Duurzaam ondernemen door een focus op Life Cycle Costing (LCC)

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Presentator

• 20 jaar Fluor ervaring
• MBu Project Consultancy
• Leraar Cost Engineering (DACE/HAN)
  – Kwaliteitsmanagement
  – Value Management
  – Life Cycle Costing
  – Risicomanagement
1. What is Life Cycle Costing?
2. Examples
3. Conclusions
4. Discussion:

Is goedkoop altijd duurkoop?
Life Cycle Costing (LCC)

The forgotten discipline!!

The cost iceberg of an Asset

Investments
Operating cost
Utility cost
Down time cost
Logistic cost
Maintenance cost
What is Life Cycle Costing?

Major elements of Life Cycle Costing:
– Life Cycle Cost (LCC)
– Asset performance → Compliance to:
  • Functional requirements
  • Performance requirements (RAMS)
  • Life time requirements

\[
\text{Asset Value} = \frac{\text{Required Asset Performance}}{\text{Lowest LCC}} \quad \text{over a defined life time}
\]

Life Cycle Costing is a method to maximize Asset Value
What is Life Cycle Costing?

Life Cycle Costing:
To evaluate and/or optimize Life Cycle Cost (LCC) while satisfying specific Performance, Reliability, Availability, Maintainability & Safety (RAMS) and other requirements over a defined (operational) period.

The aim is to provide input to decision making in all phases of a project life cycle, especially in the development phases.
Asset Performance Definitions and Formulas

- **A** - Asset
- **R** - Reliability
- **M** - Maintainability
- **S** - Safety

**Equations:****
- Asset Performance: $A = \frac{MTBF}{MTBF + MDT}$
- Asset Configuration: $A = \text{Ass}_1 \times \text{Ass}_2 \times \text{Ass}_3 \ldots \times \text{Ass}_n$
- Bath Tub Curve
- Maintenance Time Between Major Overhauls (MTBM)
- Failure Rate (MTBR)

**Acronyms:**
- FMECA
- RAMS
- F&VE
- Asset Life Time

**Graphical Elements:**
- Question mark
- Person with hand on head
- Flowchart with arrows

**Brands:**
- FLUOR
Financial Definitions and Formulas

Discount Rates

- Present Value (PV) formula:
  \[ PV = FV \times (1 + DR)^{-n} \]

- Discounted Cash Flow (DCF) formula:
  \[ DCF = C_0 + C_1 \times (1 + DR)^{-1} + \ldots + C_n \times (1 + DR)^{-n} \]

Revenues

- Discounted Revenues

Cost of Capital

- Cost of Equity
- Cost of Debt

Cash Flows

- Deferred CAPEX

Value of Money

- Interest Rates
  \[ IR_t = r_t + \pi_t + \sigma \]

Downtime Cost

- Asset Cost
- NPV
- LCC
- OPEX
- CAPEX
- DISPEX

Interest

- DEBT
- Equity

FLUOR
Typical Cash Flow model

Revenues

Operational Expenditures (OPEX)

Capital Expenditures (CAPEX)

Deferred CAPEX

Start-up

Revenues

Capital Expenditures (CAPEX)

Operational Expenditures (OPEX)

years
Net Present Value (NPV) = \sum \text{discounted in- and output cash flows}

\[ NPV = \sum_{n=0}^{n} \frac{C_t}{(1 + DR)^n} \]

- \( t \) = the time of the cash flow
- \( Ct \) = the net cash flow at time \( t \)
- \( DR \) = the discount rate (decimals)
- \( n \) = the years of the project

Input Cash Flows (-)
Capital Expenditure (CAPEX)
Output Cash Flows (+)
Operation Expenditure (OPEX)
Revenues

\[
\text{Net Present Value (NPV)} = \sum_{t=0}^{n} \frac{C_t}{(1 + DR)^n}
\]
Major LCC Cost Drivers:

- Operations/Asset Management
  - Organization
  - Management systems
  - Monitoring systems
- Utility cost
  - e.g. Power
- Maintenance
  - Preventive
  - Corrective
  - Inspections
- Downtime
  - non-availability within the operating envelope

The design result has a high influence on OPEX
Asset Performance
RAMS

Non-Availability:
Unplanned Asset Downtime

Major Asset performance criteria (Cost Drivers):
R = Reliability
A = Availability
M = Maintainability
S = Safety
LCC Methodology
Value Engineering

Diverge process:
Transition from Functional Requirements into Design & Execution Options

Potential Solutions
- Design Option 1 (Reference Case)
- Design Option 2 (Alternative 1)
- Design Option 3 (Alternative 2)

Selection
Selection Criteria:
- CAPEX
- Performance
- OPEX
- RAMS

Preferred option

Converge process
Example LCC : Redundant Pump

A critical pump is not spared and if the pump fails, the plant shuts down. The alternative is to spare the pump and automatically switch over when the running pump fails. Calculate if it is Life Cycle Cost effective to spare this pump.

data:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Cost for one pump incl. automatic switch</td>
<td>€ 1.000.000</td>
</tr>
<tr>
<td>Estimated plant availability increase</td>
<td>1%</td>
</tr>
<tr>
<td>Maintenance Cost per year</td>
<td>5% of installed cost.</td>
</tr>
<tr>
<td>Cost for down time</td>
<td>€ 100.000/stream day</td>
</tr>
<tr>
<td>Plant stream days a year:</td>
<td>340</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>20%</td>
</tr>
<tr>
<td>Max evaluation period</td>
<td>10 years operations</td>
</tr>
</tbody>
</table>
Example LCC : Redundant Pump

Benefits for less deferred production:

1% x 340 days x 100.000 = € 340.000/year
Additional maintenance cost = € - 25.000/year
Yearly OPEX savings = € 315.000/year (+ CF)

Investment (CAPEX) = € 1.000.000 (- CF)
# Example LCC: Redundant Pump

## LCC\textsubscript{NPV} Calculation

<table>
<thead>
<tr>
<th>Years t</th>
<th>Cashflow C</th>
<th>PV</th>
<th>PV (cum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1000</td>
<td>-1000</td>
<td>-1000</td>
</tr>
<tr>
<td>1</td>
<td>315</td>
<td>262</td>
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</tr>
<tr>
<td>4</td>
<td>315</td>
<td>152</td>
<td>-184</td>
</tr>
<tr>
<td>5</td>
<td>315</td>
<td>126</td>
<td>-58</td>
</tr>
<tr>
<td>6</td>
<td>315</td>
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<tr>
<td>10</td>
<td>315</td>
<td>51</td>
<td>320</td>
</tr>
</tbody>
</table>

Cost x € 1000

Discount Rate @ 20%

ROI ≈ 5.5 years
Conclusions

Ja, door een LCC benadering verbeter je het duurzaam ondernemen

– Verbeterde Asset performance
– Lagere LCC
– Verbeterde concurrentie positie
  • Verbeterde verkoop
  • Potentieel meer winst
Conclusions

Why Forgotten?

• Insufficient awareness benefits by management:
  ▪ Short term focus
  ▪ CAPEX focus
• Lack of broad focus (over development + life time)
• Schedule pressure

• Insufficient integrated knowledge & experience:
  ▪ Technical + Value Engineering + Financial + RAMS
Discussie

Is goedkoop altijd duurkoop?
(Goodkoop = CAPEX)