SemI40 & Productive4.0
Different but Complementary

Authors:

SemI40 Consortium

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Power Semiconductor and Electronics Manufacturing 4.0
[05.2016-04.2019]

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Christoph
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WP2(BOSCH)
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WP7:
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WP3(KNOW)
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WP5(VIF)
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WP4(IFD)
Germar
Schneider

State of the Art before SemI40

Where are we now?

Challenges & Outcomes

How we create value?

Conclusion

1st

2nd

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- State of the Art before SemI40
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Go back 2014/2015

https://pixabay.com/de/stra%C3%9Fe-m%C3%A4dchen-toronto-jung-1026246/

2015: Top 6 Technology Trends

Internet of Things: continue its meteoric rise in 2015, further blurring the lines between our digital and physical worlds.

Wearables: Apple watch, crossover into the business space

Mobile payments: competition between companies heat up

Online security: businesses poses greater emphasis on 2015 to protect from whatever..

Augmented reality: great share of success

Virtual reality: change the way how people interact

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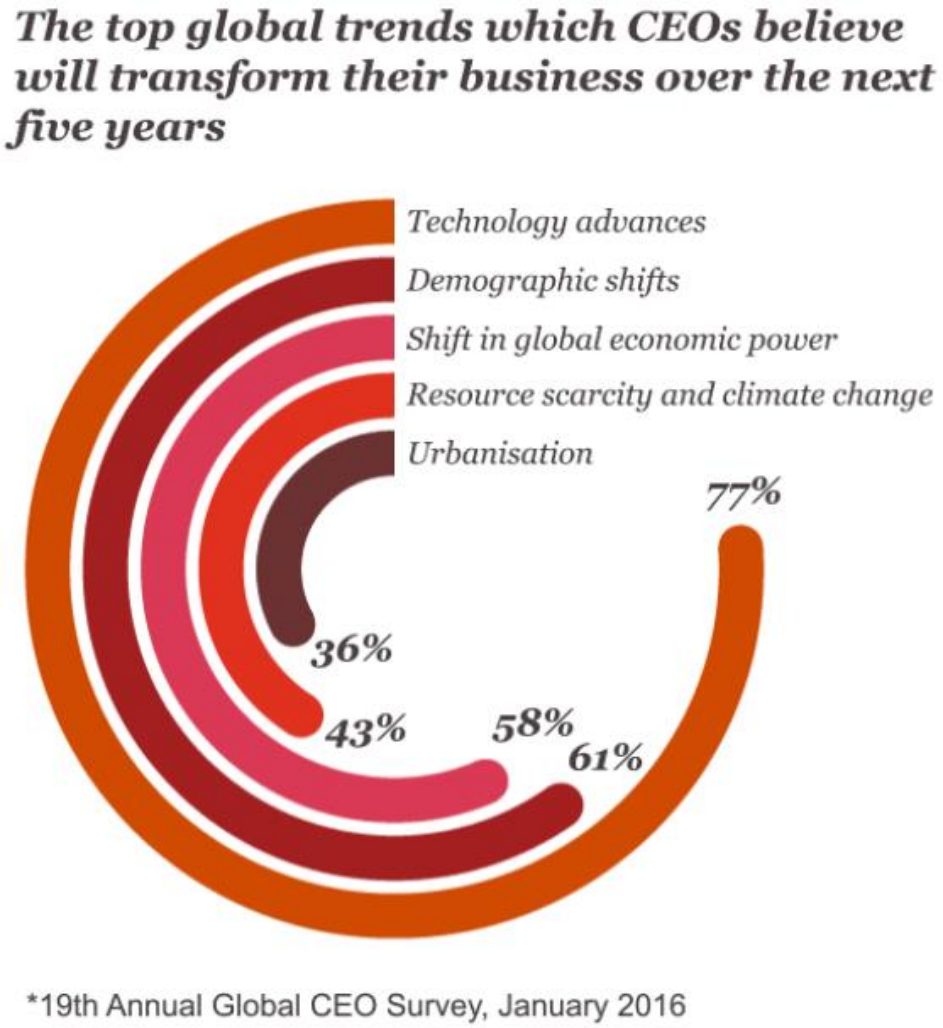
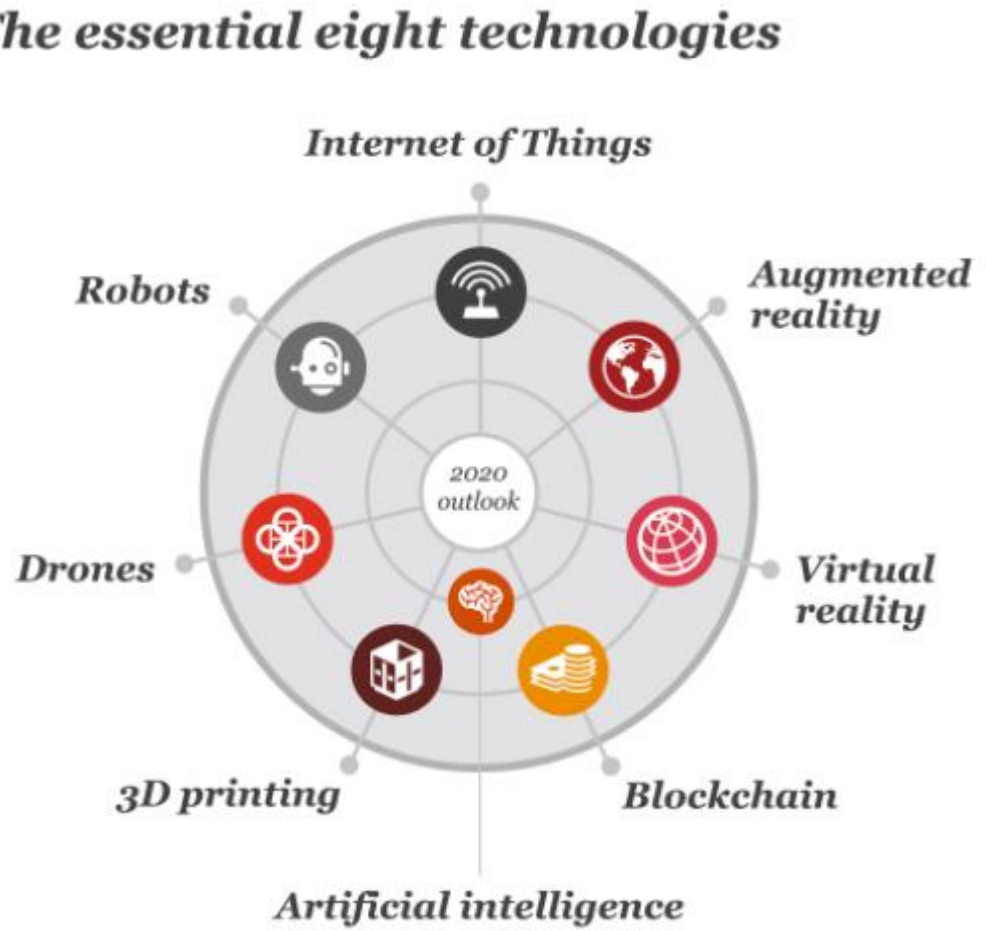
2016: How to prepare for the technological breakthroughs megatrend, and the eight technologies to start with 2016





https://www.pwc.com/gx/en/issues/technology/tech-breakthroughs-megatrend.html

+2019: Technologies Impacting Business

TRANSFORMATIONAL IMPACT

- SMART Machines (Emerging)
- Advanced Robotics (Emerging)
- Brain-Computer Interface (Emerging)
- Autonomous Vehicles (2018 Adolescent)
- Internet of Everything (2018 Adolescent)

HIGH IMPACT

- Quantum Computing (Emerging)
- Bio-computer(Emerging)
- Self Adaptive Security (2017 Emerging)
- Swarm Computing (Emerging)

IoT & CPS -The Technological Challenges

The IoT and CPS applications can have tangible benefit on the competitiveness of the manufacturing nevertheless, deployments are still in their infancy.

- State of the Art before SemI40
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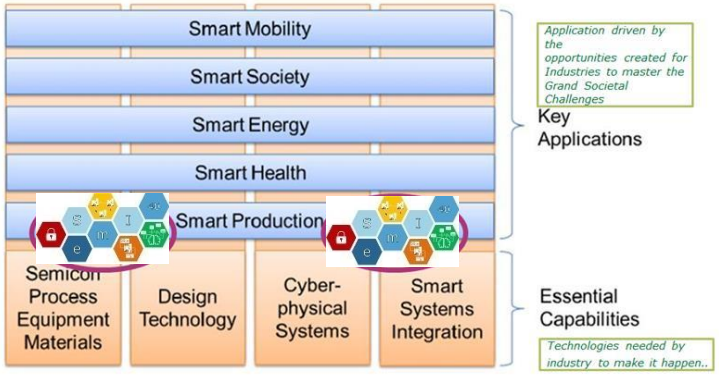
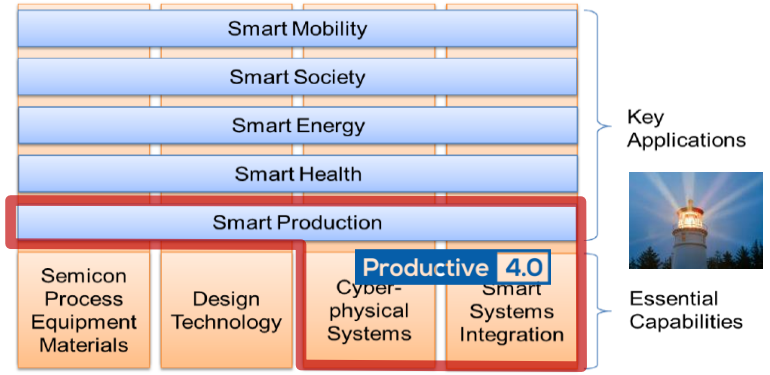
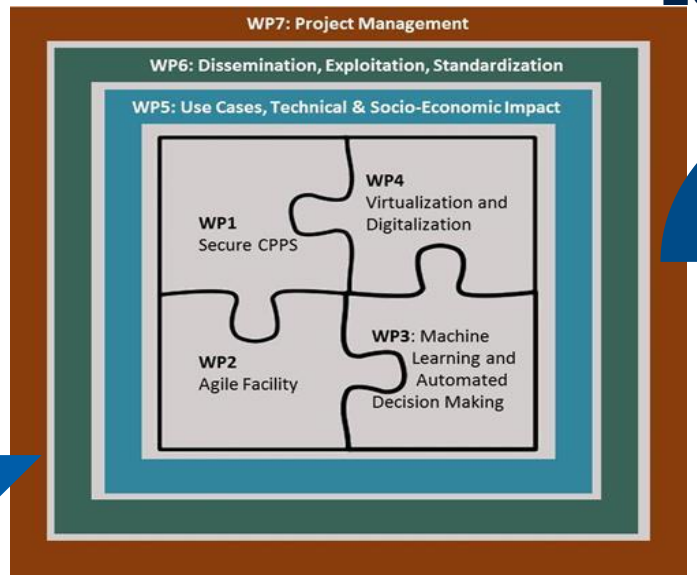
SemI40 & Productive4.0 - Goals

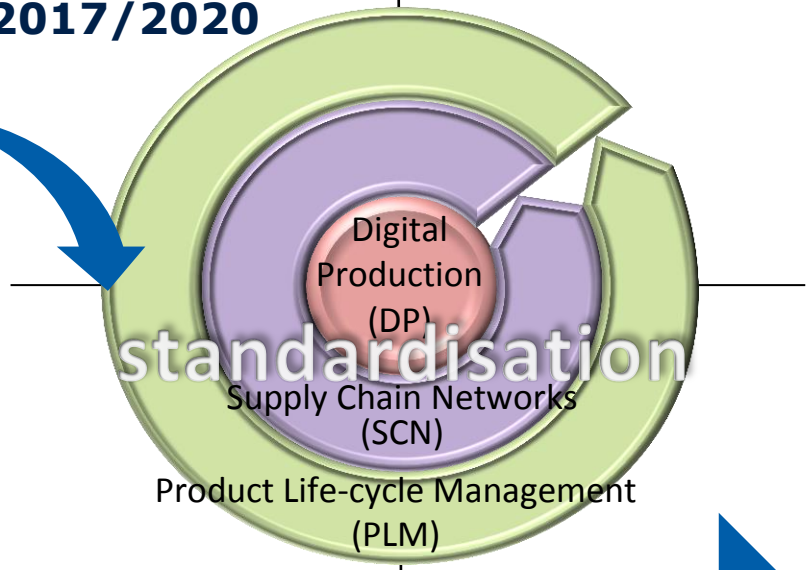




SMART Production strongly related to **"Semiconductor manufacturing"** in the More Than Moore (MtM) domain



2016/2019 – 2017/2020



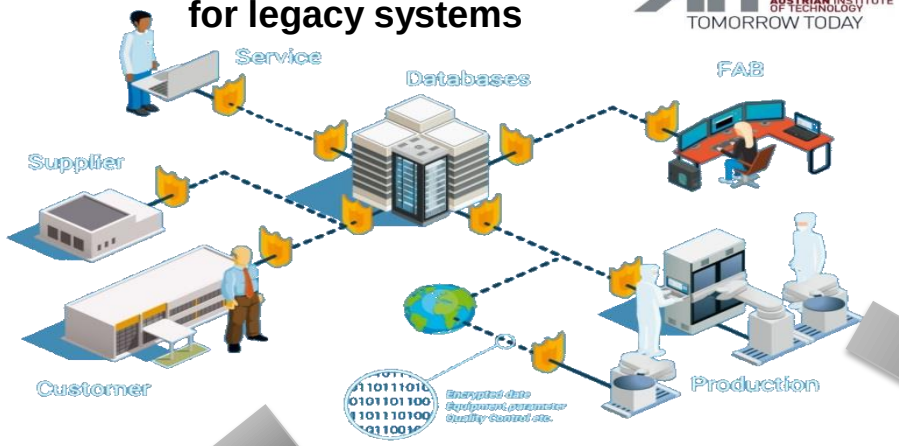
Establish the Productive4.0 framework as a cross domain platform for the Digital Industry

Power Semiconductor and Electronics Manufacturing 4.0

http://www.semi40.eu/

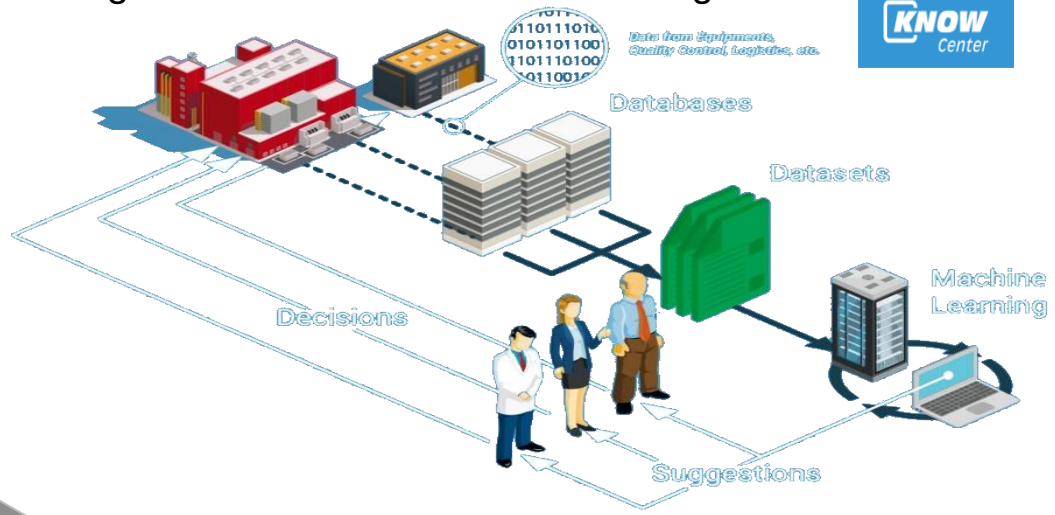
Novel security techniques
and **integration concepts**
for legacy systems

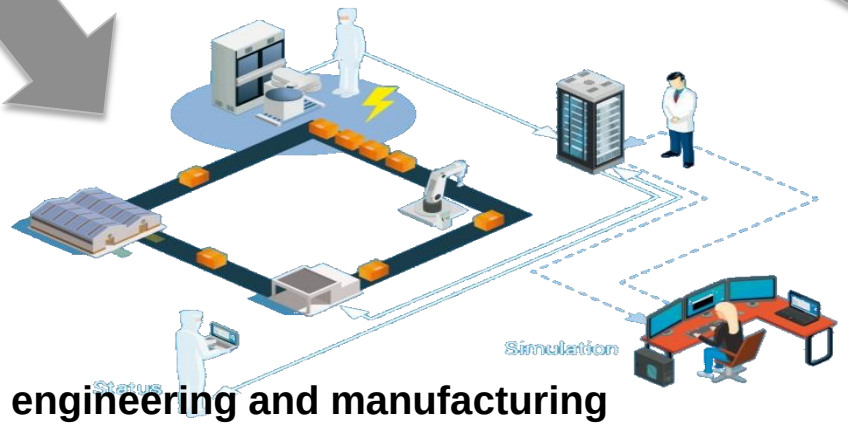
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

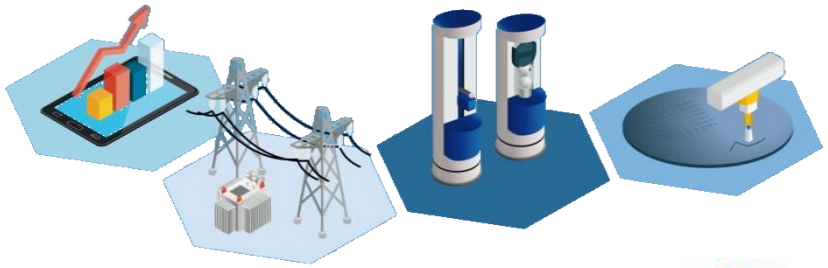


Machine Learning and Automated Decision Making

KNOW Center







BOSCH

Setup **agile engineering and manufacturing** processes, target is **fast reaction of customer** requirement and huge increases for output in a short space of time.

infineon

Virtualization / Digitalization
Innovative applications from the fields of the “internet of things”

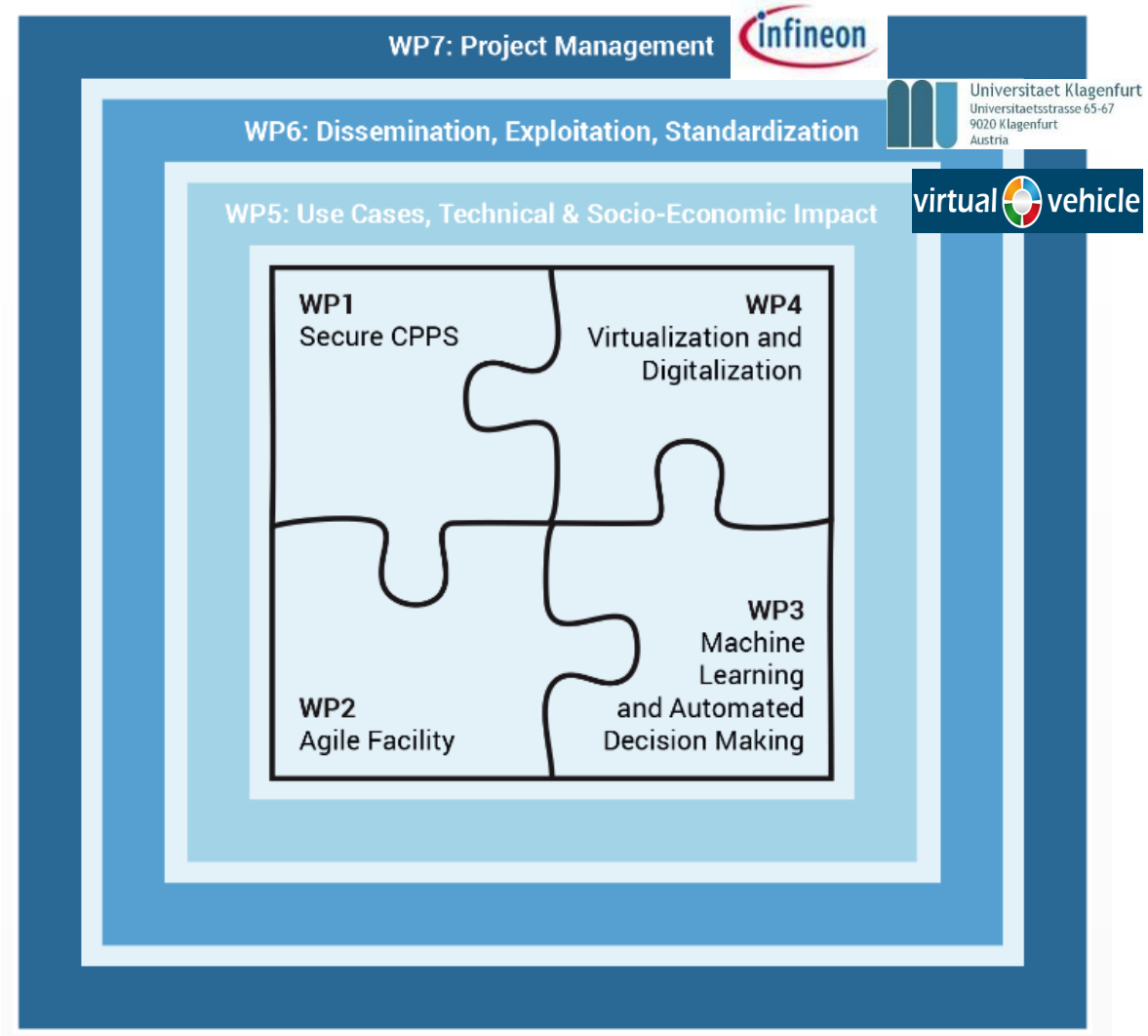
Work Plan

Power Semiconductor and Electronics Manufacturing 4.0 focusses on four highly challenging aspects of utmost importance:

- **Data Safety and security in manufacturing environment** with special attention on legacy equipment
- **Agility in ECS (Enterprise communications and services)** production for fast adaptability to changes
- **Tools and methodologies for automated decision making** in manufacturing shop floor, based on big data analysis methods
- **Virtualization and digitalization** for advanced simulation in fab environment

These aspects are thematically grouped and clearly structured by work tasks and correspondingly organized into 5 closely interacting work packages, supported by 2 strategic work packages.

- WP6, dissemination, exploitation and standardization, provides the background to make the results public and ensures exploitation of results in and for European industry and research.
- Project management and risk mitigation WP7, summarizes all coordination and management activities. The aim is to provide efficient project structures to manage resources and results according to the project plan and ensure exploitation by continuously mitigating the risk which might come up.



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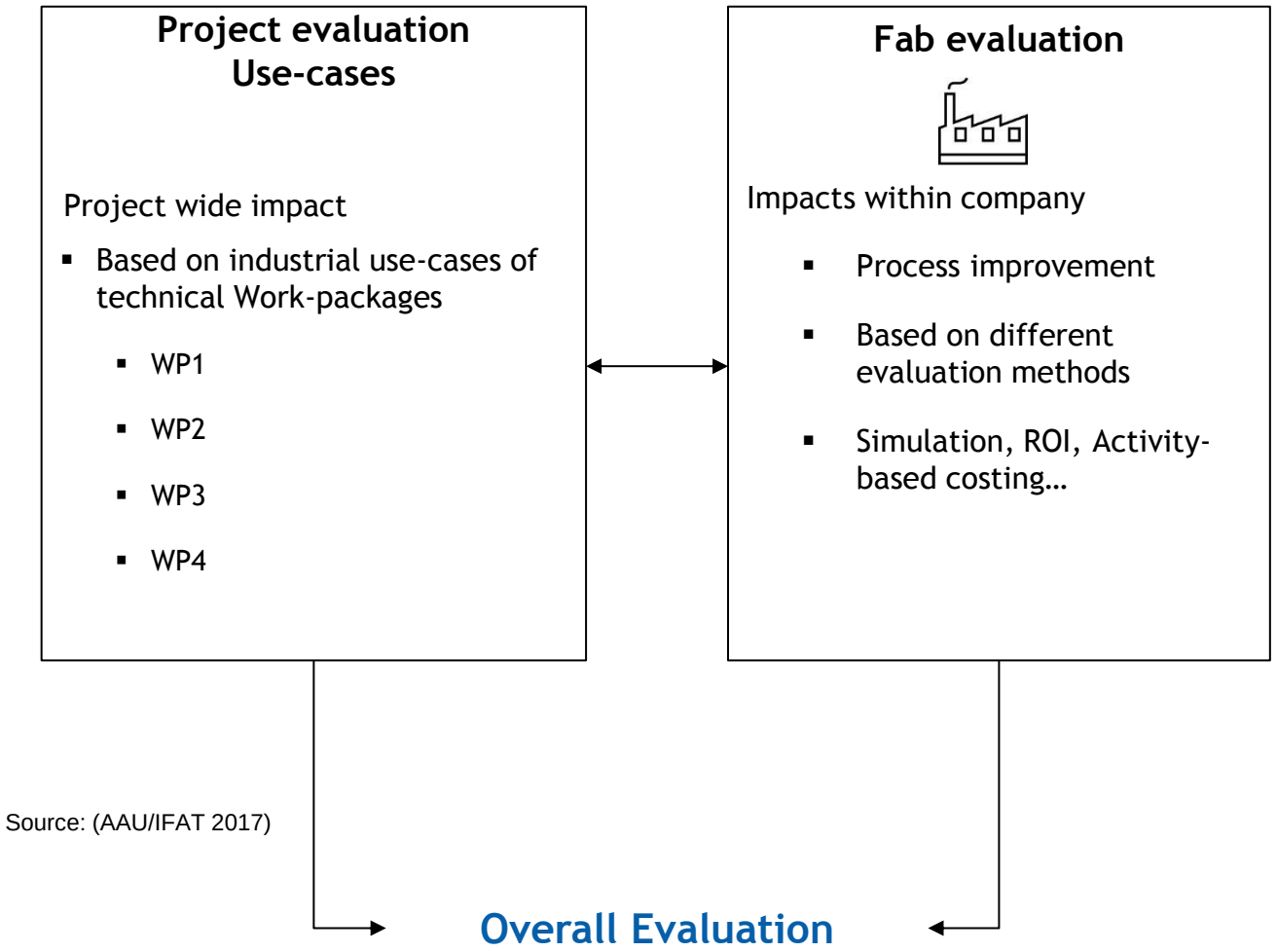
Socio-economic impact evaluation



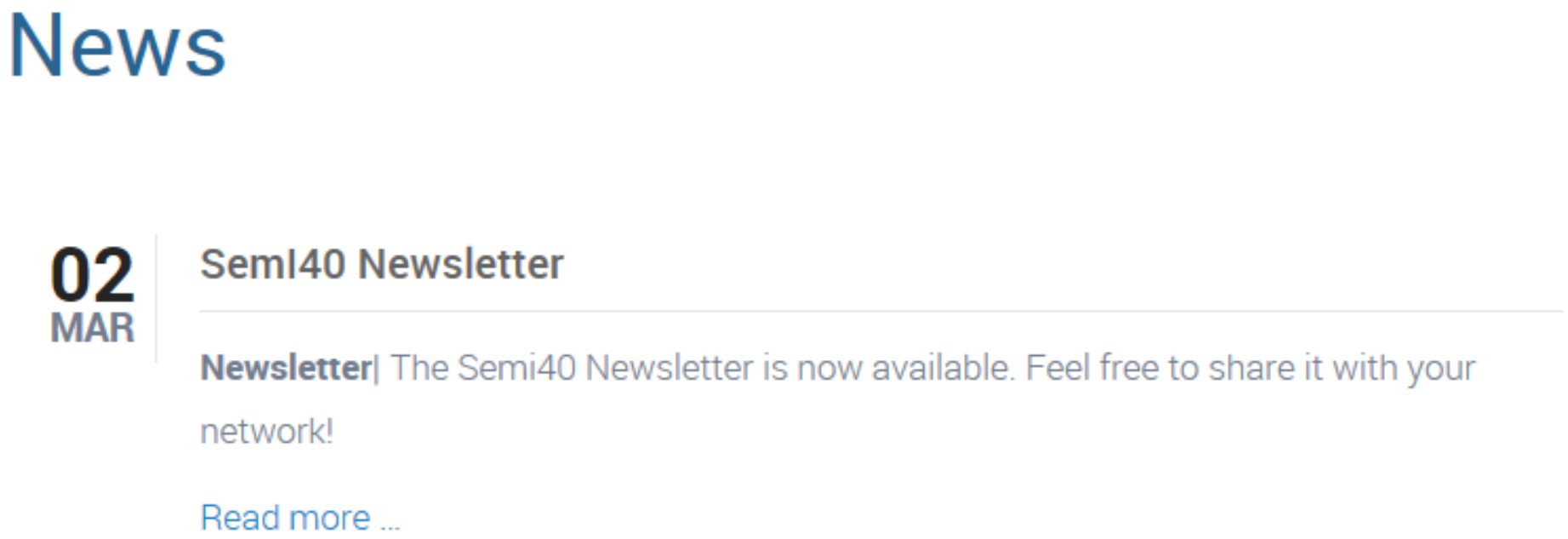
Source: (AAU/IFAT 2017)

Evaluate and assess the impact of SemI40 technologies developed in WP 1-4:

- Identification of common core indicators
- Identification/Development of evaluation methods
- Modelling dynamic dependencies of improved processes
- Benefit of technology adoption measured in a quantified way
- Delta of old and new technology
- Intangible effects

Evaluation is crucial to justify future investments into I4.0

http://www.semi40.eu/news-list.html



List of Dissemination publications, send a eMail to andreas.felsberger@aau.at ; Cristina.DeLuca@infineon.com

Fab Simulation and Virtualization – The Key to Enhance the Fab Performance within the Semiconductor Industry
Germar Schneider Infineon Technologies Dresden

A Web-based Virtualization Toolbox for the Integrated Visualization of Data within Semiconductor Fabs
Thomas Wagner TU Dresden

Optimal Wafer Dispatching based on Dynamic Programming
Alessio Mosca University of Pavia

Product health assessment using patterns in semiconductor wafer test data
Anja Zernig KAI GmbH

Grey- and Black-box Models for Predicting the Energy Performance of Water-cooled Chillers in a Semiconductor Plant
Federica Acerbi University of Pavia

APC of complex Bosch Process @ SPTS Rapier
Michael Klick Plasmetrex

…….

Interaction Section - Room 3B

State of the Art before SemI40

Where are we now?

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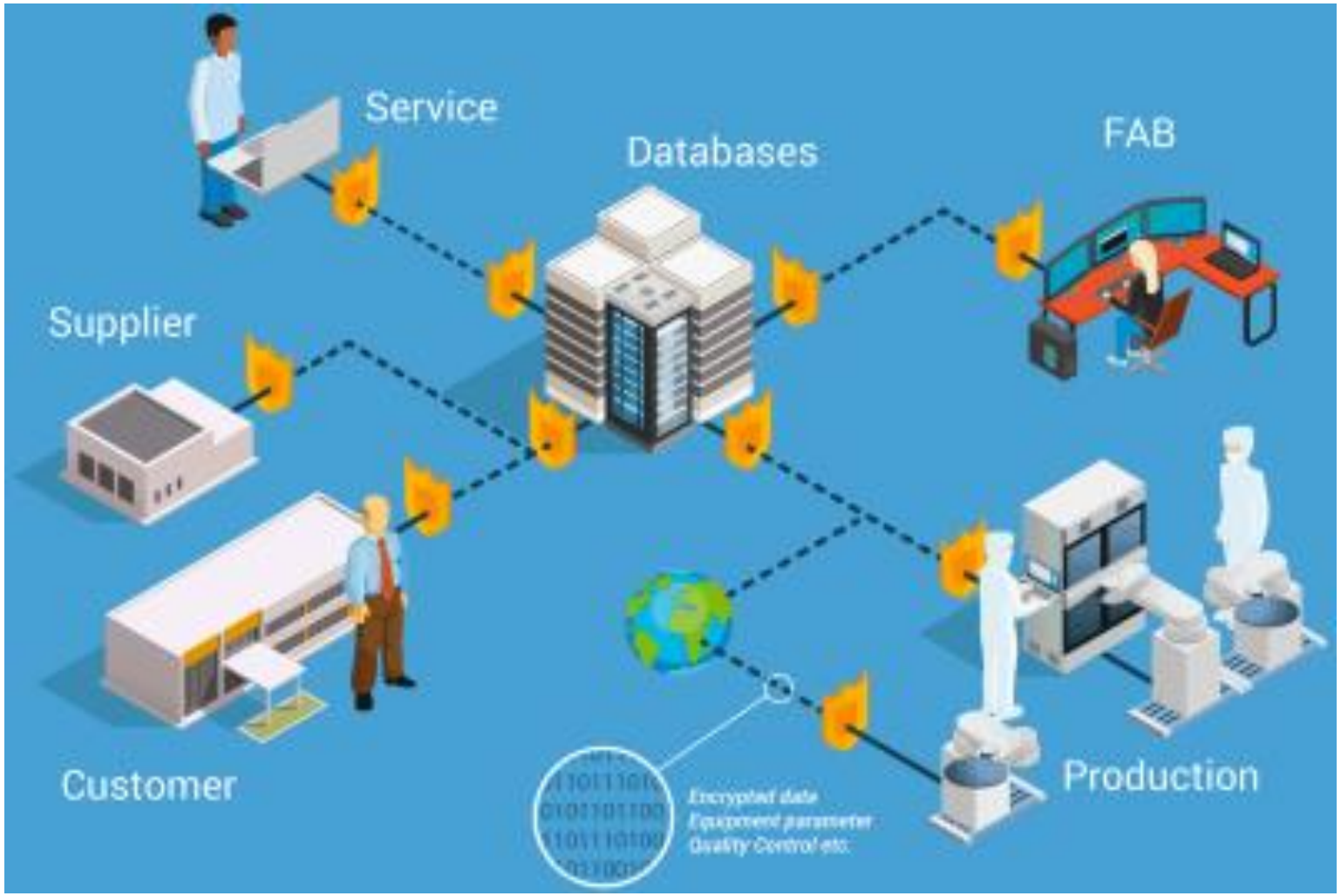
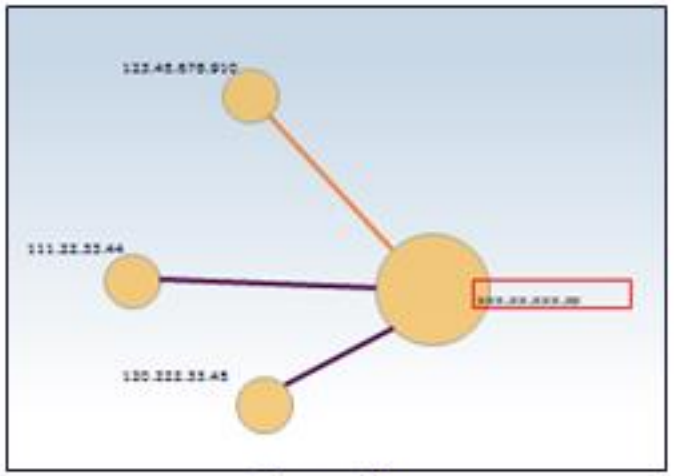
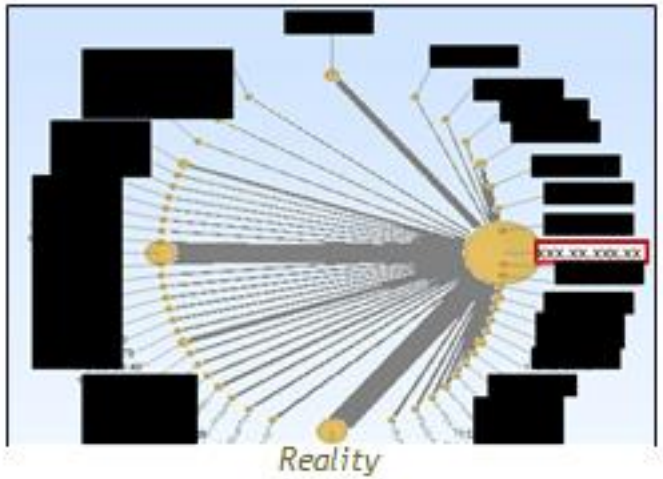
WP1: CPPS - Cyber Physical Production Systems in semiconductor eco system - CHALLENGES

http://www.semi40.eu/news-list.html







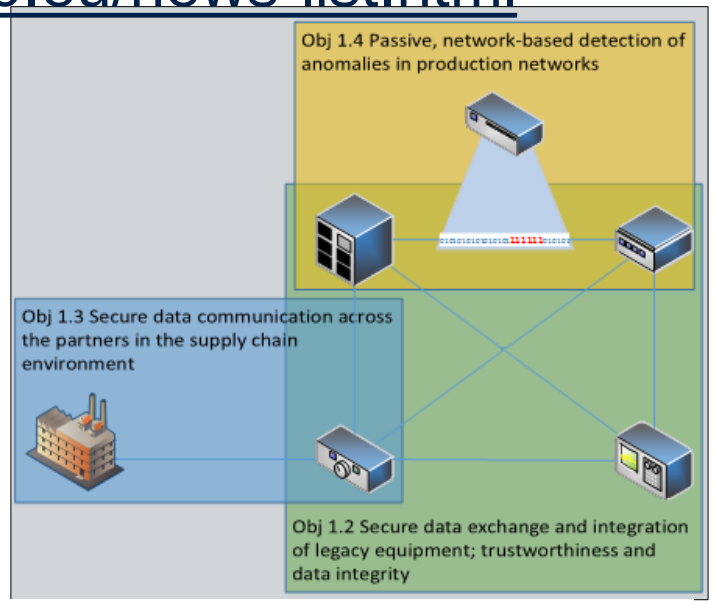
By Christoph Schmittner - AIT

ECSEL JU

WP1: CPPS - Cyber Physical Production Systems in semiconductor eco system - OUTCOMES

http://www.semi40.eu/news-list.html

- Already in the first years coordinated efforts from industry and research led to progress regarding the automated exploration and identification of assets in existing production networks and allowed to restructure a production networks towards increased security.
- In the second half year the specified secure supply chain communication was applied in practice and is already used for automated and secured machine-to-machine communication between supplier and manufacturer.
- In addition, a common CPPS evaluation environment was built up which is used by industrial and research partner for research and training and to test and evaluate solutions which cannot be immediately applied in real production environments.
- Based on this cooperation and already achieved results WP1 has an active involvement in TC65 JWG 21 Smart Manufacturing Reference Model(s) and four cooperative publications where project partners jointly disseminated project results.



Partners:
AIT Austrian Institute of Technology GmbH
Infineon Technologies Austria AG
Infineon Technologies IT-Services GmbH
Infineon Technologies Dresden GmbH
Fachhochschule Burgenland GmbH
Institut für Automation und Kommunikation e. V.
Elmos Semiconductor AG
Instituto de Telecomunicações
Universidade de Aveiro

By Christoph Schmittner - AIT

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WP2: Agile Facility - CHALLENGES

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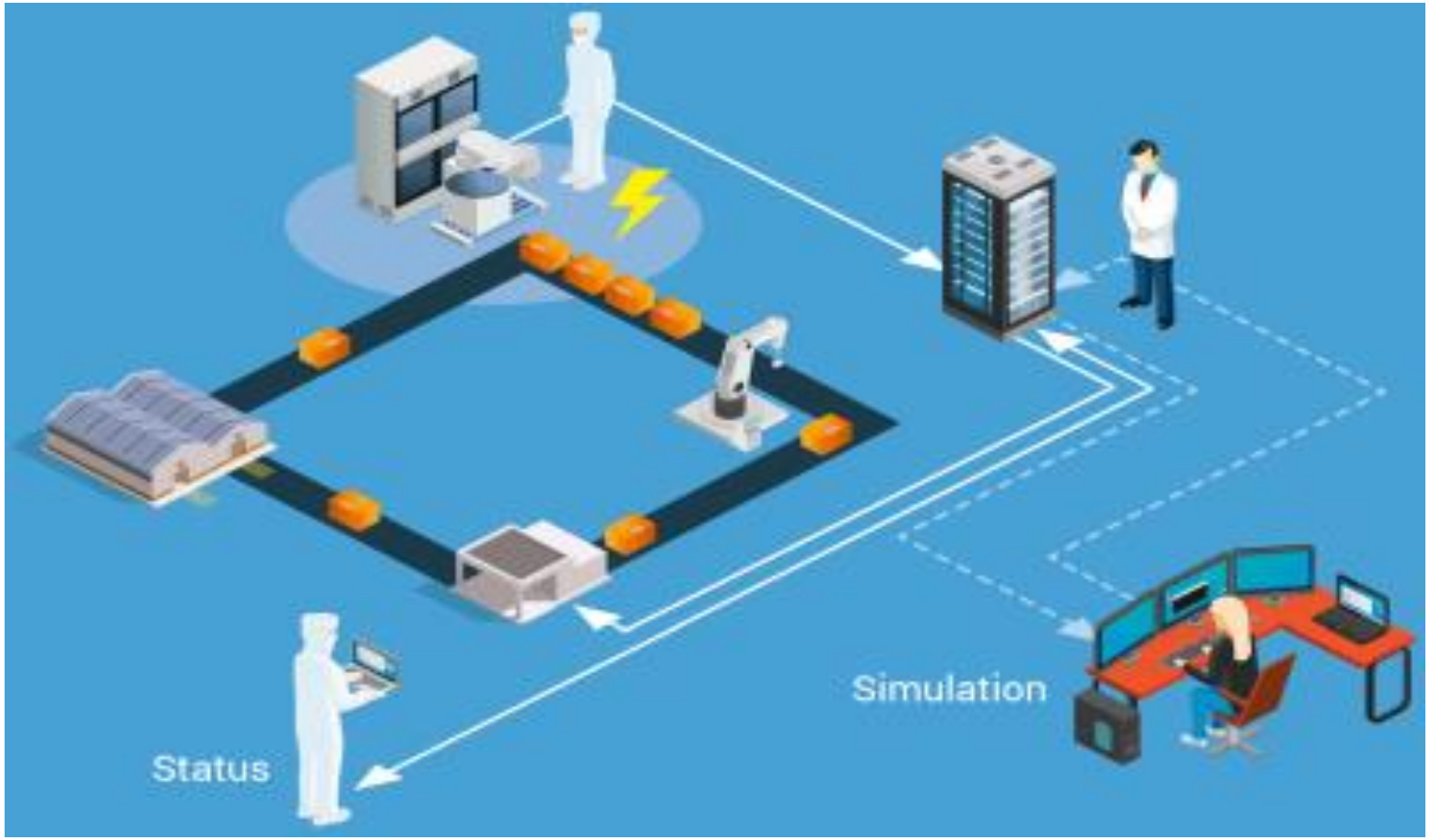

SUMMARY

Agile Facility means expanding and changing production capabilities through new technologies, innovations, use and processing of information, leading to new products or products with improved customer-specific characteristics.

WP2: Agile Facility 1 - OUTCOMES

http://www.semi40.eu/news-list.html

Manufacturing Execution System (MES)

- Data standardization along the whole of the production process was implemented which enables the realization of traceability.
- Implementation of MES systems and adjustments of existing MES for the adaption to agile requirements.
- Development of a Holistic Information Model for Fab digitalization.
- Development of a forecasting method for customer orders.
- Development of a hold lot application in a Wafer Fab.

Cycle Time

- Development of algorithms for cycle time prediction and improvement of scheduling, leading to further optimization.

Models and approaches

- Digital twin models elaborated for oven heating process and epitaxy process.
- Development and evaluation of models for improved processing of products.
- Approach for a new method of Tool Health Monitoring was confirmed by tests.
- Development of a system for independent CanBus sensor integration.

By Alexander Großer - Robert Bosch GmbH

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WP3: Machine Learning and Automated Decision Making - CHALLENGES

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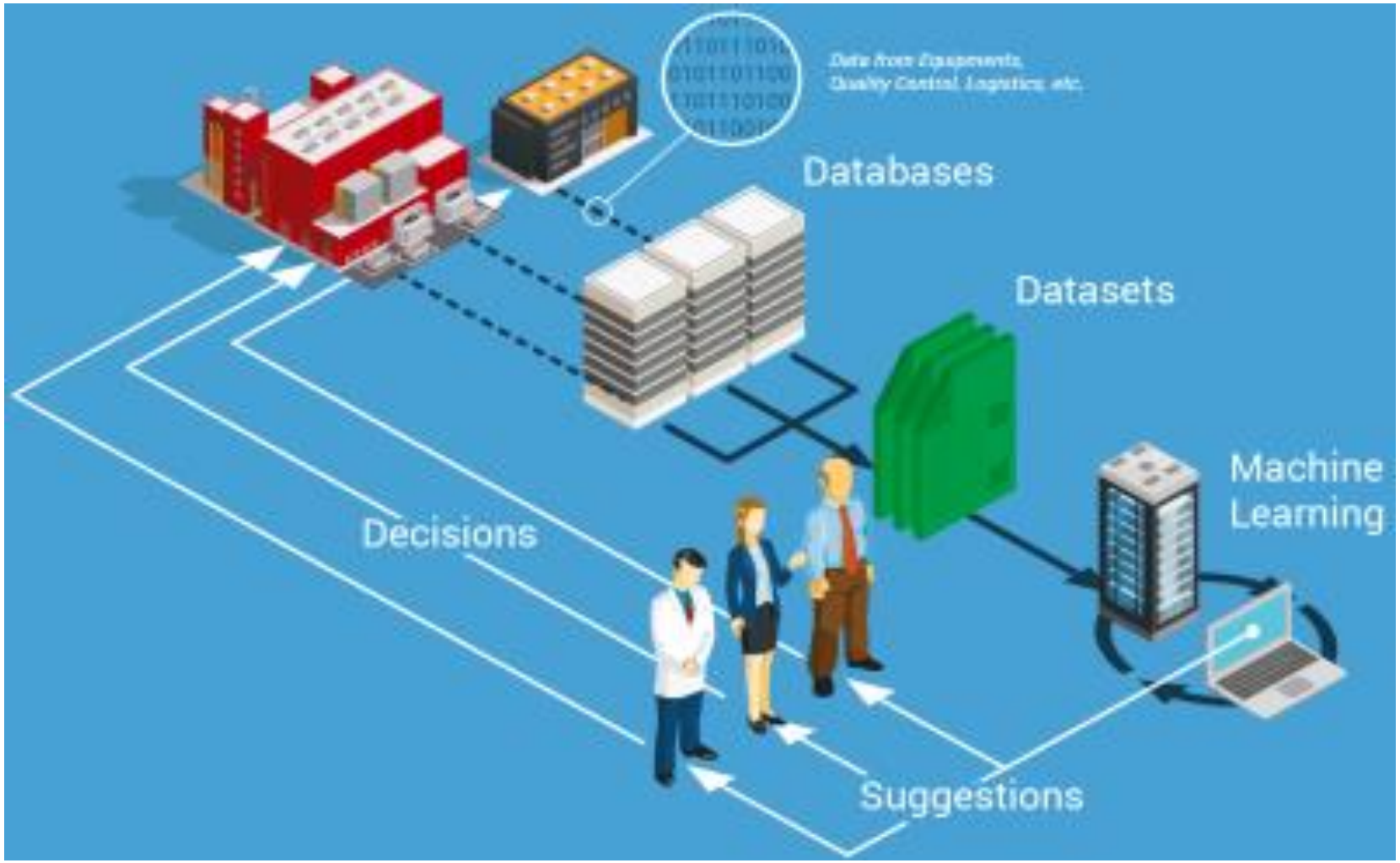

Partners:
Know Center
Infineon Technologies Austria AG
Kompetenzzentrum Automobil- und Industrieelektronik GmbH
Austria Technologie & Systemtechnik Aktiengesellschaft
Fraunhofer Austria Research GmbH
Technische Universität Wien
AVL List GmbH
Universität Klagenfurt
Kompetenzzentrum - Das Virtuelle Fahrzeug, Forschungsgesellschaft mbH
Infineon Technologies Dresden GmbH
Infineon Technologies AG
ELMOS Semiconductor AG
Ion Beam Services
Critical Manufacturing SA
AMKOR S.A.

SUMMARY

This work package addresses the specific needs of the partners from the semiconductor industry by developing solutions using state of the art machine learning and deep learning approaches. This will lead to novel paradigms in the semiconductor industry, creating opportunities to enhance the production, early defect detection and automated decision making.

By Dr. Roman Kern - KNOW

WP3: Machine Learning and Automated Decision Making OUTCOMES

http://www.semi40.eu/news-list.html

- By developing deep learning algorithms, complemented by more traditional approaches of machine learning, we were able to create an interactive visualization of learned wafer patterns. This will help in early detection of defects in wafers and thus improve the overall production process.
- Candidates for root cause relationships were identified, which is a step towards identifying the variables influencing key production parameters, like copper thickness, and thus a step towards improving the processes like photo etching.
- Important production variables used to set up the ion beam implanter process have been identified with the foal to stabilize these variables in consecutive steps. This will help improving the performance of the implanter tool and represents a unique selling point against competitors
- A dedicated algorithm was created to detect the malfunctioning stations based on the output of simulations. This algorithm can be applied in real-world data to reduce the lead time of the end of line testing procedure, in order to optimize the costs.

By Dr. Roman Kern - KNOW

ECSEL JU

WP4: Virtualization /Digitalization - CHALLENGES

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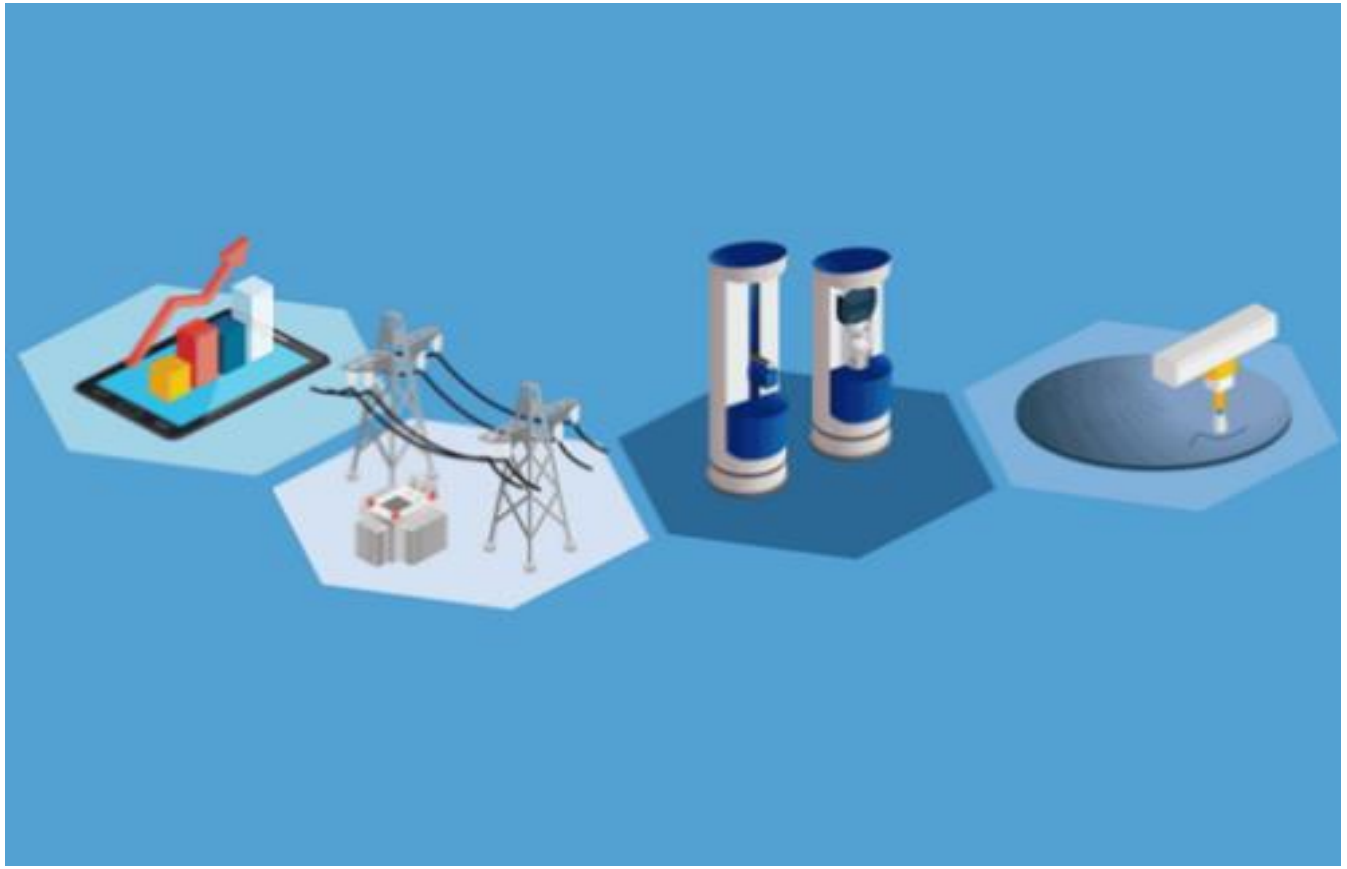

The results of the works contribute to a significant improvement of all relevant production indicators like costs, cycle time and especially the process quality. New and innovative robotic systems and transportation system solutions ensure a considerable improvement concerning product cycle times.
Through the use of camera-based image recognition simple systems can be built into the processing equipment. This enables the introduction of production processes that used to be very personnel consuming and therefore could not be executed at European plants.

By Dr. Germar Schneider – INFINEON Dresden

WP4: Virtualization /Digitalization - OUTCOMES

http://www.semi40.eu/news-list.html

- Development of a new platform and integration strategy for future robotic applications based on autonomous guided vehicles (AGV)
- Definition of tailored interfaces for a fleet management system suitable for cases in which more than one AGV is processing fab assignments
- New databases that pave the way for the exchange of lot data across different semiconductor fabs with a high reliability
- Modular systems for new dispatching rules for various applications in semiconductor fabs, optimized with regard to computing power and performance
- Demonstrators for the use of smart cams as well as specially developed algorithms for quality control of the material flow in semiconductor fabs
- Introduction of measurement systems and data bases for the visualization of energy data and the definition of saving potentials when implementing measures
- During the first year a saving potential concerning energy usage of more than 20% for one application in the wafer facility area could be identified with the use of a software solution within a first demonstrator

By Dr. Germar Schneider - INFINEON Dresden

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State of the Art before SemI40

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SemI40- How we create value?

- Tangible **benefit on the competitiveness** of manufacturers
- Impacting production quality, cost, time (at the moment no evidence that it is possible to improve them at the same time)
  - **Improve performance efficiency**
  - **Reduce downtime**
  - Industrial **systems adaptable and scalable**
- High technology **working places and new job opportunities**

ECSEL JU

- State of the Art before SemI40
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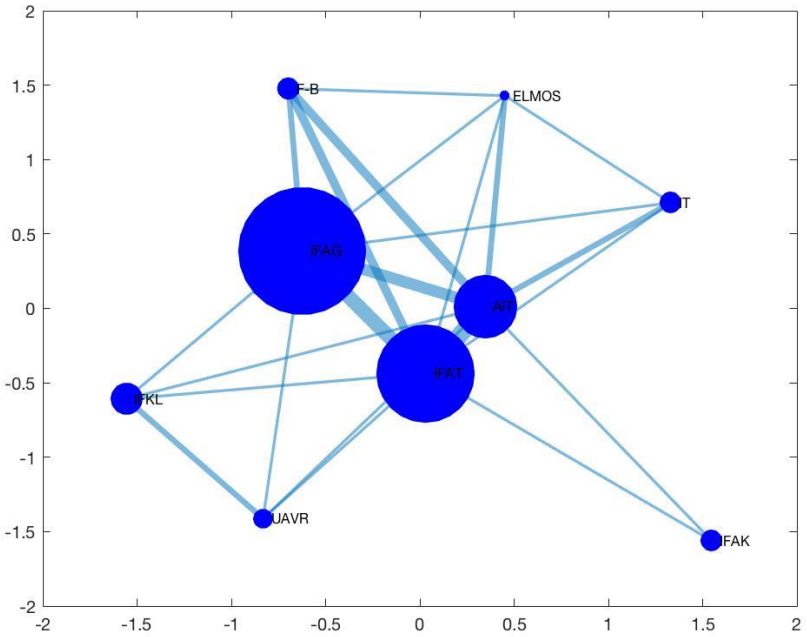
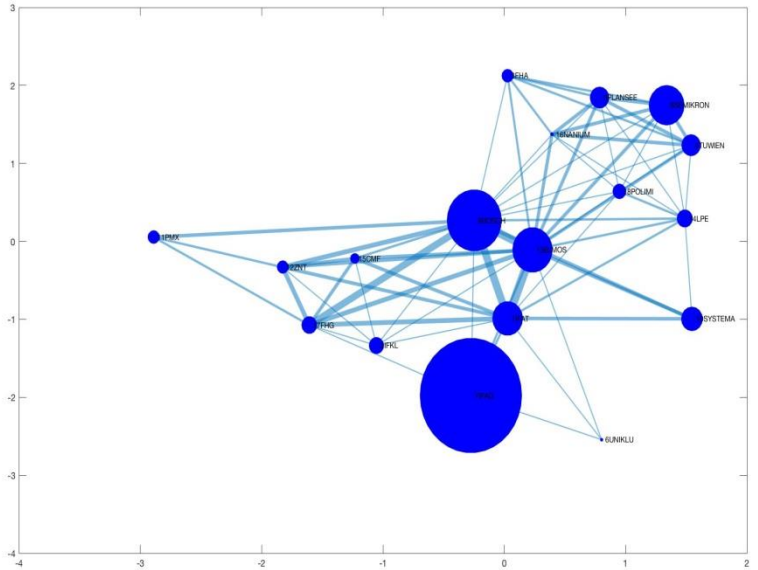
Conclusions

- **The collaboration in an Ecosystem joining all the stockholders, along the value chain, is an essential aspect** but this must be supported by policy, standards, platforms, security, semantic interoperability across the heterogeneous components like: sensors, devices, CPS environments, production automation workflows, …
- SemI40 and Productive4.0 enable the dialogue within a variety of groups and stakeholders in a **multi-disciplinary eco system working together in a flexible and complex evolving Industry**

"It's not about the cards you're dealt, but how you play the hand."

— Randy Pausch





Thank you very much for your attention!

The project receives grants from the European H2020 research and innovation programme,ECSEL Joint Undertaking, and National Funding Authorities from 19 involved countries under grant agreement no. GAP-737459 - 999978918.

The participating countries are Austria, Belgium, Finland, France, Czech Republic, Denmark, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden and Turkey.

The project receives grants from the European H2020 research and innovation programme,ECSEL Joint Undertaking, and National Funding Authorities from Austria, Germany, Italy, France, Portugal under grant agreement no. 692466