COST JUSTIFICATION
METHODS / FORMULAS

ITEC 494, TOTAL QUALITY MANAGEMENT
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PAYBACK PERIOD

• Payback Period is the length of time it will take you to recoup the initial investment.

• \( P (\text{years}) = \frac{\text{Total Cost}}{\text{Annual Savings}} \)

• \( P (\text{years}) = \frac{C}{W + I + D - (M + S)} \)

Where:
- \( C \) = Total Cost to Implement Change (Capital Investment)
- \( W \) = Wage Savings per year
- \( I \) = Savings from Installation (productivity, quality, more economic use of materials, less energy used, etc.)
- \( D \) = Equipment Depreciation Allowance
- \( M \) = Maintenance Costs
- \( S \) = Additional Staffing Costs (programmers, trainers, repair, operators, etc.)
• **Total Cost includes:**
  • Physical Equipment
  • Initial Training Costs
  • Spare Parts
  • New Test Equipment
  • Interest if a loan is utilized

W & I

• Wage Savings includes:
  • Annual Salary Savings
  • Annual Hourly Savings (include Overtime if applicable)

• Installation Savings includes:
  • Quality Savings (reduction of defects)
  • Productivity Savings (cycle time reduction)
  • Environmental Savings
  • Safety Savings
  • Energy Savings
• Depreciation is:
  • an income tax deduction that allows a taxpayer to recover the cost or other basis of certain property. It is an annual allowance for the wear and tear, deterioration, or obsolescence of the property.

  • Most types of tangible property (except, land), such as buildings, machinery, vehicles, furniture, and equipment are depreciable. Likewise, certain intangible property, such as patents, copyrights, and computer software is depreciable.

  • Consult your company accountant to obtain this value – usually based on a % depreciation such as 20%.
    • Example: if C = $125K, and %d = .20, D = $25K

M + S

• Maintenance Costs includes:
  • Supplies
  • Replacement Spare Parts

• Increased Staffing Costs
  • Additional Labor to Implement Change including Design
  • Additional labor of all personnel added to program, run, repair, and maintain the new design
PAYBACK PERIOD EXAMPLE

- The total cost of a new robot system is $125,000.
- The salary and fringe benefits of replaced workers is $24,000.
- The annual savings from using the robot is $10,000. Depreciation is $25,000 (based on 20%).
- Maintenance costs are $5,000 annually.
- The new staffing costs equal $24,000 per year.
- Robot LE = 8 years.

Determine the Payback Period.

\[
P_{\text{years}} = \frac{C}{W + I + D - (M+S)}\]
PAYBACK PERIOD EXAMPLE

\[ P_{\text{years}} = \frac{C}{W + I + D - (M+S)} \]

\[ P_{\text{years}} = \frac{125,000}{24,000 + 10,000 + 25,000 - (5,000 + 24,000)} \]

\[ P_{\text{years}} = \frac{125,000}{30,000} \]

\[ P_{\text{years}} = 4.166 \text{ years} \]
ROI

- Return on Investment (ROI) is the annual % return on investment

\[
ROI = 100 \times \frac{W + I + D - [(C/N) + M + S]}{C}
\]

Where \( C/N \) is the amount spent each year paying back the principal
And \( N \) = Useful life of the equipment in years (life expectancy)
ROI EXAMPLE

Using same numbers/info from Payback Example...

\[ \text{ROI} = 100 \times \frac{W + I + D - [(C/N)+M+S]}{C} \]

\[ \text{ROI} = 100 \times \frac{24,000+10,000+25,000 - [(125,000/8)+5,000+24,000]}{125,000} \]

\[ \text{ROI} = 100 \times \frac{14,375}{125,000} \]

\[ \text{ROI} = 11.5\% \]
**Future Value of Money**

This represents the expected value today of a money return expected some time in the future.

\[
FV = PV \times (1 + r)^n
\]

- **PV** = present value
- **r** = yearly interest rate
- **n** = # years

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FV EXAMPLE

- If we pay for a $100,000 project (includes financing costs) by taking out a loan for a 3 year period, and assume that our regular investment of that money would have returned 10% per year.

\[
FV = PV \times (1 + r)^n
\]

\[
FV = $100,000 \times (1 + 0.10)^3
\]

\[
FV = $100,000 \times (1.10)^3
\]

\[
FV = $100,000 \times 1.331
\]

\[
FV = $133,100
\]

This is how much we need to pay back to actually break even.
**NPW**

- Net Present Worth (NPW) is a method of showing how money is worth more now than in the future.

- If one can purchase something now, but pay for it later (assuming no interest is charged) – it costs less!

NPW multiplier = $1 / (1 + i)^n$

- $i =$ Discount rate
- $n =$ # years
NPW OR NPV

- NPW or NPV (Net Present Value) is a firm’s weighted average cost of capital (after tax) is often used, but many people believe that it is appropriate to use higher discount rates to adjust for risk or other factors.

- Another approach to choosing the discount rate factor is to decide the rate which the capital needed for the project could return if invested in an alternative venture. If, for example, the capital required for Project A can earn five percent elsewhere, use this discount rate in the NPV calculation to allow a direct comparison to be made between Project A and the alternative.

- Related to this concept is to use the firm's Reinvestment Rate. Reinvestment rate can be defined as the rate of return for the firm's investments on average. When analyzing projects in a capital constrained environment, it may be appropriate to use the reinvestment rate rather than the firm's weighted average cost of capital as the discount factor. It reflects opportunity cost of investment, rather than the possibly lower cost of capital.

http://www.princeton.edu/~achaney/tmve/wiki100k/docs/Net_present_value.html
NPW EXAMPLE

• If we buy an item that costs $1000 today, but do not have to pay for it for 6 months (no interest), how much will you save? Assume a discount rate of 8%

NPW Multiplier = 1 / (1 + 0.08)^0.5
NPW Multiplier = 1 / (1.08)^0.5
NPW Multiplier = 1 / 1.04
NPW Multiplier = .962

Therefore: $1000 * .962 = $962
- we save $38 by paying 6 months later
QUALITY SAVINGS

• Let’s assume we have a process that is performing at 2σ quality. Each product sells for $100 with $30 per unit profit. The company makes 100,000 units/year.
  • How much will be save (defect reduction) by increasing the quality of the process to 3σ?
  • How much more will the company make (profit) by increasing the quality of the process to 3σ?

±2σ = 95.45% good product, therefore = 4.55% defects
±3σ = 99.73% good product, therefore = 0.27% defects
SAVINGS FROM QUALITY

• **Existing** $2\sigma$
  • 100,000 units * .0455% defects = 4,550 defective units
  • 4,550 * $70$
  • $318,500 / year

• **3\sigma**
  • 100,000 units * .0027 = 270 defective units
  • 270 * $70$
  • $18,900 / year

• **Savings** = $318,500 − $18,900 = $299,600 / year
PROFITING FROM QUALITY

- **Existing 2σ**
  - 100,000 units * 0.9545 = 95,450 good units
  - 95,450 units * $30 profit / unit = $2,863,500 – defective units cost
  - $2,863,500 – (4,550 defective units * $70 cost / unit)
  - $2,863,500 - $318,500 = $2,545,000

- **3σ**
  - 100,000 units * 0.9973 = 99,730 good units
  - 99,730 units * $30 profit / unit = $2,991,900 – defective units cost
  - $2,991,900 – (270 defective units * $70 cost / unit)
  - $2,991,900 - $18,900 = $2,973,000
PROFITING FROM QUALITY

• $2,973,000 – $2,545,000 = $428,000 / year*

  *Assumes you can sell all $100,000 units @ $100/unit

• From here:
  • determine your payback period and return on investment calcs... You just need to know how much it cost you (investment) to increase the quality level!
SAVINGS FROM QUANTITY

• Cycle Time (CT) is the time it take you to produce a product.

• Reducing the CT, will increase the production capability of your operation(s).

• Note: if cycle time is reduced for a process, this may allow you to make even more profit as you now can make more products per year. This is not assured unless you have those additional orders in-hand, however. We can state, however, that we have increased production capacity!