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Applying Cost Engineering for cost effective design engineering

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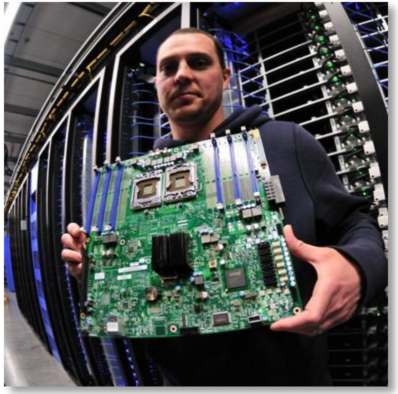
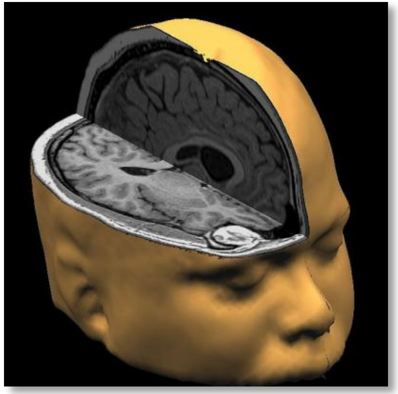
It’s hard to imagine a world without chips





Everyday objects get connected

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GPS Fleet tracking

Cash registers

Smart meters

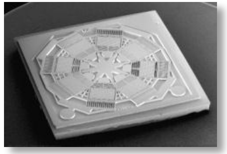
Wireless IP camera

New devices, new applications

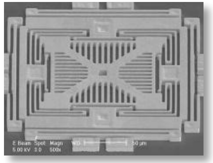
Wearable sensors
(Holst Centre)

Camera pill with
camera, transmitter
and computer

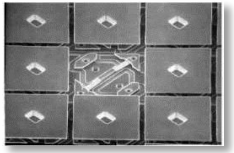
DNA analysis
(Affymetrix)



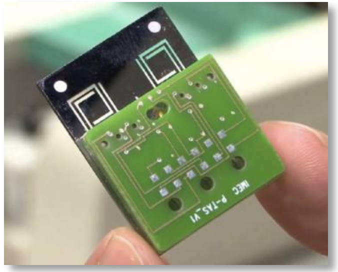
Gyroscope
(UC Irvine)



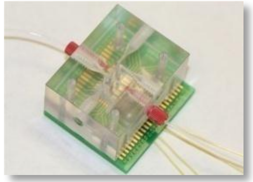
Accelerometer
(IC Mechanics)



Micromirrors for
beamers (TI)

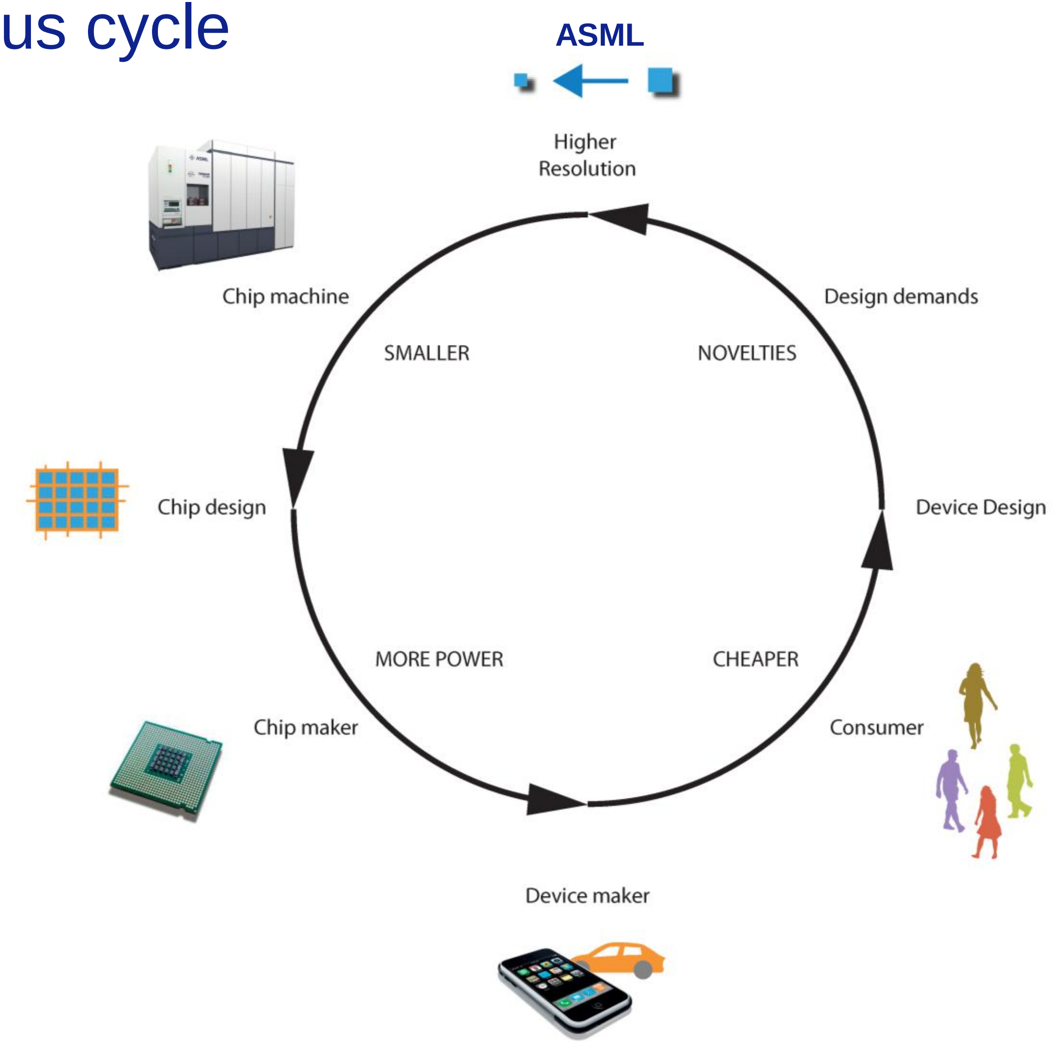


On-Chip DNA amplification and
detection (imec/Panasonic)

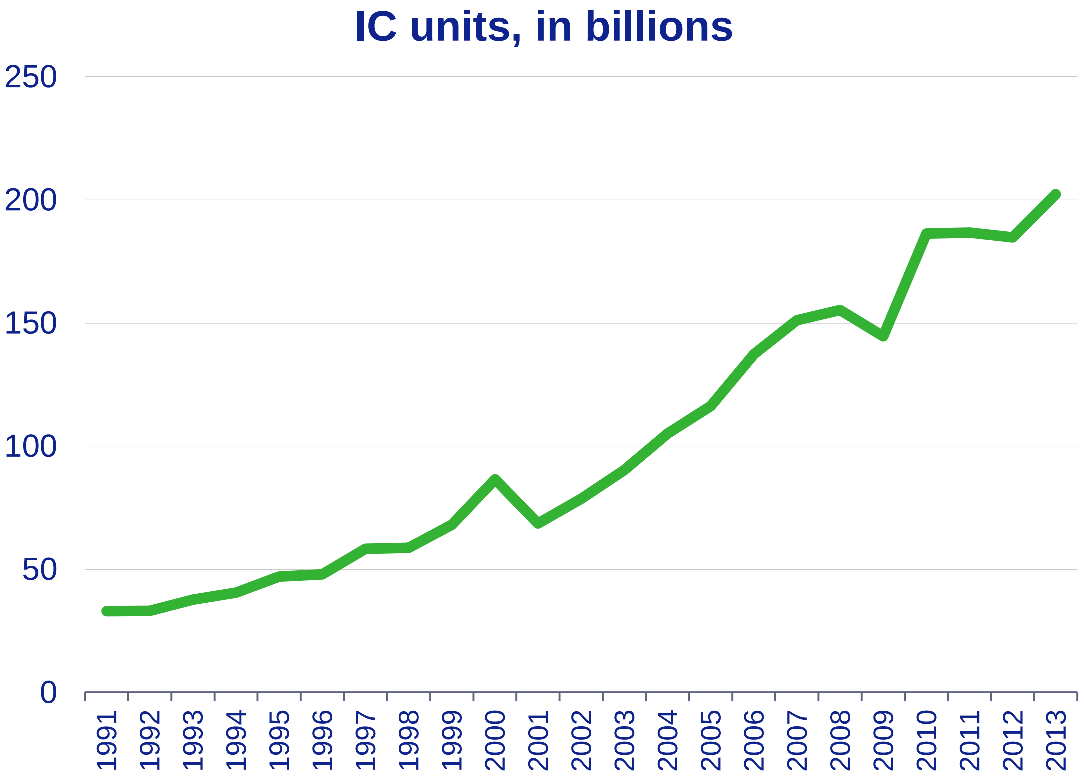


Lab on a Chip (LOC) for
counting red blood cells

A virtuous cycle



More than 200 billion ICs are made every year



In 2013, 202 billion ICs were produced — 28 for every man, woman and child on the planet.

Global semiconductor industry sales were $305.6 billion.

Data: WSTS

ASML makes the machines for making those chips

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- Lithography is the critical tool for producing chips
- All of the world’s top chip makers are our customers
- 2013 sales: €5.2 bln
- Payroll: ~13,800 FTEs

Driving the semiconductor industry: Moore's Law

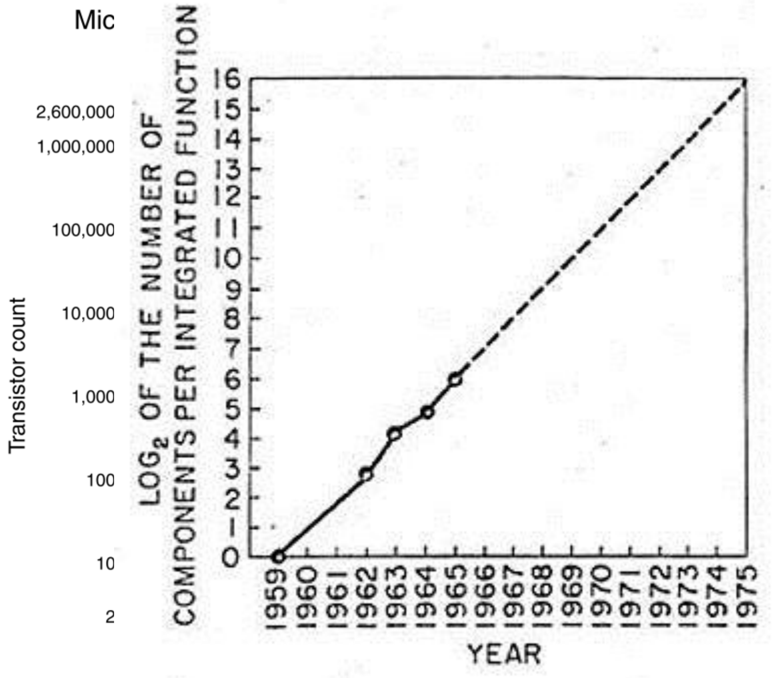

Fig. 2 Number of components per integrated function for minimum cost per component extrapolated vs time.

Gordon Moore (1965): Number of transistors per chip doubles every year.

Later adjusted to two years, the trend has held for more than four decades.

Driving the semiconductor industry: Moore's Law

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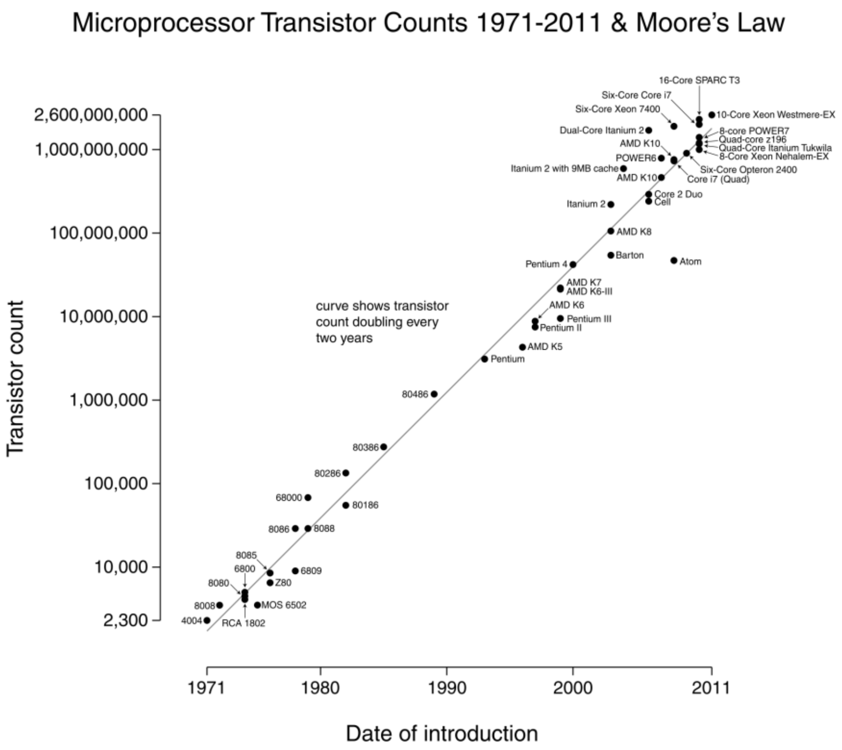
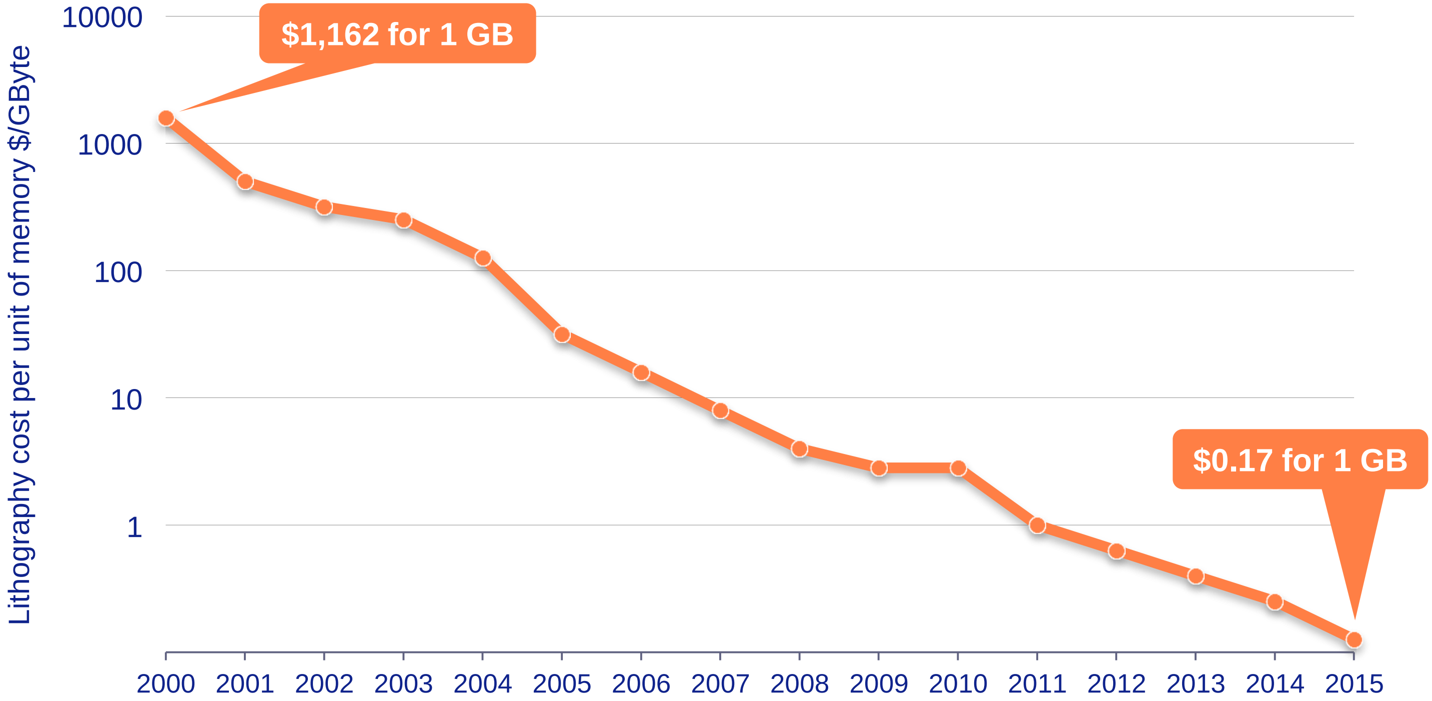


Gordon Moore (1965): Number of transistors per chip doubles every year.

Later adjusted to two years, the trend has held for more than four decades.

Moore’s Law makes chips cheaper…



Source: Gartner. High quality Flash

Keeping up with Moore's Law

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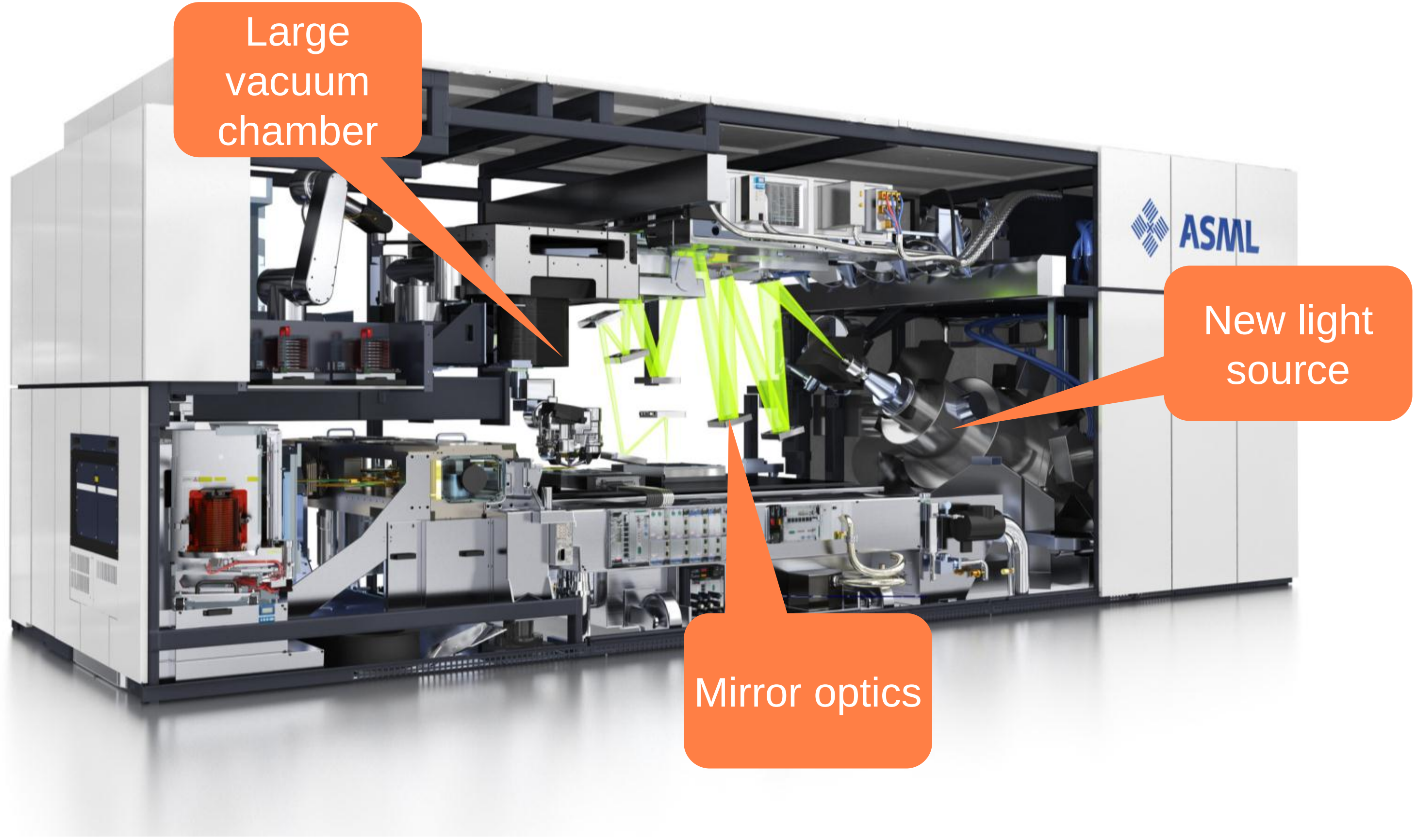
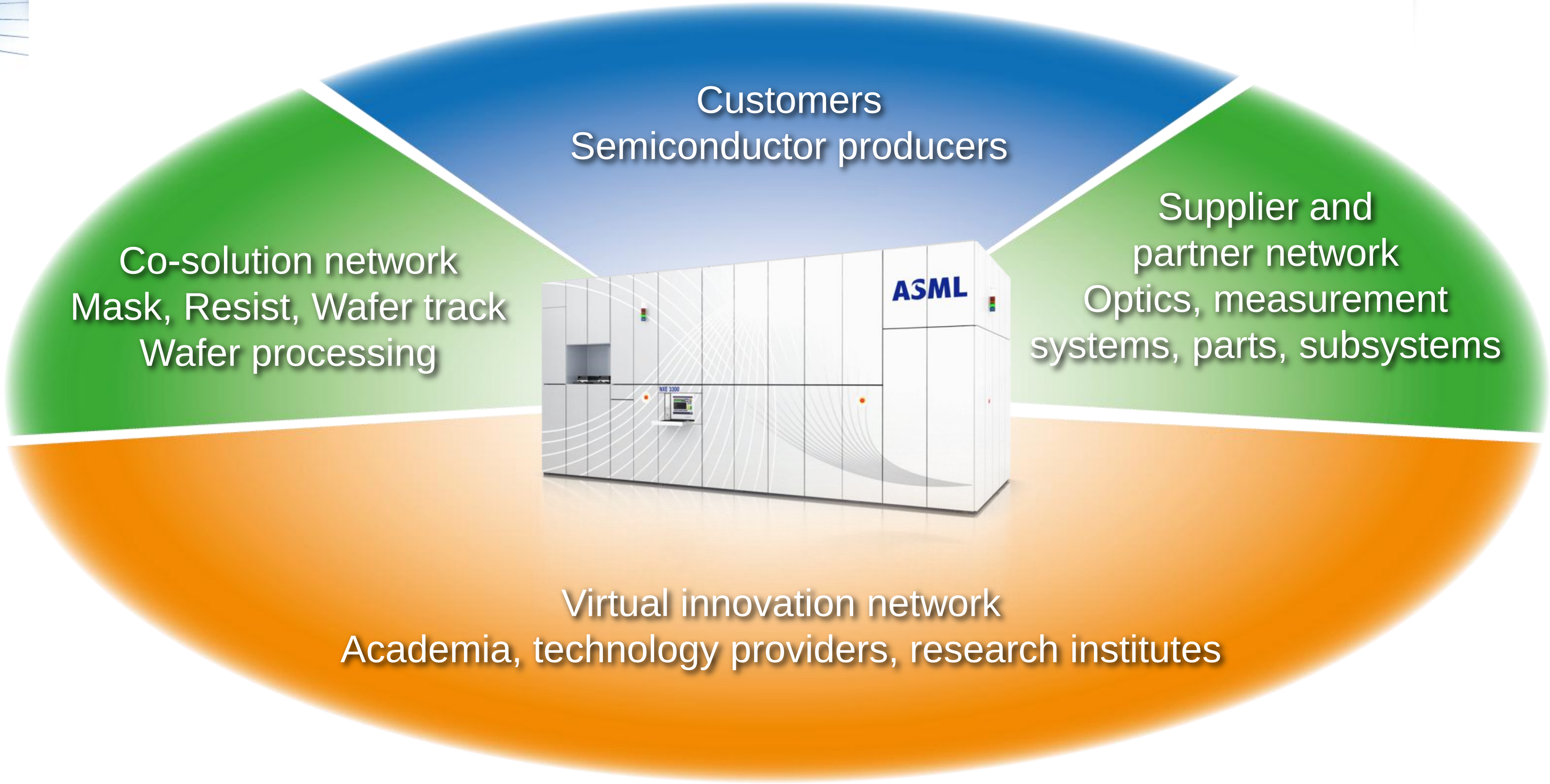
PAS 2000
ASML's first stepper, 1984

TWINSCAN NXT:1970Ci
The most advanced immersion scanner, 2013

The future of lithography: EUV



Open Innovation from design to manufacturing



Sharing risk and reward

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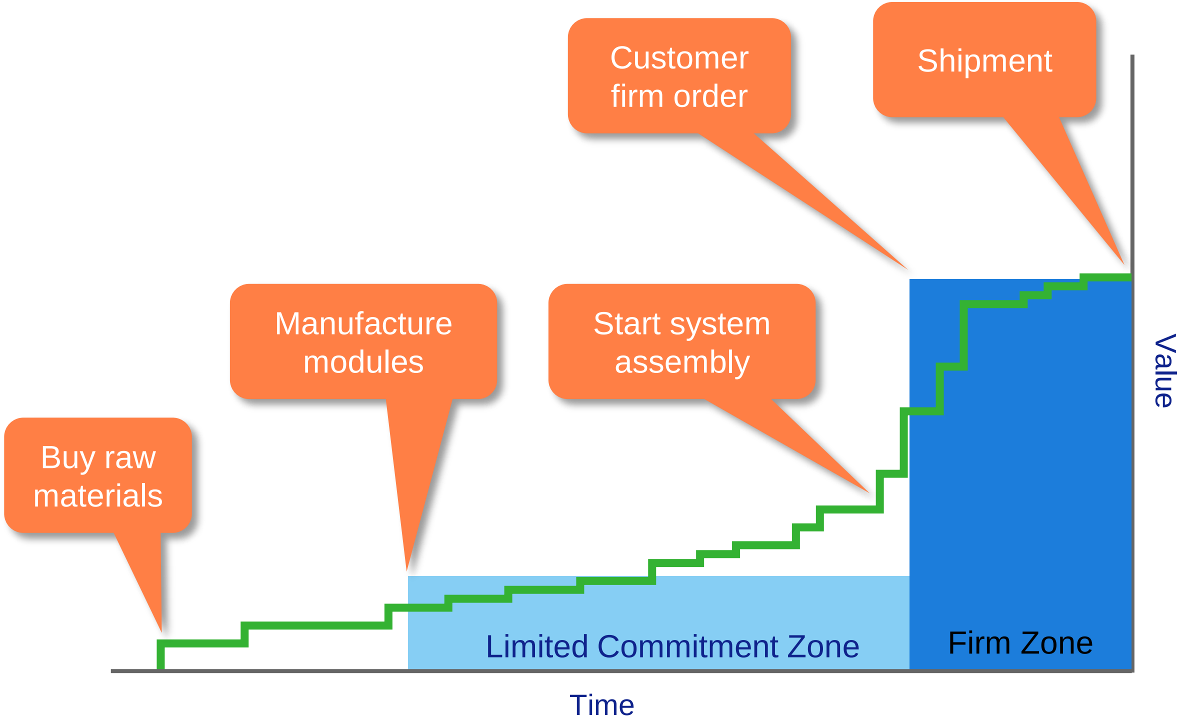

Suppliers bear some of the risk and participate in the rewards.

Mutual transparency ensures that risks are well understood and minimized.

“QLTC” sourcing model (Quality, Logistics, Technology, Cost) means that suppliers do not compete solely on cost.

Why is cost important: The Business drivers

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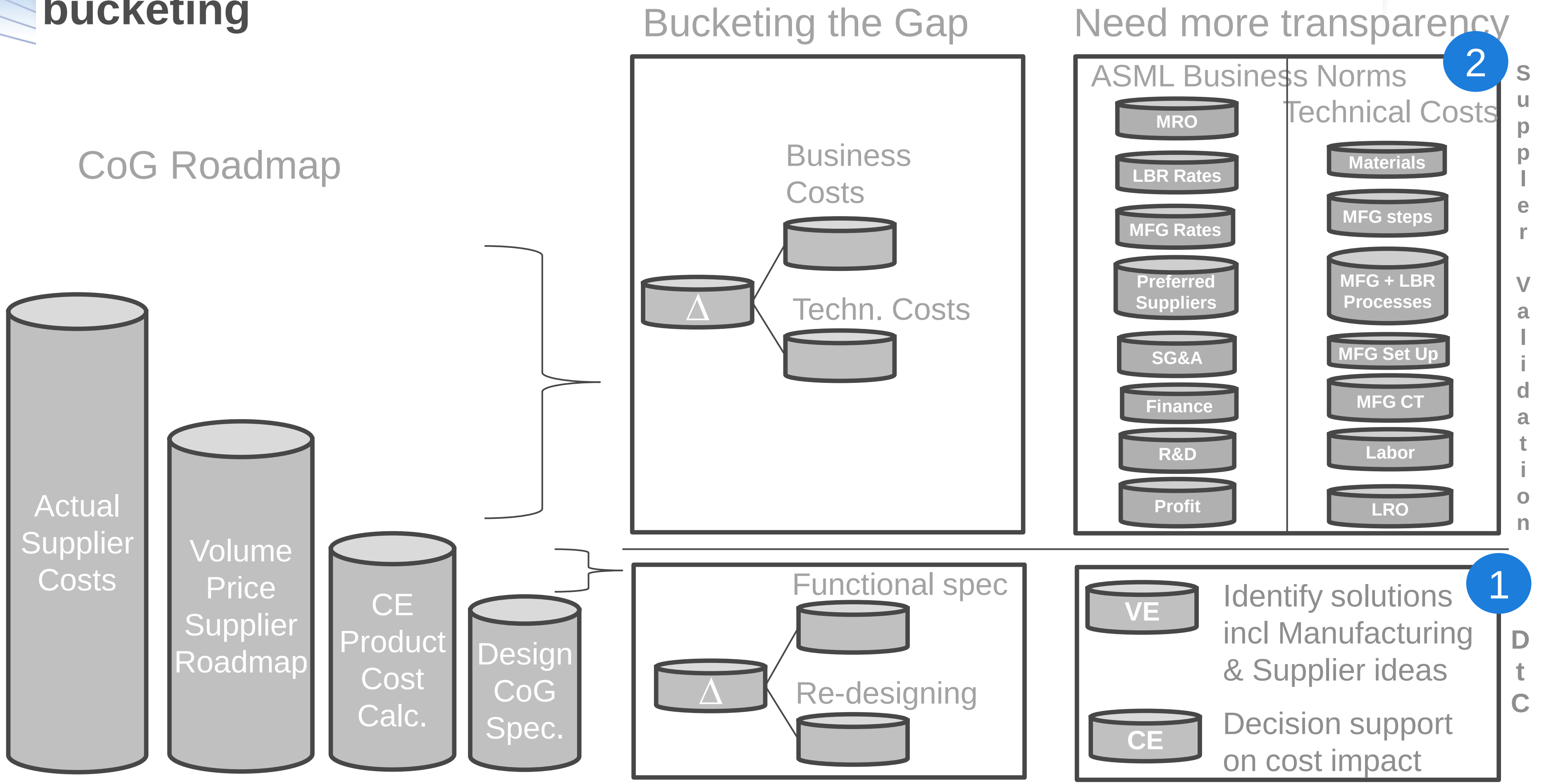
- Customers will only increase investments in lithography if we prove that we can help them continue Moore's Law towards smaller, more powerful and energy-efficient chips at similar cost.

- Consistent strategy: there are challenges to reaching our goals. Cost is the biggest one; so affordability is key.

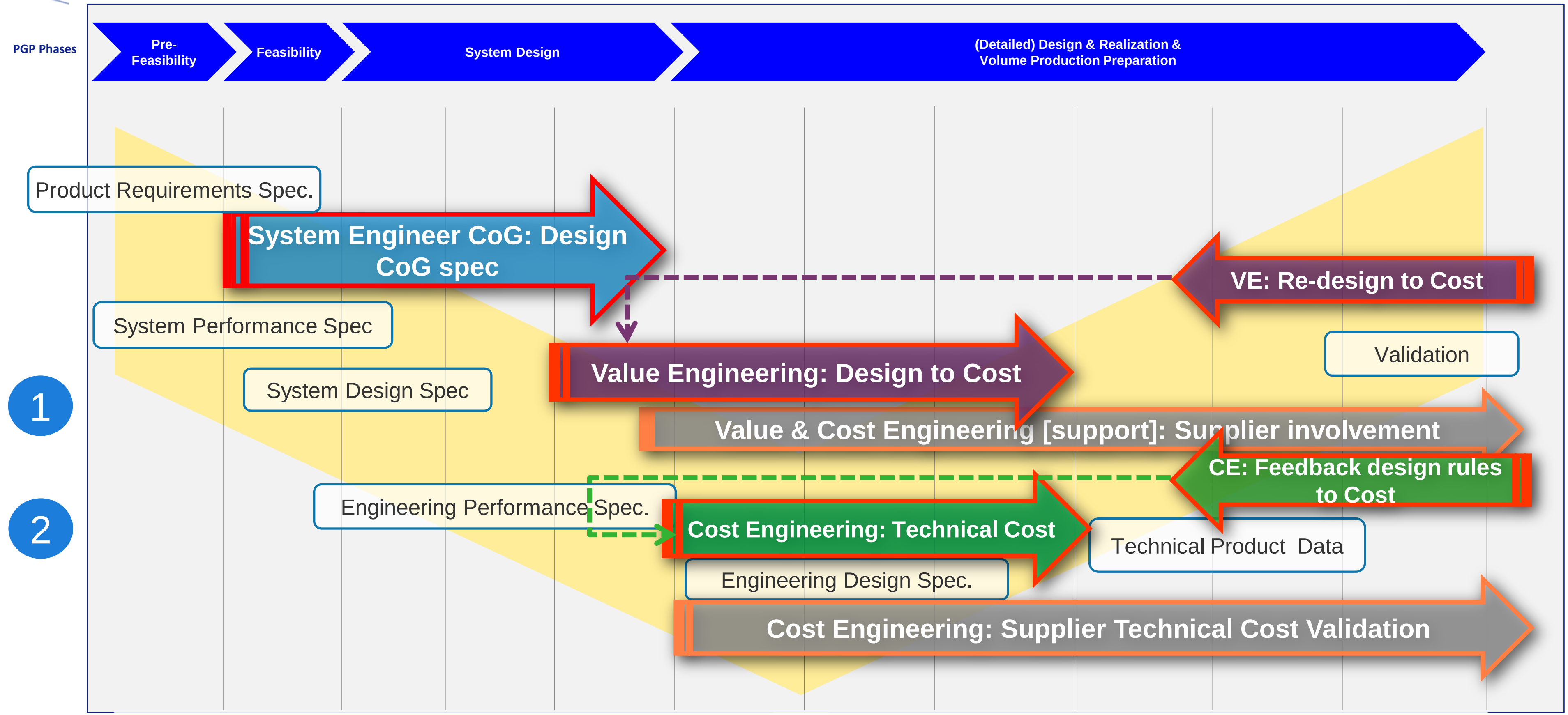
- Mobile applications are leading innovation. Our challenge is affordable scaling that creates lower cost and improved performance – possible with both EUV and immersion technology.

Create Cost transparency through the CE Cost Calculation bucketing



Areas in PGP where CoG is managed

Cost of Goods spec organized as any other performance spec



PGP: Product Generation Process

The Design Project Leader organizes the CoG team

assignment to meet design & best cost

CoG as part of the industrialization fundamentals during design engineering

➢ Architects:	Functional CoG spec [EPS], cascading to functional clusters and building blocks
➢ Designer engineers:	[DfX] Design for manufacturability & design cost estimations
➢ Value Engineers:	Design to Cost, identify solutions for integral cost optimizations with focus on Product incl Manufacturing & Supplier ideas
➢ Cost Engineers:	Decision support on CoG Support Technical Costs, Validation @ Suppliers
➢ Buyers:	Cost down roadmap Suppliers
➢ Supply Chain Engineers:	New Product Introduction, Technical Acceptance by Suppliers [Learning Curve, NRE, Tooling costs]
➢ Logistic Engineers:	Cycle time & cost reduction throughout the Supply Chain

Typical Cost Engineering support & deliverables

- Building and maintain CoG Monitors
- Product Cost calculations
- Publishing product cost data in CoG tooling used by designers
- Design decision support on CoG
- Technical Cost Validation by Suppliers
- Sourcing support during negotiations @ Suppliers
- Feedback for designer engineers [guidance & rules]

The Cost Engineering competences

COST ENGINEERING COMPETENCES

Detailed description of the different industrial manufacturing technologies and manufacturing processes:

Knowledge Sharing

- Process Description
- ASML experts & Supplier experts feed back
- Area of application
- Industrial equipment
- Industrial Norms
- Best practices& Design Rules
- Cost Driver information

CE - Electronics Manufacturing + Cost competence

- SMT Manufacturing
- Coating
- Manual Assembly

CE - Mechanics Manufacturing + Cost competence

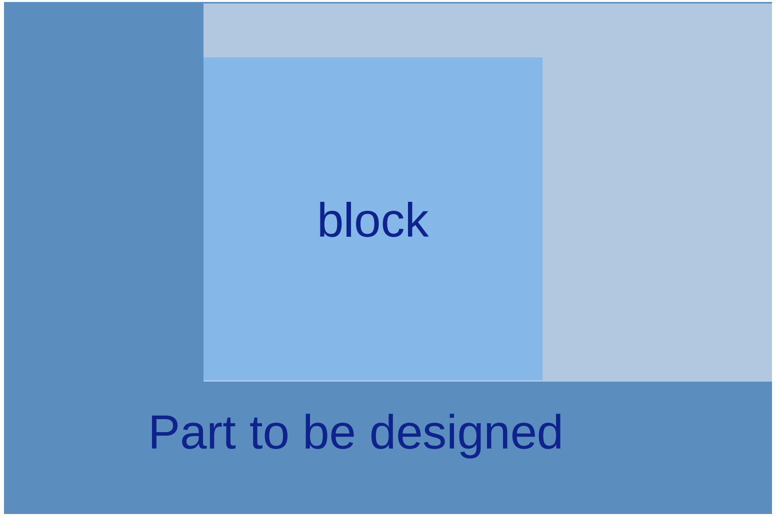
- Machining
- Welding & Brazing
- Sheet Metal & Forming
- Heat & Surface treatments
- Cleaning
- Specials

CE - Optics Manufacturing + Cost competence

- CNC Optical Machining
- Litho
- Grinindg Polishing
- Measuring & Inspection
- Coating
- Specials

Visit our Cost Engineering Competences

Typical Cost Engineering feedback to designers: Why functional design is not enough Example : simple design



Function: a block needs to be placed in a corner.

Integral cost price part < 30 euro.

Cycle time part < 2 days

Is this a good design?

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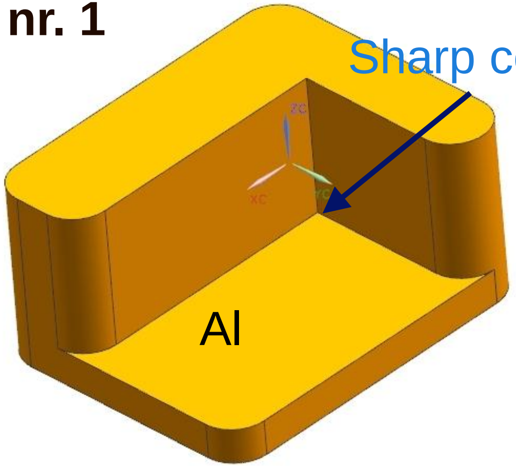
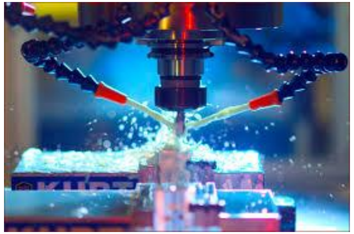
Design nr. 1



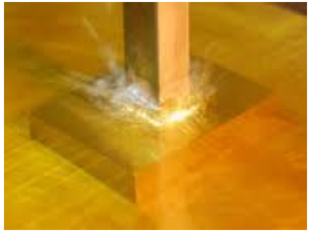
Production

Can be made!!

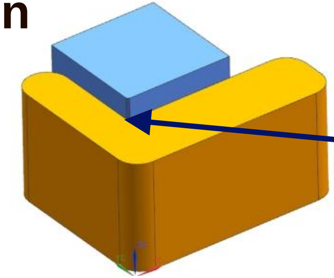
Step 1 milling



Step 2 EDM



Function



Small chamfer is required to meet function.

Function OK!

Block can be placed in corner

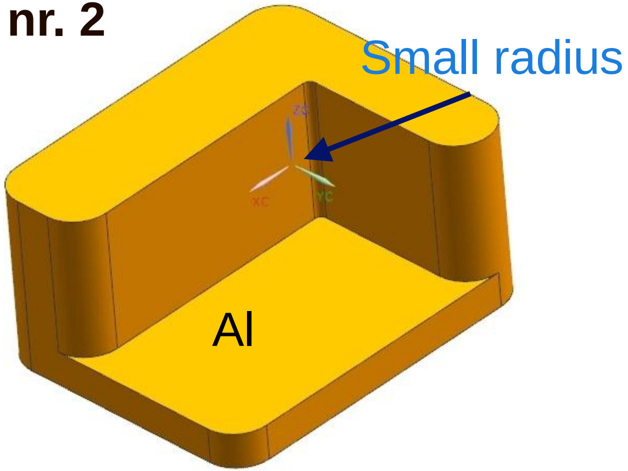
Result

- Function **OK**
- Integral cost price

  100 euro
- Cycle time **5 days**

Is this a better design?

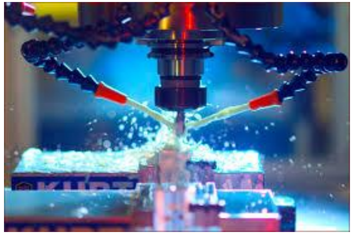
Design nr. 2



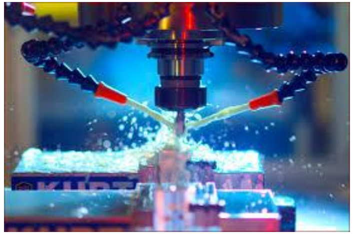
Production

Can be made!!

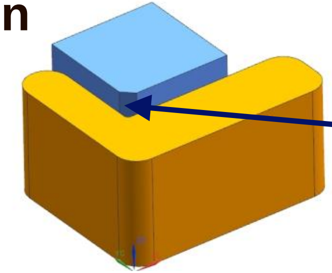
Step 1 milling



Step 2 milling corner



Function



Function OK!

Block can be placed in corner

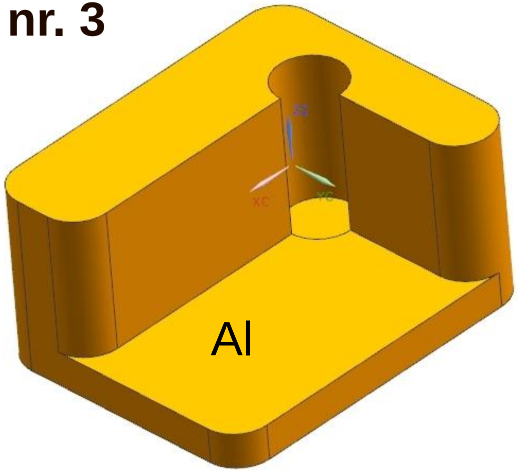
Result

- Function **OK**
- Integral cost price

  35 euro
- Cycle time **2 days**

Is this the best design?

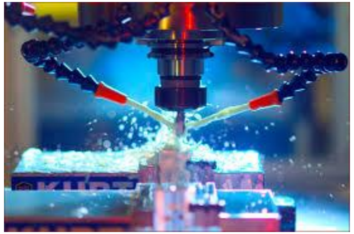
Design nr. 3



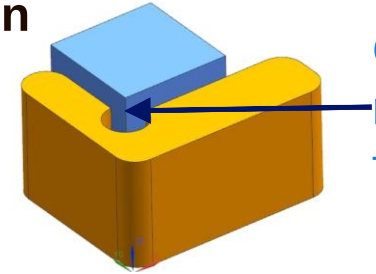
Production

Can be made!!

Step 1 milling



Function



Chamfer not required for function

Function OK!

Block can be placed in corner

Result

- Function **OK**
- Integral cost price

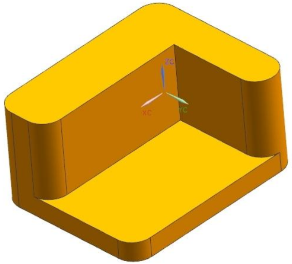
  20 euro
- Cycle time **1 day**

Why design for manufacturability + cost ?

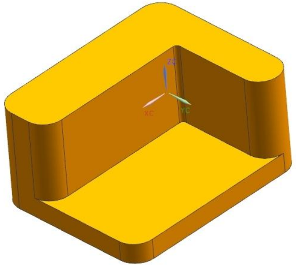
Design for manufacturability is not a goal,

but a method to reduce: ↓ € and ↓ (time)

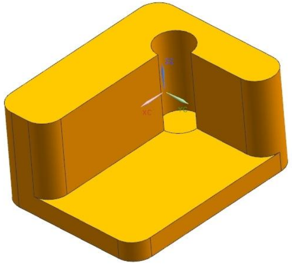
Design nr. 1



Design nr. 2



Design nr. 3



Design nr. 1

- 100 euro
- 5 days

Design **nr. 2 vs. nr. 1**

- 65 euro ↓
- 3 days ↓

Design **nr. 3 vs. nr. 1**

- 80 euro ↓
- 4 days ↓

Cost Engineering competence provides Manufacturing Process Knowledge

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Sample design rules………

General:

- Cost/part is driven by Geometric dimensioning and tolerancing & roughness spec.

Machining:

- Avoid thin walls
- Minimize number of tools required
- Avoid features deeper than 5 * D
- Avoid exotic materials (Ti, Inconel, PEEK)

Sheet Metal:

- Combine as much as possible bends into one part piece
- Bending radius ≥ Material thickness

Additive Manufacturing

- Combine as little as possible part volume with as little as possible building height.

- Process description
- ASML CE expertize
- Area of application
- Industrial equipment
- Industrial norms
- Best practices
- Design rules
- Cost driver information

Thank You