



# ICEAA International Symposium

Bristol, October 17-20

Joachim Schöffner

$$f(4cost) = \sum_{\substack{\text{Global} \\ \text{Lieferant} \\ \text{Serie}}} \left( \begin{array}{l} \text{Kosten vorhersagen} \\ \text{Kosten ermitteln} \\ \text{Potentiale identifizieren} \\ \text{Risiken vermeiden} \\ \text{Szenarien bewerten} \\ \text{Lifecycle + TCO berechnen} \\ \text{Potentiale realisieren} \\ \text{Lieferanten benchmarken} \end{array} \right) = \text{Optimum}$$

(Material, Prozess, Montage, LCC/TCO, Kosten & Preise)



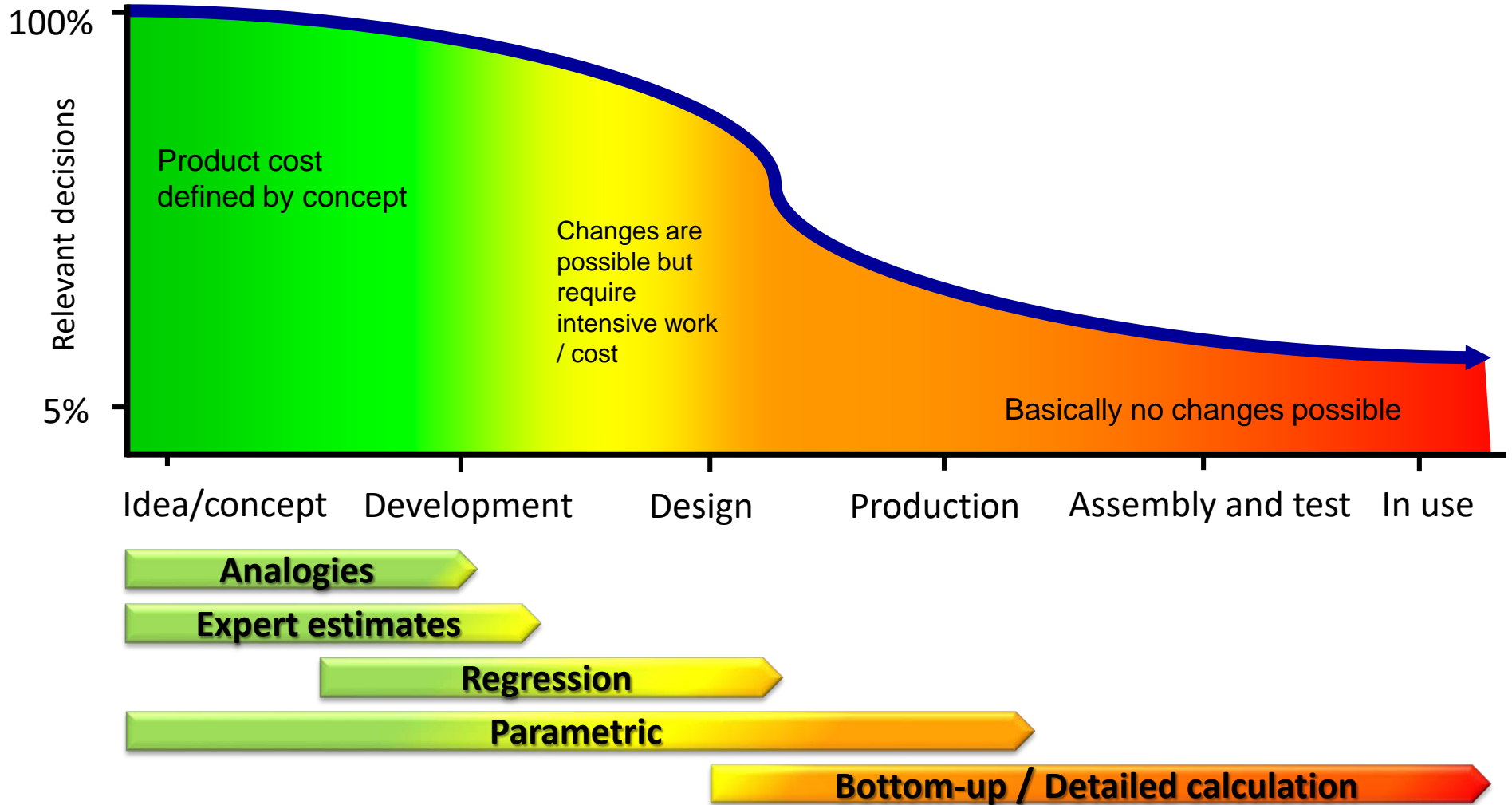
It is not the **strongest** of the species that survive,  
nor the most *intelligent*,  
but the one most *responsive to change!*

Charles Darwin



The way from a parametric estimate to a CAD-driven calculation

Initial situation





Main requirements

## Purchasing department:

1. Identify potentials quickly
2. Negotiate on the basis of detailed workplans



Main requirements

## Development department:

1. Value technical alternatives in early phases
2. Calculate detailed cost scenarios based on detailed designs

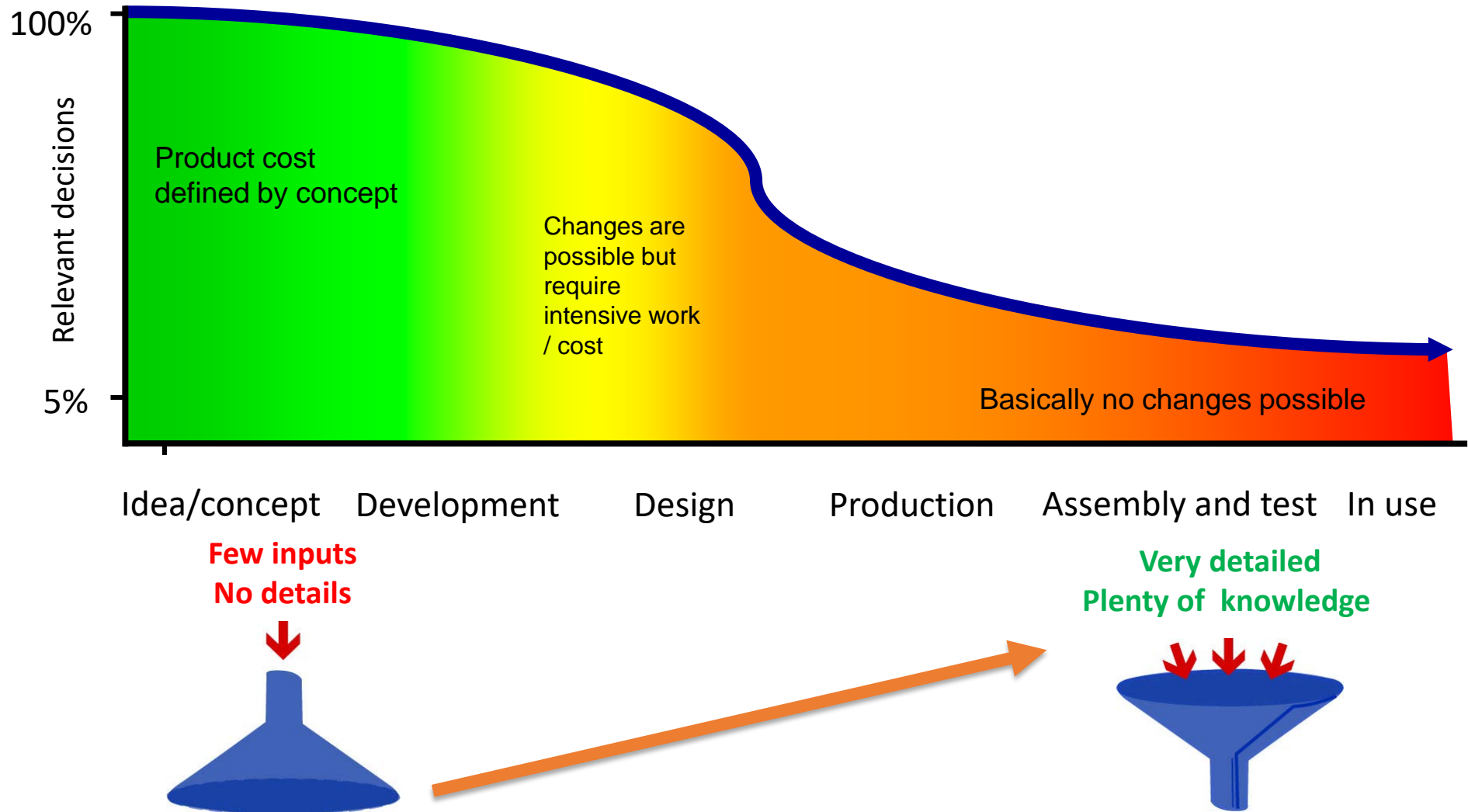


Main requirements

## Sales/Marketing department:

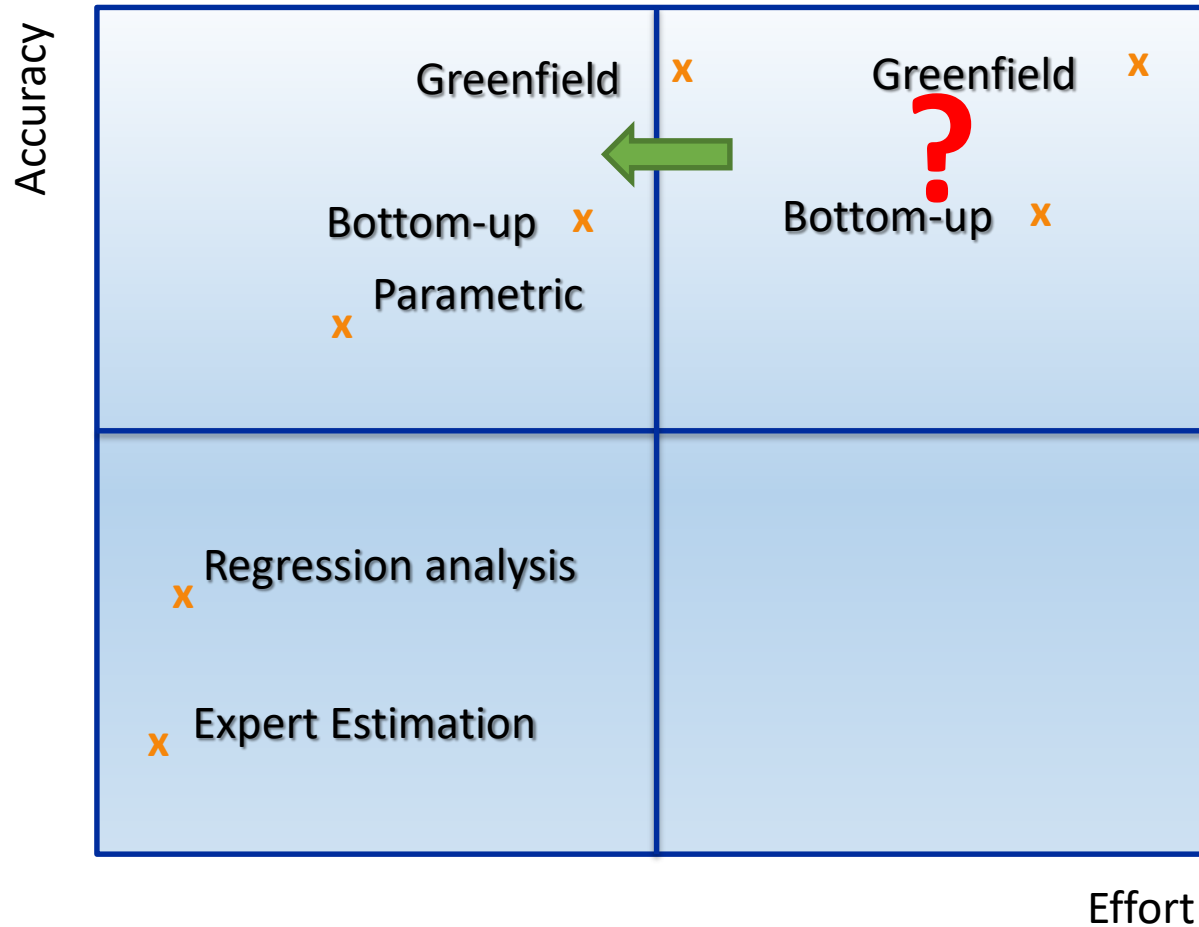
1. Budgeting and setting targets
2. Negotiate detailed cost breakdowns

Dielmma of product life cycle



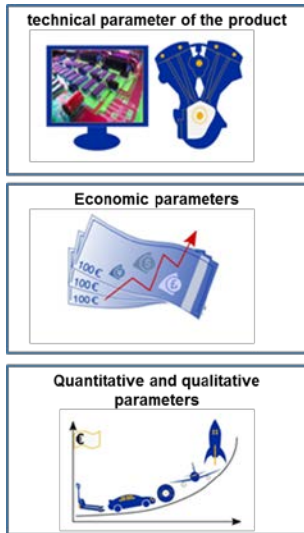
The way from a parametric estimate to a CAD-driven calculation

Situation -> Task

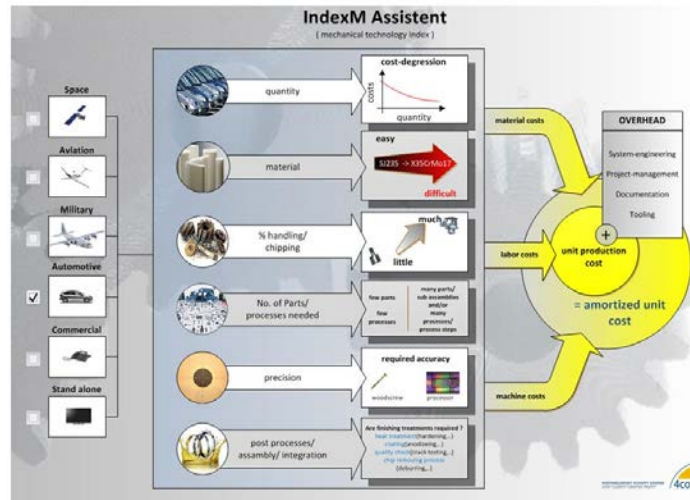




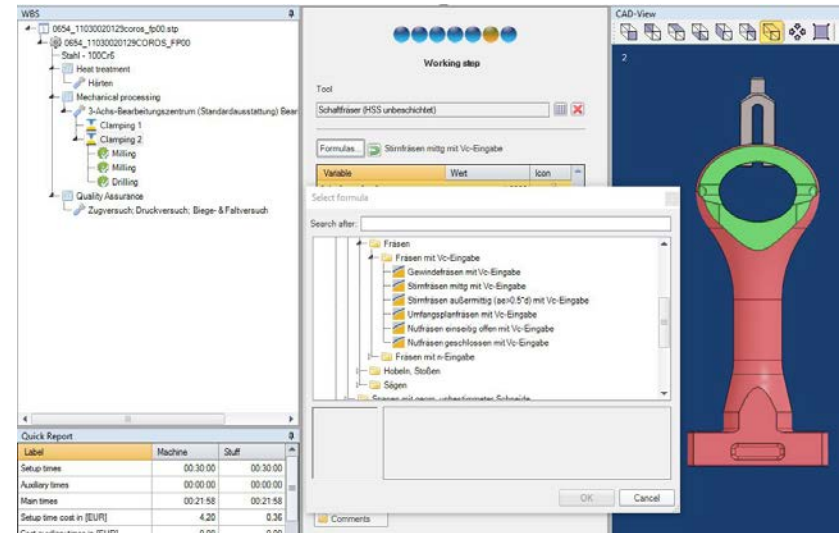
Transition (classical parametric to CAD-driven bottom-up)



Parametric



Semi-bottom-up



Detailed – CAD-driven

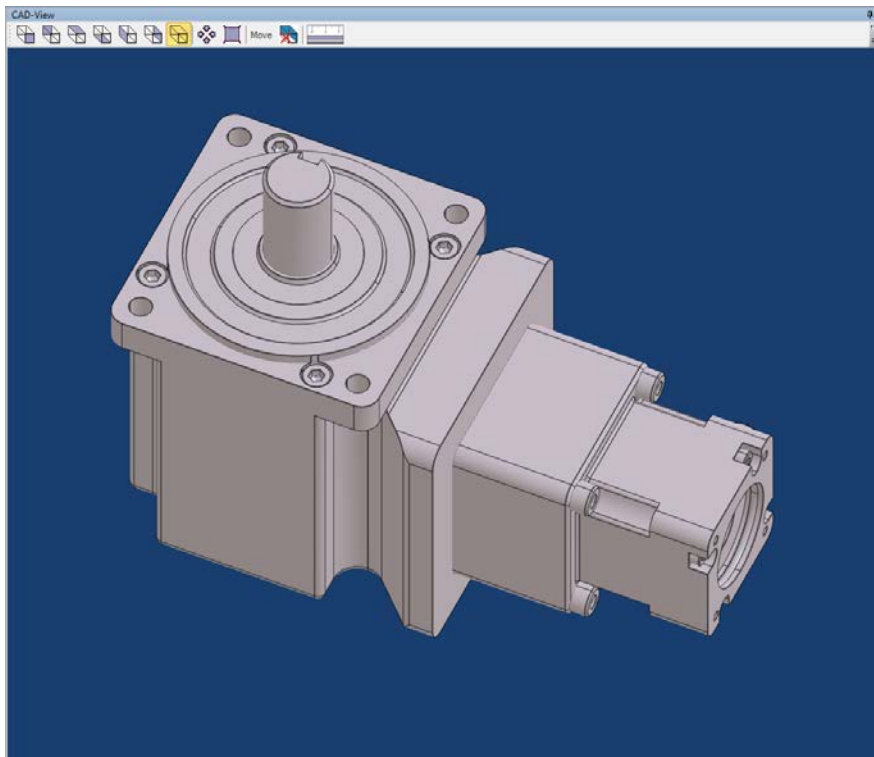


The way from a parametric estimate to a CAD-driven calculation

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Step 1: Multidim. CER for analysing 3D-CAD-Models

CER = f(#Sub Shapes  
#sig. Points  
#Components  
#Solids  
#Shells  
#Wires...)



```
Collected Information from Step Data
#Childs..... : 0
#Refs..... : 8
Is Assembly..... : 0
Is Compound..... : 0
Item global Precision.. : 0,000010
Item spez. Precision.. : 1,000000
spez. Precision Type.. : (test entry)Coaxialli
length conv. fac..... : 1,0000
appr. Weigh..... : 0,363701
Material Name..... : n/a
sepec.Weight..... : not specified (set to 7.8 Steel)
max Dimension (mm)..... : 97,39
Dim Type..... : 3D
#Sub Shapes..... : 2
#sig. Points..... : 4576
#Components..... : 1
#Solids..... : 2
#Shells..... : 2
#Wires..... : 513
closed..... : 513
```



€ (2016) without escalation

Production costs HW/piece	
Purchased costs	0
Item Material Cost	91
Item Labour Cost	13
Item Machine Cost	6
<b>UPC</b>	<b>110</b>
Prd Overhead	15
<b>Amuc (incl.overhead)</b>	<b>125</b>



The way from a parametric estimate to a CAD-driven calculation

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Step 2: Transition (classic parametric -> semi bottom-up)

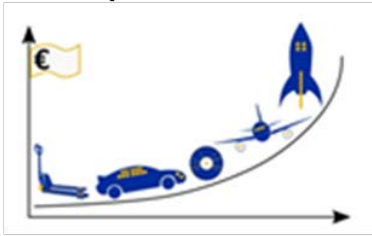
technical parameter of the product



Economic parameters



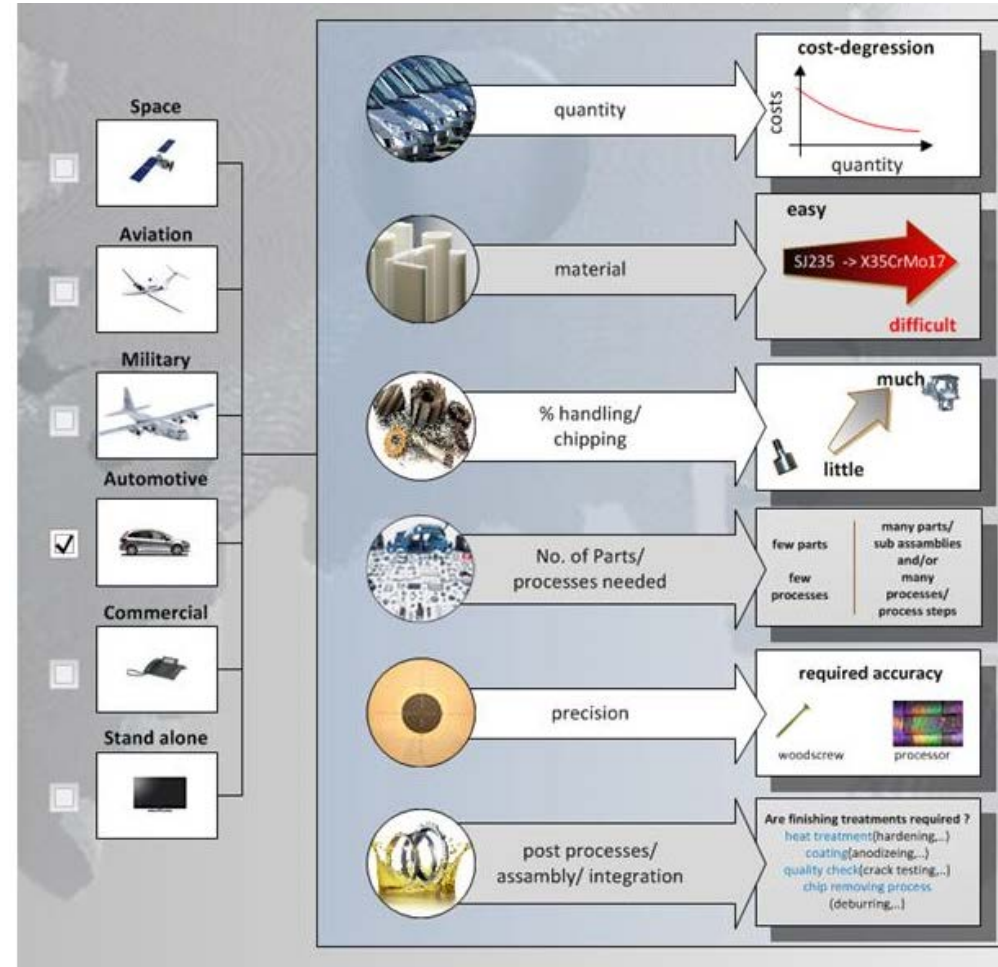
Quantitative and qualitative parameters



Detailing the parameters (Submodel):



Complexity = f (quality, scrap, precision, learning curve, stable mfg-processes, machinability, additional processes...)





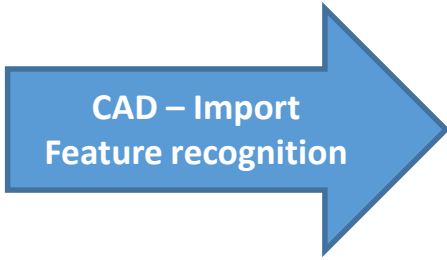
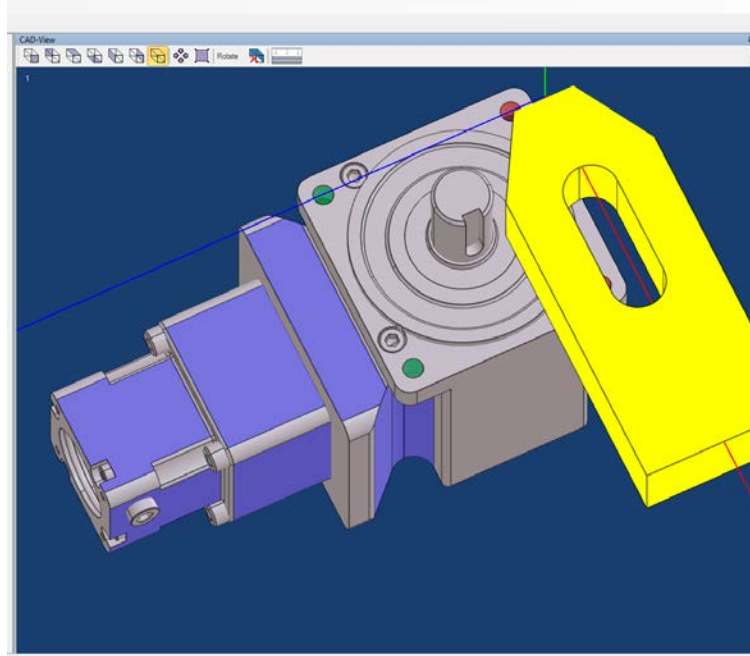
The way from a parametric estimate to a CAD-driven calculation

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Step 3: Transition (parametric -> CAD-driven calculation)

WBS  
(Parametric)

- 1 Project : Boat
  - 1.1 Basis incl. Transmission
    - 1.1.1 Steelbody
      - 1.1.1.1 Spant
      - 1.1.1.2 Sheetmetal plates
      - 1.1.1.3 Weight
      - 1.1.1.4 I&T
    - 1.1.2 Transmission
      - 1.1.2.1 Engine
      - 1.1.2.2 Gearbox
      - 1.1.2.3 Electronic
        - 1.1.2.3.1 Housing
        - 1.1.2.3.2 PCB inkl. Software
          - 1.1.2.3.2.1 Elektronik
          - 1.1.2.3.2.2 SW
        - 1.1.2.3.3 Sensoric
        - 1.1.2.3.4 Cabling
        - 1.1.2.3.5 I&T
      - 1.1.2.4 I&T
    - 1.1.3 Miniparts complete
    - 1.1.4 I&T



Detailed Working plan  
(Bottom-up)

Clamping

Spannelement Nr.	Notizen	Rüstzeit
1		0

Quick Report

Label	Machine	Stoff
Material Netto in [EUR]		46,63
Material overheads in [%]		0,00
Material gross in [EUR]		46,63
Setup cost Machine in [EUR]		0,00
Setup cost Staff in [EUR]		0,00
Total setup cost in [EUR]		0,00
Manufacturing costs machine in [EUR]		0,00
Manufacturing costs Staffing in [EUR]		0,00
Manufacturing costs in [EUR]		0,00

Clamping Element

Size: 252,00  
Speed: 1,00

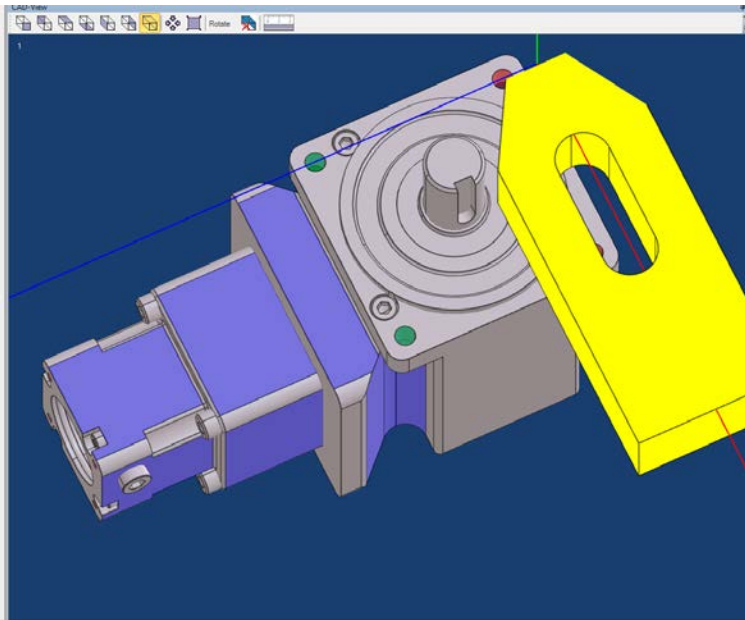
Move: X (+), Y (-), Z (+)  
Rotation: X, Y, Z (Rotation angle)



# The way from a parametric estimate to a CAD-driven calculation

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## Step 4: Detailed parameters for process calculation



### Detailed process plan

Winkelgetriebe.stp

- NEVAC-B3-B1
- Stahl - Federstahl (46 Si 7)
- Mechanical processing
  - Vertikale 3-Achse-Bearbeitungszentrum (Maximala...
  - Clamping 1
  - Drilling
  - No basic process
  - Mechanical processing

Quick Report

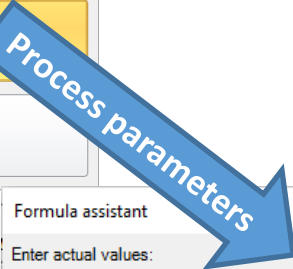
Label	Machine	Stuff
Setup times	00:00:00	00:00:00
Auxiliary times	00:00:00	00:00:00
Main times	00:00:00	00:00:00
Setup time cost in [EUR]	0,00	0,00
Cost auxiliary times in [EUR]	0,00	0,00
Cost of main times in [EUR]	0,00	0,00

Label	Current
Material Netto in [EUR]	144,61
Material overheads in [%]	0,00
Material gross in [EUR]	144,61
Setup cost Machine in [EUR]	6,82
Setup cost Staff in [EUR]	2,90
Total setup cost in [EUR]	9,71
Manufacturing costs machine in [EUR]	0,03
Manufacturing costs Staffing in [EUR]	0,04
Manufacturing costs in [EUR]	9,78
Manufacturing overheads in [EUR]	0,00
Manufacturing cost in [EUR]	9,78
Manufacturing cost in [EUR]	154,38

Basic process

- Casting
- Heat treatment
- Mechanical machining**
- Transport

Plan Do Check Act Quality Assurance



#### Formula assistant

Enter actual values:

Mill

- Technology
  - Base formulas
  - Metal forming
  - Cutting
  - Assembling
  - Coating
  - Mathematical formulas
  - Machining
  - Drilling
  - Milling
    - Groove milling
    - Face milling**
    - Thread milling
  - Sawing

Face milling

Variable	Value	Re
workpieceLength_mm	200,00	
startUpWay_mm	2,00	
spillwayRoute_mm	2,00	
cuttingWidth	30,00	
cutterDiameter_mm	80,00	
numberOfCuts	1,00	
cuttingRate_vc	68,00	
pitch	0,12	
numberOfCutting	8,00	



# The way from a parametric estimate to a CAD-driven calculation

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## Transition

The screenshot displays a CAD software interface with the following components:

- Tree View (WBS):**
  - Winkelgetriebe.stp
    - NEVAC-B2-B1
      - Stahl - Stainless Steel 1.4571
        - Mechanical processing
          - Vertikale 3-Achs-Bearbeitungszentrum (Maximalausstatu
            - Clamping 1
              - Drilling

- Clamping Control Panel:**
- Clamping: 1 (Notice)
- Clamping: [On/Off icons]
- Spannelement: [Icon]
- Table:
 

Spannelement Nr.	Notizen	Rüstzeit
1		0
- Clamping Element:
  - Size: 252,00
  - Speed: 1,00
  - Move: x (+, -), y (+, -), z (+, -)
  - Rotation: x, y, z (Rotation angle)
  - Buttons: Reset, Delete
  - Comments: [Text field]
- Quick Report Table:**

Label	Machine	Staff
Setup times	00:30:00	00:30:00
Auxiliary times	00:00:00	00:00:00
Main times	00:00:04	00:00:04
Setup time cost in [EUR]	6,82	2,90
Cost auxiliary times in [EUR]	0,00	0,00

Label	Current
Material Netto in [EUR]	46,63
Material overheads in [%]	0,00
Material gross in [EUR]	46,63
Setup cost Machine in [EUR]	6,82
Setup cost Staff in [EUR]	2,90
Total setup cost in [EUR]	9,71
Manufacturing costs machine in [EUR]	0,03
Manufacturing costs Staffing in [EUR]	0,04
Manufacturing costs in [EUR]	0,79

**Result**

**Purchasing department:**

1. Identify potentials quickly ✓
2. Negotiate on the basis of detailed workplans ✓

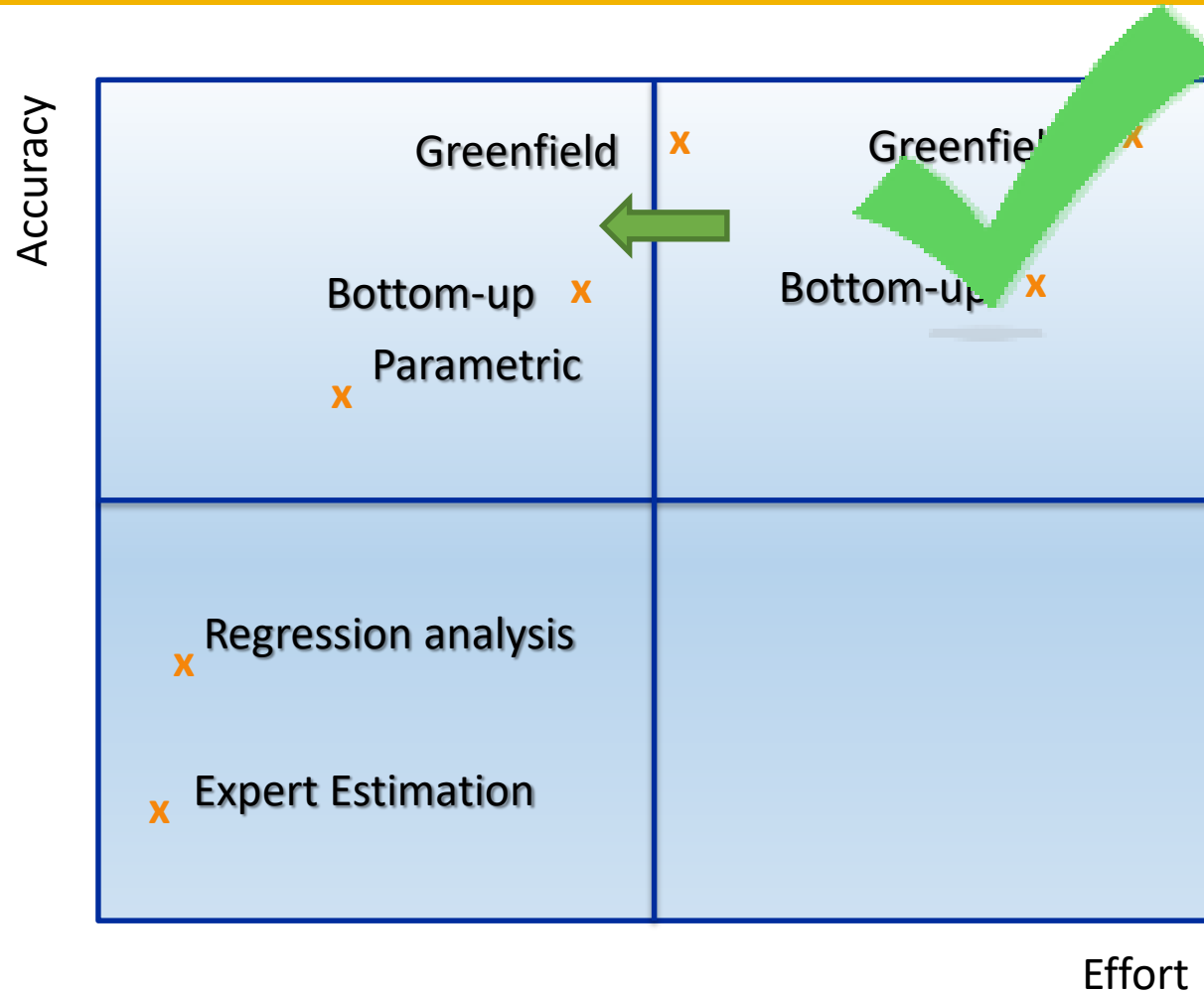
**Development department:**

1. Value technical alternatives in early phases ✓
2. Calculate detailed cost scenarios based on detailed designs ✓

**Sales/Marketing department:**

1. Budgeting and setting targets ✓
2. Negotiate detailed cost breakdowns ✓

Result



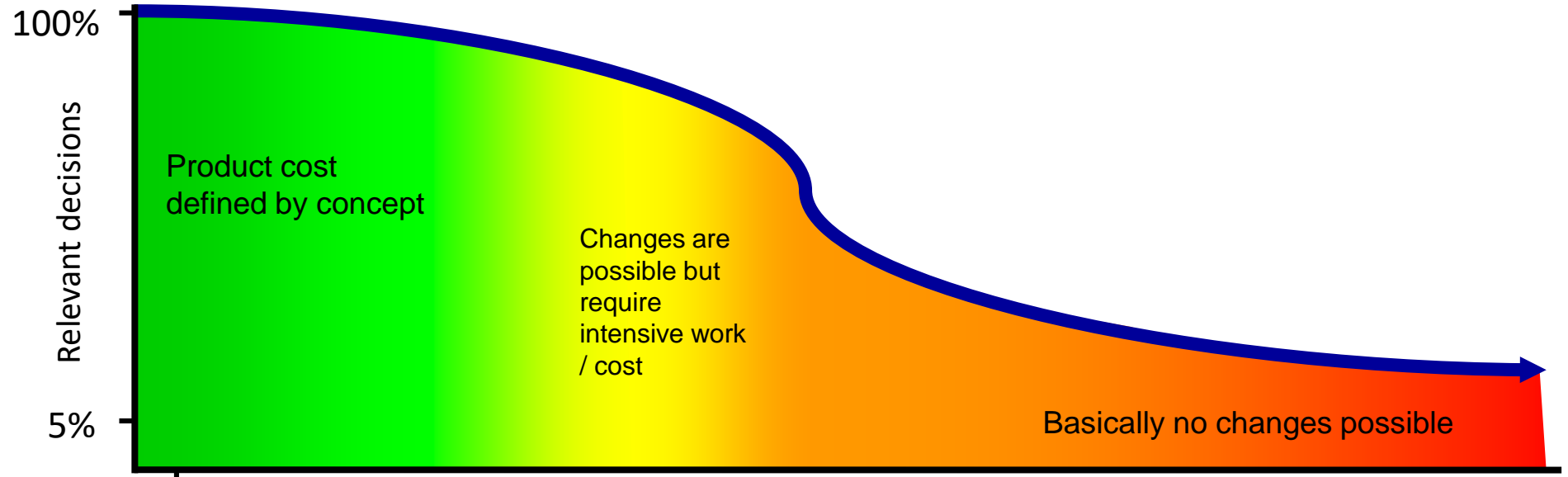




The way from a parametric estimate to a CAD-driven calculation

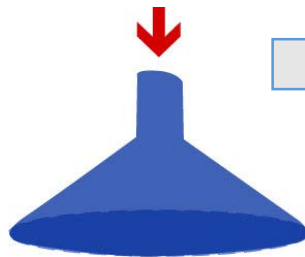
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Result

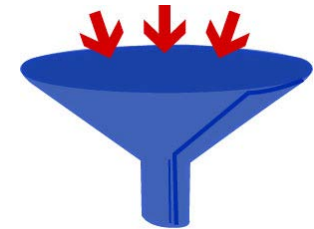


Idea/concept    Development    Design    Production    Assembly and test    In use

Few inputs  
No details



Very detailed  
Plenty of knowledge





**Outlook**

**Next steps:**

- 1. Additional basic processes (forging, sheetmetal, electronics ...)**
- 2. Automate the working plan generation**
- 3. Learning algorithm to suggest „best-in-class“ calculation**



Thank you for your attention

<http://www.4cost.co.uk/en>

[schoeffe@4cost.de](mailto:schoeffe@4cost.de)

Joachim Schöffer

$$f(4cost) = \sum_{\substack{\text{Global} \\ \text{Lieferant} \\ \text{Serie}}} \left( \begin{array}{l} \text{Kosten vorhersagen} \\ \text{Kosten ermitteln} \\ \text{Potentiale identifizieren} \\ \text{Risiken vermeiden} \\ \text{Szenarien bewerten} \\ \text{Lifecycle + TCO berechnen} \\ \text{Potentiale realisieren} \\ \text{Lieferanten benchmarken} \end{array} \right) = \text{Optimum}$$

(Material, Prozess, Montage, LCC/TCO, Kosten & Preise)



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## The way from a parametric estimate to a CAD-driven calculation

[Backup](#)



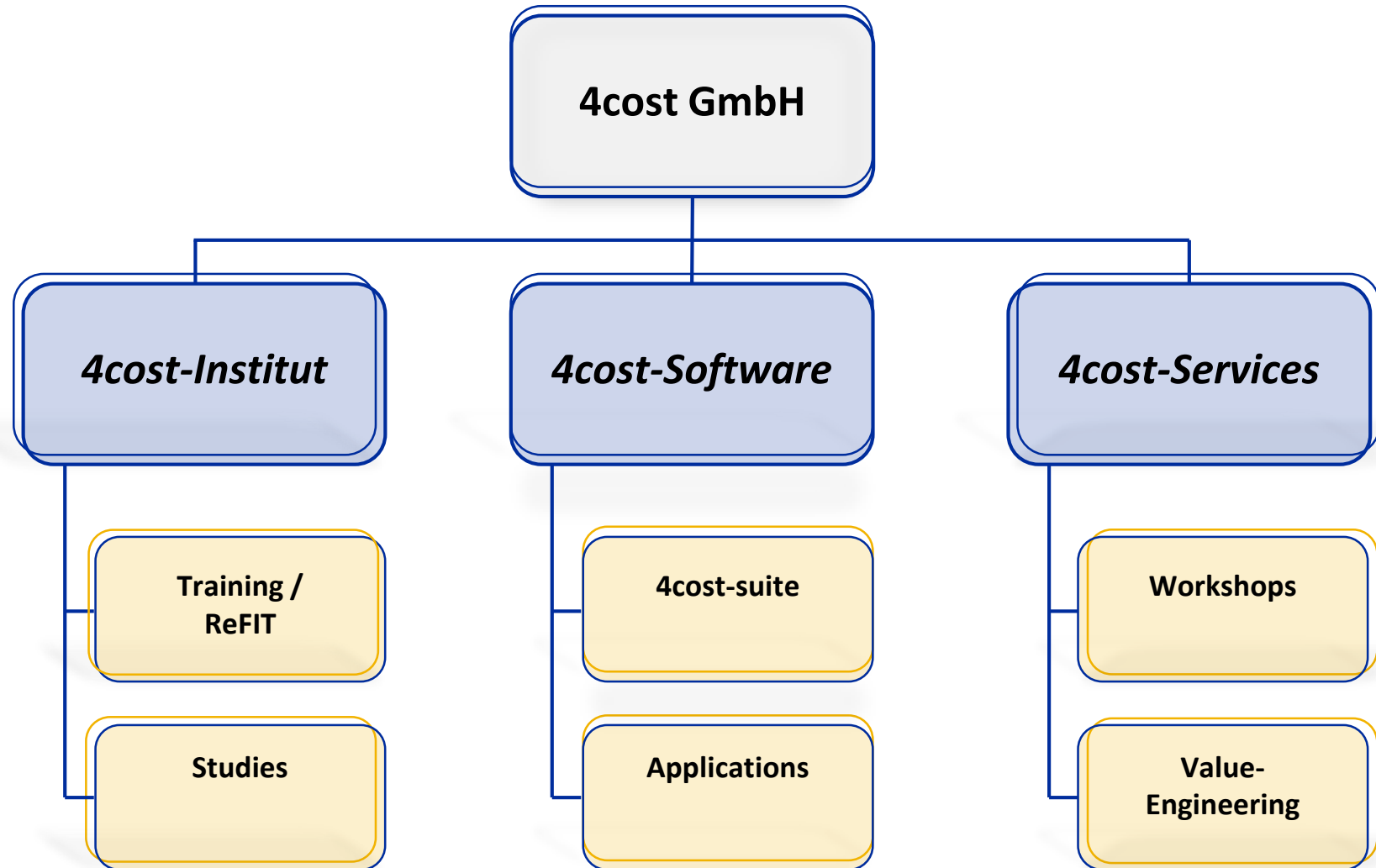
4cost GmbH

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→ **Intro** → 4cost Module

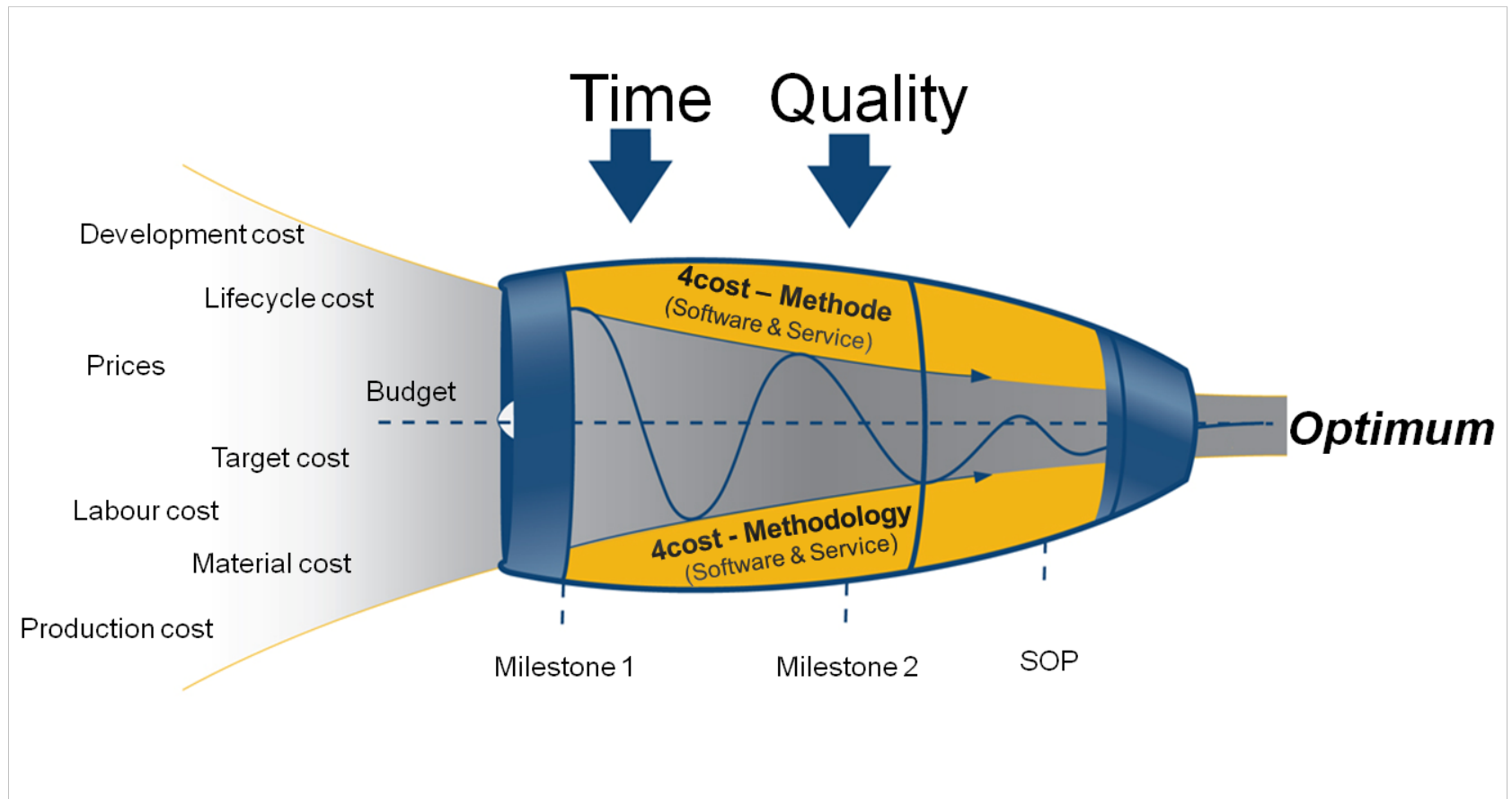
structure aces prediction scenario cadcal reporter

→ summary





## Using 4cost models optimizes timeline and product quality





## Die integrierte Methode

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➔ **Intro** ➔ 4cost Module

structure aces prediction scenario cadcal reporter

➔ summary

