Life Cycle Costing in Asset Management and Maintenance

Omaintec Conference

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Life Cycle Cost – Examples

Wind Turbine: Maintenance cost is approx. 1/3 of the Life Cycle Cost

AC motor: Acquisition cost 2 – 4 % of the Life Cycle Cost
Life Cycle Cost – Life Cycle profit

Agenda:

What is Life Cycle Cost?
Definitions and interest rate calculation
Iceberg models
Exercises
Closing of the workshop
Net Present Value

Definition 1:

Net Present Value is all the costs and income from an asset, or an investment referred back to the year of investment.
Objectives for a Life Cycle Cost Analysis

LCC is a process for:

- Compare different alternatives for investments
- Identification of expected future cost for operation and maintenance in the life cycle of the investment
- Impact the expected future cost for operation and maintenance

Life Cycle Cost, Turbine - 20 Years

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum investment in maintenance</td>
<td>DKK</td>
<td>945,000</td>
</tr>
<tr>
<td>CYM Sum annual maintenance cost</td>
<td>DKK</td>
<td>5,607.995</td>
</tr>
<tr>
<td>Sum disposal cost - Maintenance adjustment Y1 and 2</td>
<td>DKK</td>
<td>-</td>
</tr>
<tr>
<td>Sum Operating cost</td>
<td>DKK</td>
<td>-</td>
</tr>
<tr>
<td>Sum Modifications</td>
<td>DKK</td>
<td>-</td>
</tr>
<tr>
<td>Sum Downtime costs - lost margins</td>
<td>DKK</td>
<td>26,918.374</td>
</tr>
<tr>
<td>Total Life Cycle Cost</td>
<td>DKK</td>
<td>33,471.369</td>
</tr>
</tbody>
</table>
Cost in the life cycle

- Investment cost
- Maintenance cost
- Operating cost
- Test and maintenance equipment
- Transport and logistic
- Training and education
- Facilities
- Documentation
- Disposal

Iceberg model for the costs in the assets lifetime
Cost in the life cycle

- Investment Cost
- Operating Cost
- Maintenance Cost
- Test- and maintenance equipment
- Transport and handling Cost
- Education and Training cost
- Building
- Disposal
- Documentation

Iceberg model for the costs in the assets lifetime
Scope for a LCC/LCP Analysis

Example 1:

LCC/LCP scope:

1. Investment – Capital
2. Annual Maintenance cost
3. Annual operating cost
4. Annual fixed cost
5. Disposal cost
6. Annual income - or losses

Evwery LCC(LCP analysis must describe and define the terms used by the company
Life Cycle Cost

Concept and definition → Design and development → Manufacturing → Installation → Operation and Maintenance → Disposal

Acquisition cost → Life Cycle Cost
"Net Present Value is all the costs and income related to an asset or investment referred back to the year of investment!"
Company interest rate

Inflation %
Project risk %
Return on investment to shareholders %

Return on Investment %

Y1 Y2 Y3 Y4
LCC model

Life Cycle Costs

- Acquisition Costs
  - Life Modification Cost
  - Life Support/Maintenance Cost
- Ownership Costs
  - Life Termination/Disposal Cost
  - Life Operating Cost
  - Life Unavailability Cost
LCC model example

- LCC
  - Life Cycle Cost
    - Investment Cost
    - Installation Cost
    - Energy Cost
    - Maintenance Cost
    - Disposal Cost
Life Time Extension
Passenger bridge

<table>
<thead>
<tr>
<th>Items</th>
<th>Down time cost DKK</th>
<th>Operating Cost DKK</th>
<th>Disposal Cost DKK</th>
<th>Maintenance Cost DKK</th>
<th>Investment - in maintenance DKK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>1,294,392</td>
<td>452,500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life Time Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Investment in a HVAC Unit for a Pharmaceutical unit

Comparison HVAC Unit GF
10 Y – 10%

- Cost of Unavailability - Down time cost DKK
- Operating Cost DKK
- Disposal Cost DKK
- Maintenance Cost DKK
- Investment DKK
Thanks for your attention!

Question and comments?

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Life Cycle Costing in Asset Management and Maintenance

Or

By cheap - By twice

Proposed WS Plan

<table>
<thead>
<tr>
<th>Start</th>
<th>End</th>
<th>Subject</th>
<th>Name</th>
<th>Materials and purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Mins.</td>
<td></td>
<td>Welcome and Introduction to the LCC workshop</td>
<td>Facilitator</td>
<td>Materials: Lego bricks, Posters</td>
</tr>
<tr>
<td>30 Mins.</td>
<td></td>
<td>LCC/LCP Method</td>
<td>Facilitator</td>
<td>Presentation of the LCC method</td>
</tr>
<tr>
<td>20 Mins.</td>
<td></td>
<td>Business investment rate</td>
<td>Facilitator</td>
<td>Business Investment rates Component in an investment rate</td>
</tr>
<tr>
<td>20 Mins.</td>
<td></td>
<td>Exercise 1</td>
<td>Delegates</td>
<td>Life Cycle Cost for a commodity Wrap up</td>
</tr>
<tr>
<td>20 Mins.</td>
<td></td>
<td>Exercise 2</td>
<td>Delegates</td>
<td>Life Cycle Cost for a domestic appliances Wrap up</td>
</tr>
<tr>
<td>10 Mins.</td>
<td></td>
<td>Project evaluation with the LCC method</td>
<td>Facilitator</td>
<td>The LCC method used as a part of a project evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The LCC method used as a part of an asset Life Time Extension project.</td>
</tr>
<tr>
<td>10 Mins.</td>
<td></td>
<td>Closure of the Workshop</td>
<td>Facilitator</td>
<td>Did we meet the objective for the workshop? Certificates</td>
</tr>
</tbody>
</table>
LCC exercise 1

I am in the process of buying a new car. The two alternatives are a Volvo and a Mercedes. Which alternative is most favourable based on an economic analysis?

<table>
<thead>
<tr>
<th>Calculation for my new car</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Volvo</td>
<td>Mercedes</td>
</tr>
<tr>
<td>Prices</td>
<td>£34,000</td>
<td>£28,000</td>
</tr>
<tr>
<td>Sales price after 3 years</td>
<td>50% of new price</td>
<td>50% of new price</td>
</tr>
<tr>
<td>Economy Miles/l</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Annual Mileage</td>
<td>Miles</td>
<td>20,000</td>
</tr>
<tr>
<td>Gas prices</td>
<td>£/l</td>
<td>1.00</td>
</tr>
<tr>
<td>Insurance</td>
<td>£/year</td>
<td>800</td>
</tr>
<tr>
<td>Taxes</td>
<td>£/year</td>
<td>280</td>
</tr>
<tr>
<td>Service interval</td>
<td>Miles</td>
<td>10,000</td>
</tr>
<tr>
<td>Price service interval</td>
<td>£</td>
<td>600</td>
</tr>
<tr>
<td>Interest rate</td>
<td>%</td>
<td>15</td>
</tr>
</tbody>
</table>

LCC exercise 6

The annual maintenance cost for a compressor is £5,000.00. Please calculate the life cycle cost for maintenance over 8 years.

The company's rate for investment is 20% p.a.
LCC exercise 8

A company has reviewed two proposals for a pump unit. The pumps are positioned in the production flow with no, or limited impact to the downtime. There is no difference in the power consumption for the two pumps.

The company consider an interest rate on 17 % p.a as sufficient. The expected life time for the investment in the pumps is 10 years.

Solution 1:  
Investment in pump: 200,000 EUR  
Installation: 45,000 EUR  
Maintenance Cost: 40,000 EUR/Y

Solution 2:  
Investment in pump: 282,000 EUR  
Installation: 35,000 EUR  
Maintenance Cost: 20,000 EUR/Y

Please choose the most favourable solution for the company.
LCC exercise 44 – Life Cycle Cost/Life Cycle Profit

A friend to you is going to buy a new refrigerator for his apartment. For the purchase of the refrigerator your friend has decided he wants a refrigerator, which is most cost effective in the refrigerators lifetime

Your friend has asked you as an engineer and expert in life cycle costing for your advice on the choice of refrigerator supplier.

Your friend has provided the following technical specifications:

- The refrigerators expected life time is 10 years
- The power price is 1.25 DKK/kWh
- The temperature in the refrigerator will be set at +5 grd. C.
- The inflation rate is 4%

Your friend has 3 options for the refrigerator:

<table>
<thead>
<tr>
<th>Alternative</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;Bosch&quot;</td>
<td>&quot;AEG&quot;</td>
<td>&quot;Supercool&quot;</td>
</tr>
<tr>
<td>Price</td>
<td>6,500.00</td>
<td>8,000.00</td>
<td>3,999.00</td>
</tr>
<tr>
<td>Annual power consumption at + 5 grd. C - kWh</td>
<td>800</td>
<td>550</td>
<td>1600</td>
</tr>
</tbody>
</table>

Please advice your fiend to buy the most cost effective refrigerator based on an economical decision??
LCC exercise 131 – 45 kW AC motor

A company has installed a 45 kW AC motor for one of the process units.

The required load on the motor is 40 kW.

The practice in the company is to buy AC motors from the supplier "AC Motor Expert". The reason being the AC Motor Expert has a track record of delivering reliable motors at a reasonable cost.

The company has decided to acquire a spare motor for the 45 kW motor and has received a proposal at approximately 33% of the cost for the motor from an alternative supplier.

The alternative supplier has issued a documented warranty giving the same reliability performance as for the motors delivered from "AC Motor Expert".

The company decides to buy the motor from the alternative supplier at 33% of the costs compared to the motor from the AC Motor Expert.

In order to evaluate the decision, the technical specifications are listed below.

<table>
<thead>
<tr>
<th></th>
<th>AC Motor Expert</th>
<th>Alternative supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost price DKK</td>
<td>40,000</td>
<td>14,000</td>
</tr>
<tr>
<td>Power consumption at a load of 40 kW</td>
<td>42 kW</td>
<td>47 kW</td>
</tr>
<tr>
<td>Power cost</td>
<td>1.25 DKK/kWh</td>
<td>1.25 DKK/kWh</td>
</tr>
<tr>
<td>Operating time/Year</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>Company interest rate</td>
<td>15%</td>
<td>15%</td>
</tr>
<tr>
<td>Expected life time – motor</td>
<td>10 Y</td>
<td>10 Y</td>
</tr>
</tbody>
</table>

Please evaluate the decision??