

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

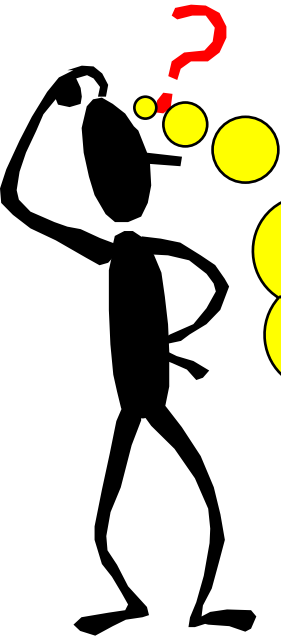
Presentation

1. What is Life Cycle Costing?
2. Examples
3. Conclusions
4. Discussion:

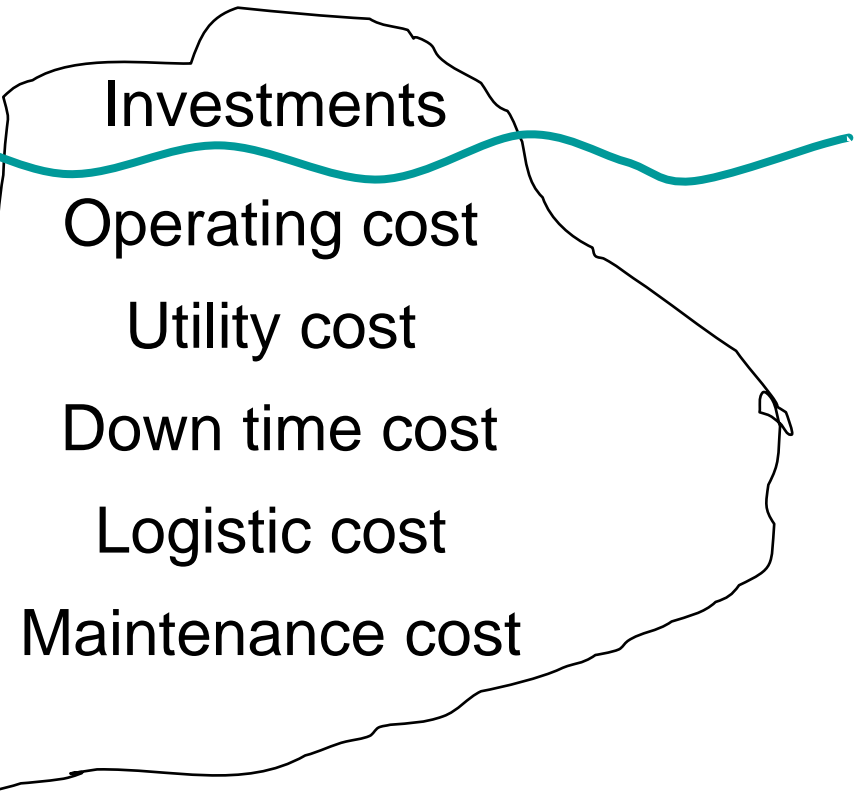
Is goedkoop altijd duurkoop?

Life Cycle Costing (LCC)

The cost iceberg
of an Asset



LCC
The forgotten
discipline !!



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

$$\text{Asset Value} = \frac{\text{Required Asset Performance}}{\text{Lowest LCC}}$$

over a defined life time

Life Cycle Costing is a method to maximize Asset Value

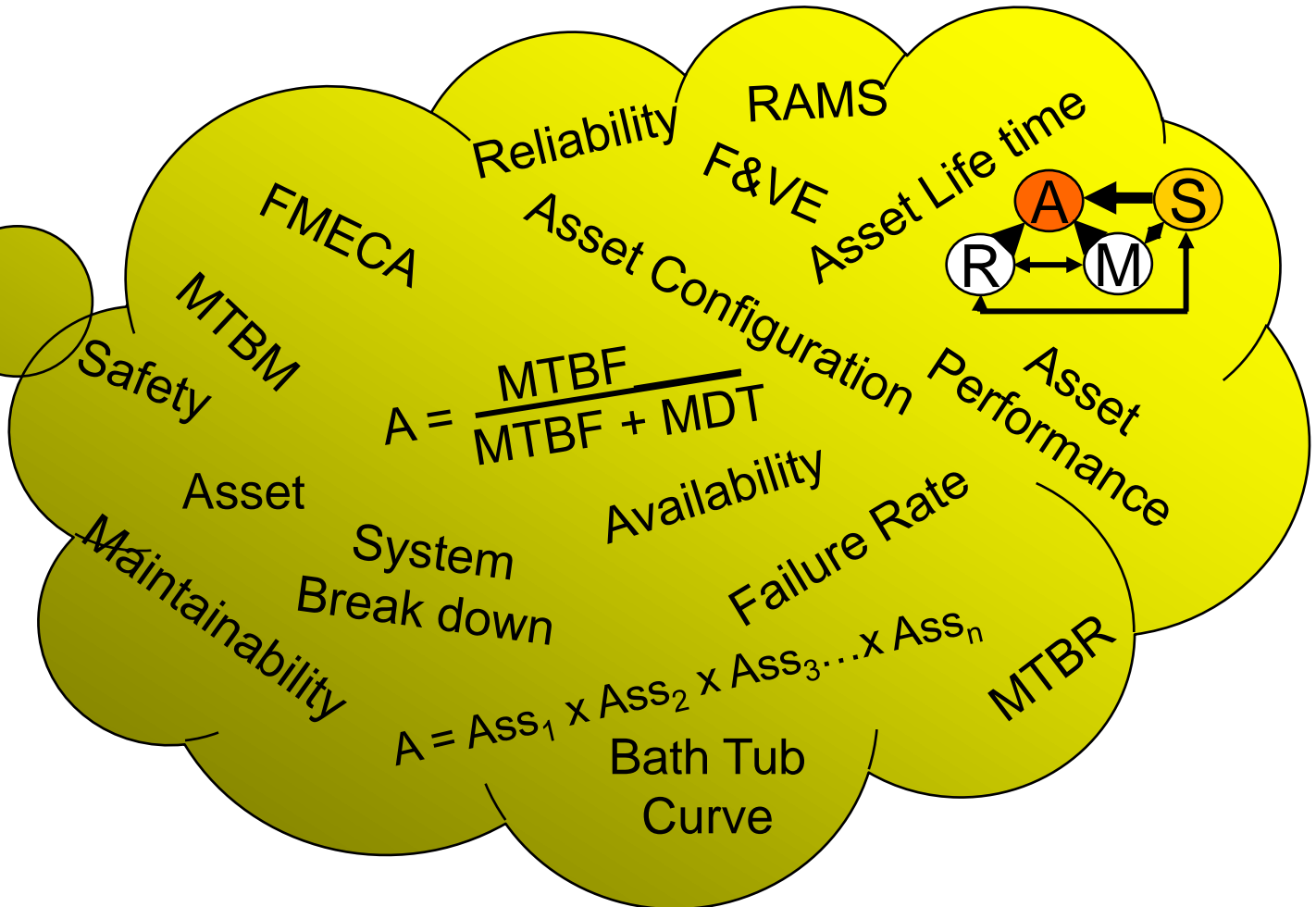
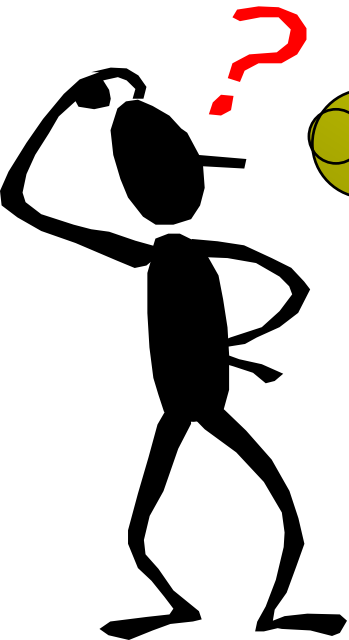
What is Life Cycle Costing?

Life Cycle Costing:

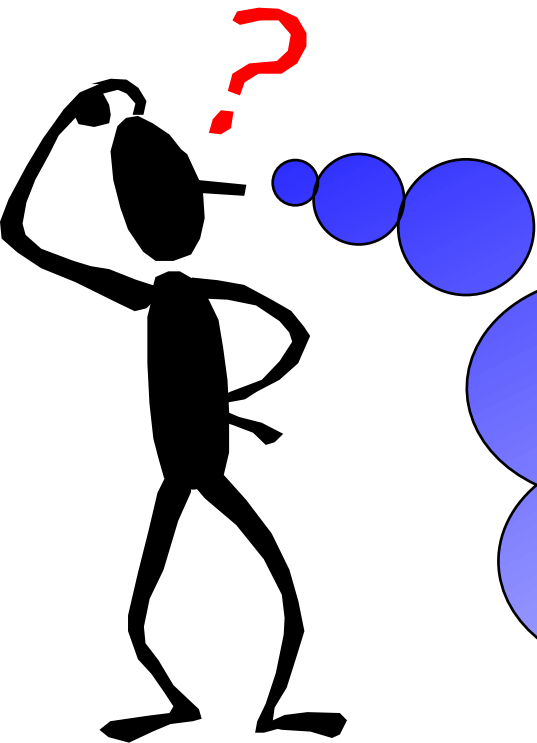
To evaluate and/or **optimize Life Cycle Cost (LCC)** while **satisfying specific Performance, Reliability, Availability, Maintainability & Safety (RAMS)** and other **requirements** over a **defined** (operational) **period**.

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

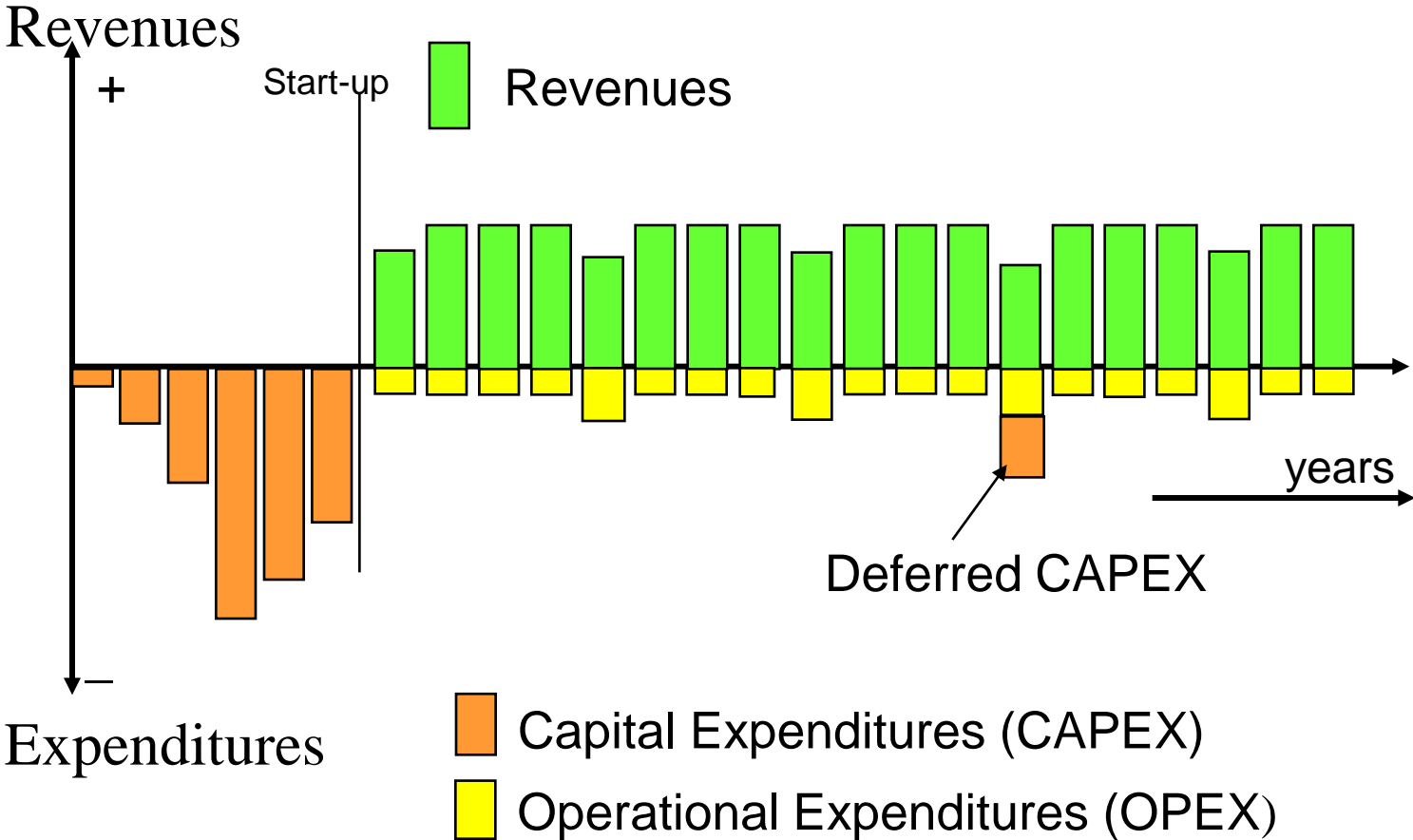


Financial Definitions and Formulas

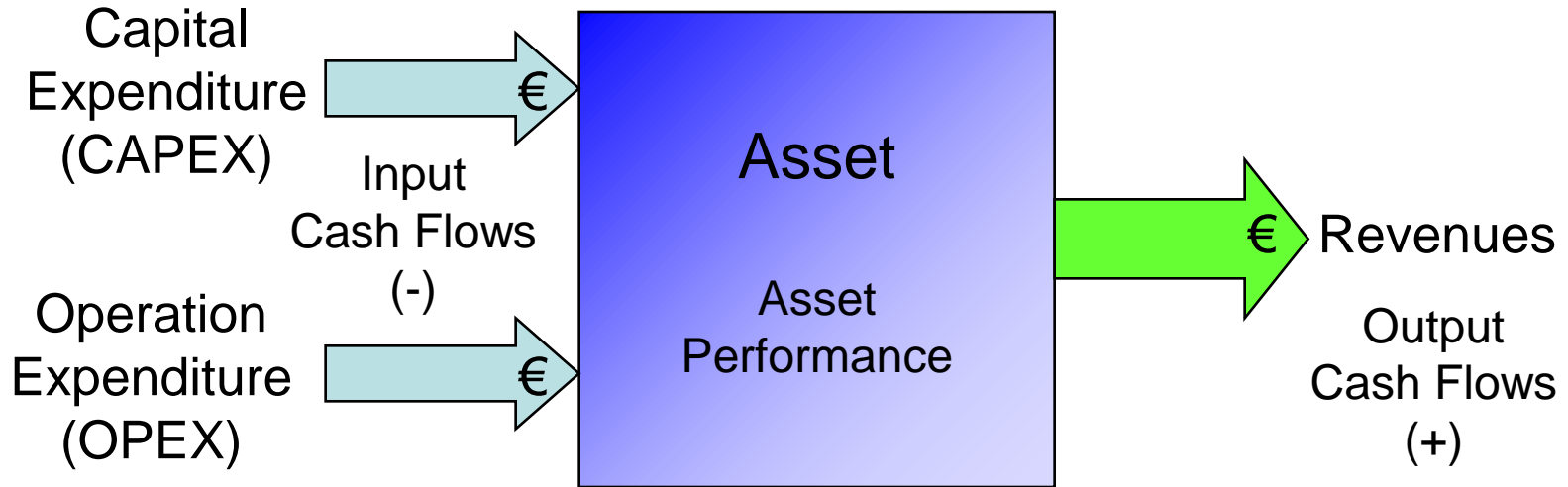


DR $PV = FV \cdot (1 + DR)^{-n}$ Asset NPV LCC
 Cash Flows Discount Rates Interest
 Revenues Downtime Cost OPEX
 Cost of Capital Deferred CAPEX $IR_t = r_t + \pi_t + \sigma$ CAPEX
 Value of Money Interest Rates DISPEX
 $DCF = C_0 + \frac{C_1}{(1 + DR)^1} + \dots + \frac{C_n}{(1 + DR)^n}$
 DEBT Equity

Typical Cash Flow model



Net Present Value (NPV)



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

$$NPV = \sum_{n=0}^n \frac{Ct}{(1 + DR)^n}$$

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

Major LCC Cost Drivers:



- Studies
- Requirements
- Specifications

- System
- Sub-system
- Equipment
 - Specification
 - Requisitions

- Purchasing:
- Equipment
- Materials
- Test equipment
- Factory testing
- Initial Spares
- Documentation
- Special tools

- Transportation
- Construction & installation
- Inspection
- Commissioning Start-up
- Site testing & acceptance
- Training

Operations/Asset Management

- Organization
- Management systems
- Monitoring systems

Utility cost

- e.g. Power

Maintenance

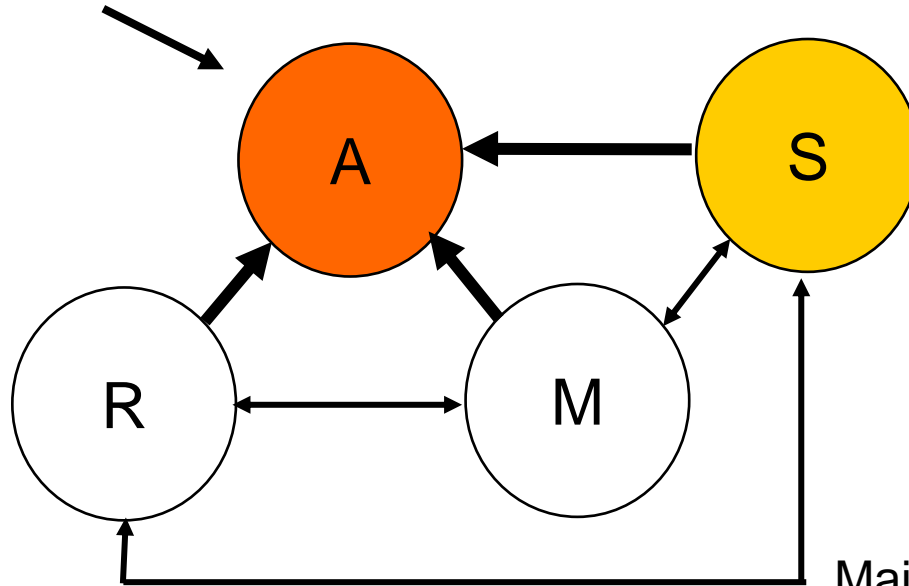
- Labor
 - Spares
 - Renewals
 - Training
 - Overhauls
 - Spare inventory
- } • Preventive
• Corrective
• Inspections

Downtime

- non-availability within the operating envelope

Asset Performance RAMS

Non-Availabilty:
Unplanned Asset Downtime



Major Asset performance criteria
(Cost Drivers):

R = Reliability

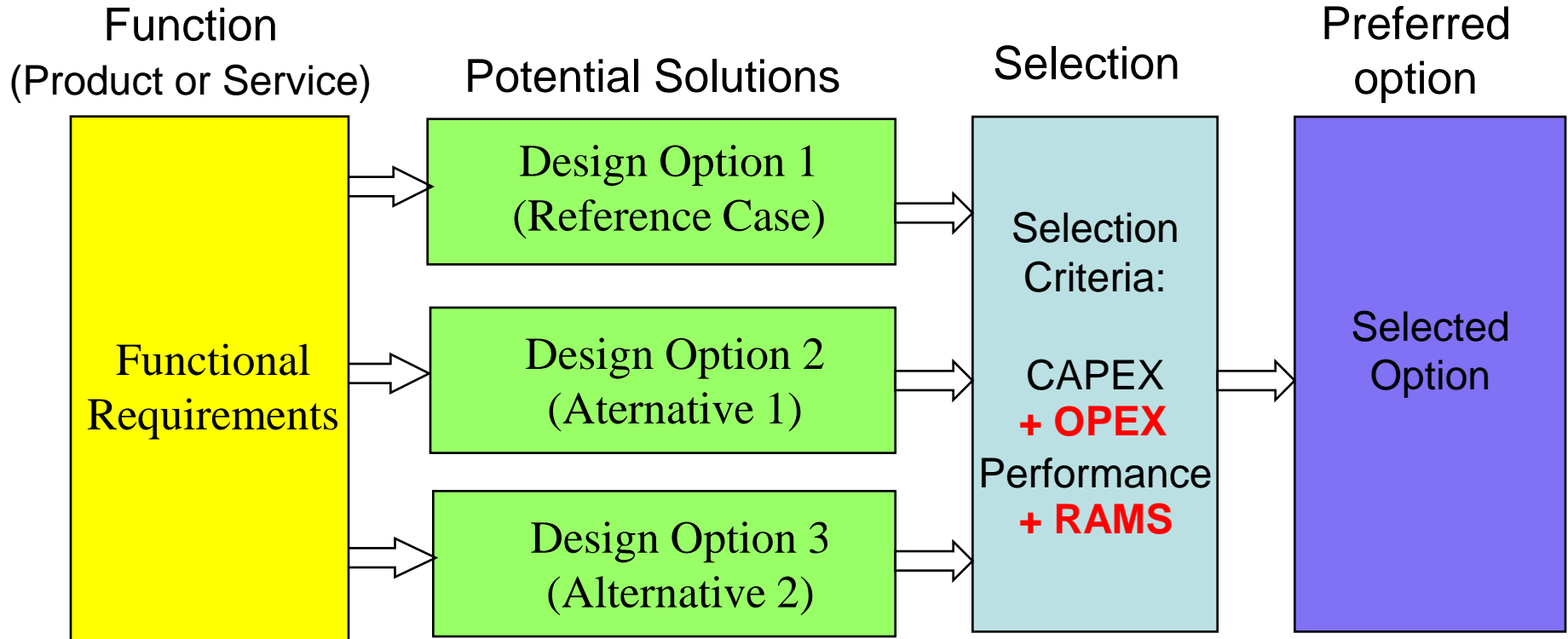
A = Availability

M = Maintainability

S = Safety

LCC Methodology

Value Engineering



Diverge process:

**Transition from Functional Requirements
into Design & Execution Options**

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:

Installed Cost for one pump incl. automatic switch	€ 1.000.000
Estimated plant availability increase	1%
Maintenance Cost per year	5% of installed cost.
Cost for down time	€ 100.000/stream day
Plant stream days a year:	340
Discount Rate	20%
Max evaluation period	10 years operations

Example LCC : Redundant Pump

Benefits for less deferred production:

1% x 340 days x 100.000 =		€ 340.000/year
Additional maintenance cost =		€ <u>- 25.000/year</u>
Yearly OPEX savings =		€ 315.000/year (+ CF)
Investment (CAPEX)	=	€ 1.000.000 (- CF)

Example LCC : Redundant Pump

LCC_{NPV} calculation

Redundant Pump			
Years t	Cashflow C	PV	PV (cum)
0	-1000	-1000	-1000
1	315	262	-738
2	315	219	-519
3	315	183	-336
4	315	152	-184
5	315	126	-58
6	315	105	48
7	315	87	135
8	315	73	208
9	315	61	269
10	315	51	320

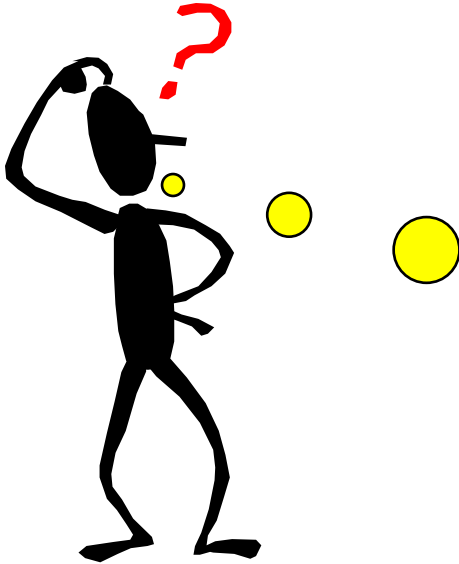
← ROI
≈
5.5 years

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?
(Goedkoop = CAPEX)