بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / سامية زكى يوسف

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

ملاحظات: لا يوجد

STUDY OF ECONOMIC FEASIBILITY OF PHOSPHATE ORE BENEFICIATION USING FINANCIAL RISK ANALYSIS, MODELING, AND OPTIMIZATION WITH UNCERTAINTIES

By

Mahmoud Said Abd El-Salam Ahmed

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Mining Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
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Key Words:
Phosphate beneficiation; net present value; uncertainties; financial risk analysis; optimization

Summary:
The mineral industry is a field of risk for all stakeholders. Financial risk analysis, uncertainty analysis, and optimization are the most crucial mining investment issues. This study aims at analyzing the net present value (NPV) of a phosphate ore beneficiation flowsheet, considering all mining project-related uncertainties. A new Economic Mine Value (EMV) dynamic model is developed to assess the feasibility of the mining project. The stochastic NPV from the EMV model project is 53% more economically viable than the static NPV. Risk analysis showed that the expected net present value-at-risk (NPVaR) is about 4.7%. The EMV model maximized the project simulated NPV by about 35%. The EMV model is universal, as it can be applied to various mineral deposits.

Disclaimer

I hereby declare that this thesis is my original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Mahmoud Said Abd El Salam Ahmed Date: / / 2022

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Dedication

I dedicate this work to my lovely family, parents, and Dalia for their love, support, and encouragement which gave me the strength to overcome many obstacles.

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Abstract

Mine is a risky project with an uncertain nature. The engineering assumptions and the related data from the ore deposit to market through cost and recovery estimations have their variability and uncertainty. Therefore, the business decision to invest capital in developing a mine and constructing a mineral processing plant and services is crucial.

Although, the net present values (NPV) can conclude the profitability and feasibility of a mining project, the uncertain nature of the mine and market indicates the investor's need for proper quantitative risk analysis to get an accurate and reliable estimation of the NPV of the mining project, considering their risks and uncertain variables.

The conventional (deterministic) NPV excludes variability or uncertainty. However, the financial risk analysis can be used to give a mine realistic NPV evaluation and optimization using stochastic variables. The stochastic estimation of NPV incorporates uncertain parameters and risks to overcome the problem of obtaining a deterministic or single-point NPV.

The acute lack of knowledge related to any mine, costs, and market variables proposes the modeling using a uniform or skewed probability distribution. However, the availability of data reduces the considered scenarios and gives investors a clearer vision of the project assessment with a higher level of certainty with the inputs modeled with other distributions of probability.

This thesis develops a new dynamic model for financial risk analysis and optimization for Abu-Tartur phosphate ore beneficiation as an example, incorporating uncertainty to estimate the stochastic NPV using the @Risk 8.1 software.

The new model uses Monte Carlo (MC) simulation to generate stochastic and simulated data representing the uncertainty assessment for each variable as probability distribution functions, regarding which the data are actual, assumed, or researched. Probability distribution functions evaluate a large number of hypothetical scenarios with related uncertainties by searching in the solution space, giving more accurate results. It allocates a stochastic value to each uncertain variable between its lower and upper boundaries. A determined distribution function follows the frequency of each value.

The elimination of the mining project's risk is not the ultimate. Every mining project has the most important stage from the money perspective, which is the optimization of NPV to maximize the expected profit yielded by the mine and minimize the net present value at risk (NPVaR). The optimization process comes down from the simulated NPV.

The interpreting sensitivity analysis establishes how to maximize the NPV by adjusting the data about the most sensitive parameters. Finding the optimum NPV, considering the simulated strategies and ultimate conditions, depends on finding the optimal way to meet the other recovery and production parameters adequately; while minimizing the related costs.

Abu-Tartur phosphate ores plateau, Western Desert, Egypt is selected as a case study for a better understanding and application of the newly developed model.