The necessary technological environment for competitive manufacturing

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SIITME 2017

Agenda

1. Understanding Smart Manufacturing, Industrie 4.0

2. ASM Smart SMT Factory in practice & 4 innovation fields

3. All beginnings are difficult

Together
#1

What is Industrie 4.0?

Is it a Product ?

Is it a System ?

Industrie 4.0 is a campaign

What are the factors influencing Industrie 4.0?

We are at the beginning of a new machine age

INDUSTRY 1.0
Mechanization, steam power, weaving loom

INDUSTRY 2.0
Mass production, assembly line, electrical energy

INDUSTRY 3.0
Automation, computers and electronics

INDUSTRY 4.0
Cyber Physical Systems, internet of things, networks

1784   1870   1969   TODAY
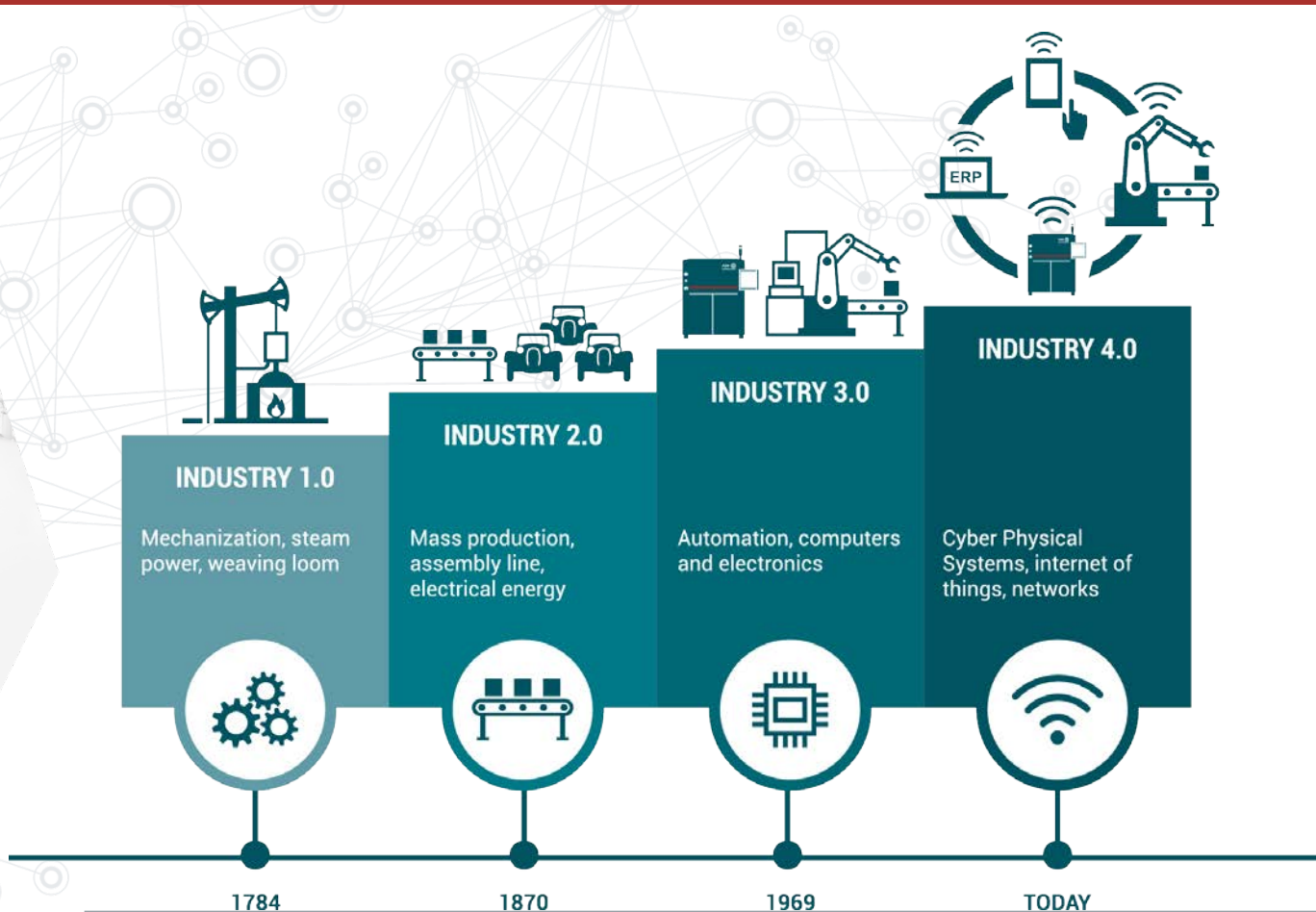
What are the factors influencing Industrie 4.0?

Society is changing
> Change of market environment
> More transparency
> Different consumer behavior
> Different tools

Higher quality requirements for production processes and products
> Higher safety standards
>> e.g. driver assistance systems
> Health monitoring

Increasing demand for individualized products
> Automotive industry
> IT industry with servers, PCs,...
> Personalized consumer products

Shorter product lifecycles
> Shorter innovation cycles
> Higher complexity of products

How did we get here

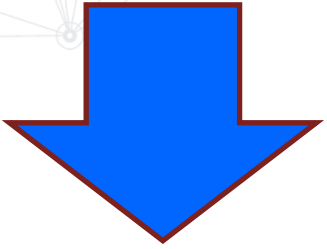OVER THE LAST 15 YEARS

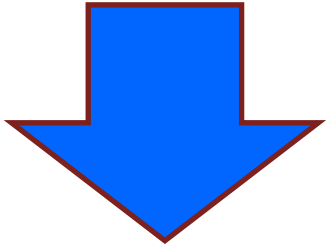**COST OF SENSORS**   **COST OF BANDWIDTH**   **COST OF PROCESSING**

3x   40x   60x

Wi-Fi coverage now
ubiquitous, available for free or at very low cost

Smartphones are becoming a
standard for everybody

Availability of Big Data analytics is key enabler

The new Internet Protocol v.6 allows
for an almost limitless amount of
addresses (3.4×10^{38})

IPv6

Is Industrie 4.0 limited to the manufacturing process?

NOT AT ALL! IT COVERS THE COMPLETE LIFE CYCLE OF A PRODUCT

Use of new media before and after the manufacturing process makes it possible

- Virtual production can detect product flaws in the design phase
- Restrictions can be considered real time within the price proposal phase and planning
- Last minute changes of the consumer can still be implemented
- Finished and shipped products and systems communicate with the manufacturer and send status and trouble reports
- The manufacturer can start processing returns from the field before the products actually arrive ...
- Consumer feedback immediately processed in actual production
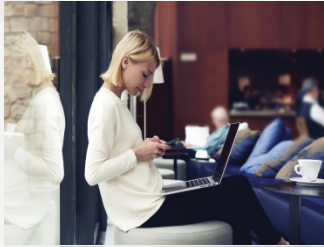
So is Industrie 4.o important for everybody

- **It eases current challenges for manufacturers**

- **It leads to an innovation economy**

- **It puts the consumer in the centre of all activities**

- **It changes workforce skill and knowledge requirements**

BUT it is also a race…

And should governments be engaged

Source: Global Industry 4.0 Readiness Report 2016 – DII 4.0 & ROLAND BERGER Consulting
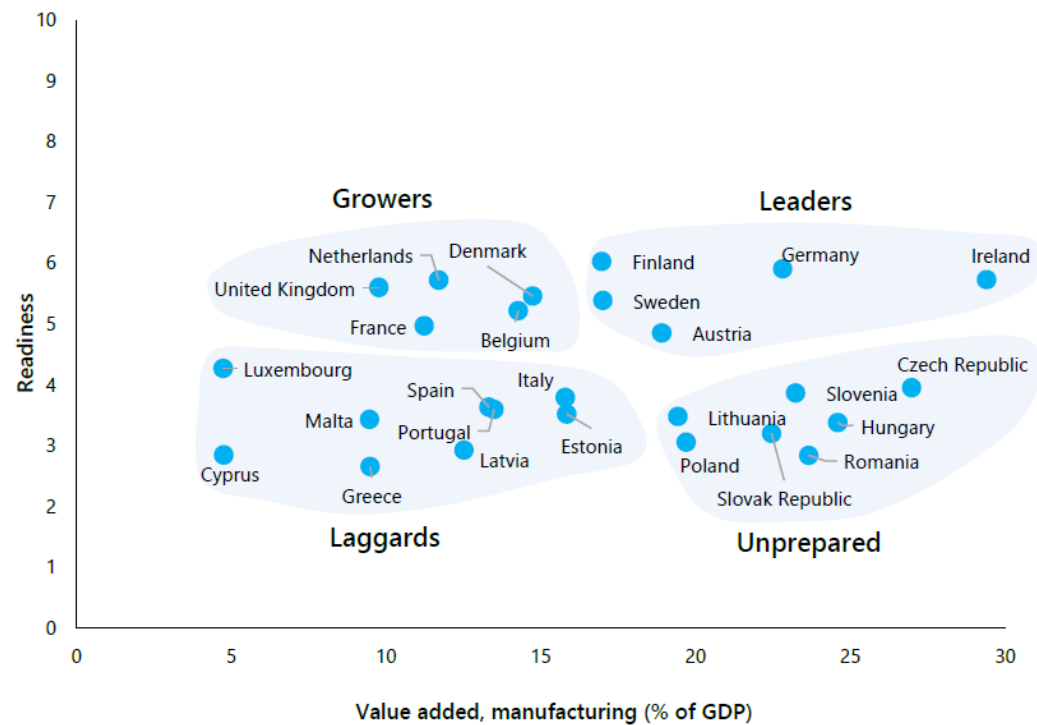
	50	Cyprus	2.8
	51	Romania	2.8
	52	Mexico	2.8
	53	South Africa	2.8
	54	Russian Federation	2.8
	55	Turkey	2.7

	1	Singapore	6.6
	2	Switzerland	6.6
	3	Finland	6.0

Romania score

Basic enablers

Driving forces

Industry 4.0 specific enable

Demand forces

Technological sophistication

Enterprise excellence

Innovation aptitude

10
8
6
4
2
0

Switzerland

Singapore

Romania
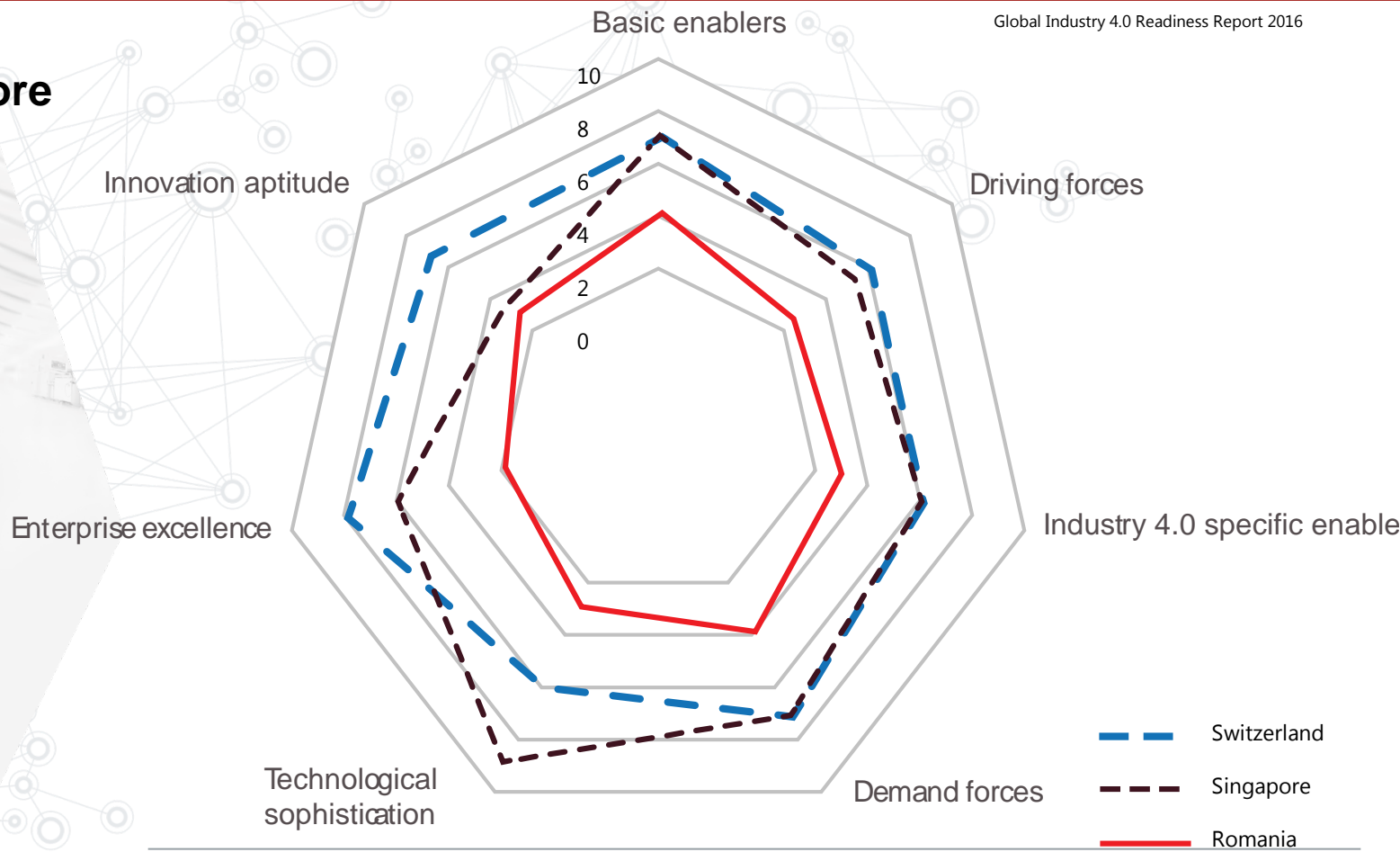
Industrie 4.0 – understanding "Smart Factory"

1. **Multi CPS, working interactively**
   – Fully Process Control & optimal balance among Throughput, Quality and Inventory.

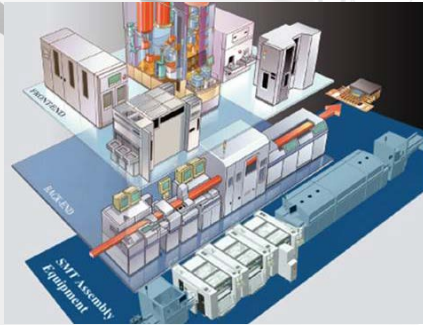2. **Integrated System which has capability to Learn & Improve (Artificial Intelligence AI)**
   – continuous process optimization among different systems

3. **Pre-defined logics with Expert Knowledge**
   – able to handle process Variants

4. **Closed loop Control in single production step**
   – long-term, reliable process

5. **All Repeated Processes which can be automated**
   – Throughput and Quality

6. **All Manual Work which has to be done by people**
   – the most cost-effective way

Smart Factory — 1
Cyber-Physical Systems — 2
Smart Systems — 3
Closed Loop Systems — 4
Automation — 5
Manual Process — 6
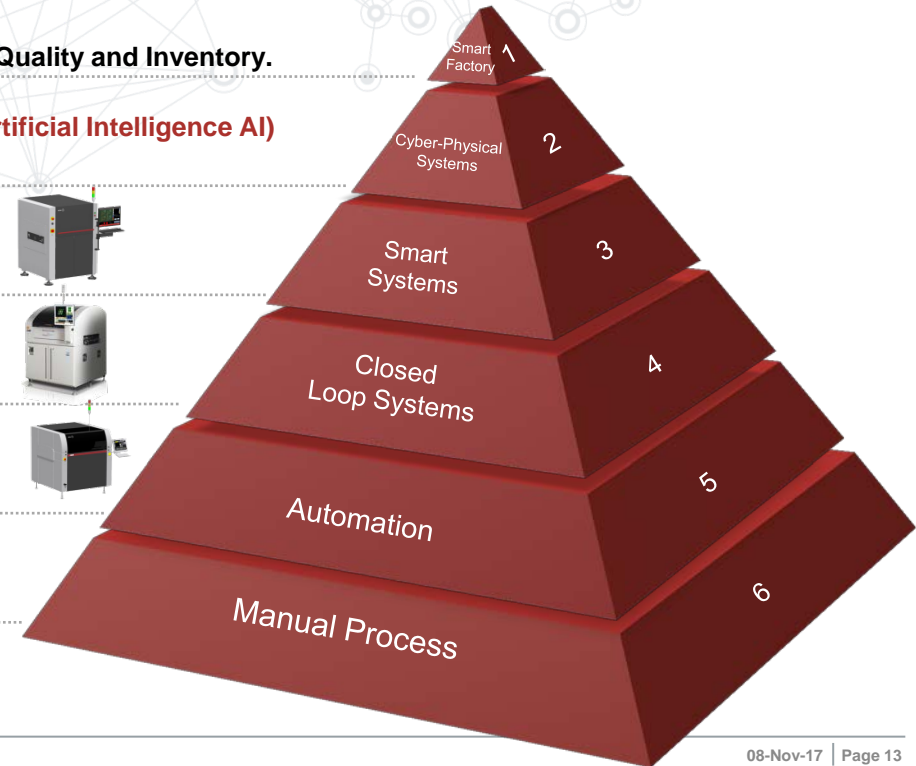
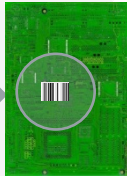# Prerequisites for implementing Industrie 4.0 in a smart factory

Suitable and standard interfaces for networking

- Machines and systems from different vendors
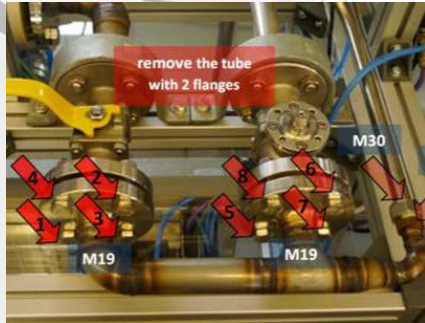- Workpieces
- Material logistics
- People

Proper identification of workpieces and end devices

- For example, RFIDs with ability to store information locally

Only standard interfaces of workpieces and machines allow seamless integration.

Prerequisites for implementing Industrie 4.0 in a smart factory

Suitable human interfaces

- Web Browser based User Interfaces
- Consideration of mobile devices
- i.e. Google glasses
- Voice and gesture controls
- Augmented Reality

Flexible production equipment

Fast setup and changeover capabilities

- Allow production of jobs with small batch sizes
- Enable quick changeovers
- …

Mobile devices will play a major role in a smart factory to allow immediate reaction; independent from the current location.

Prerequisites for implementing Industrie 4.0 in a smart factory

Ability to rapidly process large amounts of data

- Display important information in real time

Cloud capability

- Hosting of data and applications on virtual servers (PaaS)
- Avoid having to build your own IT infrastructure
- Allow implementation for small and medium size companies

Data security
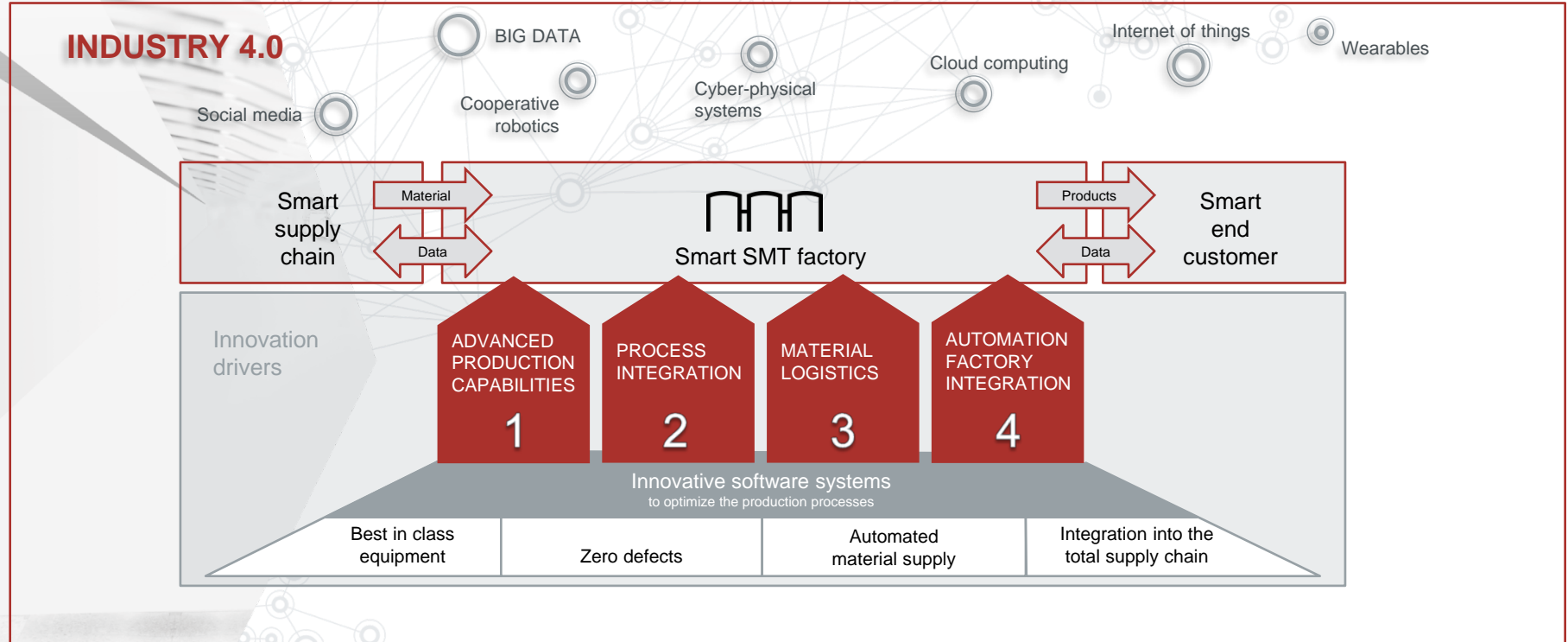
- Prevent unauthorized access to sensitive company data

IT systems need to be able to process much more data than today. Ensuring data security will be a major challenge with todays Internet based communication.

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Seeing the competitive advantage through the Hype:
Smart SMT Factories in the age of Industry 4.0

INDUSTRY 4.0

Social media   BIG DATA   Cooperative robotics   Cyber-physical systems   Cloud computing   Internet of things   Wearables

Smart supply chain — Material / Data — Smart SMT factory — Products / Data — Smart end customer

Innovation drivers

| ADVANCED PRODUCTION CAPABILITIES 1 | PROCESS INTEGRATION 2 | MATERIAL LOGISTICS 3 | AUTOMATION FACTORY INTEGRATION 4 |

Innovative software systems
to optimize the production processes

| Best in class equipment | Zero defects | Automated material supply | Integration into the total supply chain |

ASM's Focusing Areas
to help you move to the Smart Manufacturing

| ADVANCED PRODUCTION CAPABILITIES | SPEED, ACCURACY, SCALABILITY
Smart Equipment |

ADVANCED PRODUCTION CAPABILITIES — SPEED, ACCURACY, SCALABILITY / Smart Equipment

PROCESS INTEGRATION — LINE LEVEL PROCESS CONTROL / "0" Defects Process

MATERIAL LOGISTICS — SMART MATERIAL SUPPLY / Complete Transparency for Entire Supply Chain

FACTORY INTEGRATION — FACTORY SOLUTIONS / Smart Manufacturing

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|	
ADVANCED PRODUCTION CAPABILITIES	**SPEED, ACCURACY, SCALABILITY** **Smart Equipment**
PROCESS INTEGRATION	LINE LEVEL PROCESS CONTROL "0" Defects Process
MATERIAL LOGISTICS	SMART MATERIAL SUPPLY Complete Transparency for Entire Supply Chain
FACTORY INTEGRATION	FACTORY SOLUTIONS Smart Manufacturing

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ASM ProcessExpert:
Enter a new dimension

Process Optimization

Process control

Process validation

DFM Process

DFM Health Check
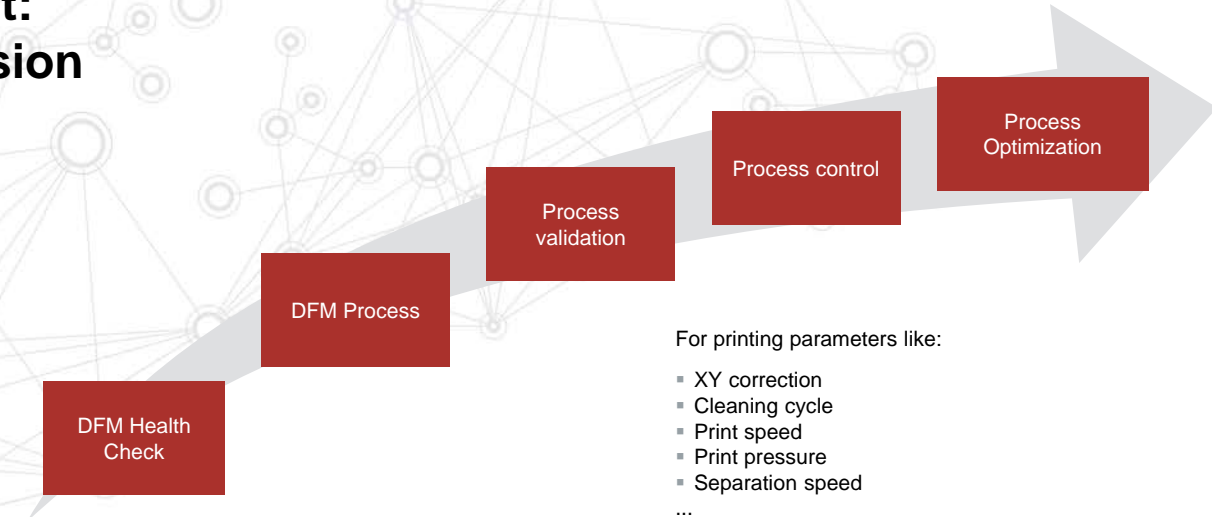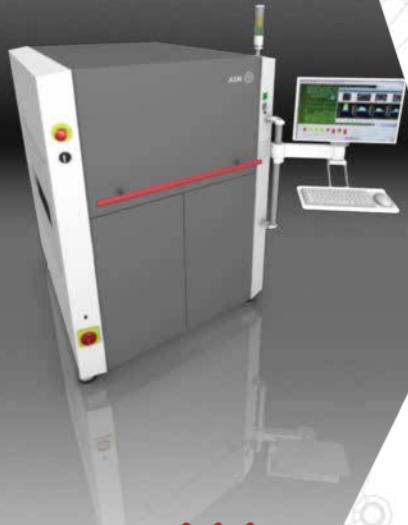
For printing parameters like:

- XY correction
- Cleaning cycle
- Print speed
- Print pressure
- Separation speed
...

ASM ProcessExpert = Process Lens + Process Engine

The ASM ProcessExpert is the world's first inline expert system for electronics manufacturing.

Virtual Printing

Before Production Starts

DFM Health Check
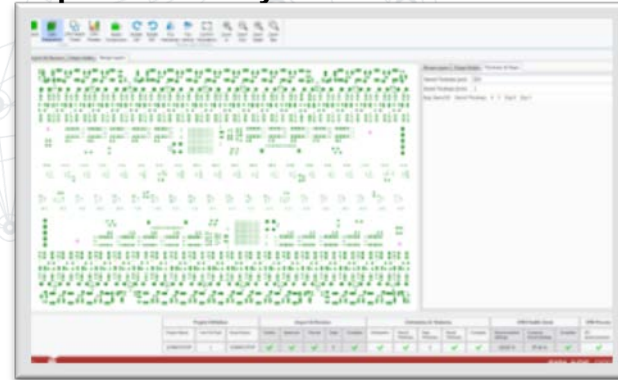
Optimize process design
(stencil, paste type, printer settings)

Using Gerber Design Data and our Knowledge Database to evaluate the design.

Propose best solution (settings and hardware) for least variation and stability.

Evaluate alternative settings

1. **Import and analyze the Gerber data**

2. **Virtual Printing -> Make Recommendations**

ASM's Focusing Areas
to help you move to the Smart Manufacturing

| ADVANCED PRODUCTION CAPABILITIES | SPEED, ACCURACY, SCALABILITY
Smart Equipment |

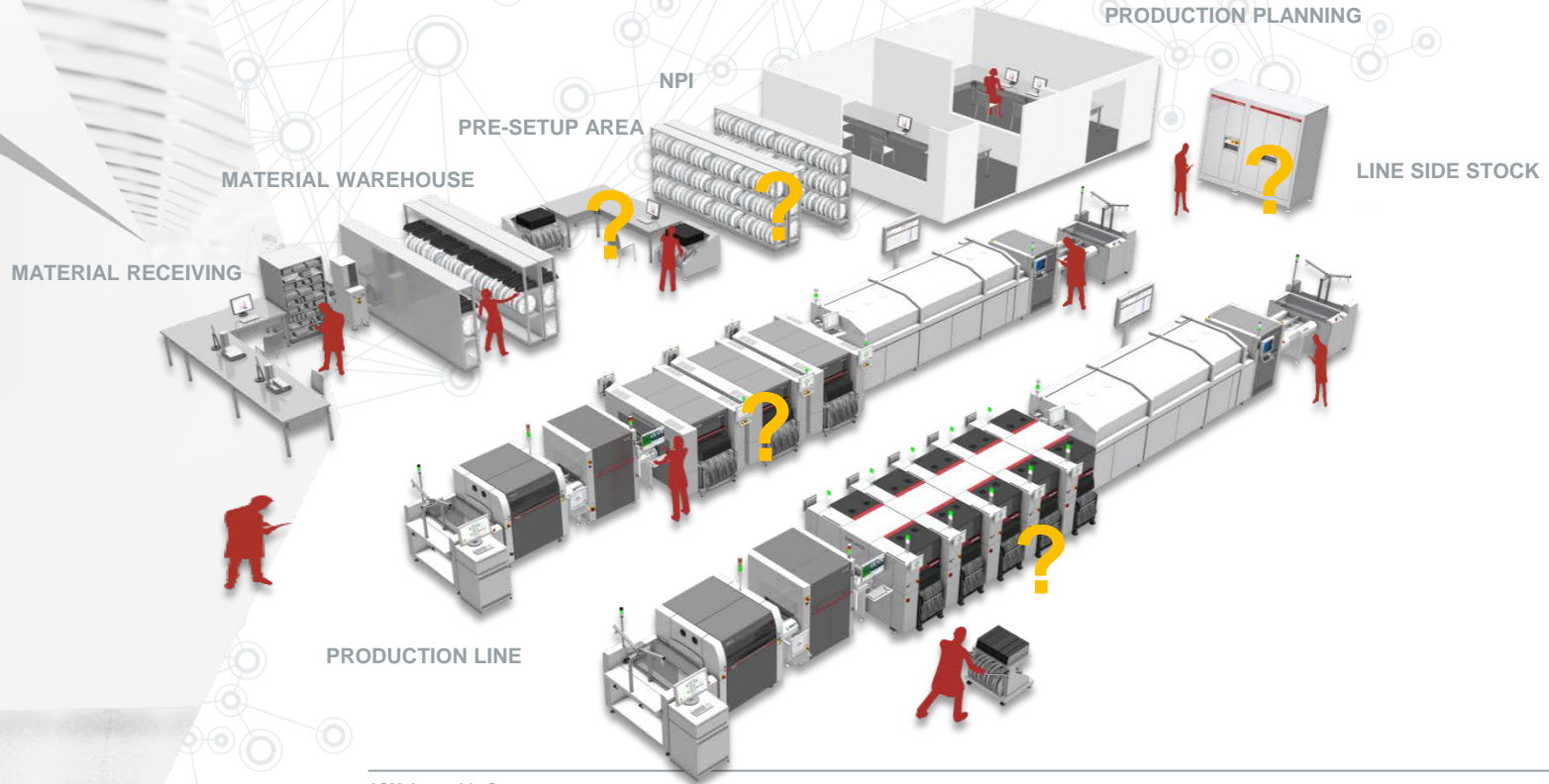| PROCESS INTEGRATION | LINE LEVEL PROCESS CONTROL
"0" Defects Process |

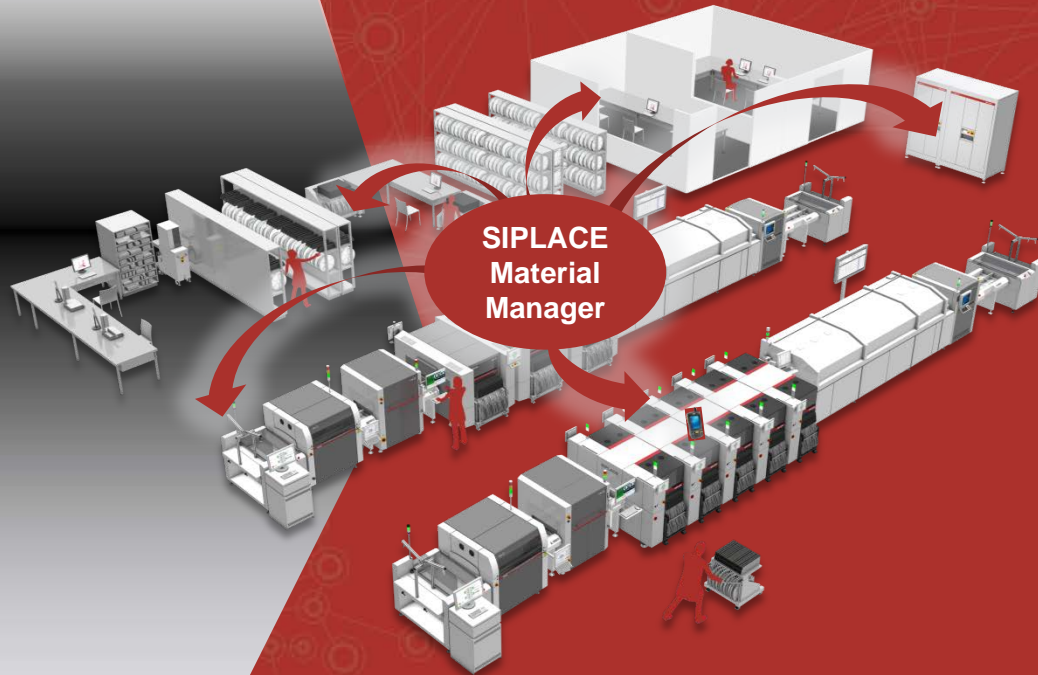| MATERIAL LOGISTICS | **SMART MATERIAL SUPPLY**
Complete Transparency for Entire Supply Chain |

| FACTORY INTEGRATION | FACTORY SOLUTIONS
Smart Manufacturing |

'Grey area' in the Shop floor

PRODUCTION PLANNING

NPI

PRE-SETUP AREA

LINE SIDE STOCK

MATERIAL WAREHOUSE

MATERIAL RECEIVING

PRODUCTION LINE

SIPLACE Material Manager

SIPLACE Material Manager

#1 Material Management of SMD Material

- Transparent Material locations
- Updated material inventory
- Less material costs
- Automatic material processes
- Higher line availability
- Faster setup
- Fewer material logistics

ASM's Focusing Areas
to help you move to the Smart Manufacturing

ADVANCED PRODUCTION CAPABILITIES	SPEED, ACCURACY, SCALABILITY Smart Equipment
PROCESS INTEGRATION	LINE LEVEL PROCESS CONTROL "0" Defects Process
MATERIAL LOGISTICS	SMART MATERIAL SUPPLY Complete Transparency for Entire Supply Chain
FACTORY INTEGRATION	**FACTORY SOLUTIONS** **Smart Manufacturing**

Smart Operator
Operator Guidance with Smartwatch

Operator Guidance with Smartwatch

Use Case Offline Setup Preparation

- Target track for Refill Feeder on COT is indicated on Smartwatch
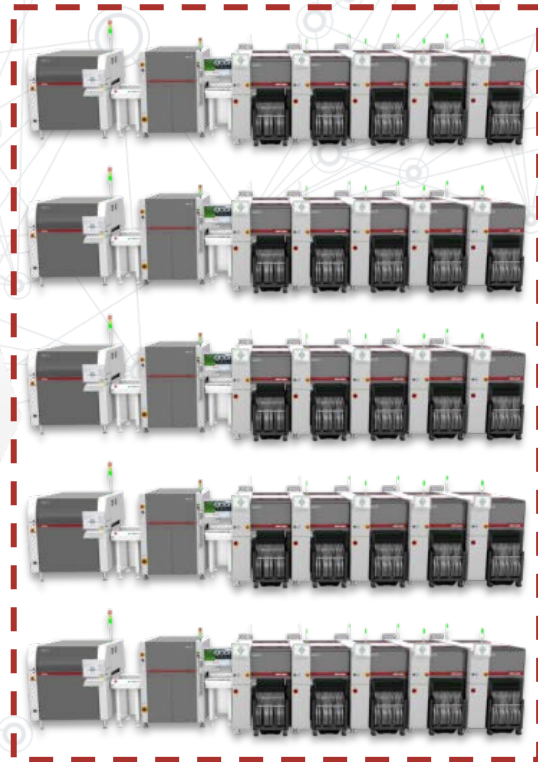
Use Case Material Return from Line

- COT is identified with Smartwatch using NFC and iBeacons
- Smartwatch shows tracks of Feeders to put into Active Feeder Pool
- Sorting of returning material possible without Docking Station
- Parallel material sorting with several Smartwatches possible

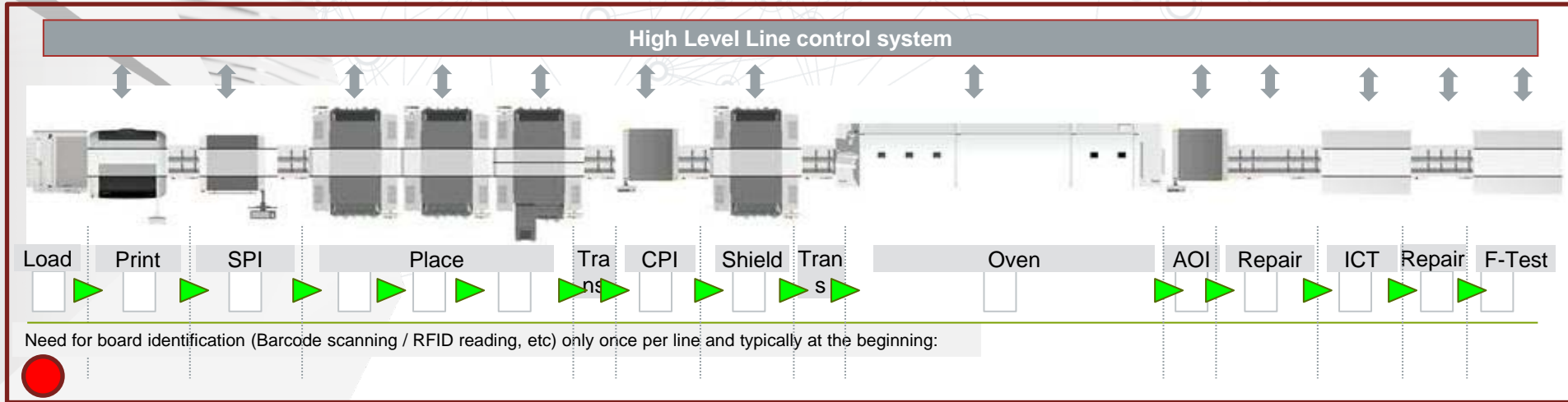# ASM Smart Manufacturing – 'self-running' production

2017

2 Operator / Line

1 Operator / Line

The Hermes Standard: More value from the line through smooth communication

With The Hermes Standard: Full Process data availability, Maximum Line throughput & Traceability

High Level Line control system

Load | Print | SPI | Place | Trans | CPI | Shield | Trans | Oven | AOI | Repair | ICT | Repair | F-Test

Need for board identification (Barcode scanning / RFID reading, etc) only once per line and typically at the beginning:

▶ Standardized M to M Interface via The Hermes Standard

- **The Hermes Standard** establishes a method for Board tracking over the entire line without the necessity to use multiple barcode readers or barcode readers at all. This will allow e.g. to collect process data and traceability data per board / batch without the necessity to read barcodes again and again.

● only here, Board ID Scanning is required
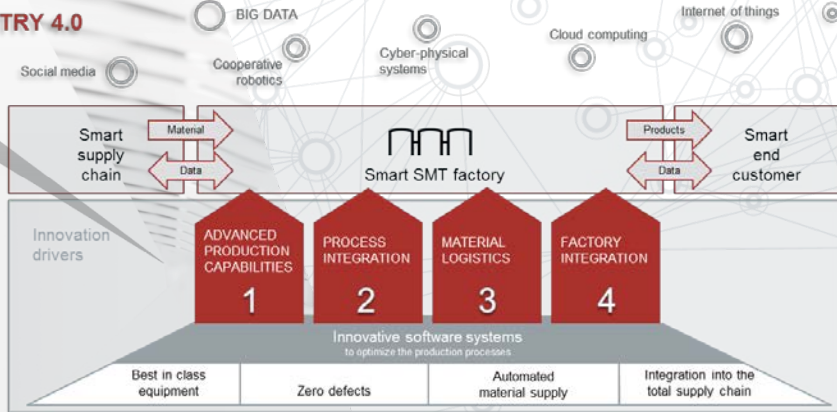
ADAMOS Digital Platform and App Factory
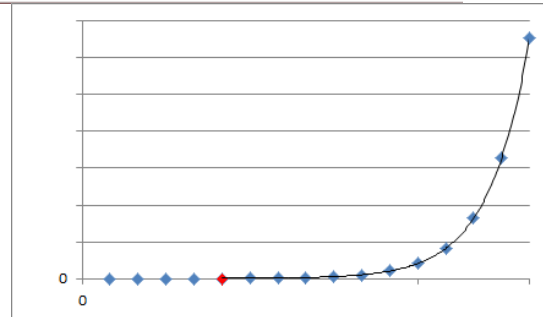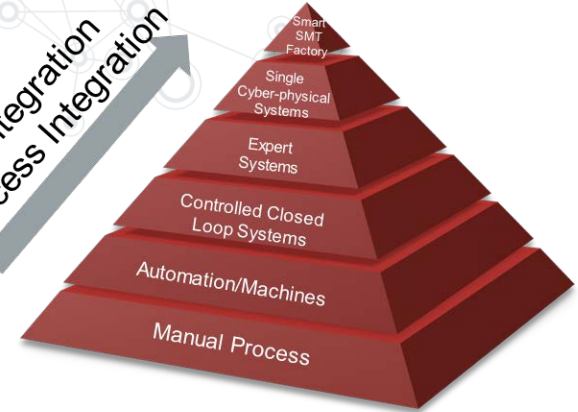
DMG Mori
Dürr
Software AG
Zeiss
ASM
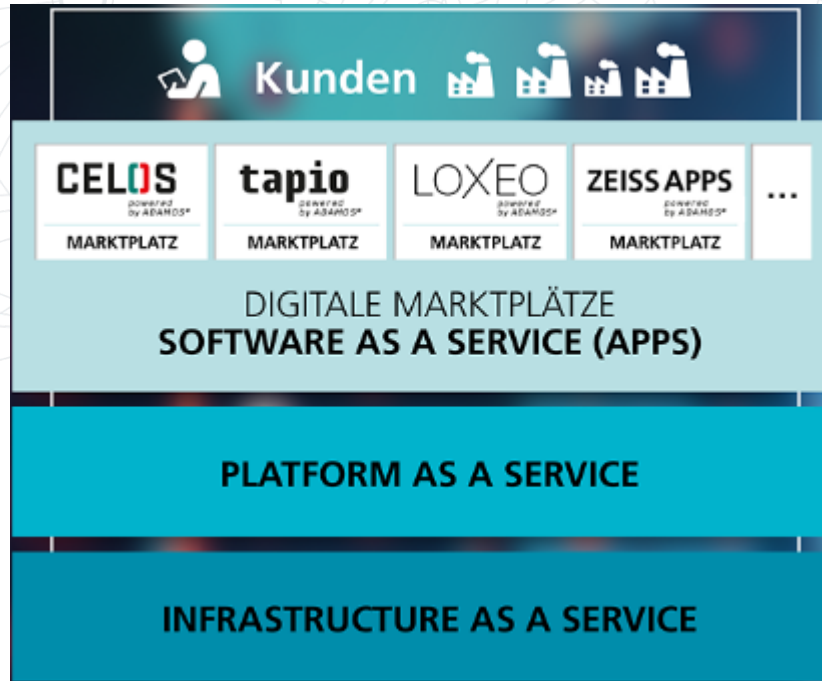
https://de.adamos.com/

Got some ideas?

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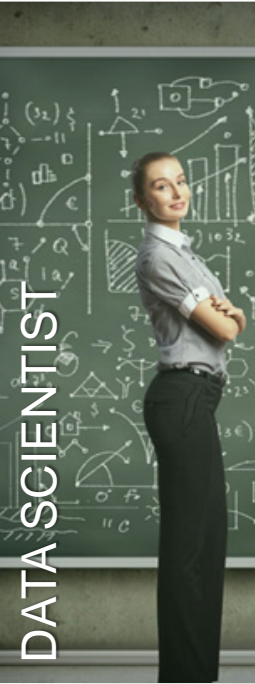| 2. ASM Smart SMT Factory in practice, 4 innovation fields |

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Manufacturing workplace will change dramatically!

5 future proof studies

DATA SCIENTIST

CODING

MECHATRONIC

ROBOTICS

ENERGY

SMT Centers of Competence and Smart Factory Reference Sites
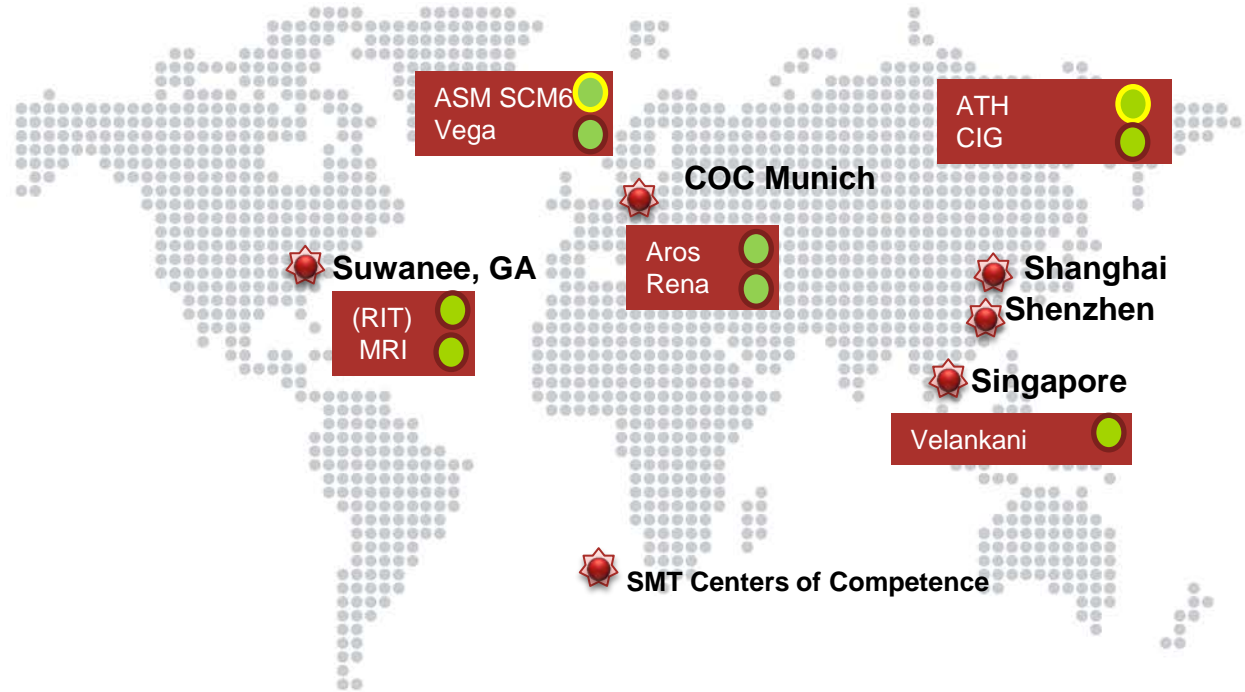
Thank You!
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