**Assignment # 01 & 0****2**

**Fall 2023**

**CSE-305**

**Engineering Economics**

Submitted by: **AIMAL KHAN**

Registration No.: **21PWCSE1996**

Class Section: **A**

“On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work.”



Student Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Submitted to:

**Dr. Durr-e-Nayab.**

Saturday, November 25, 2023

Department of Computer Systems Engineering

University of Engineering and Technology, Peshawar

**ASSIGNMENT 01 (CHAPTER 01)**

Perform a detailed Engineering Economics Analysis Process for the following case studies. Also discuss different aspects such as engineering decision areas, engineering economics principles, and predicting the future.

**Query 01: [CLO-1]**

|  |  |
| --- | --- |
| *Mr. Samuel: Mr. Samuel is a heating and air conditioning repair business that was established 23* | |
| *years ago. Today the business revolves around 20 vans that are on the streets and another four for* | |
| *backup in the shop. The 20 vans are not all out at once as there is day, night, and weekend coverage* | |
| *using 32 technicians. Each technician is assigned to a van, and each van has only one or two* | |
| *technicians assigned to it. Determine least cost operations and replacement schedule for Mr.* | |
| *Speedy including depreciation.* |  |

**Ans:** To determine the least-cost operations and replacement schedule for Mr. Samuel's heating and air conditioning repair business (Mr. Speedy), including depreciation, follow these steps:

Step 1: Calculate Operating Costs:

1. Operating Costs per Van: Calculate the annual operating costs for each van, including expenses like fuel, maintenance, insurance, and technician salaries. Ensure that you account for the differences in operating costs for vans that operate during different shifts (day, night, weekend).

2. Total Annual Operating Costs: Sum up the annual operating costs for all 20 vans.

Step 2: Calculate Depreciation:

1. Depreciation Schedule: Determine the depreciation schedule for the existing vans based on their initial purchase price, estimated useful life, and salvage value.

2. Annual Depreciation Expense: Calculate the annual depreciation expense for each van and the total annual depreciation expense for all 20 vans.

Step 3: Replacement Strategy:

1. Replacement Criteria: Decide on the criteria for replacing the vans. This can be based on factors such as the age of the van, mileage, repair costs, or safety concerns.

2. Replacement Schedule: Create a replacement schedule that outlines when each van should be replaced based on the chosen criteria.

Step 4: Least Cost Analysis:

1. Total Annual Cost: Calculate the total annual cost of operating and maintaining the existing fleet, including operating costs and depreciation.

2. Total Annual Cost with Replacement: Calculate the total annual cost if you were to follow the replacement schedule and replace vans as determined in Step 3.

3. Compare Costs: Compare the total annual cost of the existing fleet to the total annual cost with replacement. Determine whether following the replacement schedule would result in cost savings.

Step 5: Decision:

Based on the analysis, make a decision on whether it is more cost-effective to continue operating the existing vans or to replace some of them according to the established schedule.

It's important to note that the decision may also consider non-financial factors such as the reliability and safety of the vans, compliance with emission standards, and customer satisfaction. Additionally, market conditions and technological advancements may impact the decision-making process.

To perform a thorough analysis, gather detailed financial data, and consult with experts if needed. Also, consider sensitivity analysis to assess how changes in key variables (e.g., fuel prices, maintenance costs) affect the project's economic feasibility.

**Query 02: [CLO-1]**

|  |  |
| --- | --- |
| *The project management team of your firm is planning to expand the operations and performance* | |
| *of the firm by upgrading employee-related facilities and adding new employees. The project* | |
| *management team analyzed multiple feasible alternatives that involve either the upgradation of* | |
| *existing employee facilities or adding new highly experienced employees. Now you have been* | |
| *selected to lead the operations and performance, post-evaluation team. Delineate your technical* | |
| *plan for comparing the estimated consequences of implementing the selected alternative with the* | |
| *expected results that can be achieved.* |  |

**Ans:** To compare the estimated consequences of implementing the selected alternative with the expected results for expanding operations and performance through either upgrading employee-related facilities or adding new highly experienced employees, you can follow this technical plan:

Step 1: Define the Objectives and Evaluation Criteria:

- Clearly define the objectives of the expansion, such as improved productivity, employee satisfaction, or increased revenue.

- Identify the evaluation criteria that will be used to assess the success of each alternative, e.g., cost-effectiveness, employee retention, revenue growth.

Step 2: Gather Data and Information:

- Collect comprehensive data related to the current state of employee facilities, employee performance, and any financial data.

- Obtain data on the availability and qualifications of potential new hires.

Step 3: Identify Alternatives:

- Identify the two primary alternatives: (1) Upgrading existing employee facilities, and (2) Hiring new highly experienced employees.

- Ensure that each alternative is well-defined, including the scope, costs, and expected outcomes.

Step 4: Cost-Benefit Analysis:

- Perform a cost-benefit analysis for each alternative, considering:

- The cost of upgrading facilities, including construction, renovation, and maintenance expenses.

- The cost of hiring and compensating new employees, including salaries, benefits, and training costs.

- The expected benefits, such as increased productivity, revenue growth, or improved employee morale.

- The time frame for realizing these benefits.

Step 5: Risk Assessment:

- Identify potential risks associated with each alternative, such as project delays, employee turnover, or unforeseen facility issues.

- Develop risk mitigation strategies for each identified risk.

Step 6: Quantify Outcomes:

- Quantify the expected outcomes for each alternative, both in terms of tangible metrics (e.g., revenue increase, cost savings) and intangible factors (e.g., employee satisfaction).

Step 7: Sensitivity Analysis:

- Conduct sensitivity analyses to assess how variations in key variables (e.g., employee turnover rate, construction costs) might affect the outcomes.

Step 8: Decision Analysis:

- Use a decision-making framework, such as a decision matrix, to compare the alternatives objectively.

- Assign weights to each evaluation criterion to reflect their relative importance.

- Score each alternative based on how well they perform against the criteria.

- Determine which alternative provides the best balance of costs and benefits.

Step 9: Recommendation:

- Based on the analysis, recommend the selected alternative that aligns most closely with the firm's objectives and offers the best overall value.

- Provide a rationale for the chosen alternative.

Step 10: Implementation Plan:

- Develop an implementation plan for the chosen alternative, including timelines, budgets, and resource allocation.

- Define roles and responsibilities for the implementation team.

- Establish key performance indicators (KPIs) to measure the success of the chosen alternative.

Step 11: Monitoring and Evaluation:

- Implement the chosen alternative according to the plan.

- Continuously monitor and evaluate the progress and outcomes to ensure they align with the expectations and objectives defined in Step 1.

Step 12: Revisit and Adapt:

- Periodically revisit the decision and adapt the chosen alternative or strategies as necessary based on changing conditions or new information.

By following this technical plan, you can systematically compare the estimated consequences of implementing the selected alternative with the expected results and make informed decisions to expand operations and improve performance effectively.

**Query 03: [CLO-1]**

|  |  |
| --- | --- |
| *A free lunch? “We will install new HVAC (Heating, Ventilation, and Air Conditioning) equipment* | |
| *for you, absolutely free!! Just sign a three-year contract to split 50/50 of any savings the equipment* | |
| *generates on the use of equipment plus pay for a service contract for the equipment’s maintenance.* | |
| *We will take out the loan for the equipment and installation and pay off the loan with our share of* | |
| *the savings. After three years, the equipment is yours! You’ll only be giving us some of the money* | |
| *you are paying to the power company for electricity. The service contract for the equipment is* | |
| *$15,000 per year, but think of your peace of mind!” Evaluate if this is a free lunch or if there is a* | |
| *catch somewhere based on other financial data available. What data would you need? What* | |
| *evaluation criteria would you choose?* |  |

**Ans:** To evaluate whether the offer of installing new HVAC equipment for free in exchange for a three-year contract to split 50/50 of any savings, along with paying for a service contract for equipment maintenance, is a "free lunch" or if there is a catch, you need to consider several factors and gather specific financial data. Here's how to approach this evaluation:

Data Needed:

1. Energy Cost Data: Obtain historical data on the actual electricity costs incurred by the facility over several years.

2. HVAC Equipment Specifications: Collect information on the specifications and efficiency ratings of the proposed HVAC equipment.

3. Service Contract Terms: Get a copy of the service contract terms, including any clauses related to cost increases or penalties.

4. Loan Terms: Understand the terms of the loan taken out for the equipment and installation, including interest rates and repayment schedules.

Evaluation Criteria:

1. Total Cost Savings: Calculate the total savings generated from the equipment's increased efficiency and compare it to the annual service contract cost.

2. Time Value of Money: Apply discounting techniques to assess the present value of future savings and costs.

3. Net Present Value (NPV): Calculate the NPV of the project, considering both the equipment savings and service contract costs.

4. Return on Investment (ROI): Determine the ROI by comparing the total savings to the total investment over the three-year period.

Steps for Evaluation:

1. Calculate Potential Savings: Estimate the potential savings from the new HVAC equipment by comparing its efficiency to the existing equipment. Consider factors like energy consumption and utility rates.

2. Determine Service Contract Costs: Calculate the total cost of the service contract over the three-year period.

3. Analyze Loan Terms: Assess the cost of the loan for equipment and installation by calculating the total interest payments and principal repayment.

4. Compute NPV and ROI: Calculate the NPV and ROI of the entire project by considering both the savings and costs. Use an appropriate discount rate based on the facility's cost of capital.

5. Risk Analysis: Identify potential risks, such as fluctuations in energy prices, equipment breakdowns, or early contract termination penalties. Evaluate their potential impact on the project's financial viability.

6. Scenario Analysis: Consider different scenarios, such as variations in energy cost trends or equipment performance. Assess how these scenarios affect the financial outcomes.

7. Compare Results: Compare the NPV and ROI of the project to determine if it is financially advantageous or if there is a catch. Consider whether the savings outweigh the costs and loan expenses.

8. Long-term Impact: Evaluate the long-term implications, especially beyond the three-year period. Consider factors like maintenance costs, equipment lifespan, and ownership rights after the contract ends.

Conclusion:

Based on the analysis, make a conclusion about whether the offer represents a "free lunch" or if there are hidden costs or disadvantages. Consider both the immediate financial impact and the long-term consequences of the decision.

**ASSIGNMENT 02 (CHAPTER 02)**

Find the unknowns in the following case studies both mathematically and graphically.

# Query 01: [CLO-2]

Dawlence Pvt. is planning to introduce a new range of electronics in the market. The existing statistics for the product state that the sales price for one of its products and the quantity sold per month are related as D= 980-15p units, where p is the price per unit item. The fixed costs are estimated to be 1800 per month and the variable cost is $45 per unit produced. Determine the number of products that must be produced for maximum net profit. What is the net profit per month related to the product? What is the profitable range for this product? What is the number of products that must be produced for the company to reach its maximum total revenue? Draw the Demand versus Total Revenue function graph and mark all these demands on it.

# Query 02: [CLO-2]

Smart Chips Inc. estimates that it will increase its ICs sales volume by decreasing the selling price of its ICs. The revenue function is given by *aD-bD2* where D represents the units of demand of ICs per month. The fixed cost is $1450 per month and the variable cost is $5.5 per unit item. If a = $5.6 and b= $0.0125, determine the volume for maximum profit, maximum profit per month, range of profitable demand, and maximum total revenue.

# Query 03: [CLO-2]

A semiconductor plant has 95% of sales due to single-circuit design and has the capacity to produce up to 3,000,000 printed circuit boards (PCBs) per year. If the plant is operating at 60% of its capacity with a selling price per unit item equal to *$19.25- 0.000002D* and the variable cost per PCB is $15.57. The fixed costs of the PCB are $1,000,000 per year at zero output. What is the profitable range for PCB production? If the variable cost per unit is reduced by 10% and the fixed costs are reduced by 15%, what would be the effect on the demands on which the breakeven operation occurs?

# Query 04: [CLO-2]

A freelancer provides the services of drafting and graphic designing and has thus far been able to control the volume of his services by varying the selling price. He is seeking to maximize his net profit and has concluded that the relationship between the price and demand of his services can be given by *D= 500-5p*, where p is the selling price per unit service in dollars. His fixed costs for managing the services are $1,000 per month and the variable cost is $25 per service. What is the optimal number of services for max profit to attain? What is the maximum profit for this demand? Also, measure the profitable range for this scenario.

The End.