

CostInsight Economical Modelling

Of future production of innovative solar applications

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Today's agenda

Cost Modelling

- Techno-Economical modelling of future solar production facility
- Modelling principles
- Input and Output
- CostInsight Workflow
- Screen shot examples
- Questions



Before we start

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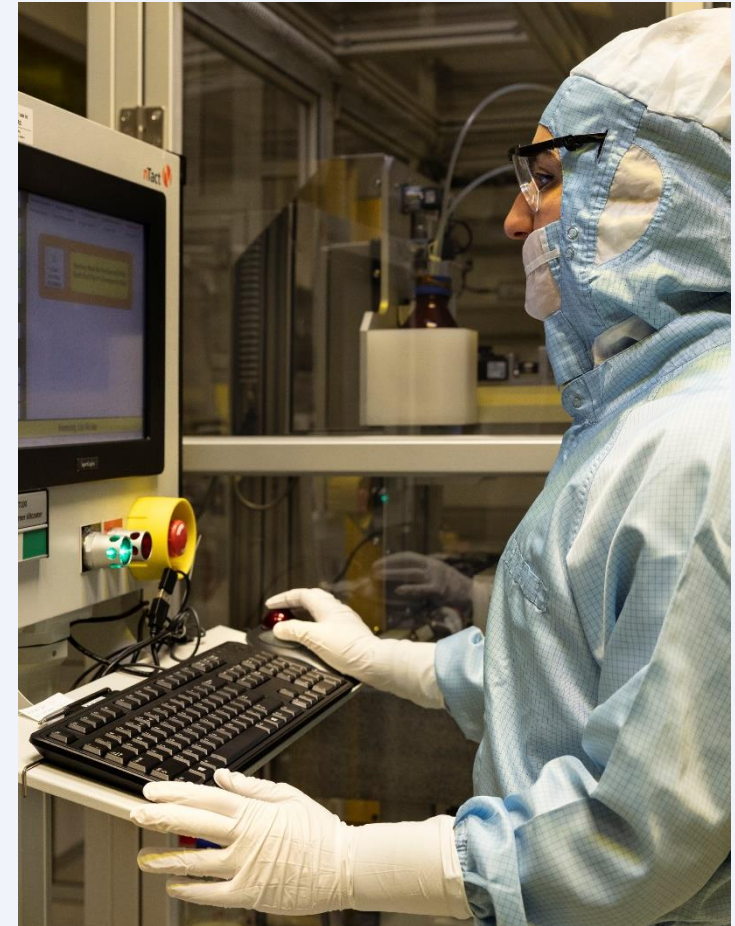
Cost Modelling

CostInsight Cost Model

Why cost modelling of (low TRL) technologies?

Looking at process in detail

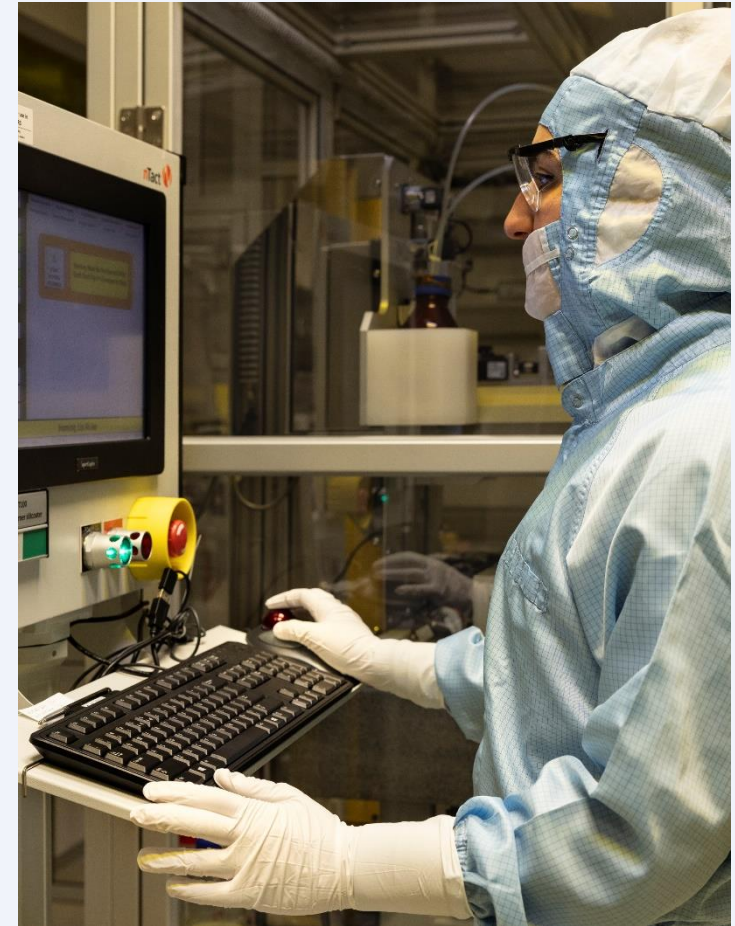
- Process uncertainties
- Cost drivers
- Supply chain effects
- Industrial approach



Best Practices on low TRL cost modelling

Cost Modelling is best used for:

- Comparing technologies
- Determining cost drivers
- Determining cost effect of certain technology or material
- Sensitivity analyses



Modelling principle

TECHNOLOGY IN THE LEAD

Modelling principle

Technology in the lead

- Bottom Up Approach
- Production process breakdown
- For every process is calculated:
 - Yield, Uptime, throughput
 - Depreciation, building and utilities
 - Labor, Material and energy usage



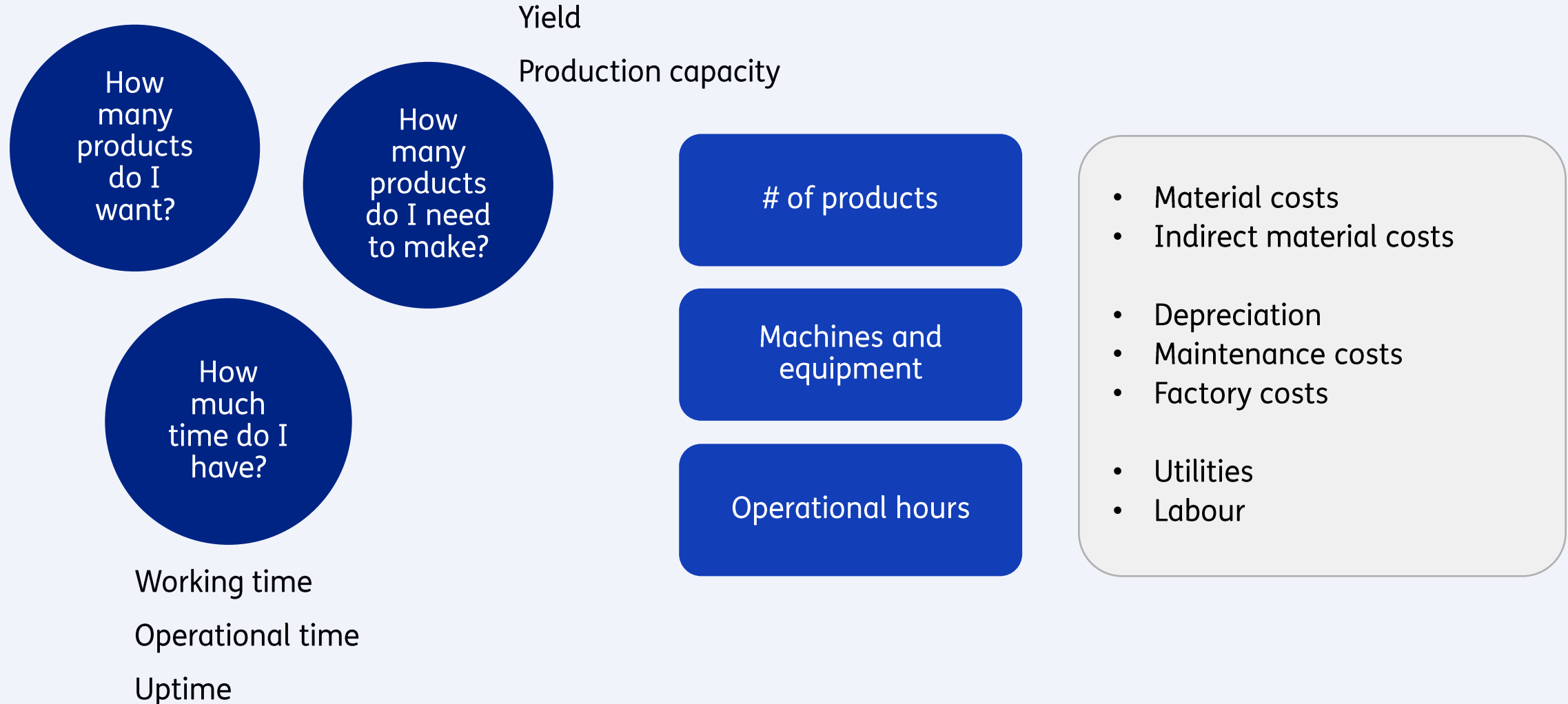
Modelling principle

Important assumptions

- One factory, one product, all year long
- Processes are mature
- Equipment is mature
- Material costs according to industrial data
- No learning effects in supply chain



Modelling



Model Input

Product definition

- Size, thickness
- Materials used
- Production outlook

Process Definition

- Detailed definition of production steps and processes
- Material usage
- Throughput
- Yield / efficiency

Equipment

- CoGS
- Footprint
- Production capacity
- Availability
- Utilities
- Labour

Materials

- Costs
- (raw) Usage
- Ingredients
- Processing

Model output

Fixed costs	Operational Costs	Material costs	Costs per process	Material Cost Breakdown
• Depreciation • Factory costs • Transport costs	• Labour costs • Utilities • Waste costs	• Consumables • Wear parts • Supporting materials	• Cost factors per process • Cost drivers • Yield • Utilization	• Cost contribution per material • Cost drivers • Sensitivity analyses

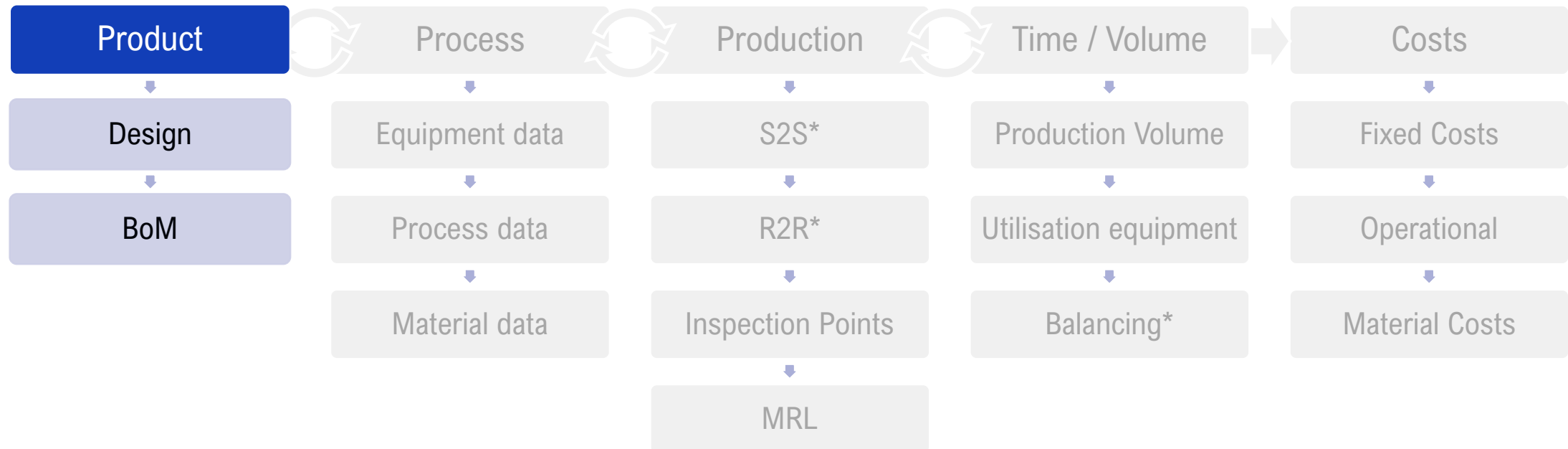
What is **NOT** calculated?

- Financing costs
- Engineering costs
- Service costs
- R&D
- Logistics
- Factory optimisation
- WIP-costs
- Optimal buffer stocks



CostInsight Workflow

COSTinsight workflow



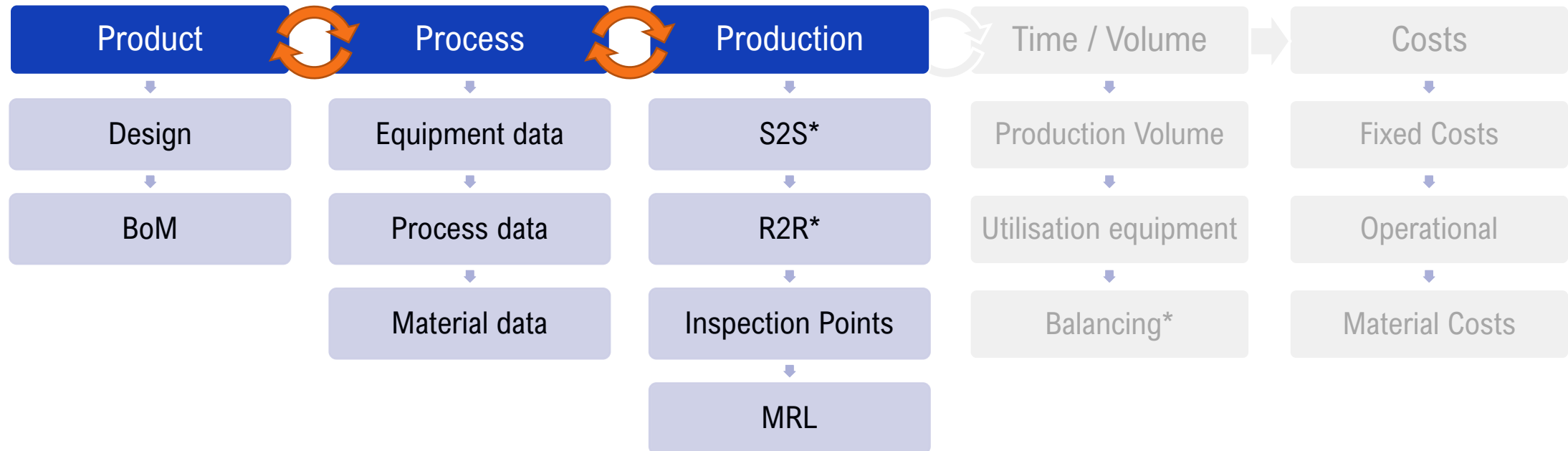
Materials

- Name
- Purchase price
- Unit
- Usage type
 - Per product
 - Per operational hour

MATERIAL DATA SHEET

Mat.ID	Materials	Purchase Price [€/purchase unit]	Purchase Unit	Usage Type	Waste Category
1	Material A (example)	9,99	kg	per produced product	Waste
2	Material B (example)	50,00	set	per operational hour	Reusable
3	Material C (Example)	3,99	m2	per produced m2	Waste
4	<not defined>				
5	<not defined>				
6	<not defined>				
7	<not defined>				
8	<not defined>				
9	<not defined>				
10	<not defined>				

COSTinsight workflow



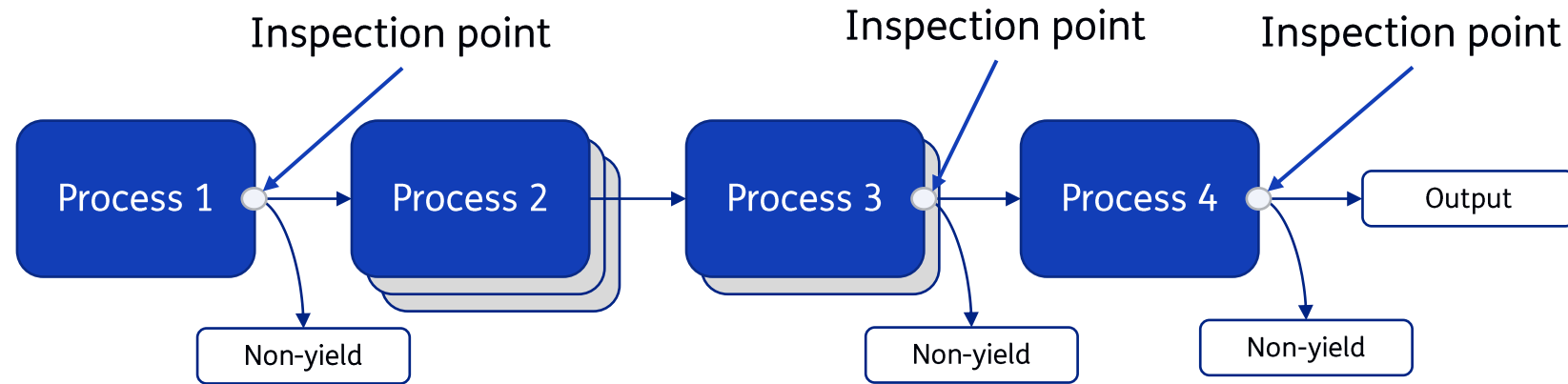
Process data

- Equipment data
 - Cost price, Footprint, Spareparts
- Operations
 - Uptime, unplanned downtime, utilities
- Process related
 - Inspection point
 - Throughput
- Material Usage
 - Gross Usage
 - Waste

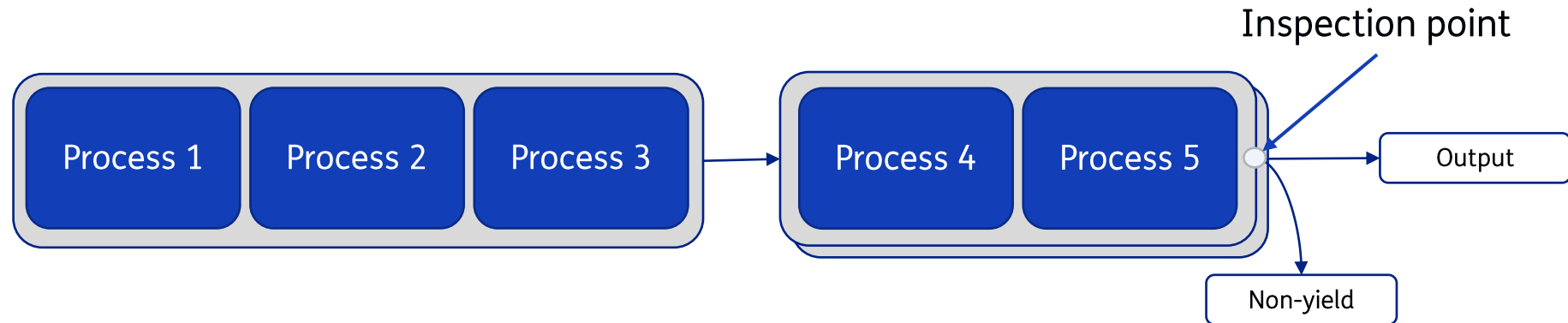
PROCESS DATA SHEET							
Step ID				☒ Process 1 ☒ Process 2 ☐ Process 3 ☐			
Scheduled Downtime							
Scheduled production stop Interval		Time interval between stops (consumable re-fill, cleaning etc)	hr	100	233	999999	
Scheduled stop time		Consumable re-fill, cleaning, small maintenance	hr/event	1,00	0,10	0,00	
Unschedule Downtime							
Mean Time Between Failure			hr	800	1200	99999999	
Mea]			hr	1	1	0,0009	
Process related							
Process Yield		Yield of specific process (% units produced within specification)	%	99,5%	99,5%	99,5%	
Inspection Point after process?		Are non-yield items taken from the production line?	Boolean	FALSE	FALSE	FALSE	
Throughput		# units processed per hour (note: this includes non-yielded items)	unit/hr	75	30	999	
Operator FTE's		Labour needed for operation and	#-FTE/mach	1	0	0	
Materials usage and waste				Usage Waste Usage Waste Usage Waste			
Be sure to define materials in Material sheet first							
1	Material A (example)	kg/unit		0,09	0,01		
2	Material B (example)	set/hour				2	1
3	Material C (Example)	m2/unit				4	1
4	<not defined>	Q/unit					
5	<not defined>	Q/unit					
6	<not defined>	Q/unit					
7	<not defined>	Q/unit					
8	<not defined>	Q/unit					
9	<not defined>	Q/unit					
10	<not defined>	Q/unit					

S2S and inspection points

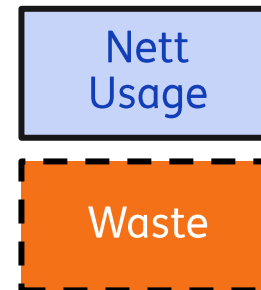
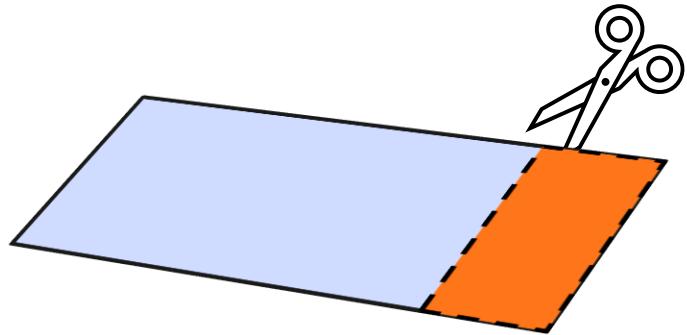
S2S



R2R

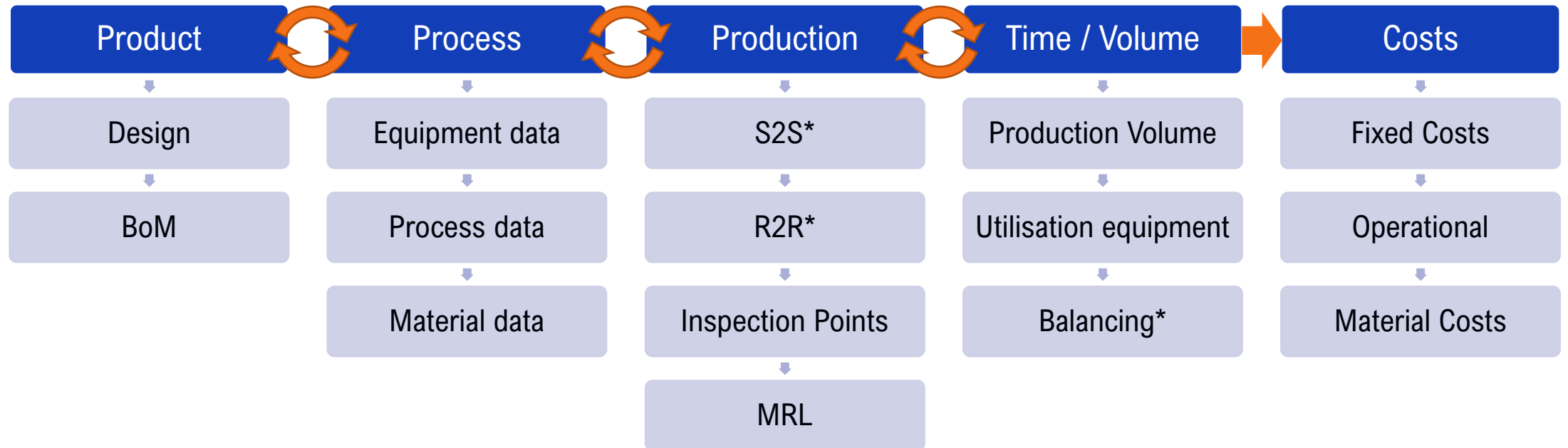


Material – Gross Usage and Waste definition

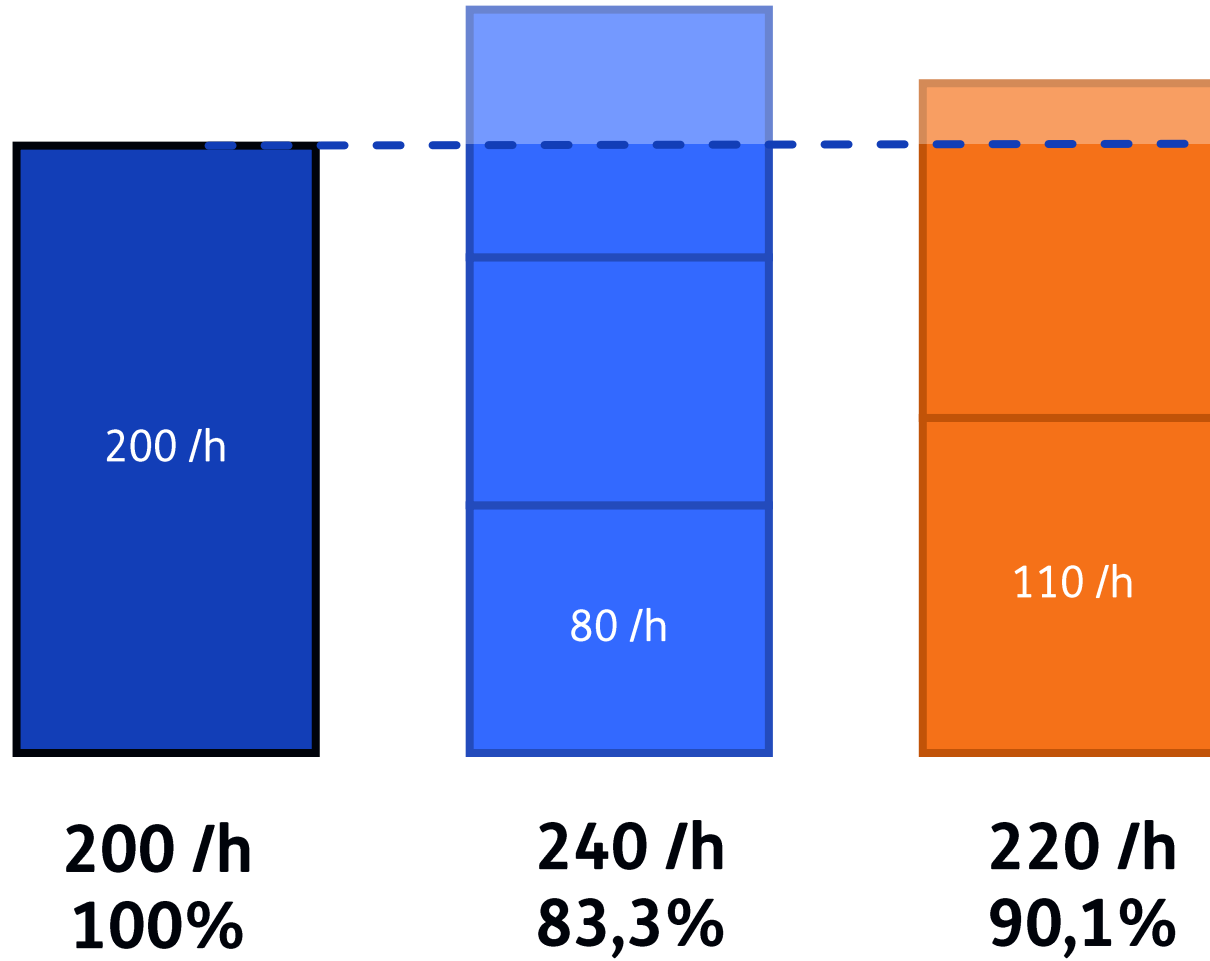


Gross Usage

COSTinsight workflow



Balance your factory sim



- Automatically calculated, but please check
- Advice: Aim to 80% utilisation
- Equipment selection based on Yearly volume
- Model does not optimise for factory logistics, intermediate stocks, WIP etc.

Balance your factory sim

SYSTEM BALANCE AND UTILISATION

Step ID

Process name

1

Step 1

2

step 2

3

Step 3

Required Production Volume

In the calculation referred to as 'batch'

unit/yr

1,80E+05

System Balance and Utilisation Rate

Total Utilisation	Required production time over available operations time	%	83,1%	178,1%	154,1%
Recommended # of Systems per process step			1	2	2
Manual input # of Systems per process step					
# of systems parallel		#	1	2	2
Operations Time	working days (210) x working hours per day (16)		3.360	3.360	3.360
System Utilization	Utilisation of Operations time, given the number of machines	%	83,1%	89,1%	77,1%

Transport systems

Calculated # of transport system(s) to next process step	2	4	4
Manual input # of Transport system(s) to next process step			
Transport Costs	200.000	400.000	400.000

Handling Estimates and Uncertainties

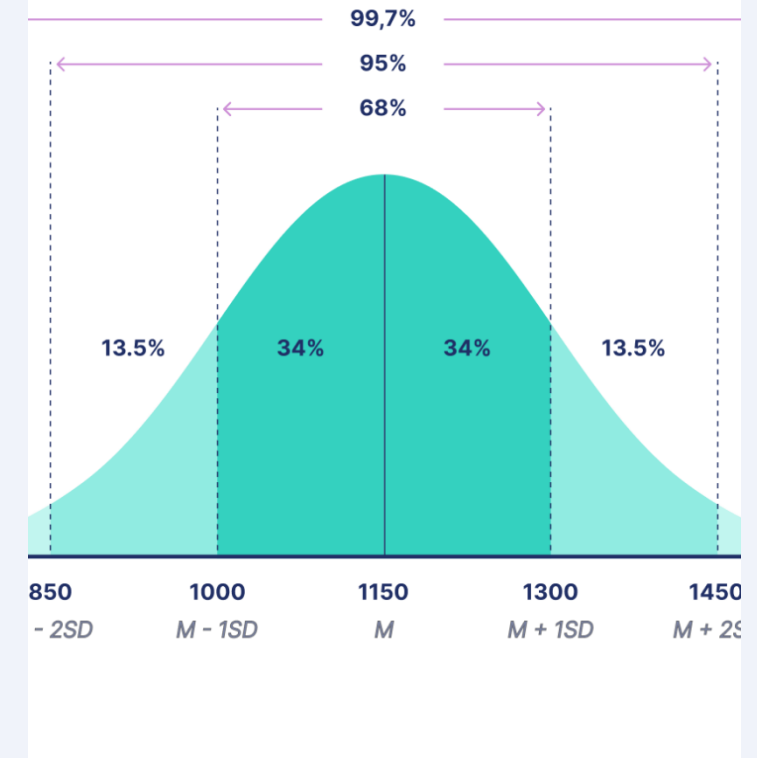
Data and estimates

- Document your estimates
- Document your sources
- Determine **impact** of uncertainty on your estimate
- Calculate multiple **scenarios**

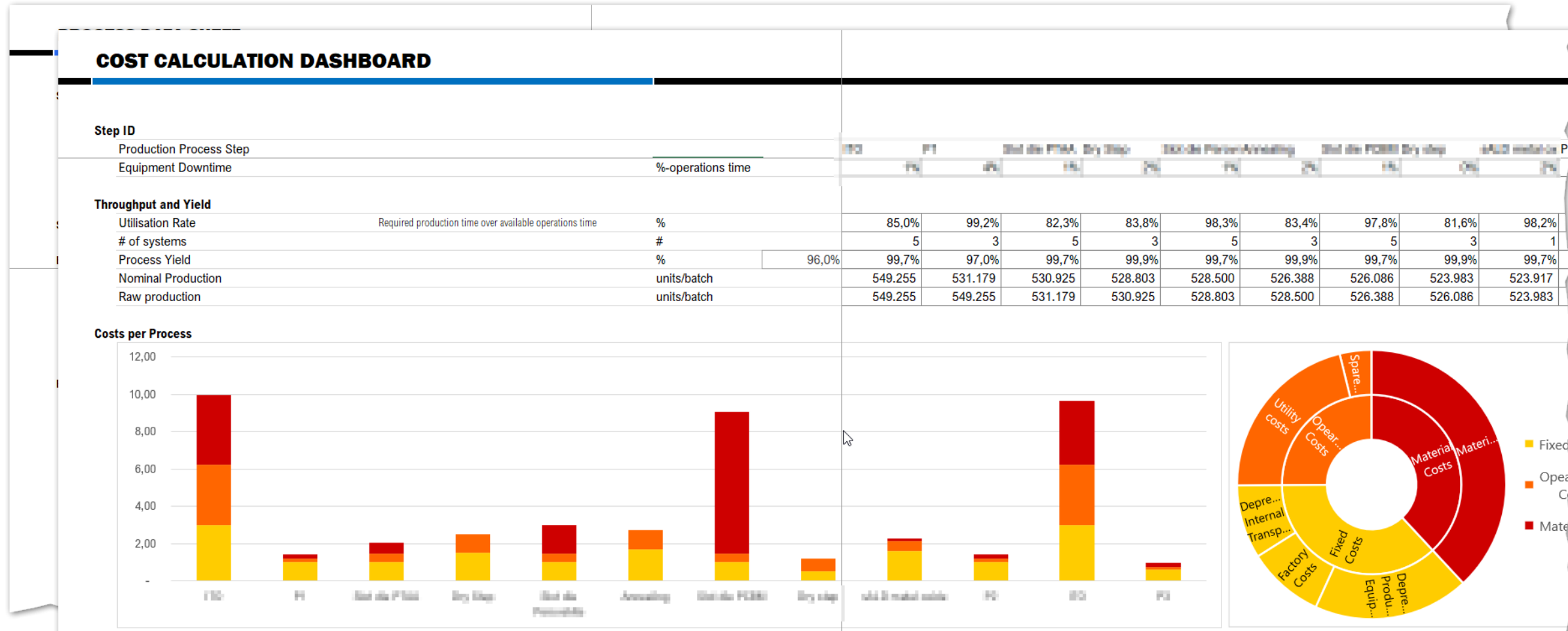
Low maturity

- Manufacturing Readiness Level (MRL) assessment on production processes
- Technology Readiness Level (TRL) assessment on equipment

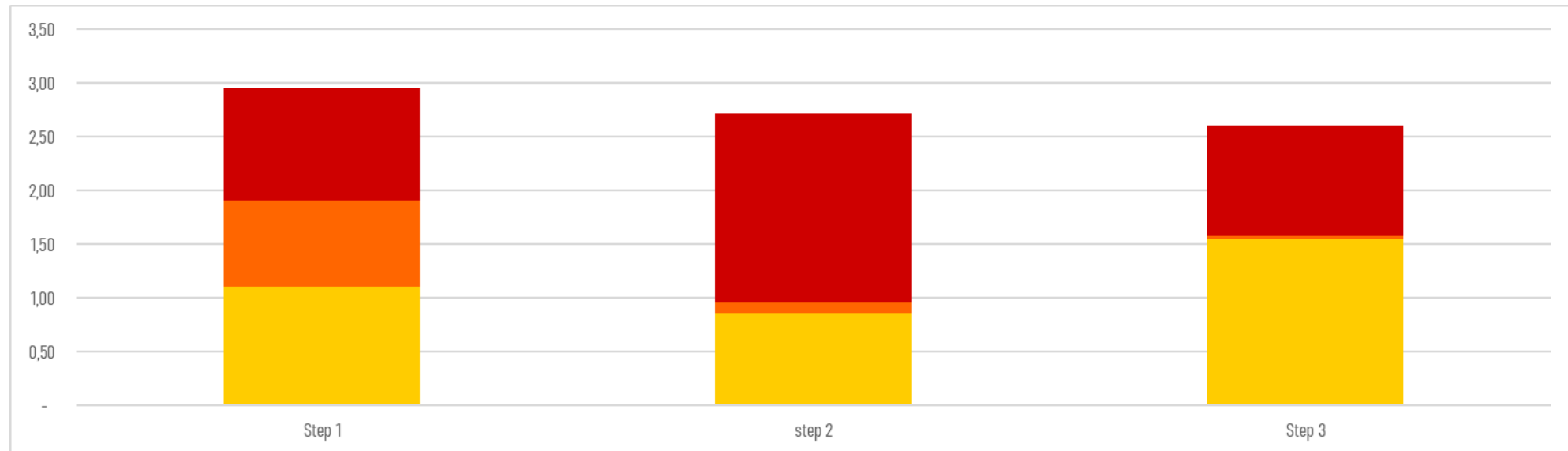
Using the empirical rule in a normal distribution



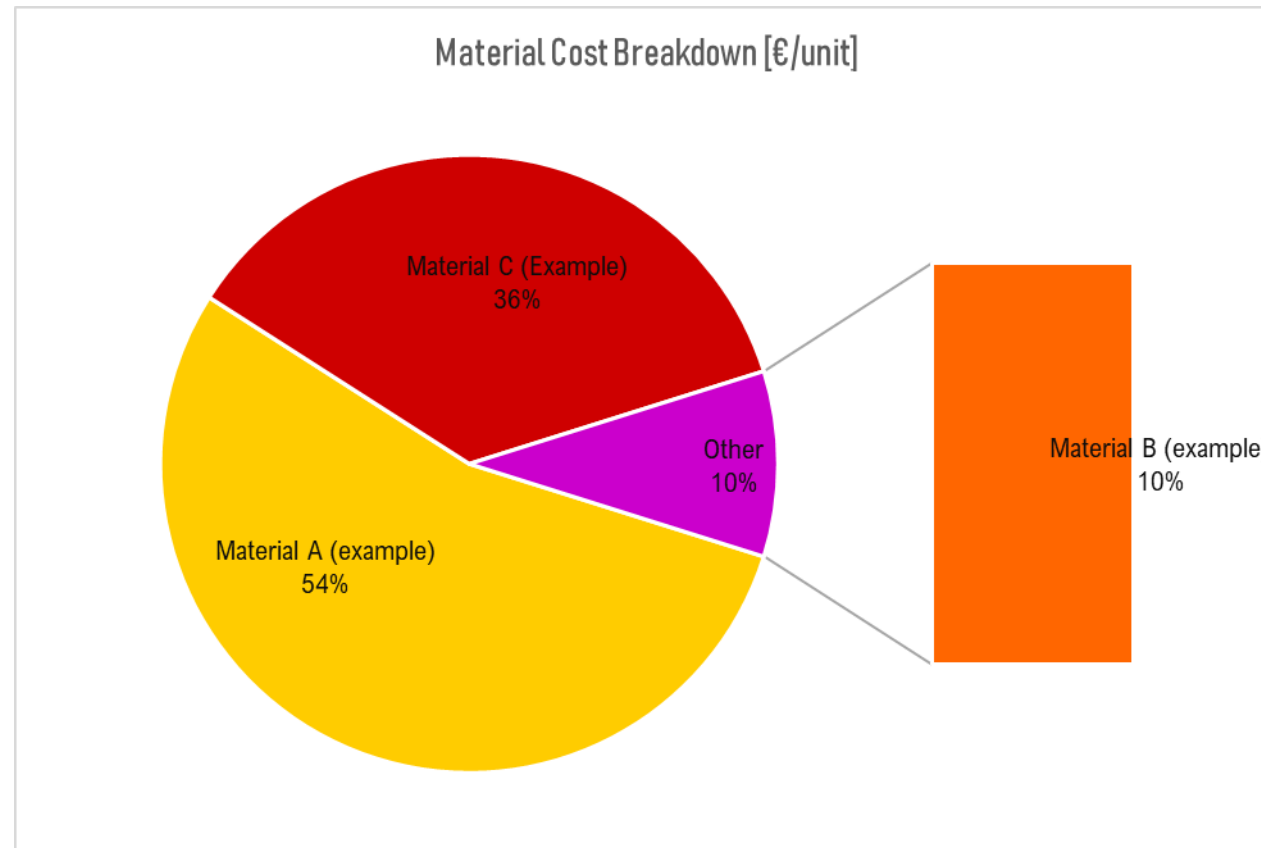
COSTinsight Screen shots



Cost per process



Material Cost Breakdown



**Thank you for your
attention**

Contact information

Do you want more info on production costs simulations or learning effects on costs?

Feel free to contact me:

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