FHI – D&E Event 2023

Early involvement 2.0 – Right First time

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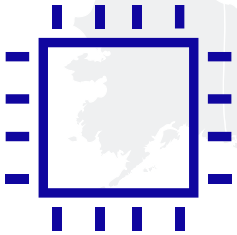
VERSION 1.0

Agenda

- **Introducing the world of ASML**
- Challenges
- Where do we stand now on Right First time?
  - Design
  - Manufacturing
- Early Involvement 2.0 – The next step

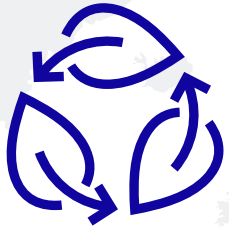
Chips are everywhere

The world is changing faster than ever before



Connected world

- Smarter cities, factories, homes, cars
- Connecting billions of ‘things’
- Unprecedented data volumes
- Privacy in a connected world
- Cybersecurity
- …



Climate change and resource scarcity

- Rising energy use
- Exploding energy costs
- Accelerating climate change
- More waste and pollution
- Fragile food chains
- Material shortages
- …

Social and economic shifts

- Rising population
- Higher medical costs
- Faster urbanization
- Need for tech talent
- Deglobalization
- Technological sovereignty
- …

And this industry can help unlock the potential

Connected world

- Cloud infrastructure
- Artificial intelligence
- Hyperconnectivity
- Edge computing

Climate change and resource scarcity

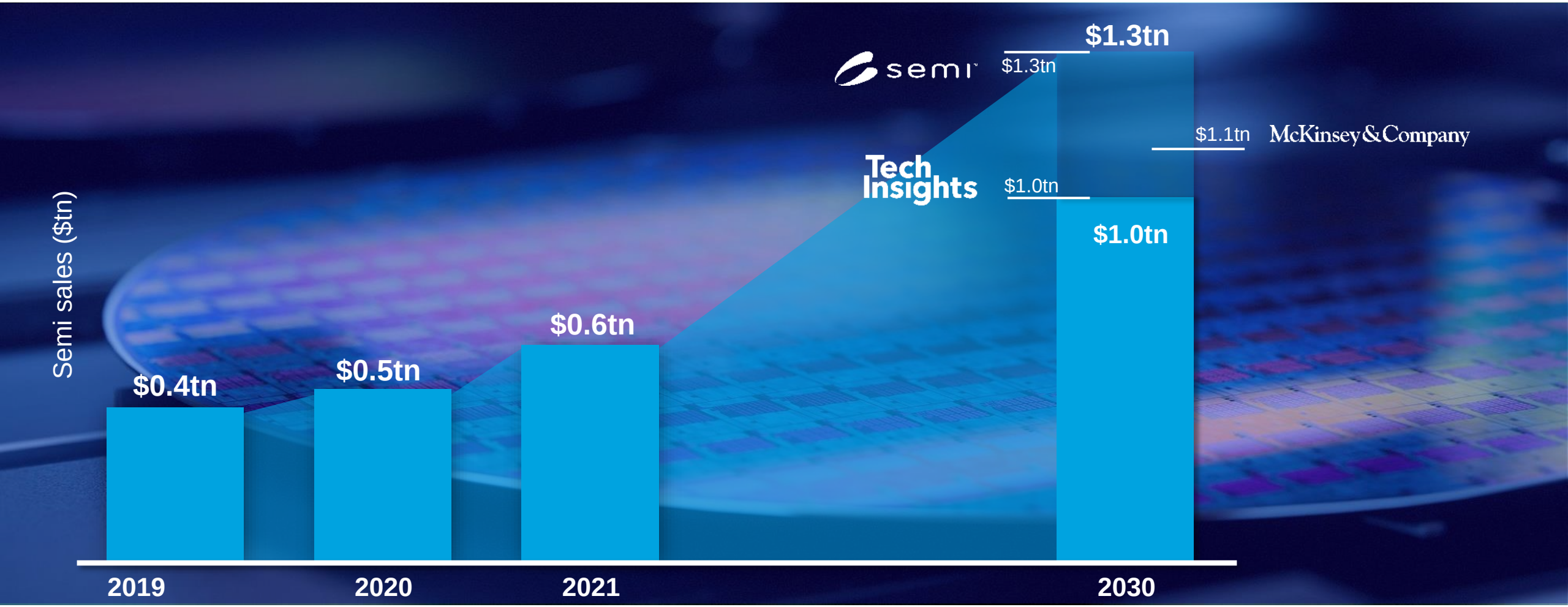
- Energy transition
- Electrification, smart mobility
- Agricultural innovation
- Smarter use of limited resources

Social and economic shifts

- Working, learning remotely
- Healthcare, medical tech
- Technological sovereignty
- Automation

And the semiconductor market is expected to double in 10 years

Analysts' views on 2030 market are ranging from $1.0tn to $1.3tn



Sources: TechInsights, McKinsey, SEMI.org

Introducing ASML

Our story begins in the Philips lab in 1984

Humble beginnings make for a strong can-do culture

Started as a joint venture by Philips and ASMI

Just 31 employees with a can-do attitude

It took a decade of perseverance to break into the market

Innovation and perseverance have brought us here

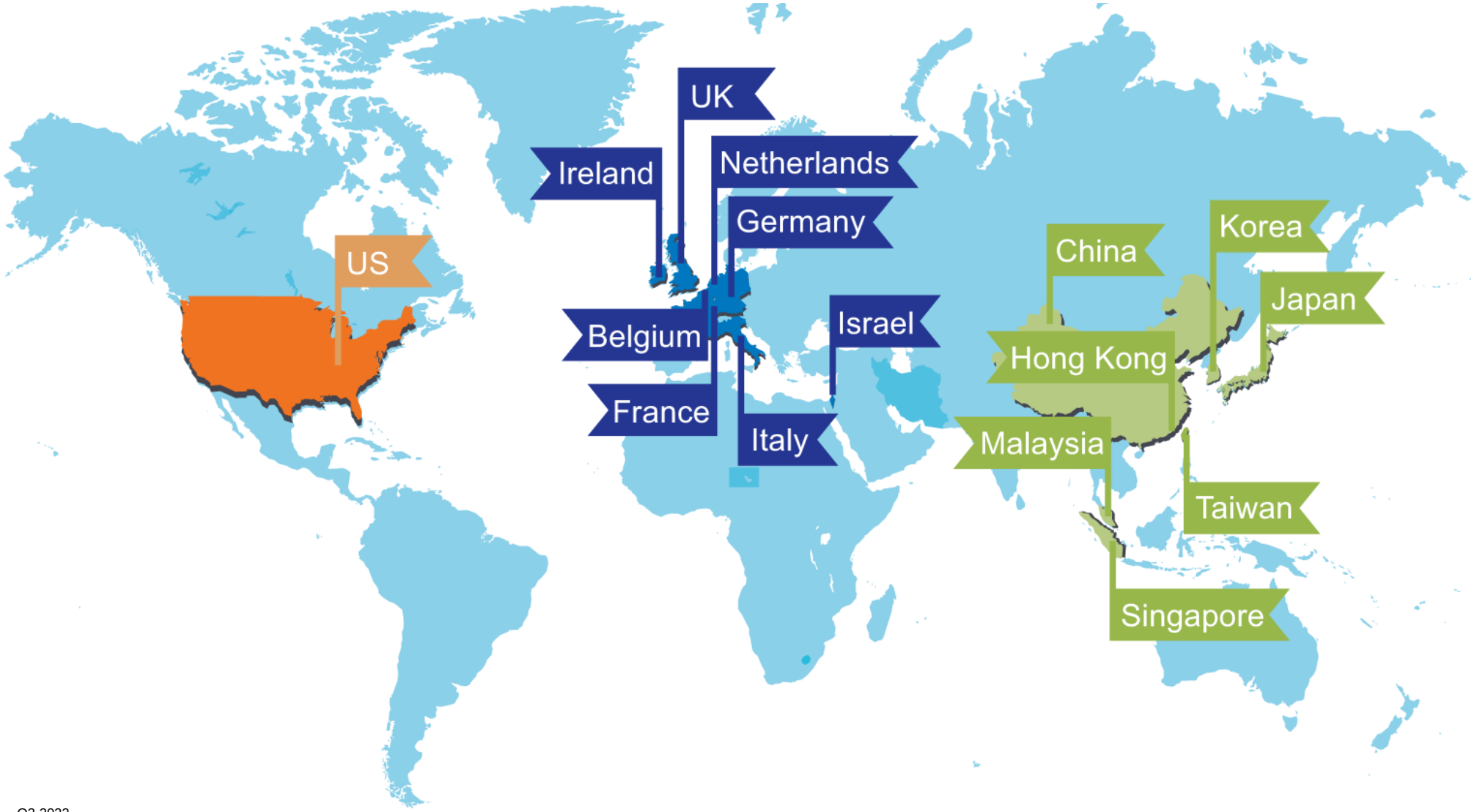
All major chipmakers use ASML's technology

Europe's biggest tech company by market cap

Annual R&D budget of >€3bn

A global presence with >40,000 employees (Q4 2022)

Offices in over 60 cities in 16 locations worldwide



In the world of EUV, everything is bigger

Transportation takes 40 containers, 20 trucks and 3 fully loaded 747s

NXE has over 100,000 individual parts, 3,000 cables, 40,000 bolts and 2 km of hosing…

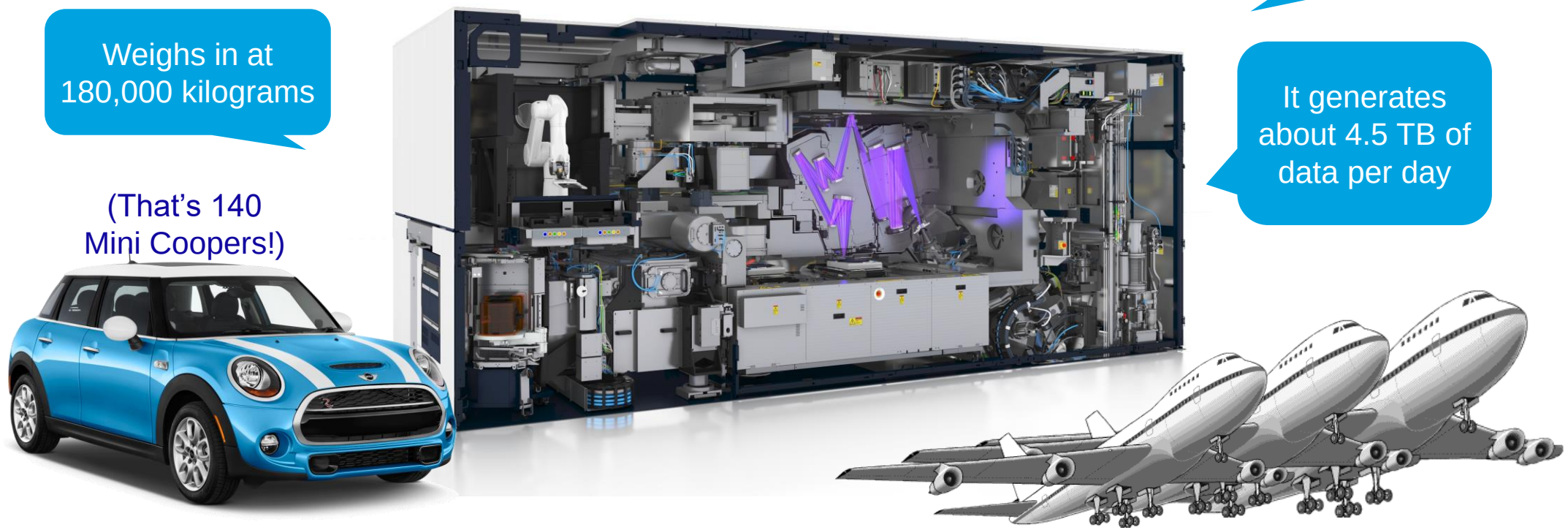
20 years of sustained R&D

Transportation takes 40 containers, 20 trucks and 3 fully loaded 747s

It has about 1,500 sensors to capture imaging data

Weighs in at 180,000 kilograms

(That's 140 Mini Coopers!)



It generates about 4.5 TB of data per day

How do we do it

R&D is our life blood: this is how we push technology further

Our R&D investments amount to >€3 billion per year

1980s:
PAS 2000/5000

1990s:
PAS 5500

2000s:
TWINSCAN

2010s:
EUV

2020s:
High-NA EUV

Open Innovation from design to manufacturing – Our ecosystem

Customers

- Commit early to innovation path
- Test, qualify, scale lithography
- Drive ecosystem for innovation

Peers

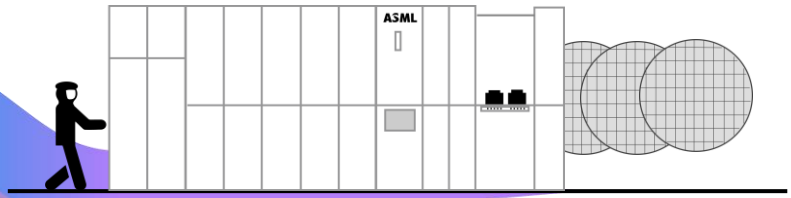
- Deliver critical infrastructure
- Innovate manufacturing process steps

Academic partners

- Long-term academic tracks yield advances across fields (physics, chemistry, material sciences, etc)

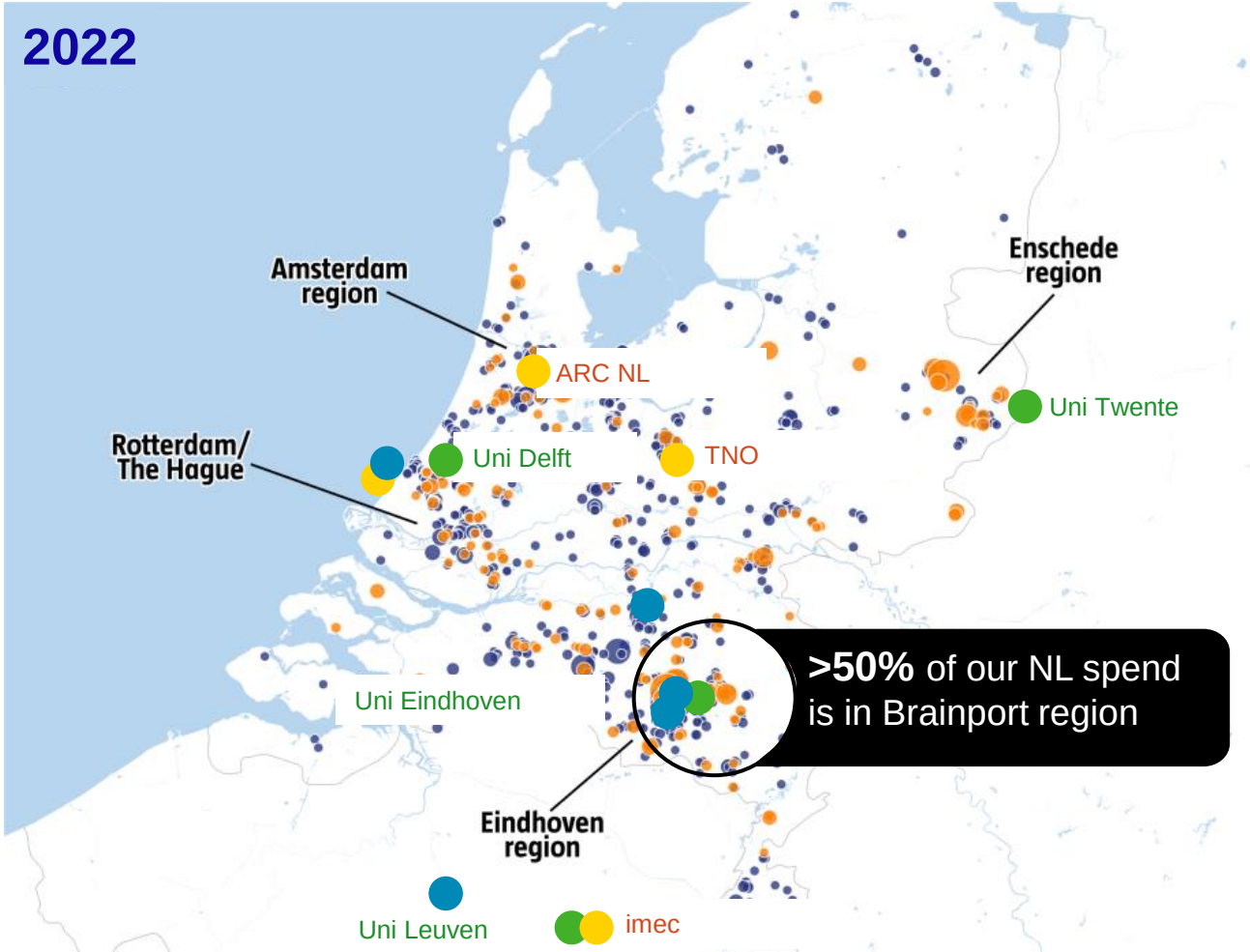
Suppliers

- Drive innovation and cost roadmap
- Share risk and reward



ASML

Example: our supply chain ecosystem in The Netherlands



Suppliers

We see ourselves as **architects and integrators:**

Some **85%** of the bill of materials of our machines is **manufactured by suppliers**

Universities

Research institutes

Government

Agenda

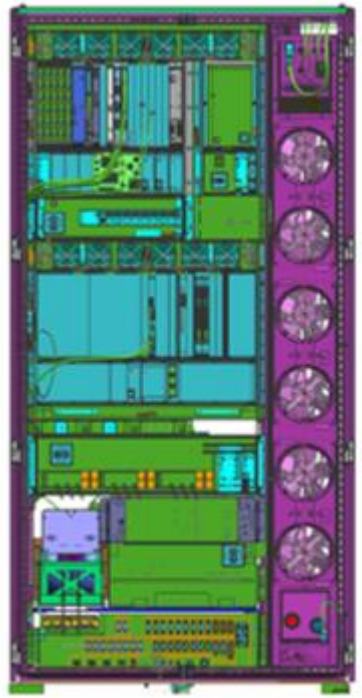
- Introducing the world of ASML
- **Challenges**
- Where do we stand now on Right First time?
  - Design
  - Manufacturing
- Early Involvement 2.0 – The next step

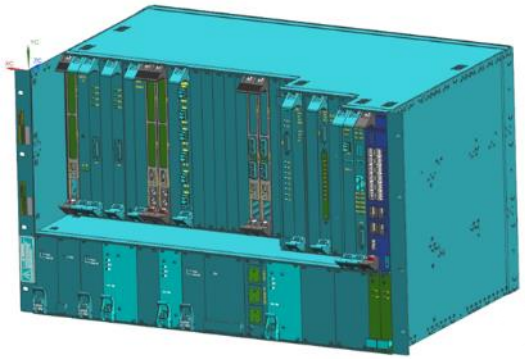
Challenges

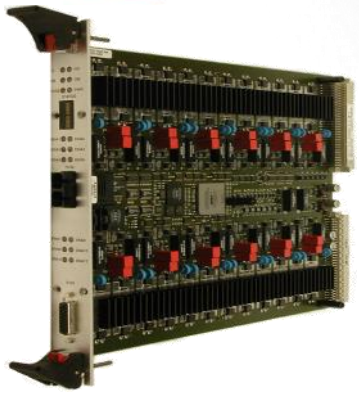
- Low volume – High mix industry
- Increasing complexity
- Increasing amount of Parts
- Increasing costs

- Concurrent engineering
- Continuous improvements

- Increasing Lead times
- Scarcity of components
- Need to Doubling our output







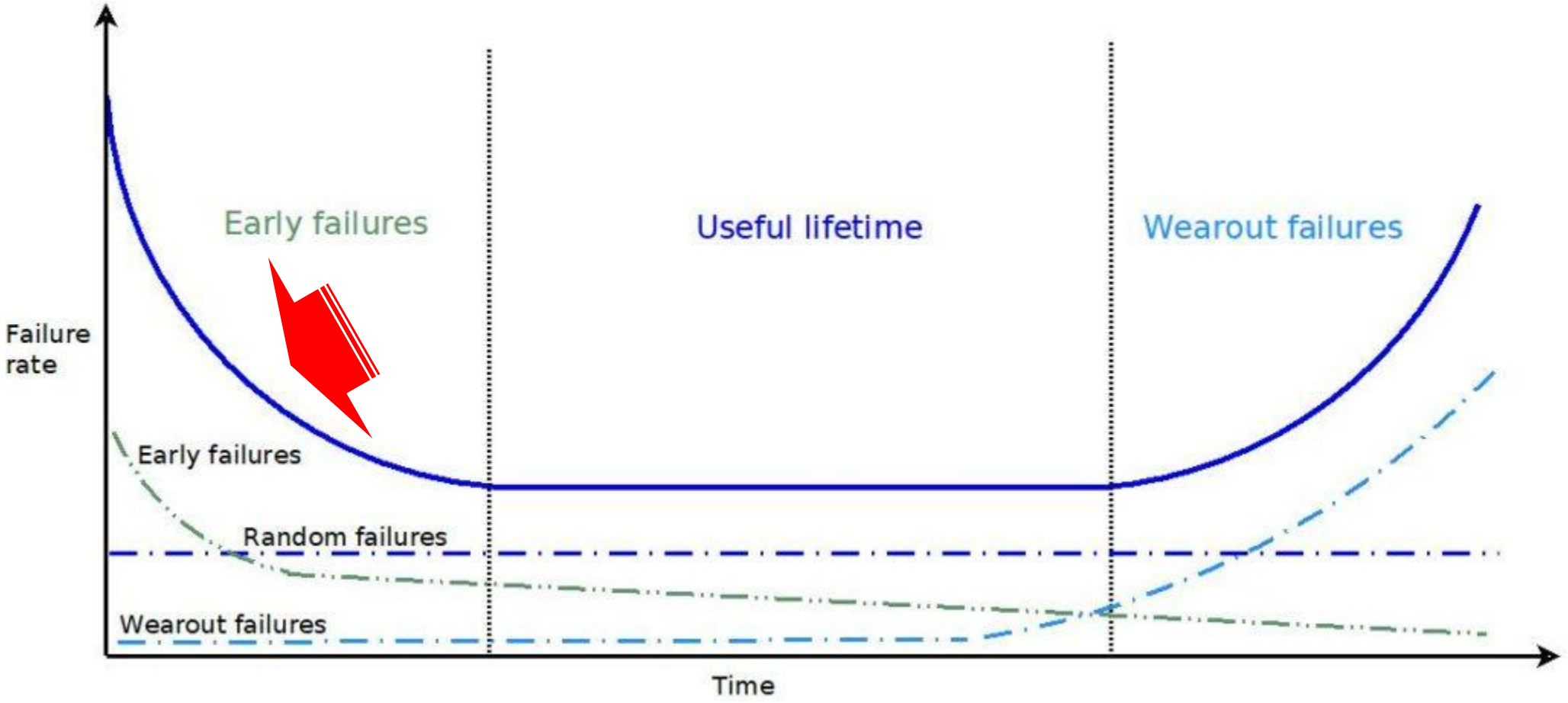
To deliver **Plug & Play** Electronics rather than **Plug & Pray** (zero disturbances in factory and field)

Right First time at **Design** and **Manufacturing**

To shorten **Time 2 Market** with a mature product

The Bathtub curve

The first part of the curve describes **early failures**. At this stage a high number of failures is seen due to errors in design or manufacturing



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- Challenges
- **Where do we stand now on Right First time?**
  - **Design**
  - **Manufacturing**
- Early Involvement 2.0 – The next step

How to deliver Right first time

Upstream Quality

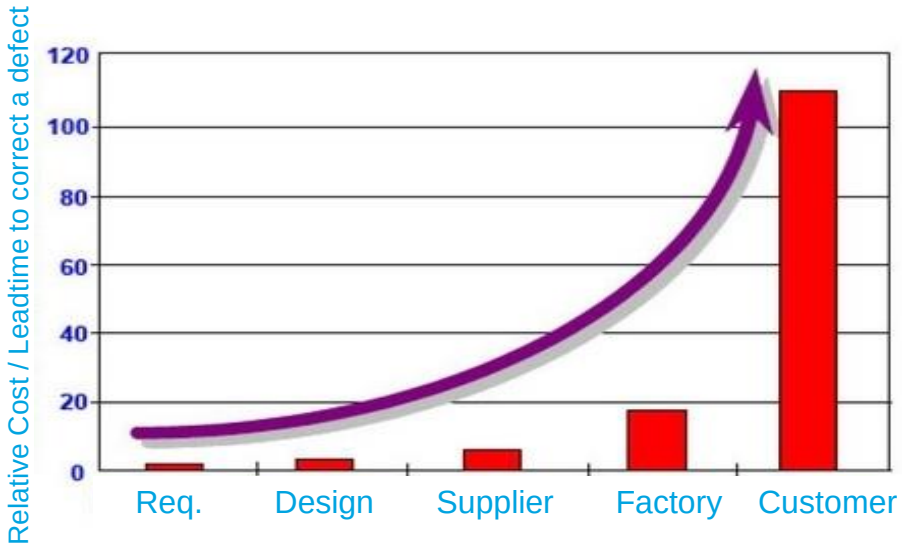
Design

- **By Early Supplier Involvement**
  - Supply Chain Requirement Specification
  - Architectural Design Review / Preliminary DR / Critical DR
  - Design for Manufacturability / Testability / Cost
  - Technical Product Documentation (TPD) Review
  - Proto Review
- **By Closing the Feedback Loop from**
  - Factory
  - Field
  - Suppliers

Manufacturing

- High Level Qualified Buys
- Introduction of test platforms
- Standardized NPI processes

Quality
Logistics
Technology
Costs
Sustainability



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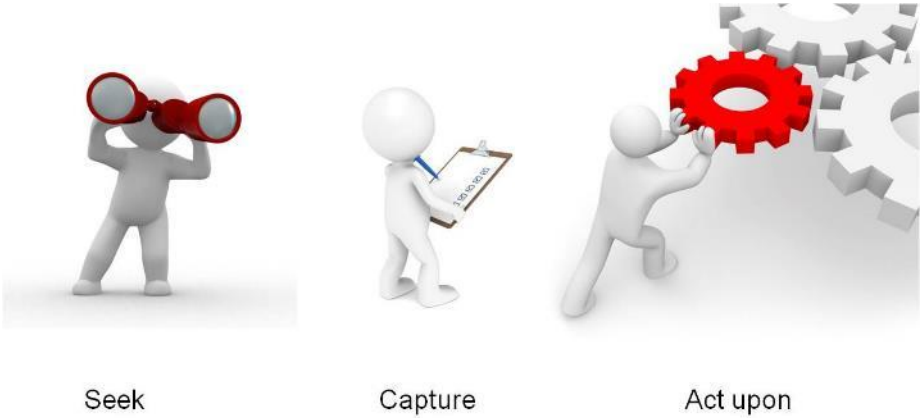
- Lessons Learned to be incorporated in the Design Guidelines

- Examples
  - BIST is required
  - SW for complete I/O accessibility; not application specific
  - Specify tightening torque levels
  - Prevent stiff labels on fibers causing sharp bends



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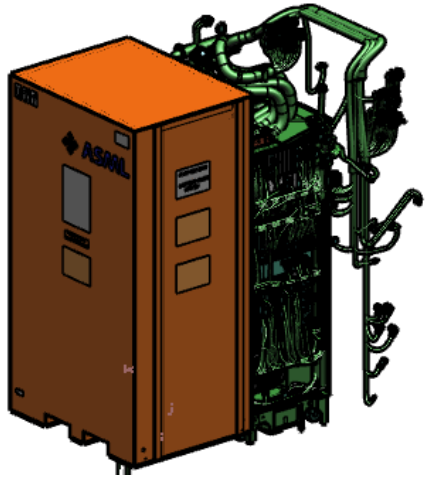
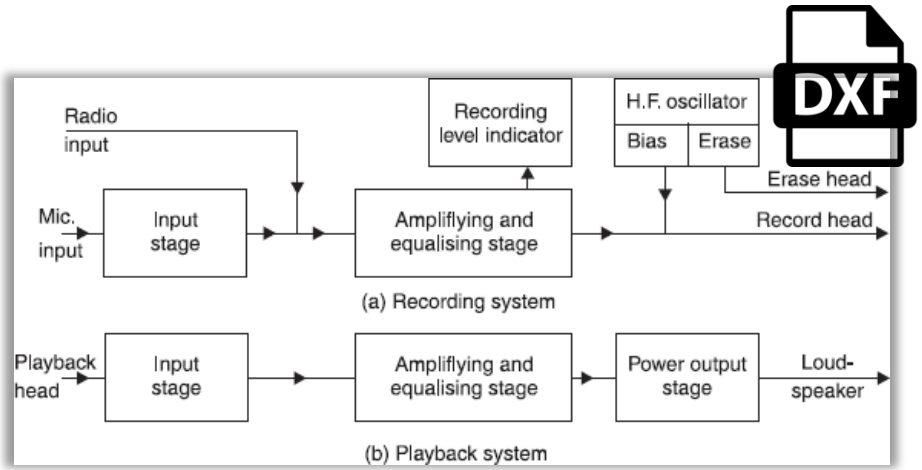
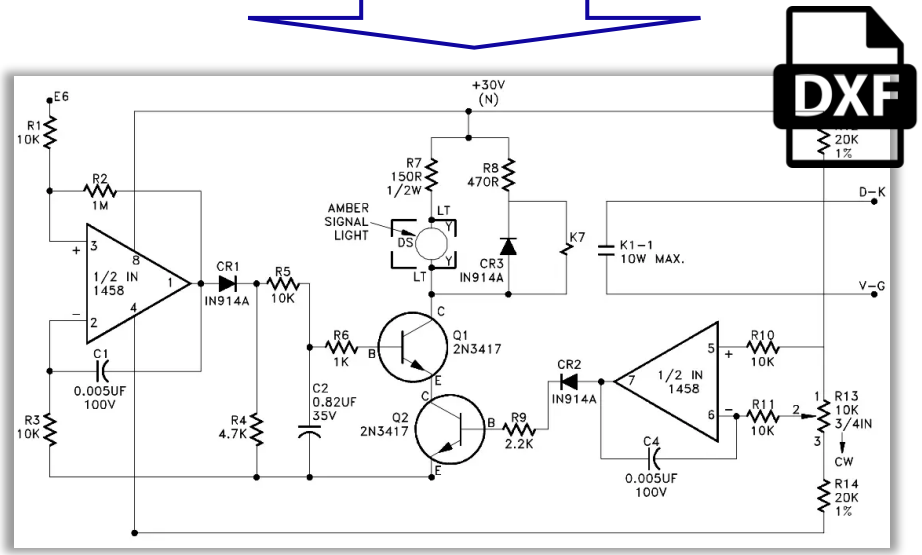


- Block diagrams



- Schematics



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Theoretical approach

- Manufacturable
- Testable
- Unambiguous information
- Missing information
- Incorrect information

TPD Accepted By Supplier

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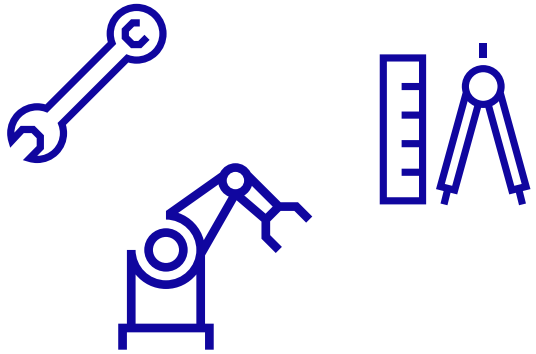
Practical approach

- Length of cable
- Bending radius of cable
- Sharp edges
- Accessibility
- Cost efficient assembly



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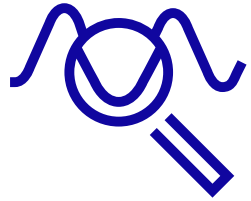
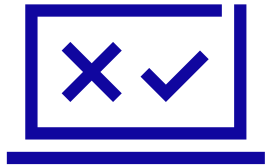
Input:

- Disturbance Notifications
- Material Notifications
- Deviation Notifications



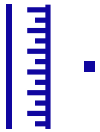


Output:

- Design guidelines
- Lessons Learned

Examples:

- Scratches on Metal sheet ➔ surface treatment brush finishing
- Machine limitations ➔ Dimensions, size of large flex pcb
- DAO DOI ➔ Packaging



How to deliver Right first time

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Manufacturing

- High Level Qualified Buys
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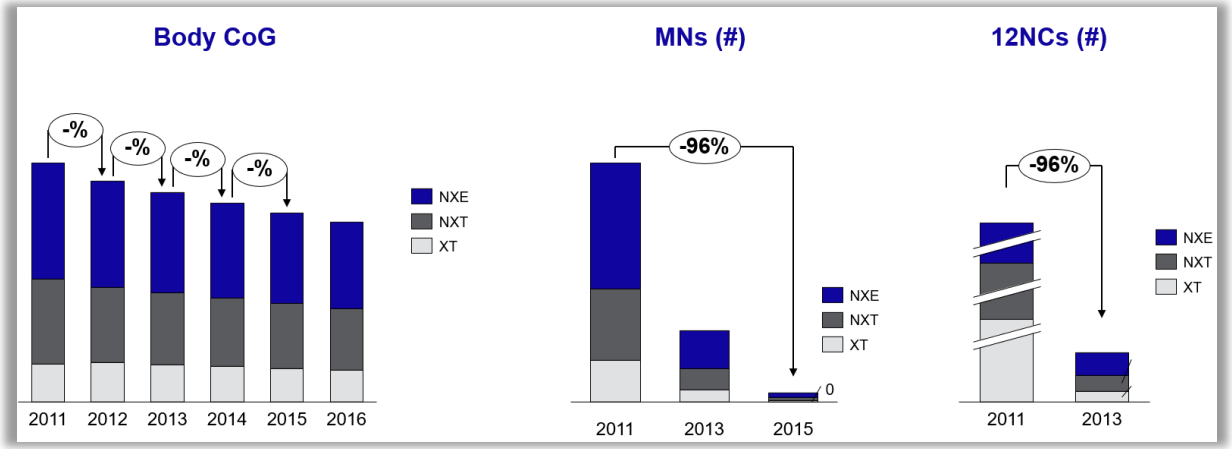
- Standardized NPI processes



ASML Work center → Assembly → Supplier

How to deliver Right first time

Upstream Quality

Manufacturing

- High Level Qualified Buys
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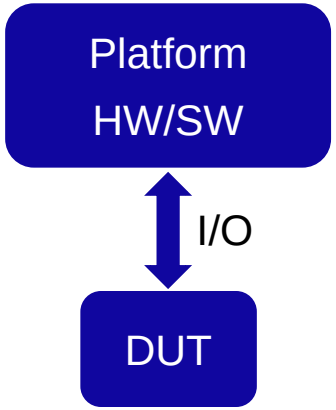
- Production verification i.s.o. Functional verification
- Generic approach ➔ Maximize reuse
- Minimize cost/effort ➔ Once platform is realized
- Reduce time2market ➔ Qualified at first build

Platforms for

- Interconnect (Connectivity)
- Robustness (Safety)
- PLC
- Mains
- Current
- Signals
- Optical



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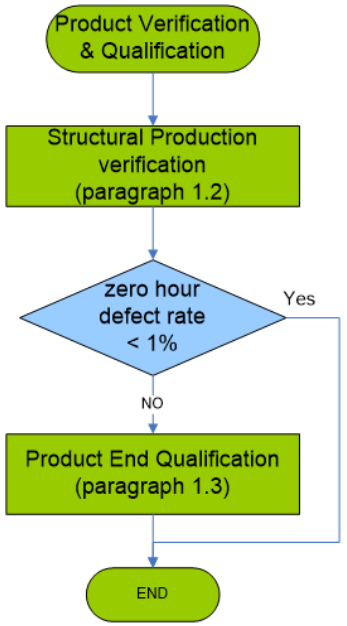

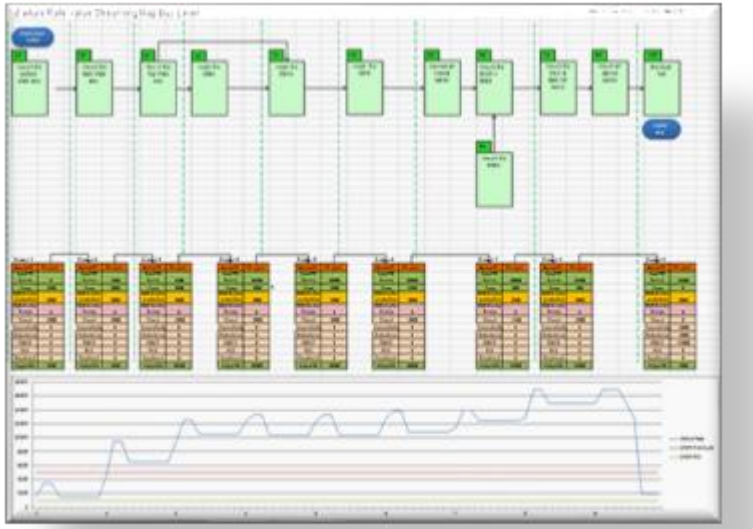

Creating standard production corridors

- Aligning Supplier NPI process with ASML PGP process
- Setting up production process flow

Risk identification based on

- Production process flow – pFMEA
- Production process capabilities
- Test specification from design perspective

Risk mitigation

- Setting up Structural production verification
  - Failure rate Value Stream Mapping, SPC

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- **Early Involvement 2.0 – The next step**

Early Involvement 2.0

Agenda

- Early Involvement Today
- Early Involvement 2.0
  - Part Quality Specification
  - Part Quality Assurance

- MRMc Services

Early Involvement Today

Situation Today

Early Involvement

- Communication designer ⇔ Manufacturer
- Documented process
- Much higher succes rate of Right First Time
- Lower Cost
- Lesser Redesigns
- ….

Early Involvement

- Not equal partners: manufacturing issues not resolved
- Involvement manufacturer too late
- Qualitative process (Is it reaching the Part Quality specification)
- ….

Early Involvement 2.0

Early Involvement 2.0

Qualitative Process

Quantitive Process

Quantitive Process

Part Quality Manufacturing Specification

- What is the required quality to secure
  - Building the machine
  - Customer use

Part Quality Assurance

- What is the expected manufacturing quality

Part Quality Manufacturing Specification

Part Quality Manufacturing Specification

Quantitive Process

- Agree on Part Quality contribution from Parts/manufacturing process
  - How many parts are allowed to fail due to parts/manufacturing (…DPMO)

Manufacturing Part Quality = 100 DPMO max

Manufacturing caused failures (Infant mortality) are the largest failure contributors in machine build/use.

Part Quality Assurance

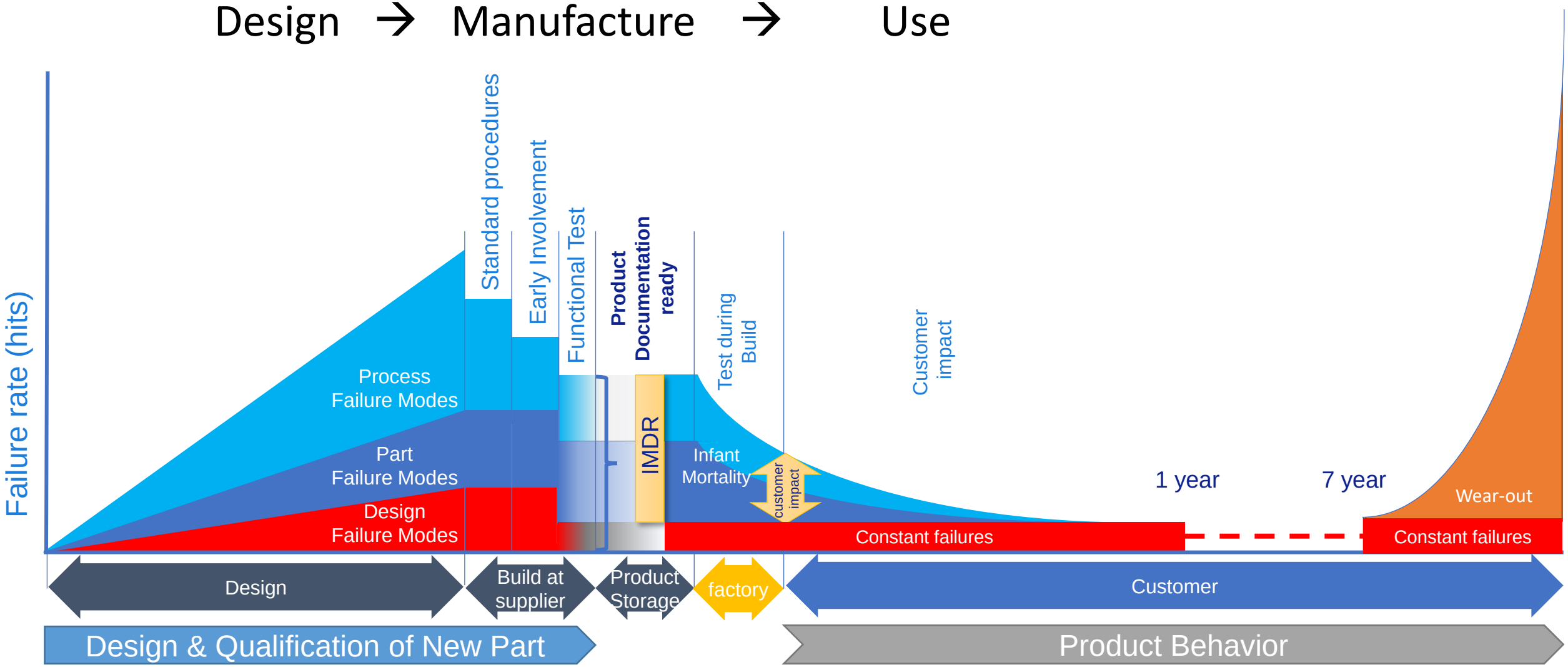
Part Quality Manufacturing Assurance

Predict Contribution Parts/manufacturing process

- Expectation how many parts are going to fail due to parts/manufacturing (…DPMO)

Failure Modes(Machine builder)

Design → Manufacture → Use



Predict Product Quality Principles

1: Product consist only parts and processes used to manufacturer

2: Every used process is coupled to a part in the BoM






3: Risk contribution based on manufacturer capabilities/Industrial Standards

- Part Contribution
- Process Contribution

Quality data

Part Quality Manufacturing

Machine 10000 cables (average 20 contacts/cable)

Number of crimps	Wurth		Number of defective cables
Beurs	Incorrect	DPMO	
15	6	400000	8000/machine
Automated			
100000	1	10	2/machine

MRMconsultancy

MRM Consultanty

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MRM Consultanty

- Determine required Product Manufacturing Quality
- Predict Manufacturing caused defect rate
- Mitigate Identified manufacturing Risks
- Component Selection/Management

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End

Thanks