

Industrial AI @ ASM Pacific Technology

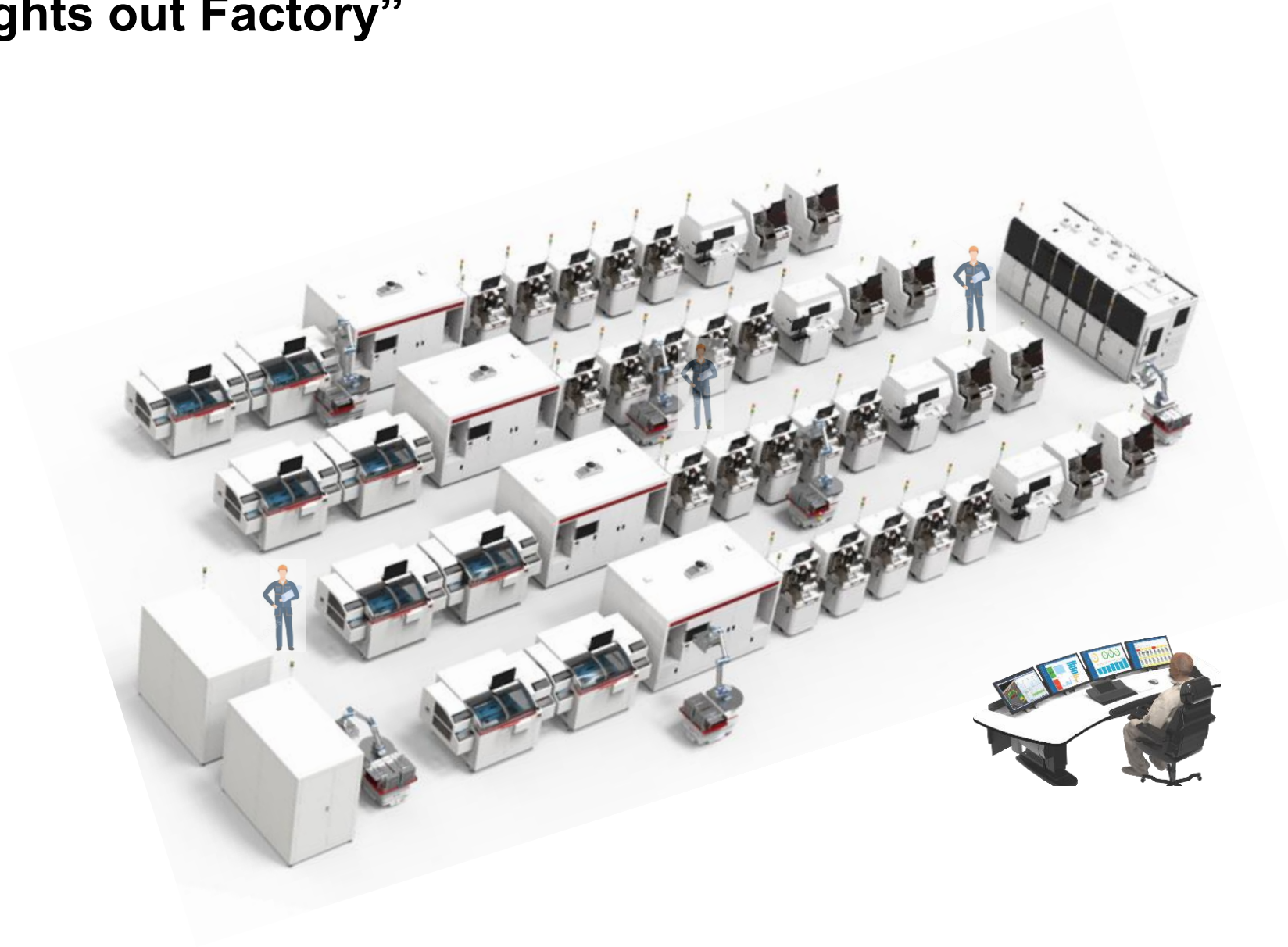
April 19th, 2022

Faysal Boughorbel
Jordi Riemens

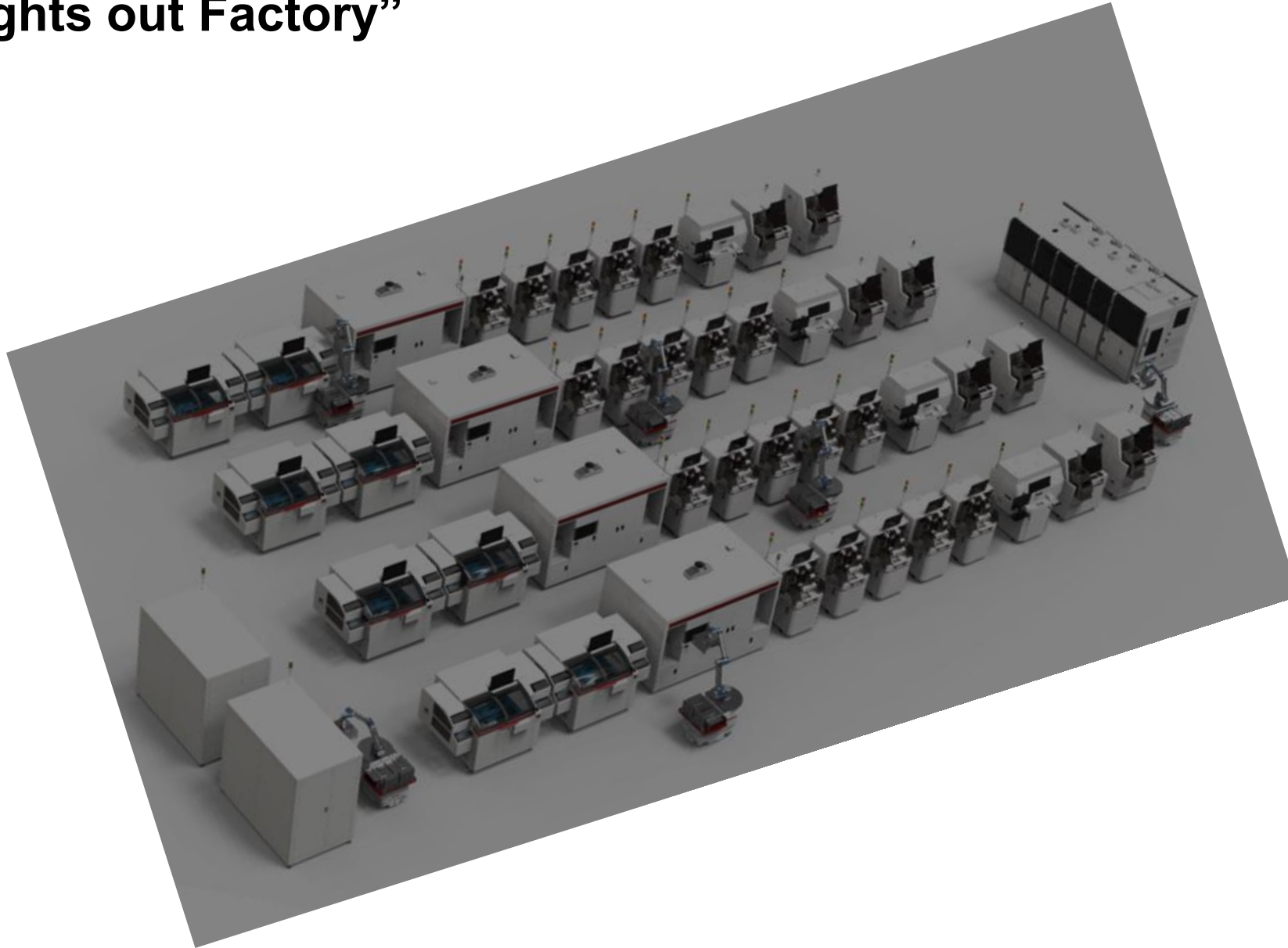
ASMPT Netherlands
Center of Competency



AI for a “Lights out Factory”



AI for a “Lights out Factory”



In the Meantime: The “AI Centaur”



“Weak human + machine + better process was superior to a strong computer alone and, more remarkably, superior to a strong human + machine + inferior process.” **Garry Kasparov**

ASMPT Introduction

FY2021 At a Glance

~12k
Number
of employees
As of 31 December 2021

Global footprint of
29
Territories

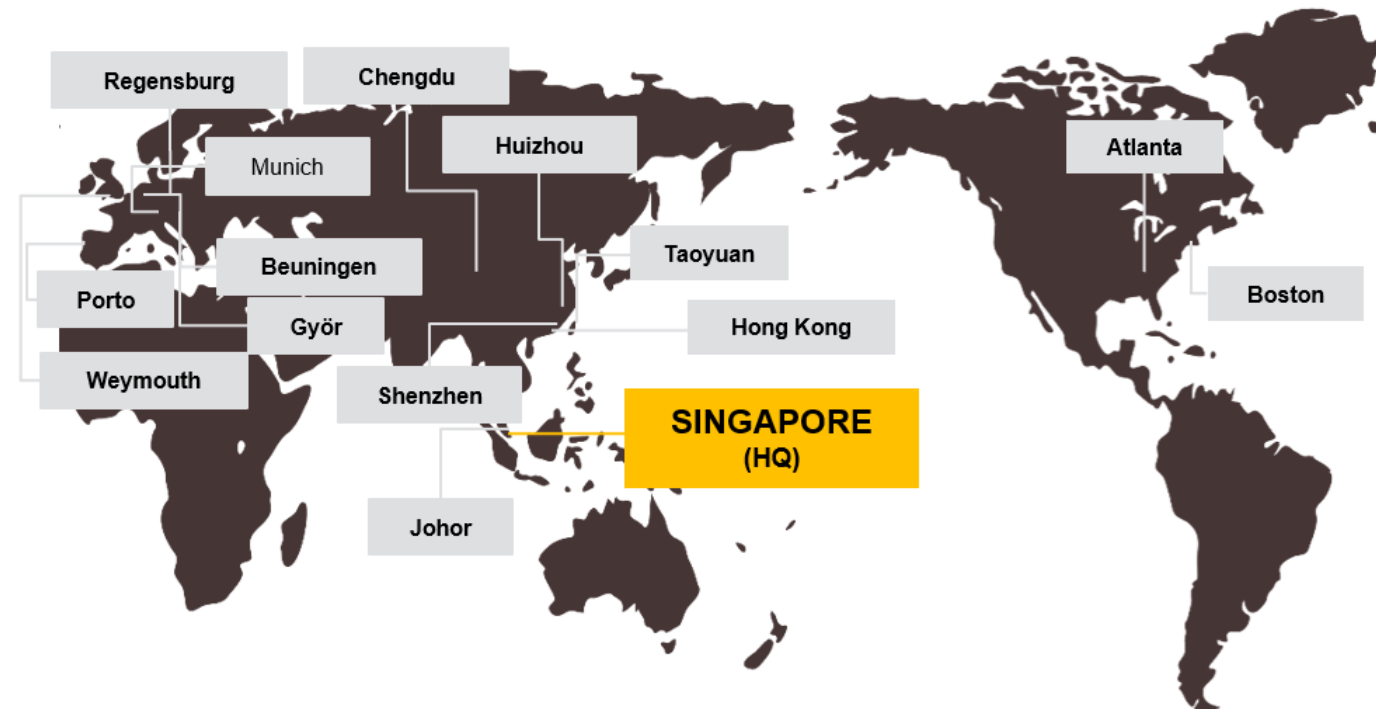
~ US\$3.9B
Market Cap
As of 7 March 2022

US\$2.82B
Revenue

40.6%
Gross Margin

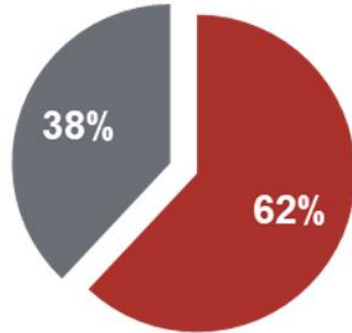
HK\$4.9B
Cash & Deposits

Business Centres / R&D / Manufacturing Sites



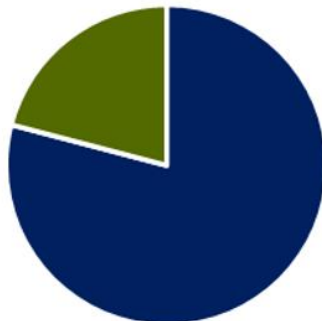
ASMPT, Segments

FY2021 Group Revenue Mix



■ Semiconductor solutions ■ SMT Solutions

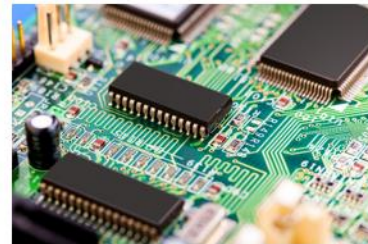
FY2021 Group Revenue Mix



■ Mainstream & Applicative Tools ■ Advanced Packaging Tools

Semiconductor Packaging and Assembly Solutions

ICD



Opto



CIS









SMT Assembly Solutions

Integrated Smart SMT Factory Solutions



ASMPT, End Market Applications

Computers	Consumer	Communication	Industrial	Automotive	Others**
 <p>Personal Computers Servers Datacentres HPC Other Computers</p>	 <p>TV Wearables Audio devices Video devices Gaming consoles Other Consumers</p>	 <p>Smart Phones Wired Infrastructure Wireless 5G Communications Infrastructure</p>	 <p>EV Charging Smart Factories Smart Offices Other Industrial</p>	 <p>Visual Sensors Infotainment LIDAR Sensors Power Management V2X communications Entertainment Platforms</p>	 <p>Medical Devices Aerospace Others</p>
~12%	~23%	~22%	~10%	~16%	~17%

A Vision for Smart Factories

Smart factory seven pillars:

1. Predictive Maintenance
2. Digital Twin
3. Mobile Robots
4. Big Data / Deep Data
5. Process Visualization
6. MES
7. Connected Factory

AI-driven
Areas

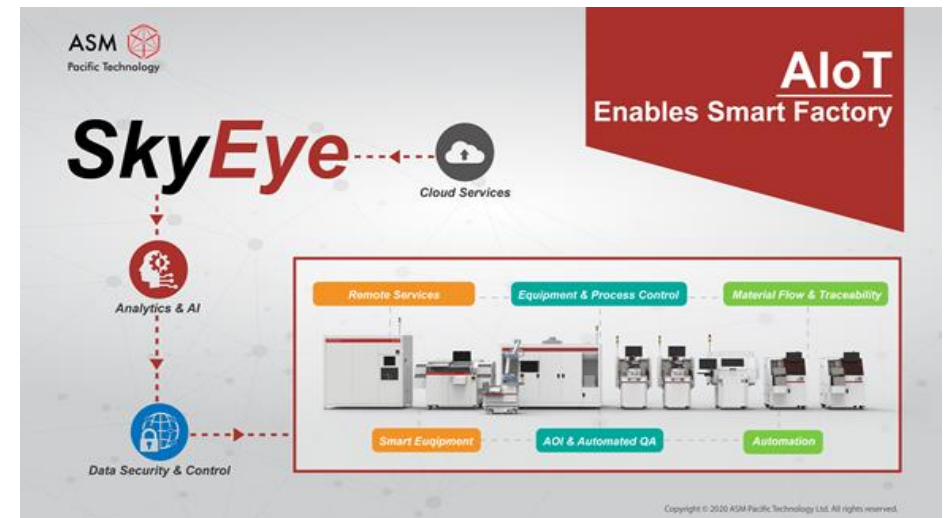


A Vision for Smart Factories

Smart factory seven pillars:

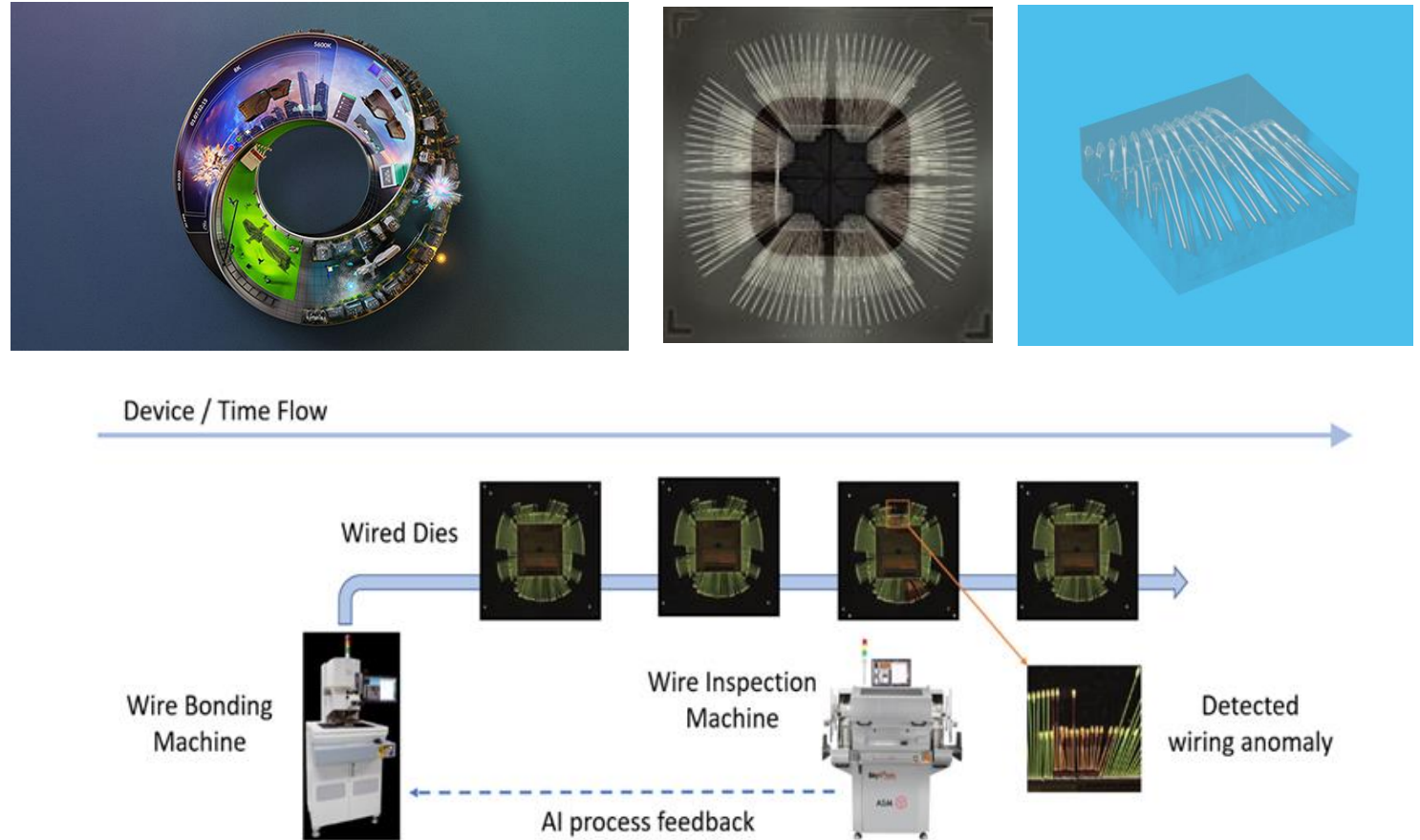
1. Predictive Maintenance
2. Digital Twin
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AI-driven
Areas



Key AI R&D Areas, ASMPT NL

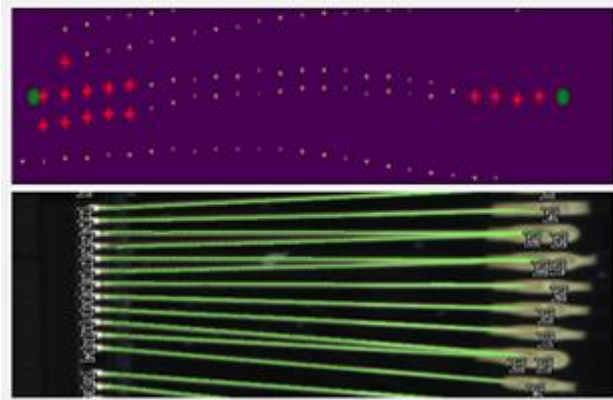
- Automated machine learning
- Image synthesis / Simulation
- Robust and Adaptive AI Systems
- 3D Reconstruction
- AI for Anomaly and Change Detection



Partnerships



MACHINE2LEARN



R&D focus areas at ASMPT Netherlands

Examples of CoC research projects

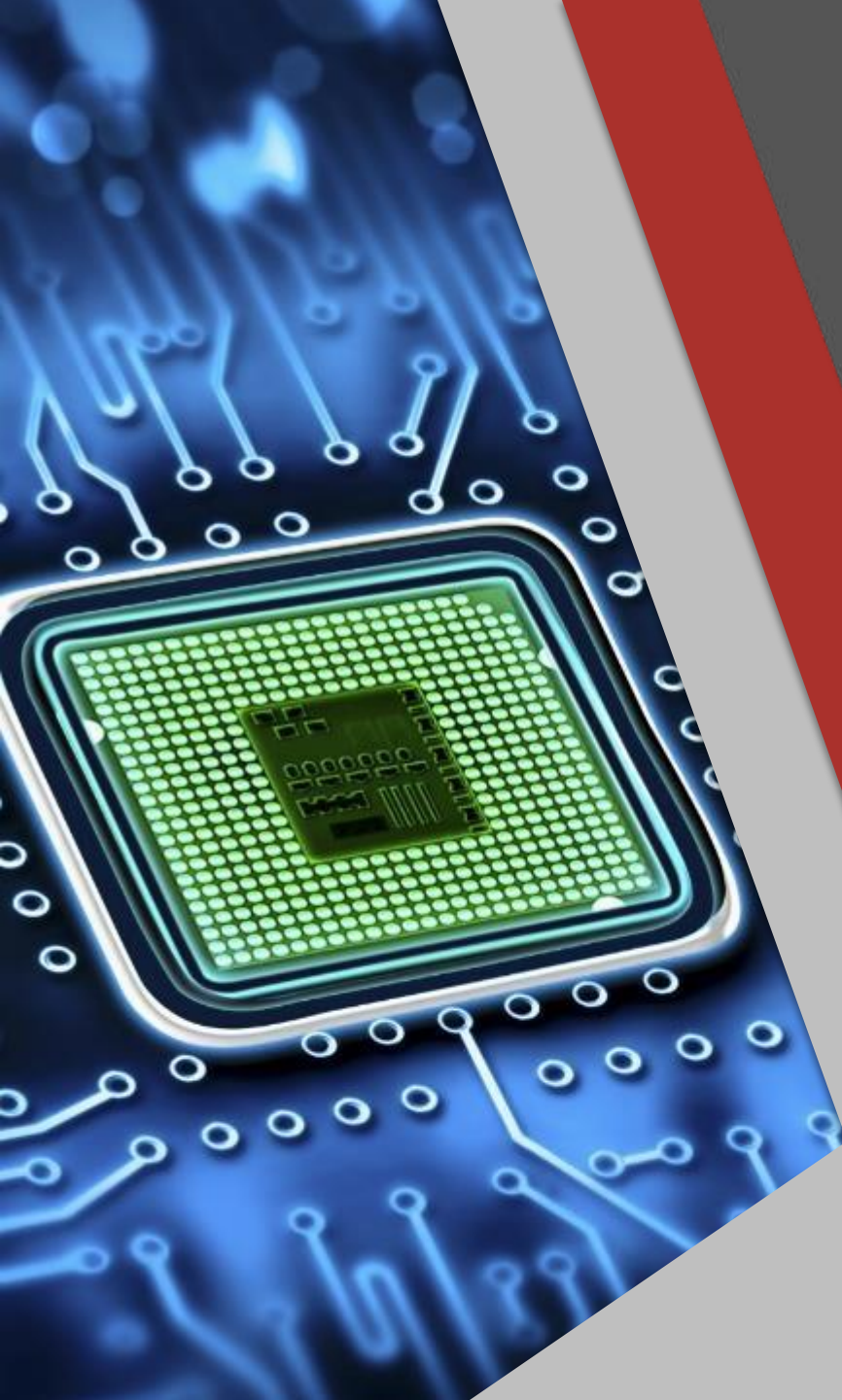
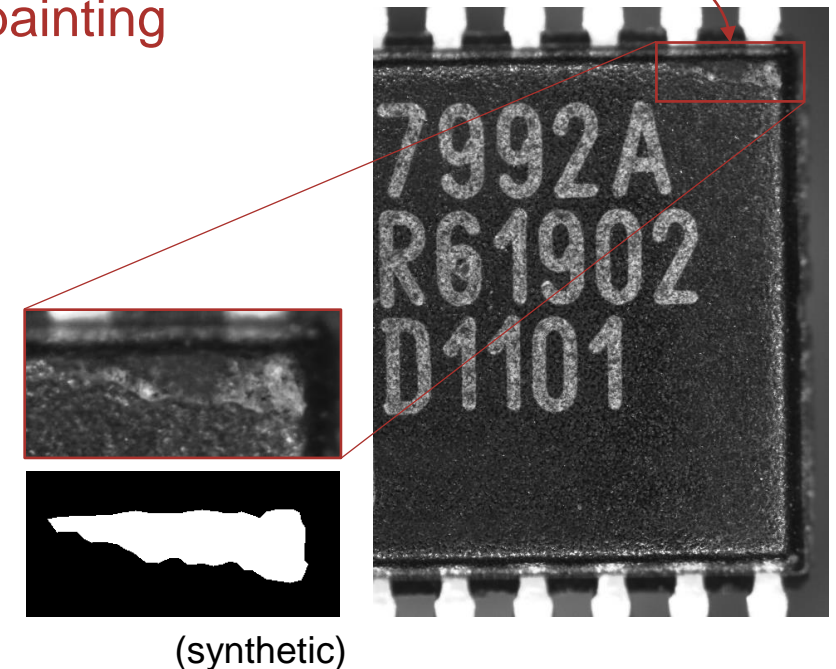
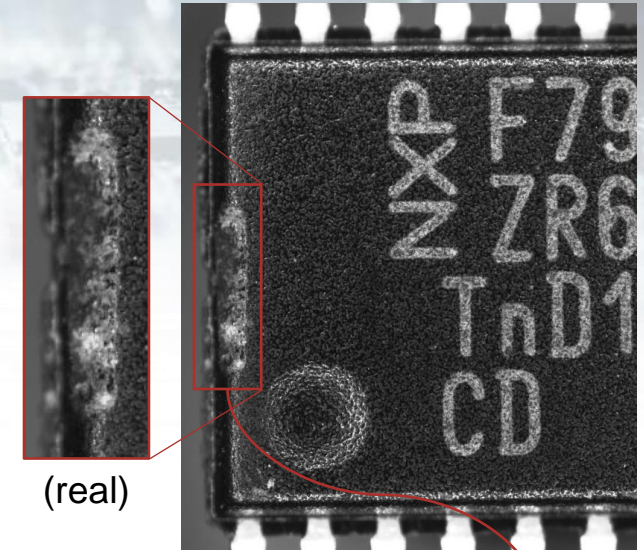
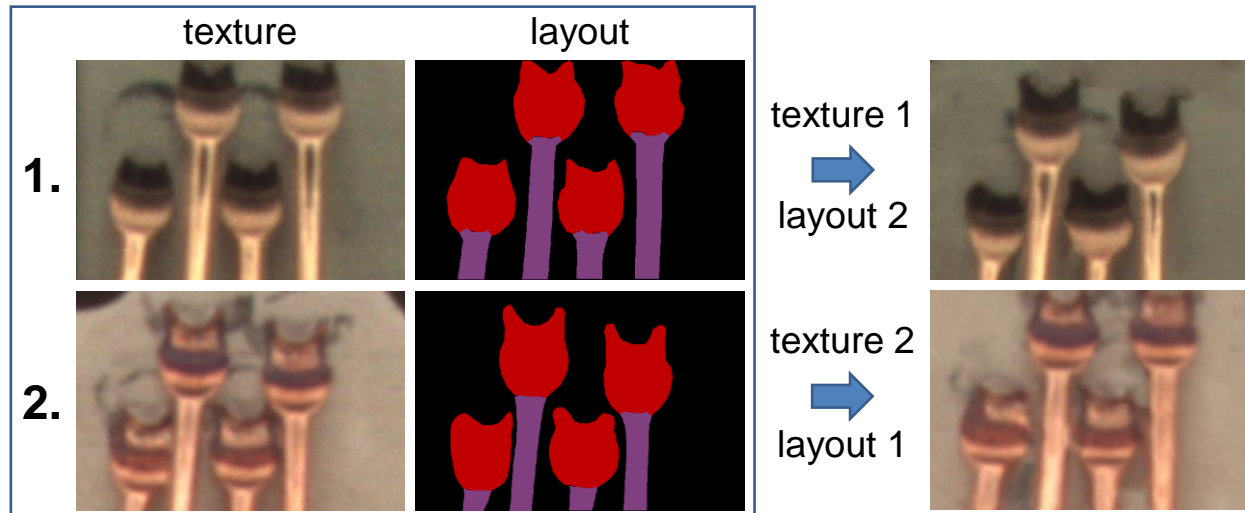


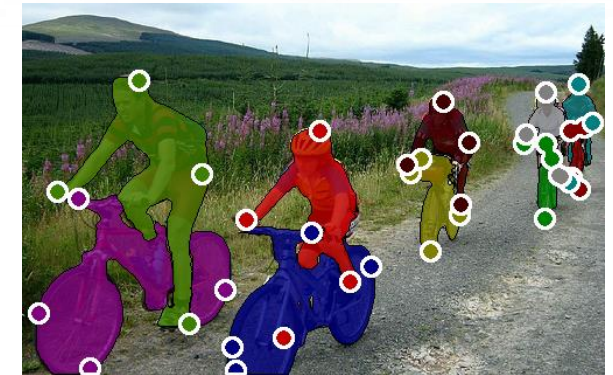
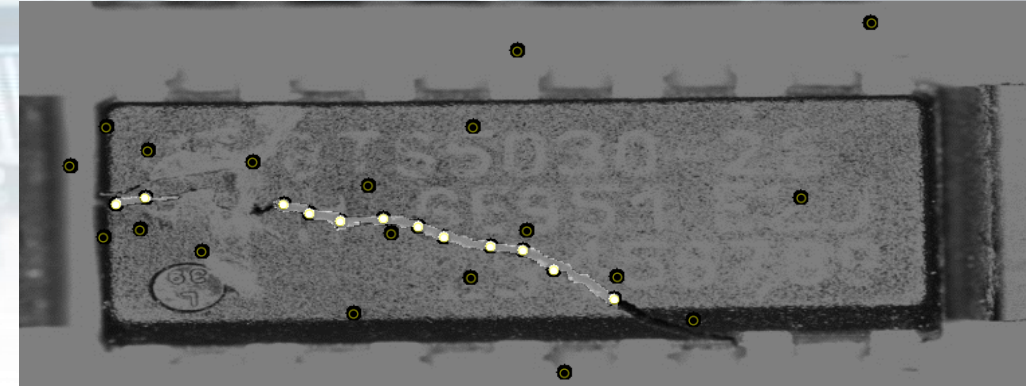
Image synthesis & simulations

- **Goal:** create data when not enough real data available
- **Why?** Data scarcity and robustness
- **Example projects:** arbitrary texture generation, transfer & inpainting



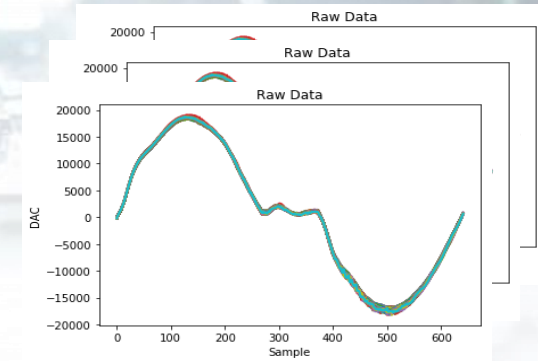
Automated machine learning

- **Goal:** reduce human bottleneck
 - Eventually: move to both “AutoModel” and “AutoData”
- **Why?** Scaling from 1-5 customers to 100+
- **Example project:** high-throughput labelling study
 - Guided/interactive image segmentation
 - Semantic boundary refinement

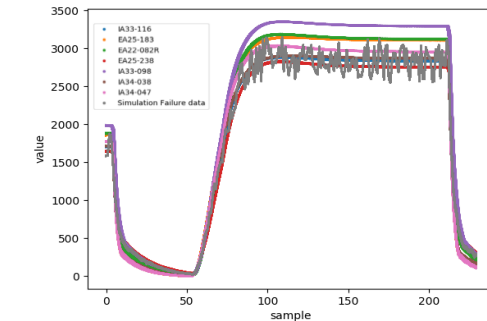


AI for anomaly and change detection

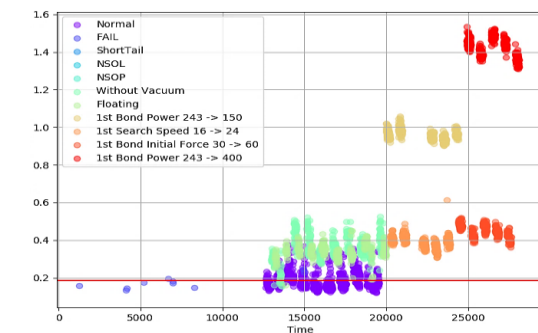
- **Goal:** learn to spot defects/changes without training samples
- **Why?** Defects rare or unknown
- **Example project:** anomaly detection for predictive maintenance



Collect measurements over multiple runs



Account for machine-to-machine variations



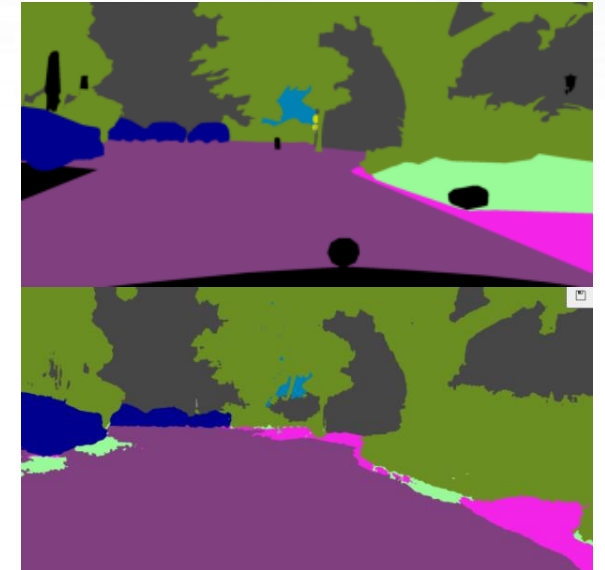
Compute anomaly score

Robust and adaptive AI systems

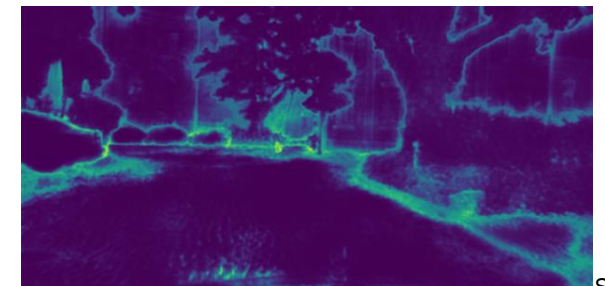
- **Goal:** better handle changes in machines' environments
- **Why?** New customers, devices, changes over time, ...
- **Example project:** using uncertainty in semi-supervised learning



Image and label



Prediction and uncertainty



3D Reconstruction

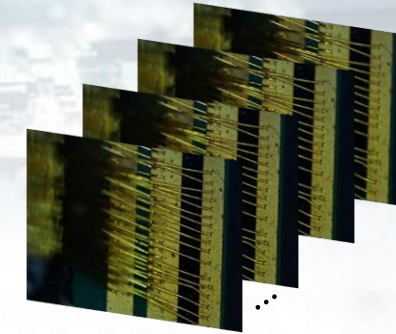
➤ **Goal:** retrieve 3D information from 2D images

➤ **Why?** 2D images too ambiguous in some applications

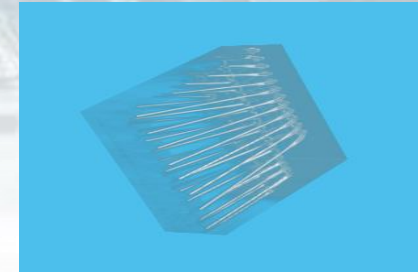
➤ E.g., instance segmentation of multiple wires overlapping in 2D

➤ **Example projects:**

- 3D reconstruction from focal stacks
- 3D reconstruction from stereo images



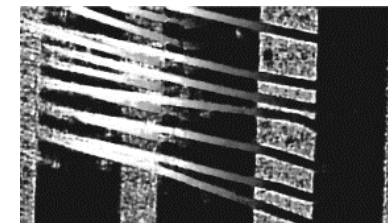
Focal stack



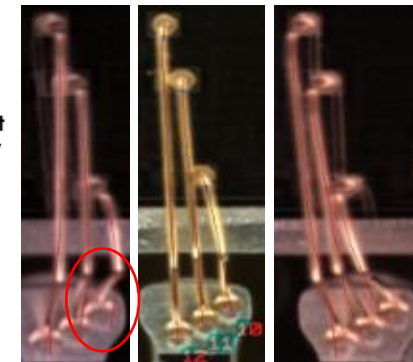
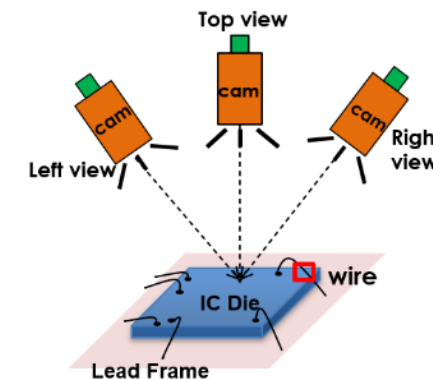
Volume



All-in-focus



Depth map



Application highlights

Examples of CoC application projects

Application highlight visual inspection

➤ Typical tasks:

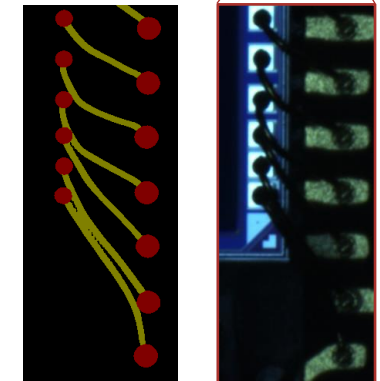
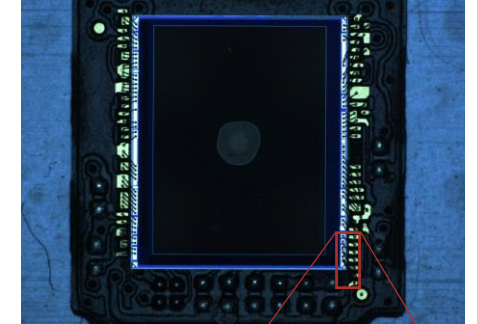
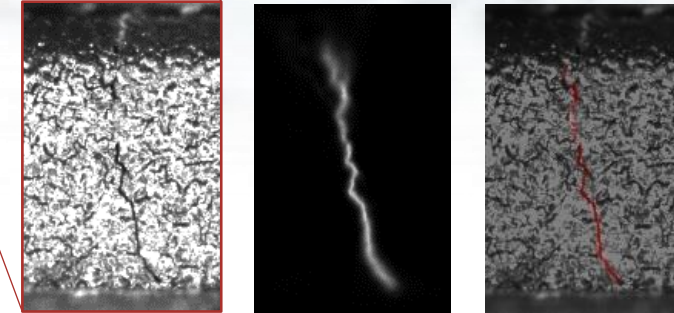
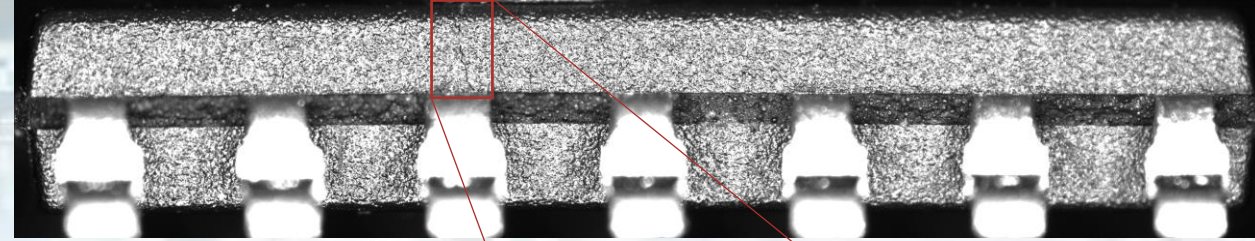
- Defect detection
- Segmenting classes of interest

➤ Challenges:

- Specifications: >99% defect detection rate & <1% false positive rate
- Inference speed requirements (e.g., <150ms)
- Limited data, especially for defects / rare cases
- Small-scale classes of interest in large, variable background

➤ Achievements:

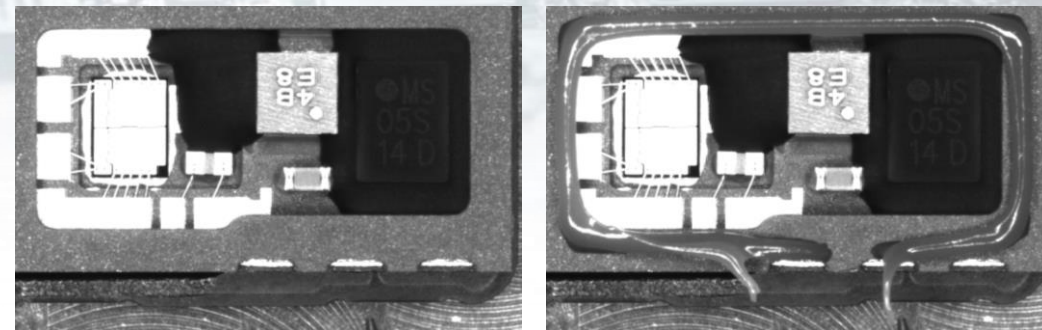
- Crack detection (↑): outperforming competitors, repeat orders, deploying in field
- AOI bond & wire segmentation (↓): outperforming predecessors, transferring



Application highlight – glue inspection & wire tracing

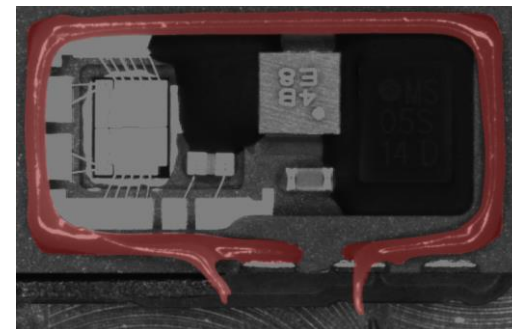
➤ Epoxy glue inspection challenges:

- Glue & background can vary wildly
- Requirement: work for new customers without retraining



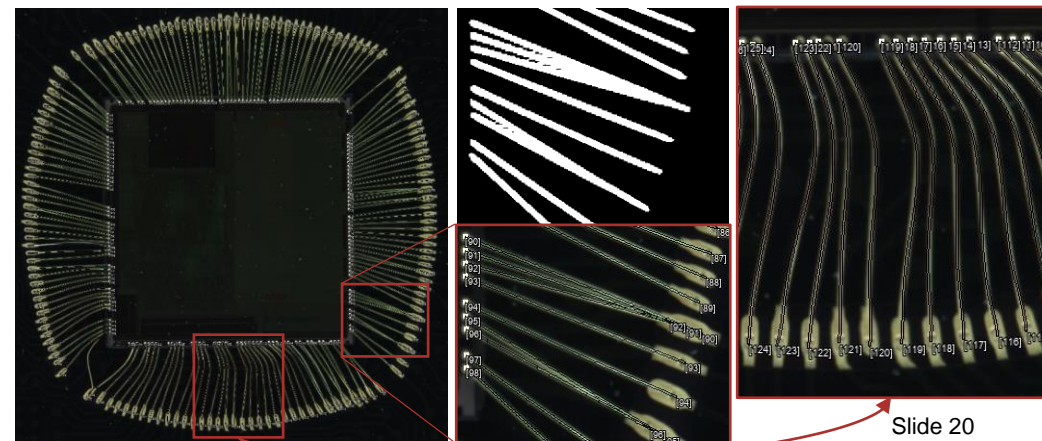
➤ Wire tracing challenges:

- Multi-layer wire structures
- High variability in wire shapes
- Robustness against overlap, merges, gaps in input masks



➤ Achievements:

- Glue inspection: outperforming predecessor solutions, transferring to production
- Wire tracing: outperforming previous solutions, integrating with inspection platform

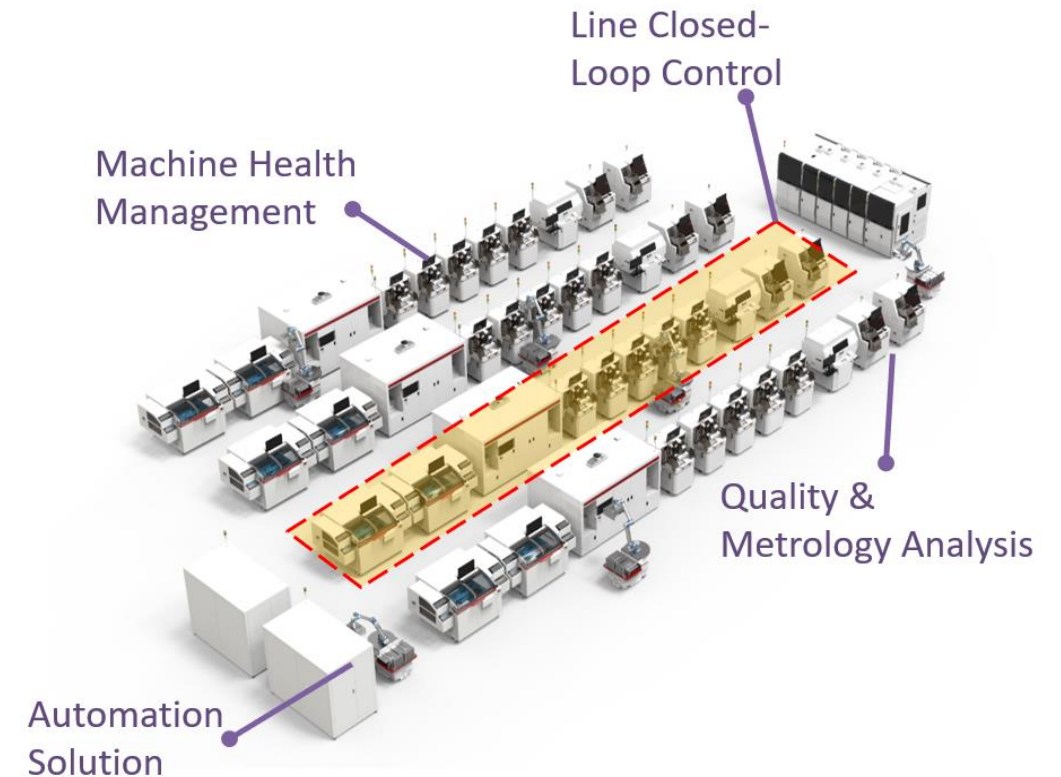


Outlook

Outlook

- From Visual and Multi-sensor Defect Inspection to AI-driven Process Control
- ASM ICAI-Lab (5PhD students + RU Staff + ASMPT Staff)

Part of the LTP ROBUST Proposal



LTP Program ROBUST wins NWO support

🕒 September 20, 2021 📄 📁 Press release

ICAI is very proud to be able to expand the network of ICAI with the LTP ROBUST program “Trustworthy AI systems for sustainable growth”, supported by NWO in the new Long Term Program with €25 million.

The challenges for developing robust AI are enormous. We focus on three areas: talent development, learning-by-doing and joint knowledge development between knowledge institutions, companies and societal parties. We can't wait to get started! ”

Programme leader Maarten de Rijke (University of Amsterdam and ICAI)

