importance. Stakeholders anticipate risks and hindsight project performance by eyeing key performance indicators of a project to direct decisions. The aim of this research is to integrate project key performance indicators with future risk perception to develop a decision support system for facilitating cost contingency release requests. The model is expected to help decision making to ease the managerial burden ensuring effective use of contingency. The findings are not conclusive due to ongoing nature of research.

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1. Introduction

Construction projects are intricate endeavors involving time, cost and other resources [1]. Herroelen and Leus [2] suggested that effective management may ensure success of the project but risks will always be there impacting the idealized project objectives. Cost contingency funds are added in project budget to financially furnish the mitigation of the identified risks. An escrow account is set up for collection and better handling of the cost contingency. Cost contingency estimation in the planning phase alone is often misinterpreted as contingency management but the full scope of contingency management includes iterative process of decision making regarding contingency amount such as reappropriation, reallocation, withdrawal, reuse of funds for other purposes, etc..

Due to their probabilistic nature, many of the anticipated risks may or may occur during execution of the project and the contingency fund anticipated for the mitigation of those risks might become an opportunity to be released. The released contingency sum may be collected as profit or capital for investment or might be reallocated to some other use outside the project [3].

Prudence might suggest a relation between project performance and decision making of contingency management. Since cost contingency has been a research topic for long, the main focus was with the estimation of contingency amount but less work has been done in the domain of contingency management [3]. To address the gap in this area, this paper is a humble effort to address the cost contingency release request during the execution of the project by proposing a decision support system to ease the distress caused by such scenario. Relying on the key performance indicators (KPIs), future risk perceptions and managerial mental models, this study tries to address the cost contingency release requests on factual project based grounds rather than pure intuition. As a part of an ongoing research, the findings are not conclusive yet but with the planned methodology, following the model proposed by Ford [4] and improvements suggested by Marco, Rafele [3], a mathematical model would be generated to calculate the amount of cost contingency fund to be released at any point of project execution.

This research paper is structured as follows. At first, significant literature is synthesized addressing the problem area. Secondly, research design for this paper is discussed in detail. Thirdly, the current findings are expressed. Finally, discussion is carried out marking the conclusions.

2. Literature Review

Cost contingency has been a focus area of research for long attending the need of proper estimation of funds with application of diverse appropriate methods [5]. For an estimator, it is important to perceive the project in whole beforehand to have better understanding and maturity relating to the risks involved to achieve actual project costs [6]. Cost contingency is defined as “*an amount of money within the cost baseline that is allocated for identified risks, which are accepted and for which contingent or mitigating responses are developed*” [7]. Estimation of cost contingency can be done using traditional [8], qualitative and semi-quantitative [9], probabilistic [10] and simulation-based [11] methods as are in practice in the present construction industry.

Marco, Rafele [3] identified the lack of research in the area of cost contingency management and studied the managerial pressures by project stakeholders during the contingency release process. There can be a budding confusion with practitioners that once the cost contingency is estimated and added in the budget, everything will be as planned but construction projects rarely live up to the plans due to the risks associated and the overall uncertainty [12, 13]. Risks need to be identified and managed as an iterative process, not only in the planning phase but during the project execution also [14, 15].

Involving reassessment, reestimation and possible reallocation of cost contingency amount, Xie, AbouRizk [16] suggested that project cost contingency should be updated during the project execution at major milestones.

Baccarini [17], Baccarini [18] studied the impact of different stakeholders on cost contingency suggesting that cost contingency decision making and management is based on personal point. The dynamism is due to the interests and influence of individual stakeholder. There is always an uncertainty in all of the decision [19]. It is quite logical to suggest that risk perception of an individual stakeholder might impact the overall decision making [20] which can be outlined as a person's evaluation of inherent risk and the confidence in overall situation [19]. A good number of project managers do not formally manage project cost contingency resulting in exhaustion of cost contingency funds

before project closure requiring additional funds to address risks later in the project [21]. For humans, the ability to consider large number of influencers in decision making is very less [22]. Also, there is a reliable relationship between risk perception and decision making suggesting consideration the incorporation of risk perception in decision making process [23].

Ford [4] created a dynamic model for cost contingency management upon system dynamics approach studying the mental models of project managers managing contingency funds. The study divided the cost contingency utilization in three main functions i.e. resolving emergencies, schedule control and facility improvement. Marco, Rafele [3] improved upon Ford [4] model further by introducing concept of contingency fund release as profit and managerial pressures as a driving factor.

3. Methodology

The research presented was carried out as follows:

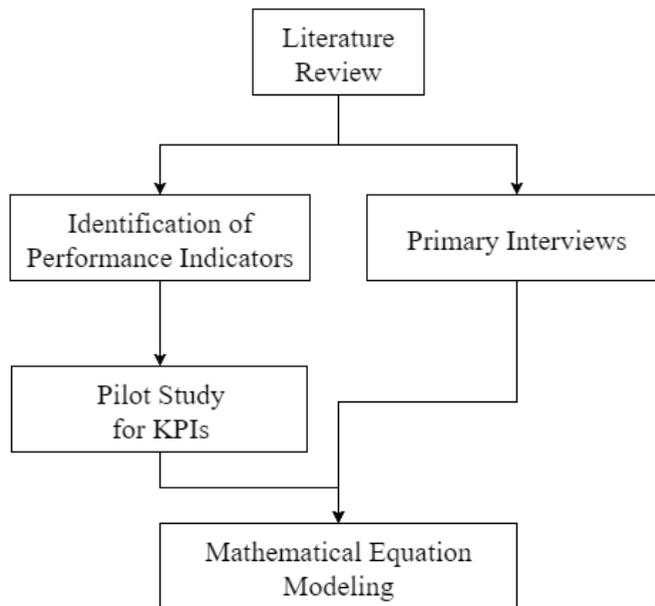


Figure 1. Methodology flowchart

In literature review, Special focus was on the work of Marco, Rafele [3] and Ford [4] as they are the basis of this research. For the identification of KPIs, research papers were studied from year 2001 to 2015 giving recent trends in the research area. “Google Scholar” was used as main search engine for the retrieval of pertinent research papers with keywords “engineering”, “management”, “business”, “decision making” and “key performance indicators” from which 110 relevant research publications were studied. A total of 53 performance indicators (PIs) were identified with a maximum appearance of a single performance indicator at 22, giving a relevance index of 20%.

After literature review, unstructured interviews are conducted from field professionals to understand the basics of cost contingency, its usage and decision making. Interviews are aimed to gather information regarding managerial influences, assessment of project performance and risk perception regarding the ongoing projects. Scenario of contingency release in a project was conversed giving an insight towards the decision making process behind this request and its mental model. Sample size for number of interviews was consulted from Hertzog [24] and Van Belle [25] suggesting minimum number of interviews should be 10 whereas for a healthy data, interviews should fall in between the numbers 10 and 40. The interviews will be carried out in two phases from which first phase interviews are completed. A number of 9 professionals were interviewed in the first phase, giving an impetus for a raw

equation depicting the decision making process of contingency release. Further improvements on the equation will be requested in the second phase.

Simultaneously with the primary interviews, pilot study interviews are also being carried out involving international industry professionals from the ranking of each PI that is identified via the literature review. This ranking will help the researchers in pin pointing the PIs that would be termed as KPIs for cost contingency decision making process. A total of 400 industry professionals are contacted via the internet for their input regarding the ranking of PIs. 7 interviews have been carried out till now. After both streams of interviews, a mental model equation will be generated incorporating the KPIs and other influencers. A flowchart of methodology is given in Figure 1.

4. Data Analysis and Results

From the synthesis of literature, a list of PIs was created with their respective appearance frequency and relative importance index (RII) was calculated following the methodology of Gündüz, Nielsen [26]. A list of PIs sorted according to their RII values is given in Table 1.

Table 1. List sorted according to RII of PIs identified via literature review

PI	RII	PI	RII	PI	RII
On Time Completion	0.773	Scope Changes and Change Orders	0.227	Units/MH	0.091
Cost Of Overall Job	0.727	Lost Time Accounting	0.182	\$/Unit	0.091
Stakeholder Satisfaction	0.727	Growth	0.182	Percentage Completion	0.091
Safety	0.591	Financial Stability	0.182	Absenteeism	0.091
Quality	0.591	Business Efficiency	0.182	Specifications	0.091
Profitability	0.500	Market Share	0.182	Organization Competency In Human Resource Management	0.091
Productivity	0.409	Labour Efficiency	0.182	Continuous Improvement	0.091
Resource Management	0.318	Predictability (Schedule/Cost)	0.182	Technological Capability	0.091
Innovation	0.318	Turnover	0.136	Empowered Work Force	0.091
Human Resource Training And Development	0.318	Motivation	0.136	Change Management	0.091
Communication and Coordination Management	0.318	Effectiveness Of Planning	0.136	Project Complexity	0.091
Managers Competency And Project Team Performance	0.273	Partnership And Suppliers	0.136	Price and Schedule Revisions	0.091
Penetration and Investment in New Markets	0.273	Policy Or Law Of Government	0.136	Punch List	0.045
Research And Development	0.273	Number Of High-Performance Professionals	0.136	Successful Tenders Rate	0.045
Conflicts And Disputes	0.227	Competitive Environment	0.136	Capital	0.045
Cash Flow	0.227	Time Variation	0.136	Interest Cover	0.045
Risk Management	0.227	Net Present Value	0.136	Project Constraints	0.045
Environmental Impact	0.227	Functionality	0.136		

The findings suggest that the key project criteria identified by PMI [7] are synonyms to the top 5 PIs identified i.e. on time completion, cost of overall job, stakeholder satisfaction, quality and safety indicating that academia

confirms the heuristics of general decision making influencers in construction industry.

Primary interview are to be conducted in two phases from managerial personnel possessing job titles such as project manager, project director and construction manager. First phase has been completed with 9 interviews, which were conducted in person lasting between 30 to 45 minutes. The insight from the first phase is of extreme importance because of the evolving nature of interview discussion. Current project performance, risk perception for the remaining project duration, management pressure to release contingency, amount in hand and percentage execution of the project are identified as influencers in the decision making process of cost contingency management.

5. Conclusions

After the study relating to decision making, Rodriguez, Saiz [27] suggested use of KPIs as an input to the process. On time completion, overall cost of project, stakeholder satisfaction, quality and safety are critical KPIs in a project and playing vital part in decision making also involving perception of future risk in a project as established by the findings of this research till now. PMI [7] recognizes these five criteria and risks fundamental which further validate the findings. Cost contingency is also managed over this principle by project managers. Every project manager creates a mental model for ease of decision making, need of organization and demands. The influencers i.e. project performance, risk perception, percentage execution etc. are identified are important players in the overall decision making process related to cost contingency release.

No conclusive results and conclusion is furnished as the research is still in progress.

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