Unlocking the next wave of accelerated innovation by AI

ASML as a part of the AI ecosystem

Wei Li
SVP D&E Software

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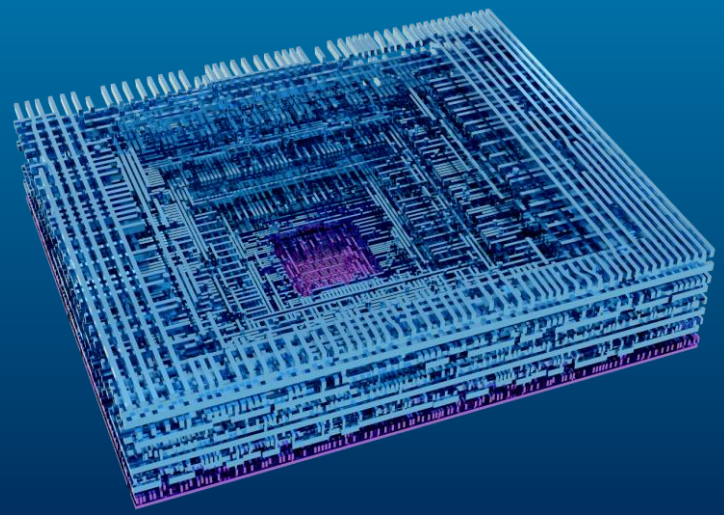
ASML plays a dual role in the AI era

The world's future will be AI and we are an integral part of it

ASML fuels the progress of AI chips
with innovations in
extreme performance requirements



ASML incorporates AI
to enhance scanner control and
enable engineers to deal with
large scale complexity

From chips everywhere to AI everywhere

It requires semiconductor strategy to align with the emerging needs of power/memory

Nvidia project DGX Spark personal AI supercomputer

Electrification, smart mobility

Automation

Working, learning remotely

Energy transition

Healthcare, medical tech

Hyperconnectivity

Technological sovereignty

Cloud infrastructure

Internet of Things

Edge computing

Smarter use of limited resources

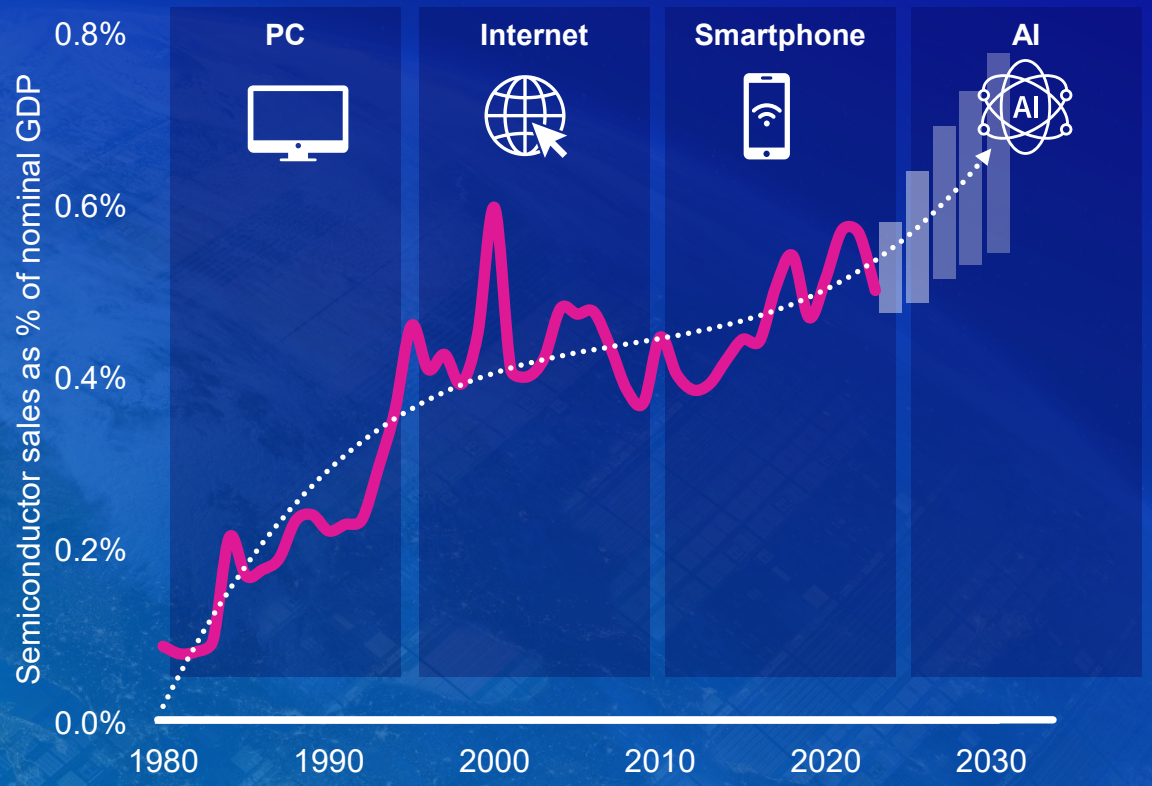
Agricultural innovation

*Source: McKinsey and Company, GenAI: The next S-curve for the semiconductor industry? | March 2024

AI has strong potential to drive the entire semiconductor industry forward

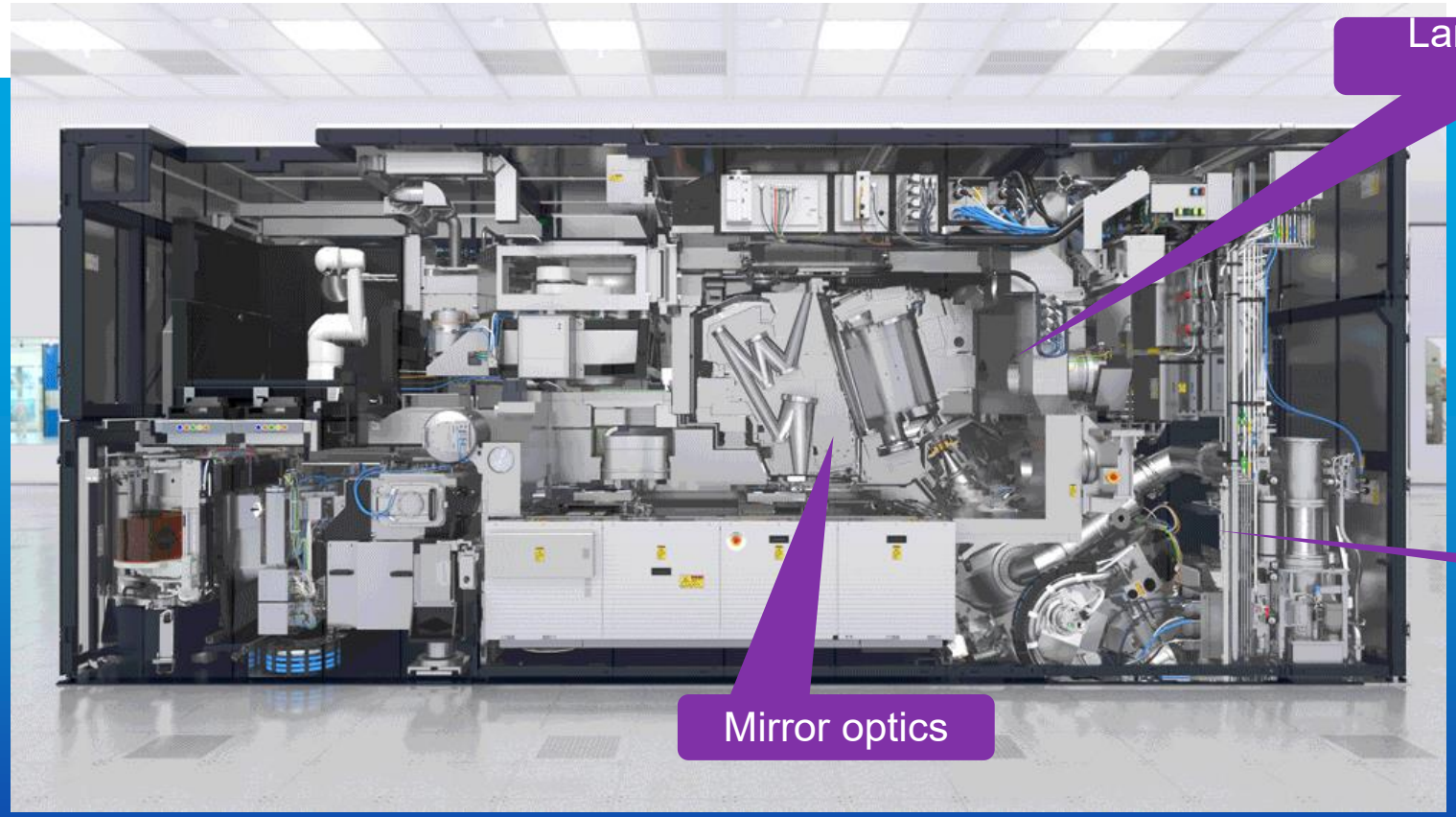
We will see AI penetrate all different segments of the semiconductor eco-system

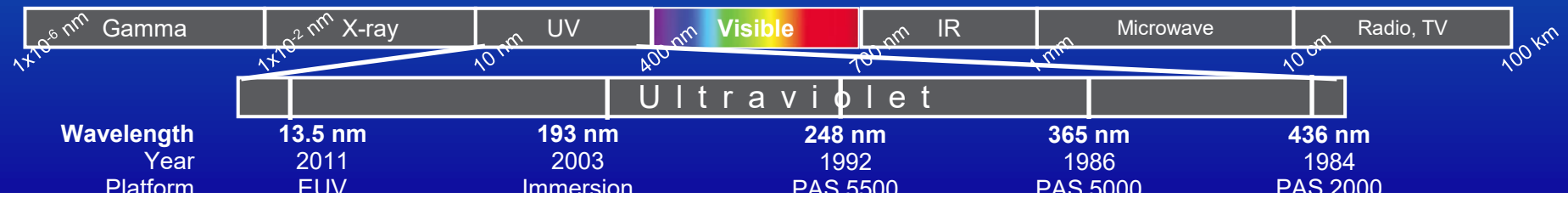
Semiconductor sales as % of global nominal GDP have steadily grown across the previous computing waves



Source:ASML analysis, International Monetary Fund (IMF), SEMI

ASML lithography system is a key equipment to produce AI chips

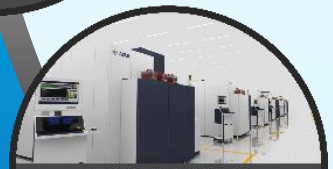




Lithography innovation keeps chip manufacturing affordable

PAS 2500/10
Res: 900nm
W: 150mm
Wph: 66

80s
436 nm → 365 nm light
100 mm → 150 mm wafers



PAS 5500/60
Res: 450nm
W: 200mm
Wph: 48

90s
248 nm → 193 nm light
150 mm → 200 mm wafers
'step & repeat' → 'step & scan'

TWINSCAN AT:850
Res: 110nm
W: 300mm
Wph: 102

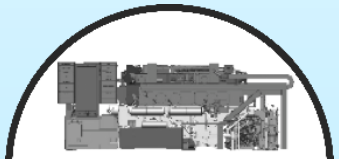
TWINSCAN XT:1400
Res: 65nm
W: 300mm
Wph: 145

00s
200 mm → 300 mm wafers
Dry → immersion lithography
Single stage → dual stage

TWINSCAN NXT:1950i
Res: 38nm
W: 300mm
Wph: 190

TWINSCAN NXE:3400B
Res: 13nm
W: 300mm
Wph: 125

10s/20s
Litho → Holistic litho
Immersion → EUV
EUV 0.33 → EUV 0.55



High NA EUV
Res: <8nm
W: 300mm
Wph: 185

Moore's law: number of transistors per chip doubles per 2 years, while the cost of computing is halved.

Relative cost per pixel

Technology-wise, we had to move mountains

$$\mathrm{CD} = \frac{k_1 \cdot \lambda}{\mathrm{NA}}$$

80s
436 nm → 365 nm light
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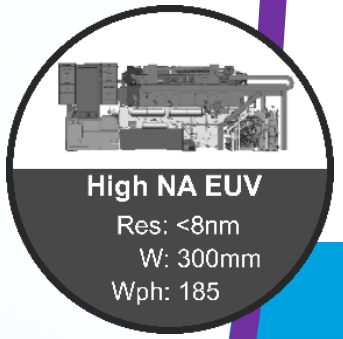


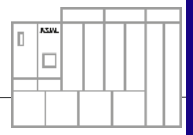
System complexity

Scanner control is inherently a holistic task and can benefit from AI

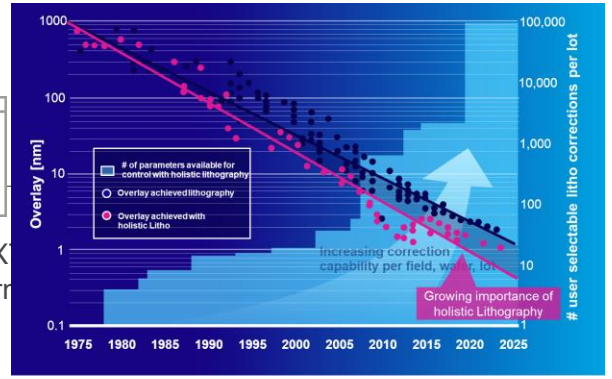
Driven by steep increase in number of actuators, amount of data, and complexity of models

Lithography scanner with advanced control capability

EUV: NXE platform

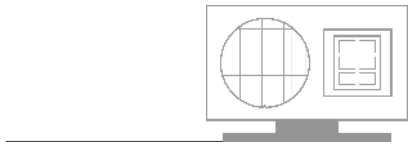


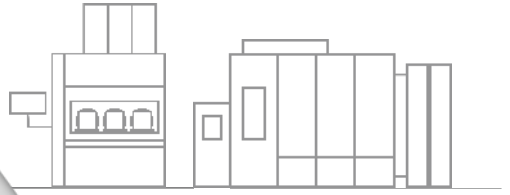
DUV: XT and NX platform

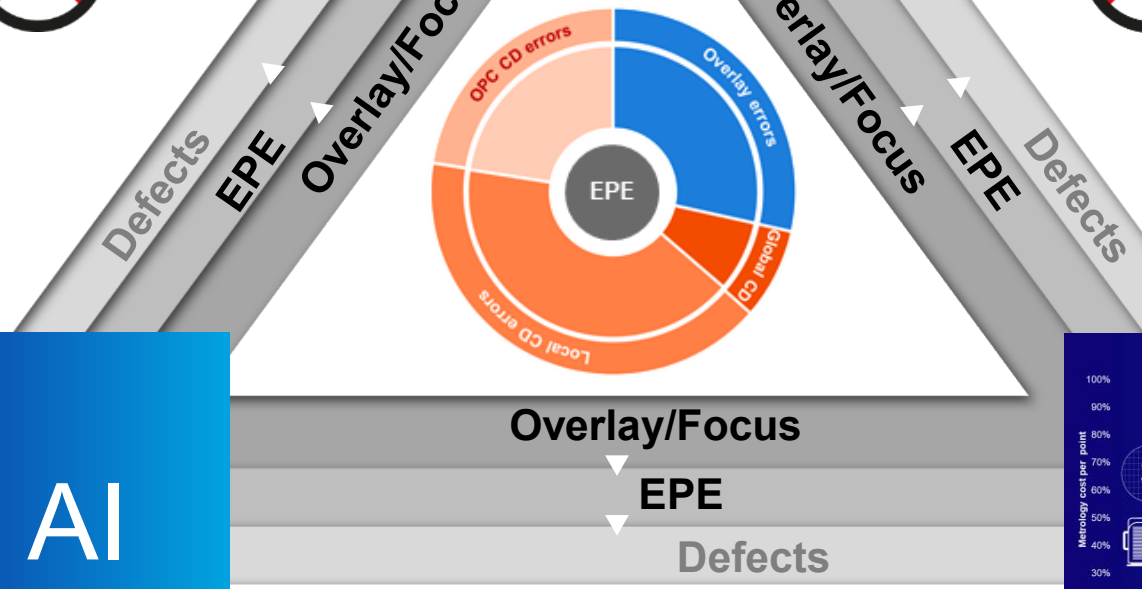


Process window **prediction and enhancement**

Process window **control**







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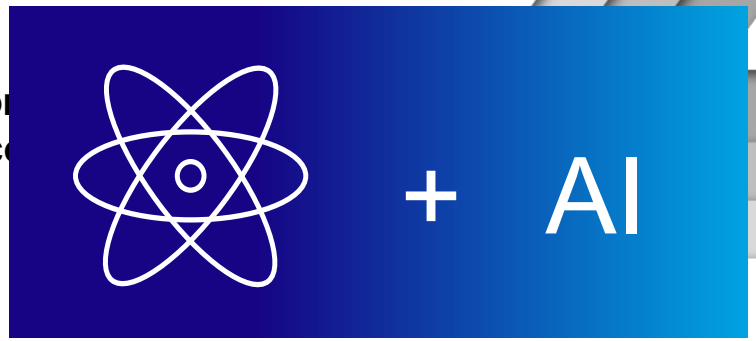
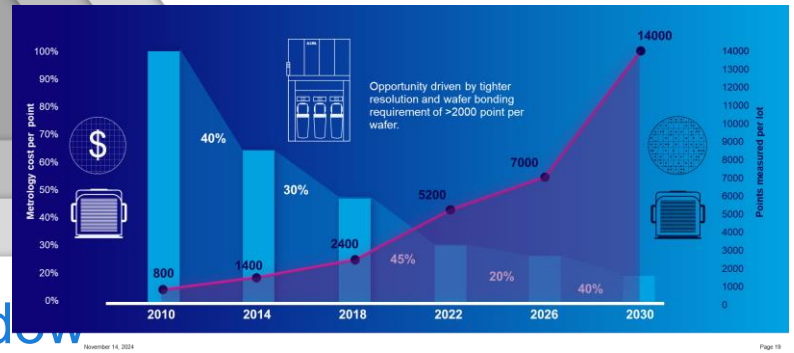
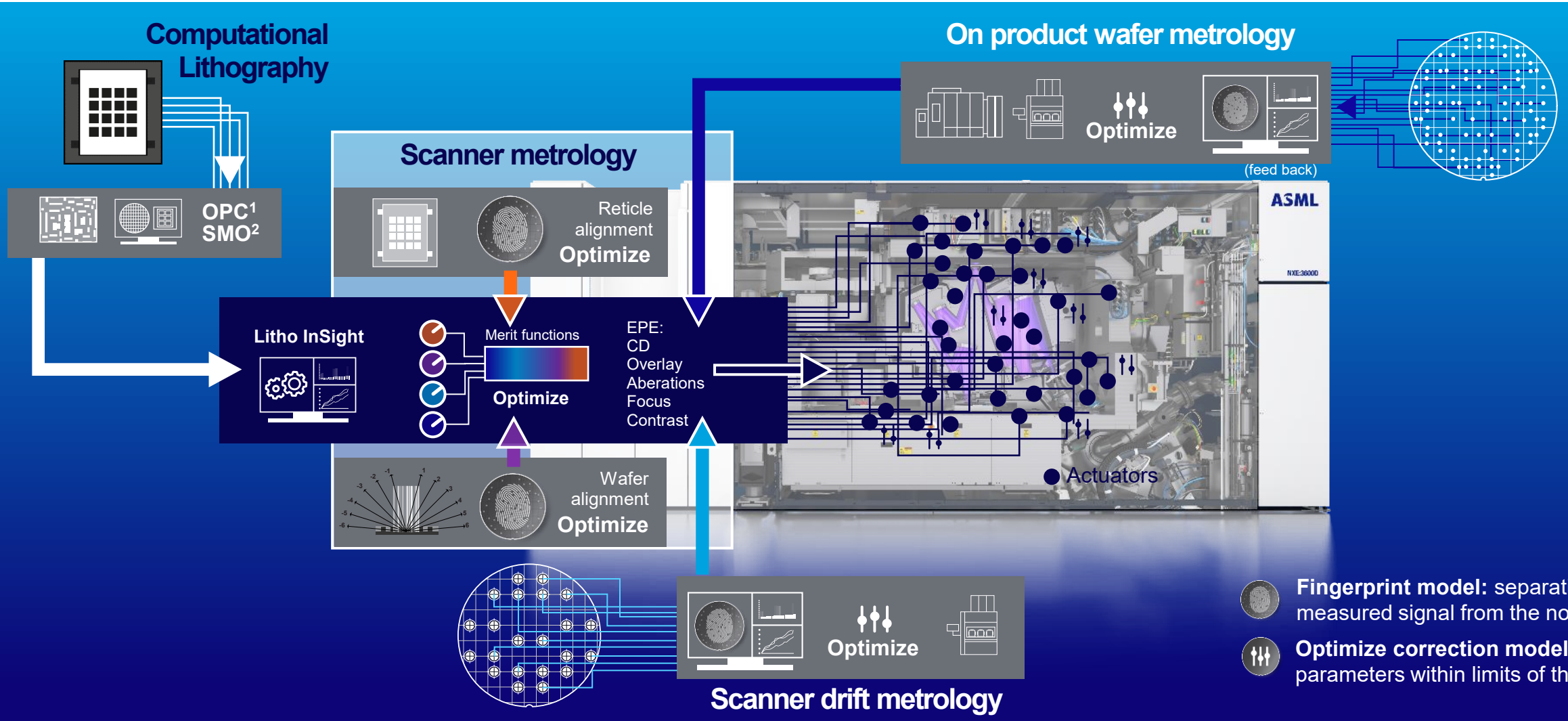




Process window **detection**

AI applied to scanner control can help optimize most effectively the fast-growing number of actuators, parameters, and mass metrology data



1: Optical Proximity Correction
2: Source Mask Optimization

From design to manufacturing: multiple level large scale complexity

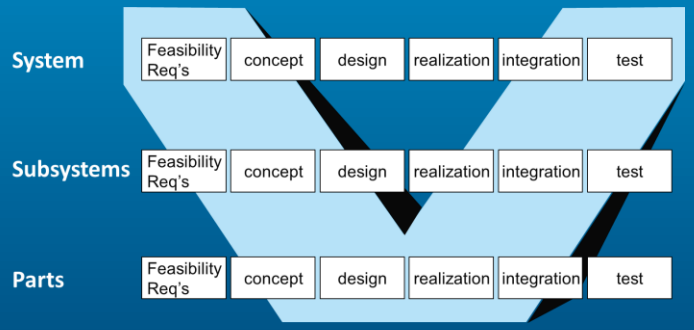
Modular system design

integration of physics, hardware, software

7 product platforms

Concurrent engineering

V-model



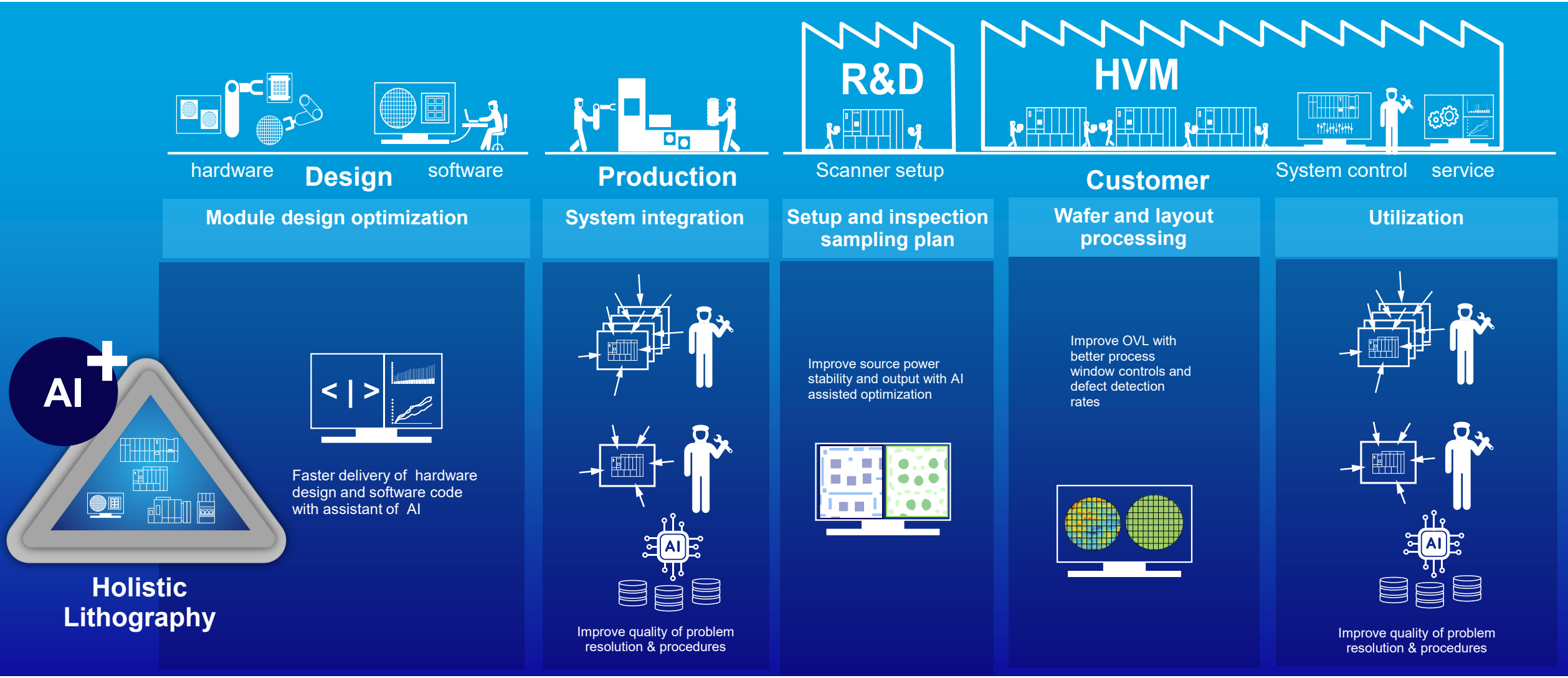
>250,000 unique parts

System integrator

~90,000 work instructions
~15,000 D&E engineers

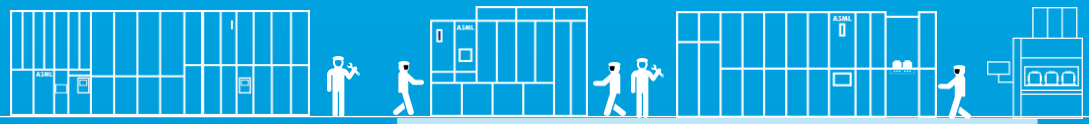
AI potential: from design contribution to customer value

First results available, many more feasibility studies to start across holistic litho triangle



AI is a key to accelerate innovation and tackle complexity in development

AI strategy and roadmap in place for all key domains of ASML



Product Functionality and Support

Capability and Efficiency

Customer & Product

Product Leadership

Scientific AI Development

Scientific AI Implementation

Product: Drive leadership in holistic lithography to unlock more advanced nodes and higher productivity

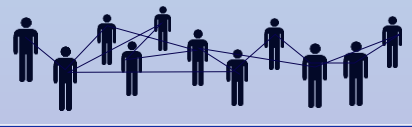
Technology: Boost efficiency and accelerate innovation, while laying the groundwork for process "rewiring".

Enabling

Collaboration and knowledge sharing

Automation

Generative AI



Technology

Research and development Speed and Quality

Generative AI

Predictive AI

Predictive AI

ML

Execution: Improve operations speed and quality and supplier collaboration

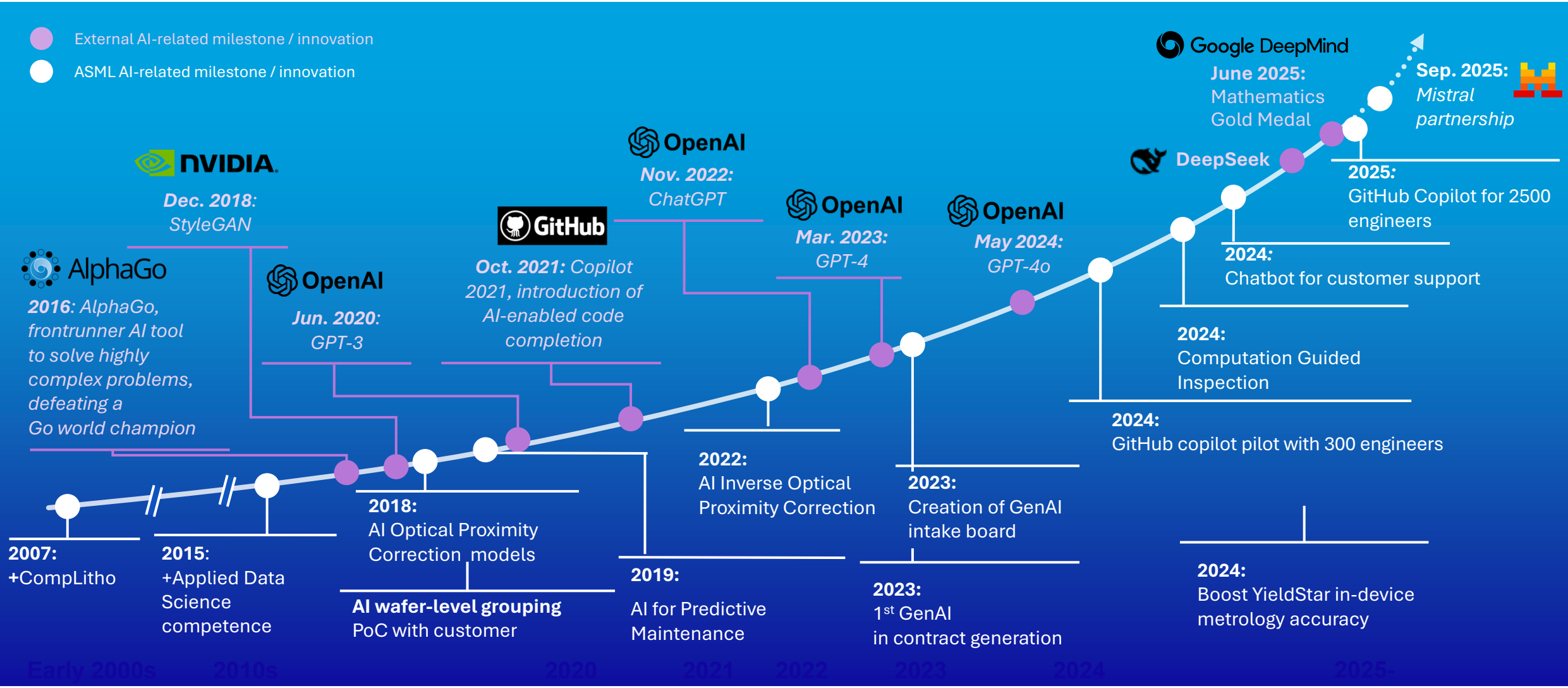
Operations

Operation speed and Quality

Generative AI

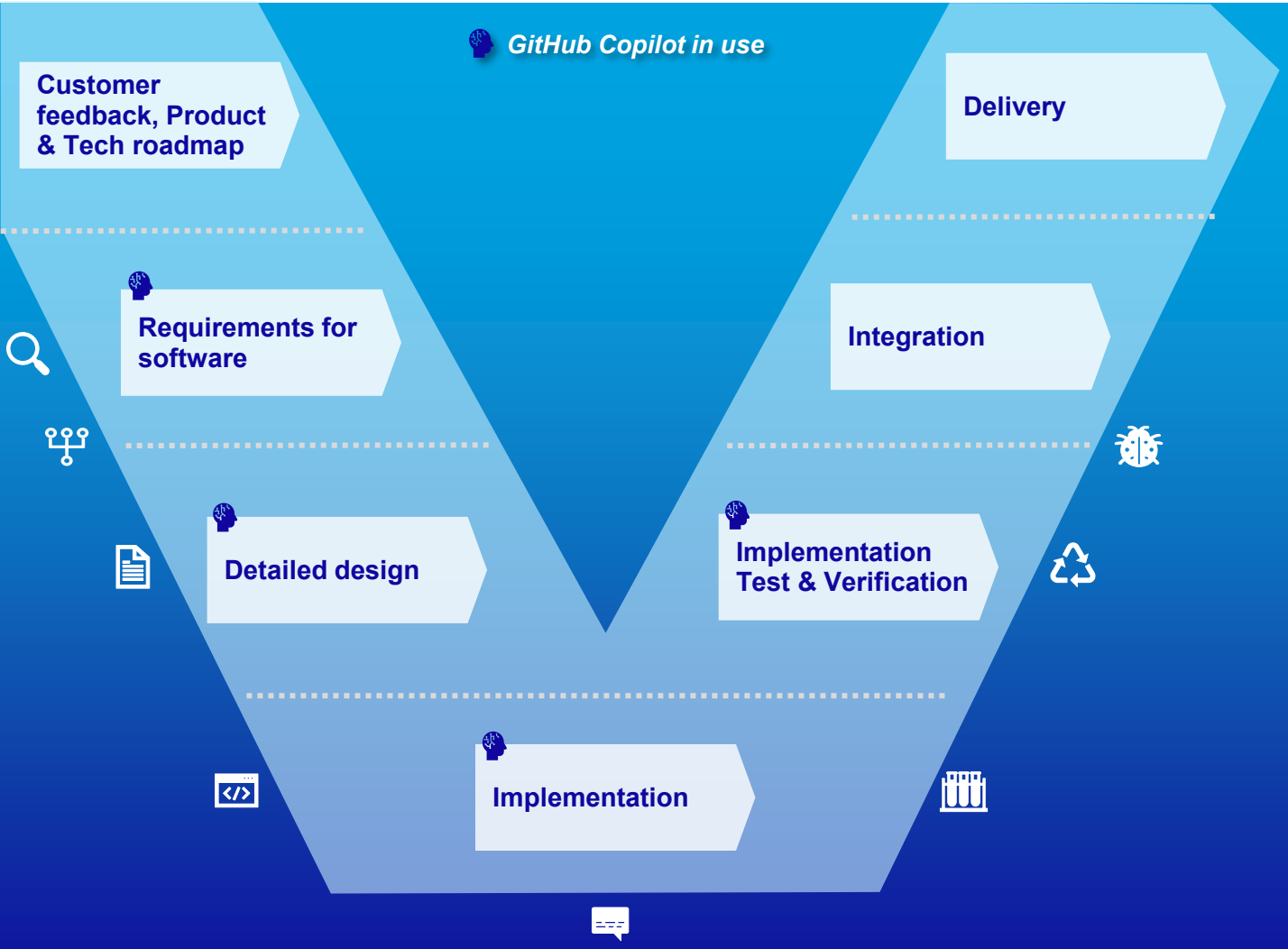
Enabling: Support ASML scaling by accelerating time to market, enhancing quality, driving operational performance and productivity

AI is not new to ASML: Responding to industry trends, we have taken great steps towards AI enablement



Show case 1: GitHub Copilot integrated in entire Software Value Stream

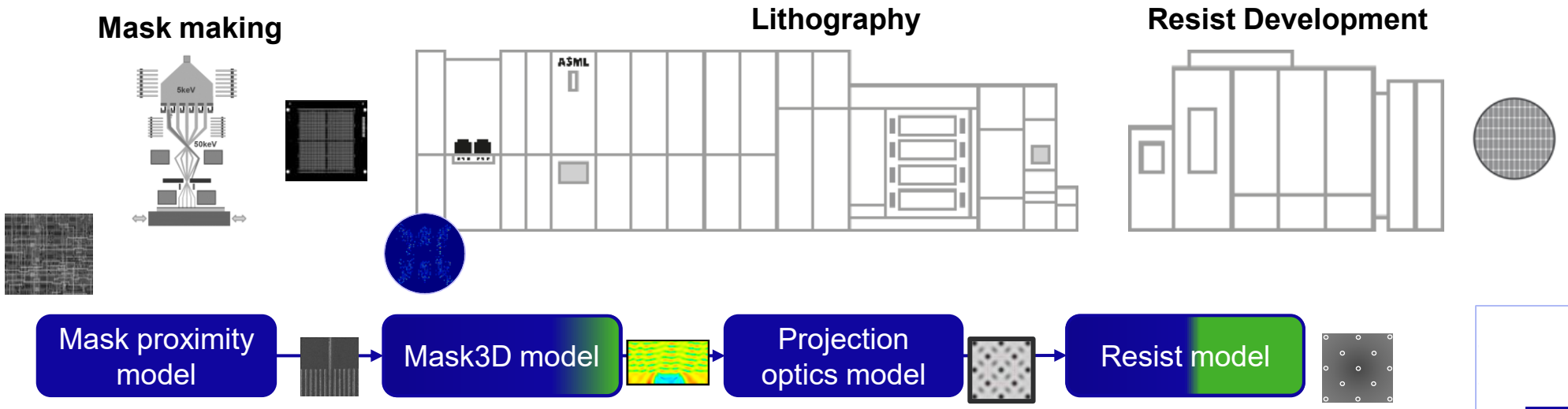
To improve code development efficiency and quality

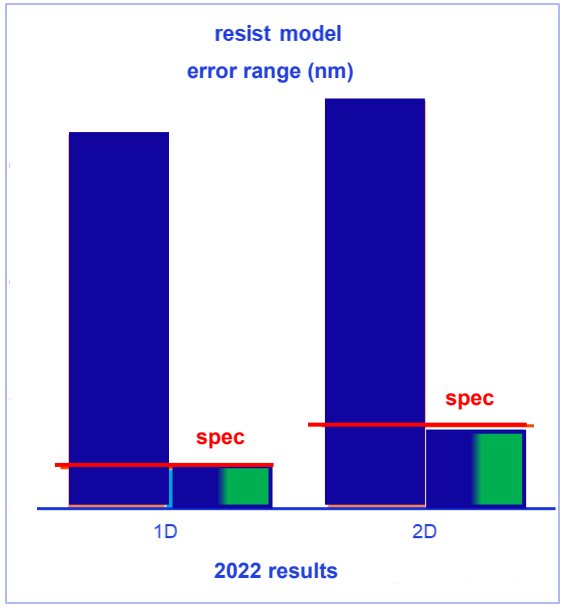


GitHub Copilot use cases	
Learn & Explore	Quickly understand unfamiliar code or libraries by generating explanations or summaries based on queries
Diagram Generation	Create a **UML*** class diagram, including all dependencies to visualize code structure and relationships
Document Generation	Generate descriptive comments or summaries for code: functions, classes, and modules based on ASML context
Code generation	Generate inline suggestions which can be accepted by the designer
Code translation	Cross-language code translation, to migrate algorithms or utilities between different programming environments
Code quality validation	Refactor existing code, suggesting improvements and best practices even for languages like MATLAB
Test creation	Automatically generate unit tests and identify gaps in test coverage by analyzing test files
Error log debugging	Assist in debugging verbose error logs for resolving issues

***UML** – *Unified Modeling Language*

Show case 2: Computational lithography model incorporates physics knowledge and deep learning technology to achieve superior accuracy





Empirical model

- Complex physics / chemistry but small effects
- Models key effects with 10^0-10^1 empirical parameters

Physical + ML model

- Maxwell equation solver is too slow (by ~ 10^6) for full-chip applications
- Simulated data used to train a hybrid model with 10^3-10^4 parameters

Physical model

- Physical model including scanner effects
- All parameters are physical

Physics Informed ML model

- Complex physics / chemistry difficult to be modeled efficiently
- Wafer data and simulated data (from semi-physical model) combined to train a deep learning model with 10^3-10^4 parameters

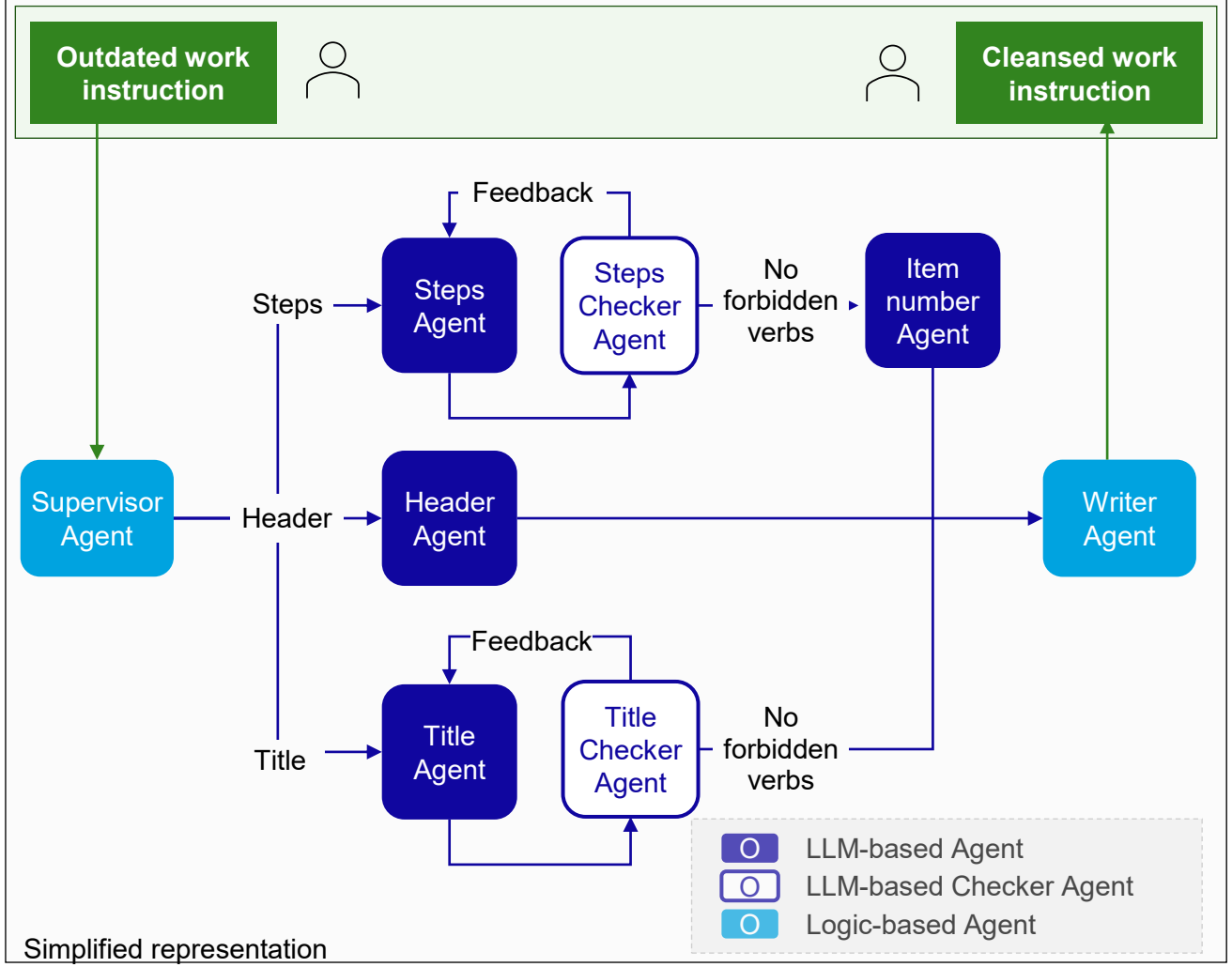
Show case 3: Feasibility study shows that GenAI can reduce manual effort for work instructions update

Business context

- 90K+ work instructions, used by 15K+ employees to build, install and service systems for their customers
- work instructions updated 2x per year, to ensure compliance with latest standards on content and structure
- GenAI shows better quality, shorter labor duration with human-in-the-loop

Work pitched by MSFT CEO during GenAI conference in Amsterdam in 2025

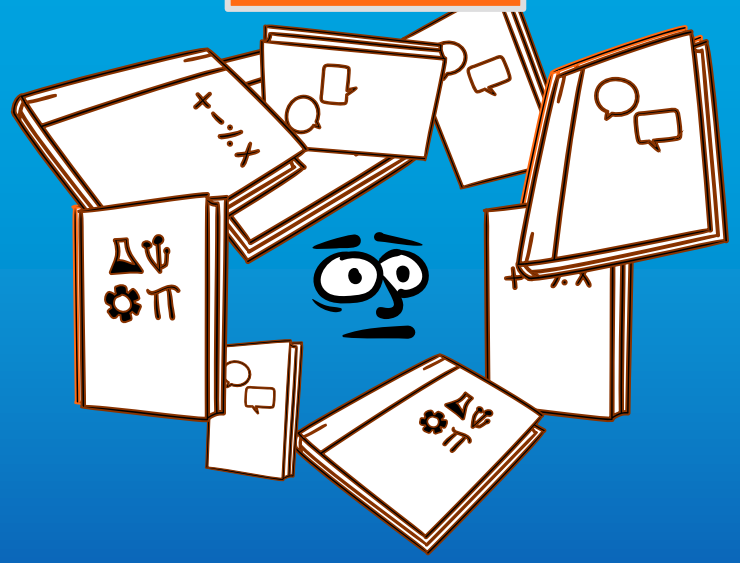
Process steps cleansing by AI



LLM = Large Language Model

Show case 4: Improving customer support capability by leveraging ChatBot in software release documents

Manual review



Challenges:

- Release bulletins require in-depth technical description of new functions and issue resolution for customers
- Lengthy release bulletins need to be generated by iterative manual process and reviews.

AI translates technical description

to customer descriptions for release bulletins, …

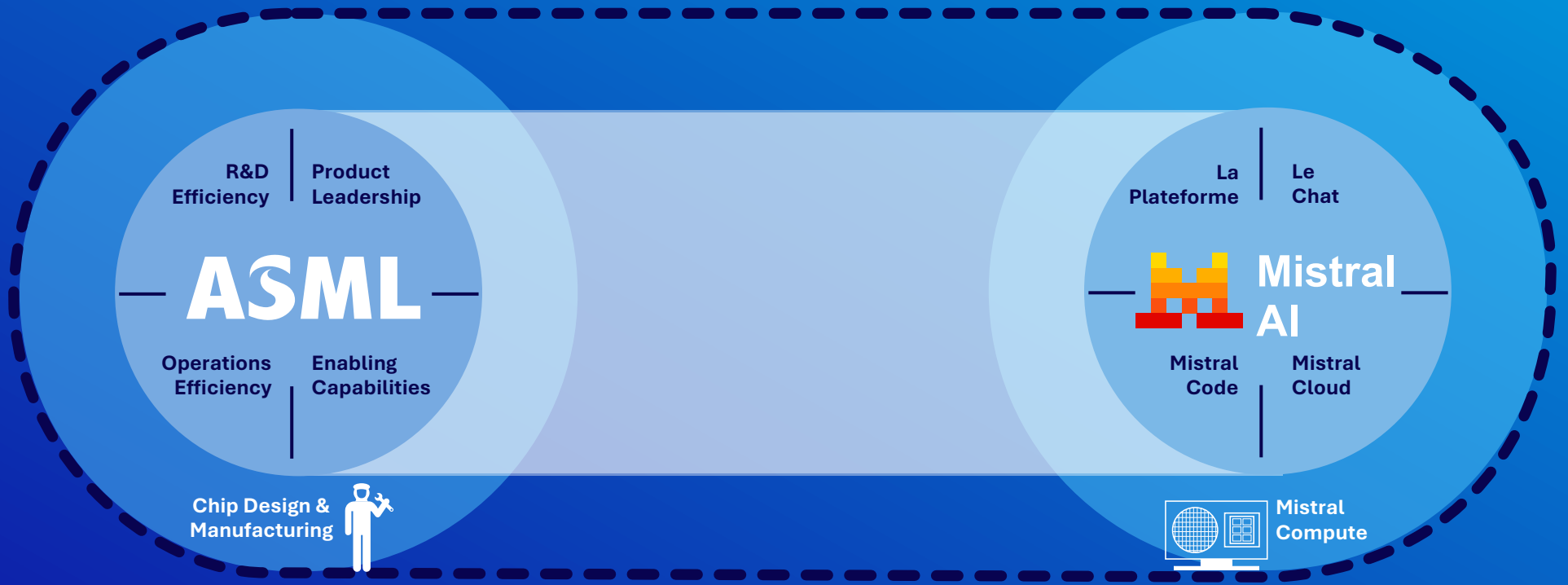
AI-assisted review

Improvements:

- Experts review and approve AI-generated customer description (“human in the loop”),
- Empowered by ChatBot, it simplifies the tasks to identify specific customer relevant features, improvements, bug fixes, and assess potential risks for upgrade.

ASML does not do this alone

The strategic partnership with Mistral will help us to strengthen our core competence and to support future customer value



Thank you!