e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:03/March-2024 Impact Factor- 7.868 www.irjmets.com

ENGINEERING ECONOMICS

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ABSTRACT

The technological and social environments in which we live continue to change at a rapid rate. In recent decades, advances in science and engineering have transformed our transportation systems, revolutionized the practice of medicine, and miniaturized electronic circuits so that a computer can be placed on a semiconductor chip. The list of such achievements seems almost endless. In your science and engineering courses, you will learn about some of the physical laws that underlie these accomplishments. Engineering economics is all about determining if engineering projects are worth carrying out. One of the biggest issues for engineering projects is the costs are usually incurred almost immediately, while the benefits might take a long time to occur, which can take decades. Engineering projects are therefore long-term investments, which must be assessed in great detail before they are initiated in physical form. However, long-term investments hold different difficulties, which must be considered.

Keywords: Engineering Economy, Decision-Making Processes, Integration Of Economics And Engineering.

I. INTRODUCTION

Economics drives the allocation of scarce resources toward unlimited human wants. In engineering, every decision navigates through a maze of alternatives, each demanding rigorous evaluation. As stewards of nature's resources, engineers shoulder the responsibility of transforming ideas into affordable, purposeful realities that cater to the needs of communities.

The roots of Engineering Economy trace back to early 20th-century pioneers like Arthur M. Wellington and Eugene Grant, who recognized the paramount importance of economic evaluation, especially in fields like railway engineering.

Principles of Engineering Economy:

1. Develop the Alternatives: Creativity fuels the identification of viable options.
2. Focus on the Difference: Only differences among alternatives matter for comparison.
3. Use a Consistent Viewpoint: Perspective shapes analysis; consistency is key.
4. Use a Common Unit of Measure: Monetary units simplify comparison and analysis.
5. Consider All Relevant Criteria: Financial interests and stakeholder needs are paramount.
6. Make Uncertainty Explicit: Future projections are fraught with uncertainty.
7. Revisit Your Decisions: Adaptive decision-making hinges on comparing projections with actual results.

Role of Engineers in Economic Decision-Making:

Engineers drive economic decisions across all facets of project execution. From conceptualization to production, they wield significant influence over costs. Capital expenditure decisions, effective asset utilization, and investment strategies are all under the engineer's purview. In a dynamic market, innovation and investment decisions shape the trajectory of companies, demanding a keen understanding of the economic landscape.

In essence, Engineering Economy is about maximizing value while navigating the constraints of scarcity. It's a balancing act that requires foresight, creativity, and a relentless pursuit of efficiency. As engineers, our mission is clear: to optimize resource utilization for the betterment of society while ensuring the viability and competitiveness of our endeavors.

II. LITERATURE REVIEW

This review explores the role of engineering economics in empowering engineers to make informed decisions that impact our daily lives.

The core concept: Engineering economics provides a structured framework, similar to the scientific method, for evaluating the economic feasibility of engineering projects. This ten-step process, outlined in a 2021 study, guides engineers through defining the problem, analyzing alternatives, and selecting the most cost-effective solution. (Ref: International Journal of Engineering Applied Sciences and Technology, 2021)

Importance: As highlighted by Dr. Binod Sinha (2018), engineering economics equips future engineers with the ability to navigate the dynamic world of economic principles and calculations within the engineering context. This expertise allows them to contribute significantly to project success. (Ref: International Journal of Mechanical Engineering and Technology, 2018)

The impact: Mr. A. Vijaya Madhavan emphasizes the role of economic analysis as a crucial tool for decision-making. By evaluating various alternatives through an iterative process, engineers can identify the option that best achieves the desired objective while considering cost-effectiveness. (Ref: Mr. A. Vijaya Madhavan's research paper on Engineering Economic Analysis)

Looking ahead: A 2010 study by Evans et al. acknowledges the need for continuous improvement in engineering economics education. By incorporating innovative teaching methods and technologies, educators can create a more engaging and relevant learning experience for future engineers. This, in turn, will ensure that they are well-equipped to make informed decisions that shape the future. (Ref: A Look Into The Engineering Economy Education Literature, AC 2010-1469)

III. INTEREST, TIME VALUE OF MONEY AND INFLATION

Time Value of Money (TVM): Money's worth changes over time due to factors like purchasing power and earning potential. Engineering projects involve substantial investments over extended periods, necessitating consideration of TVM effects.

Interest: Interest can be simple or compound. Simple interest is linearly related to principal, interest rate, and time. Compound interest accounts for interest earned on accumulated interest, either periodically or continuously.

Nominal Interest Rate: Quoted annually, compounded over a specific period.

Effective Interest Rate: Actual interest earned annually, accounting for compounding periods per year.

Continuous Compounding: Interest compounded infinitely over time, yielding continuous compounding formulas.

Economic Equivalence: Cash flows, whether single or periodic, can be equated to determine their comparative value. Equivalence hinges on a common time basis and interest rate, enabling fair comparisons between alternatives.

Inflation: Inflation signifies a decrease in purchasing power due to rising prices. Measuring inflation relies on indices like CPI, WPI, and PPI, reflecting changes in consumer and producer prices.

Inflation Concept: Inflation erodes purchasing power, necessitating adjustments in economic analyses.

Calculating Inflation Rates: Year-on-year changes in price indices reveal average annual inflation rates, essential for economic projections.

Equivalence Calculations under Inflation: Adjusting cash flows to constant dollars facilitates accurate assessments amidst changing price levels.

Interest Rate Dynamics: Market, real, and inflation-adjusted interest rates elucidate the interplay between earning potential and inflation effects.

Understanding these concepts empowers engineers to conduct robust economic analyses, ensuring informed decision-making in project planning and execution.

IV. CASE STUDY

Privatization Initiatives: A Source for Engineering Economy Case Studies

Introduction: Engineering economy courses can go beyond core concepts to teach skills like technical presentations, critical thinking, and entrepreneurship. Federal privatization initiatives offer opportunities for case studies, integrating various curricular topics.

Case Study Method Overview: Case studies introduce real-world situations into the classroom, enhancing decision-making skills and promoting teamwork. They're particularly useful for teaching engineering economics and entrepreneurship.

Privatization Initiative Context: Circular A-76 guides government privatization efforts, allowing activities to be outsourced either through direct conversion or cost comparison study. It requires detailed cost analysis to demonstrate cost reduction through privatization.

Summary:

Case studies offer flexibility and depth in teaching engineering economics, covering a wide range of topics, and promoting career skills essential for engineering practice.

Case Studies in Engineering Economics for Manufacturing Competitiveness:

Background: Competitiveness in manufacturing relies on various factors including cost competitiveness. Undergraduate engineering education often lacks emphasis on practical aspects like costing and financial management.

Course Management: The course covers principles of engineering economy, financial analysis, and decision-making processes. It includes lectures, group discussions, problem-solving exercises, and case studies.

Selected Case Studies: Case studies cover topics like hybrid vehicles, manufacturing equipment development, HVAC equipment installation, and fleet management, allowing students to apply theory to practical situations.

Applicable ABET Outcomes: The course addresses ABET outcomes related to mathematics, design, communication, global context, contemporary issues, and engineering tools. Manufacturing engineering outcomes focus on competitiveness and strategic planning.

Course Assessment: Student performance and satisfaction improved significantly with the incorporation of case studies, fostering peer and faculty interaction, and enhancing communication skills.

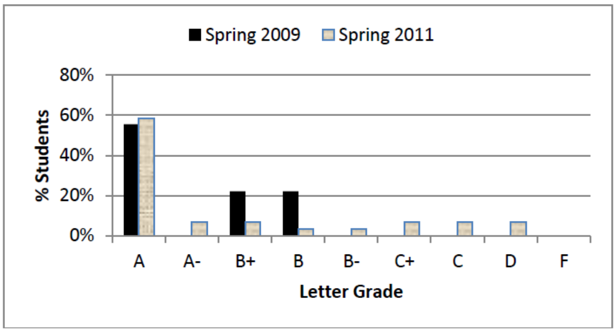

Figure 1: Student final grade distribution for Spring 2009 and Spring 2011 terms.

Summary: Case study-based teaching enhances the learning experience, promotes active learning, and provides practical insights into engineering economics. Students find it challenging and rewarding, improving their overall satisfaction with the course.

V. CONCLUSION

In conclusion, the significance of engineering economy lies in its fundamental role in decision-making processes within engineering projects of all scales. Engineering economy serves as the backbone of these decisions, encompassing the analysis, synthesis, and conclusions derived by engineers. At its core, engineering economy revolves around the essential elements of cash flows, time, and interest rates, which are integral in evaluating the feasibility and profitability of various engineering endeavors.

The integration of economics with engineering principles, as highlighted by Dr. Binod Sinha, holds paramount importance in the contemporary landscape. This integration not only enhances the success of engineers but also fosters a holistic approach to problem-solving. By thinking in terms of groups rather than individuals, engineers can effectively evaluate design and engineering alternatives, considering broader societal, economic, and environmental impacts.

Engineering economics courses serve as a platform to equip engineers with the necessary tools and techniques to evaluate and optimize engineering decisions. Through principles such as benefit-cost analysis and the understanding of economic techniques, engineers gain insight into the complexities of decision-making processes. Furthermore, these courses facilitate the development of critical thinking skills essential for navigating the dynamic challenges of the engineering profession in the present century.

In essence, the integration of economics and engineering not only enhances the technical prowess of engineers but also instills in them a broader perspective, enabling them to make informed and impactful decisions that contribute to the advancement of society and the engineering profession as a whole.

ACKNOWLEDGEMENT

It gives me immense pleasure to present my Synopsis Report on **'ENGINEERING ECONOMICS'** and to express my deep regards towards those who have offered their valuable time and guidance in my hour of need.

I would like to express my sincere and whole-hearted thanks to my project guide and Head of Department Mrs. Cissy Shaji for contributing their valuable time, knowledge, experience, and guidance in making this project successfully done.

I am also glad to express my gratitude and thanks to my college Bharati Vidyapeeth Institute of Technology, Navi Mumbai and Respected Principal Mr. P.N. Tandon for continuous inspiration and encouragement.

This report helped me to learn new techniques, developments taking place in Civil Engineering and to revise some previous concepts. Indeed, I perceive this opportunity as a milestone in my career development.

Last but not least, I sincerely thank my colleagues, the staff and all others who directly or indirectly helped me and made numerous suggestions which have surely improved the quality of my work.

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