Economic Justification for Industrial Robotic Systems

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Economic Justification for Robotic Systems

- Benefits of Robotic Automation
- Current Operating costs
- Costing a Robotic System
- Financial analysis
  - Payback period, return on investment
  - Consideration of depreciation, government taxes etc
  - More complex analysis methods
- Finance Options
Benefits of Robotic Automation

- Why use Industrial Robots?
  - Decreasing labour costs
  - Optimal use of raw materials
  - Improve cycle times
  - Increase productivity
  - Flexibility of equipment (ie. Reprogrammable)
- Results in $$$ Savings for the company!
Current Operating costs

- Cost of an typical employee on a factory floor for one year is based on:
  - Yearly wages
  - Cost of annual leave, sick leave
  - Cost of OHS, insurance
  - Cost of office/floor space, stationary, equipment

- On Average the annual cost to a company of one factory worker completing 5 shifts a week is 50K per person ( +/- 5K)
  - ~ 1.4 x annual wage
  - Can vary from company to company
Cost of a Robotic System

- Cost of Initial Capital Investment includes:
  - Robot/s price
  - Peripheral equipment – safety barriers, sensors, plc’s, HMI’s, safety systems
  - Engineering costs – programming, installation, commissioning
  - Project management costs
- Price varies based on complexity, number of robots involved, quality etc
- For a 1 Robot complete system cost can vary between 150K to 600K
  - ~ Average cost of a 1 Robot system approximately 250K
- Ongoing maintenance
  - 500 – 3K per year
Financial analysis

Factors to consider:

- Taxes – flat rate of 30% in Australia regulated by the ATO
- Depreciation – assets with finite times loose value over time
- Inflation – a rise in prices with respect to purchasing power over time
- Ongoing maintenance etc
- Time value of money

Complexity of analysis

- Case-by-case basis
### A Simple Analysis

- **2 operators, 2 shifts Vs 1 Robot Cell**

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
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</thead>
<tbody>
<tr>
<td><strong>Labour cost</strong></td>
<td>100000</td>
<td>100000</td>
<td>100000</td>
<td>100000</td>
<td>100000</td>
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<tr>
<td><strong>Cumulative Labour cost</strong></td>
<td>100000</td>
<td>200000</td>
<td>300000</td>
<td>400000</td>
<td>500000</td>
<td>600000</td>
<td>700000</td>
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<tr>
<td><strong>Robot cost</strong></td>
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<td>1000</td>
<td>1000</td>
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<tr>
<td><strong>Cumulative Robot Cost</strong></td>
<td>250000</td>
<td>251000</td>
<td>252000</td>
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<td>255000</td>
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<tr>
<td><strong>Annual savings</strong>&lt;br&gt;(Robot cost – labour cost)</td>
<td>-150000</td>
<td>99000</td>
<td>99000</td>
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<td><strong>Total savings over 7 years</strong></td>
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<td>444000</td>
</tr>
</tbody>
</table>
A Simple Analysis

Cumulative Labour Cost vs. Cumulative Robot Cost

- Year 1: Labour Cost $100,000, Robot Cost $200,000
- Year 2: Labour Cost $200,000, Robot Cost $200,000
- Year 3: Labour Cost $300,000, Robot Cost $200,000
- Year 4: Labour Cost $400,000, Robot Cost $200,000
- Year 5: Labour Cost $500,000, Robot Cost $200,000
- Year 6: Labour Cost $600,000, Robot Cost $200,000
- Year 7: Labour Cost $700,000, Robot Cost $200,000

- Year wise Comparison:
  - Year 1: Labour Cost $100,000, Robot Cost $200,000
  - Year 2: Labour Cost $200,000, Robot Cost $200,000
  - Year 3: Labour Cost $300,000, Robot Cost $200,000
  - Year 4: Labour Cost $400,000, Robot Cost $200,000
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- Cumulative Labour Cost vs. Cumulative Robot Cost
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Annual Savings

Factors to consider for a more in-depth analysis

- Accessories cost
- Maintenance costs
- Training costs
- Spare parts
- Installation costs
- Production line modifications
- Energy costs
- Reduced reject rates
- Savings in raw material
- Environmental and OHS savings
- Safety & health program savings
- Increased productivity
- New facilities construction
Payback period

- Payback period is the number of years required to recover initial investment

\[
\text{Payback Period} = \frac{\text{Total Investment}}{\text{Total yearly savings}}
\]

- This can be interpreted in various ways and can take into account different economic effects
Calculating Payback Period

- Select a time period over which to perform the analysis
- In this formula we take into account:
  - Depreciation:
  - Company tax rates:
  - Maintenance costs:

Payback Period = \frac{Total Investment}{savings - (savings \times TR) + (DP \times TR) - Maintenance costs}

where

\( TR = \text{Tax rate (\%)} \)
\( DP = \text{Total depreciation (\$)} \)
Return on Investment

- Return on Investment provides an indication of the percentage rate of return on an investment
- Provides a means to compare attractiveness of one business investment to another
- A rough return on investment (ROI) can be calculated as:

\[
ROI = \frac{\text{Annual Savings}}{\text{Cost}} \times 100\% \\
= \frac{1}{\text{Payback Period}} \times 100\%
\]
Limitations

- Some limitations in the analysis presented so far:
  - Does not consider inflation
  - Does not consider Time value of money
  - Payback period data does not factor in saving beyond break-even point
  - Does not consider all savings

- For a more complex analysis
  - Cost-benefit analysis
  - ROI calculations factoring in time value of money
  - ROI calculations over a designated period of time
  - Cash flow method
Finance Options

There are various ways a company might consider in making a capital equipment investment

- Outright purchase
- Bank Loan
- Leasing

Finance option may be based on

- potential tax savings,
- other investments available to the company
- availability of cash
A Detailed example

Factors to consider for a more in-depth analysis

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- Maintenance costs
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- Savings in raw material
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Payback Period = \( \frac{\text{Total Investment}}{\text{savings} - (\text{savings} \times \text{TR}) + (\text{DP} \times \text{TR}) - \text{Maintenance costs}} \)

where TR = Tax rate (%)

DP = Total depreciation ($)