Project Cost Management Considering the Uncertainty
(Case Study: Feasibility studies of mining projects)

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ABSTRACT: Project cost management includes the processes required to ensure that the projects are completed using the approved funds. It generally involves some basic procedures, such as enterprise resource planning, cost estimating, budgeting and control. In addition, in implementation of different projects, various engineering processes may be considered relatively certain in many branches but it cannot be claimed that the design, measurement, classification, assessment or interpretation is performed without any error. The processes related to cost management, including cost estimates, are not an exception and the data used for this purpose may not have near decisive quality, which may present as uncertainty in the data. In the present study, the effects of cost uncertainties in design and implementation process of feasibility studies for mining projects have been discussed as a case study. In order to explain the role of uncertainties, their effects on cost estimates of studies has been examined using Monte Carlo simulation. The approach explored in this study leads to better and more realistic understanding of the effects of cost uncertainties in project cost management and thus contributes to presentation of more efficient approaches to manage the associated risks.

Introduction
The mining industry is recognized as a risky industry due to the high volume of capital finance, mutable nature of the deposit, long term cycle of preparation and production, influence from and high impact upon the environment as well as nature of data that is associated with a high level of uncertainty. In the field of mining engineering, no one can claim error free design, measurement, classification, estimation or interpretation. It cannot even be argued that the raw data have close to definitive quality, because no one can claim that sampling, drilling, extraction and processing have been performed without error. Engineering processes in many branches may be assumed as relatively certain but in some engineering fields, such as mining engineering, heterogeneity within and around the deposit environment causes probable phenomena, which are likely to result in uncertainty in the data (Haldar, 2013). These uncertainties are the main risk factors in different sectors of mining projects. However, the uncertainties will not necessarily involve only negative effects and could present opportunities (Perminova et al, 2008), the possible effects of which are the subject of risk management. Uncertainties in quality and quantity of ore body (grade and stock) are the most important uncertainties in mining projects. The risks associated with mining projects are diverse and complex, while the deposit is the main source of risk (Snowden et al, 2003) and an efficient miner is mostly influenced by management of its risks. Hence, any attempt to identify and manage the sources of uncertainty and their effects that lead to risks in these projects before implementation would be a useful and necessary measure (Haldar, 2013). Feasibility studies are a main component in implementation of projects, especially mining projects, and are an integral part in development of a commercial project. Several uncertainties and risks will affect the process of planning, implementation and reporting of these studies (Snowden et al, 2003). In the present study, while examining and identifying the sources of uncertainty, the effects of cost uncertainties upon costing and planning processes of feasibility studies in mining projects have been discussed.

Project Cost Management
Project cost management involves the processes required to ensure the completion of projects using the approved funds. It generally includes a number of processes as follows (PMI, 2008):
Resource planning: determination of resources (people, equipment, materials) and their quantity to be used to complete the project.
Cost estimate: Cost estimation of resources necessary to complete the project activities.
Cost budgeting: Estimation of overall cost allocation to individual project activities.
Cost control: Controlling the changes in project budget.