“Architectural Blueprint Solution for Migrating towards FAR-EDGE”

Ambra Calà, Filippo Boschi, Paola Fantini, Giacomo Tavola, Marco Taisch

13th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies – UBICOMM 2019
September 22 – 26, 2019 – Porto, Portugal

Towards the next industrial revolution

Characteristics of CPPS:

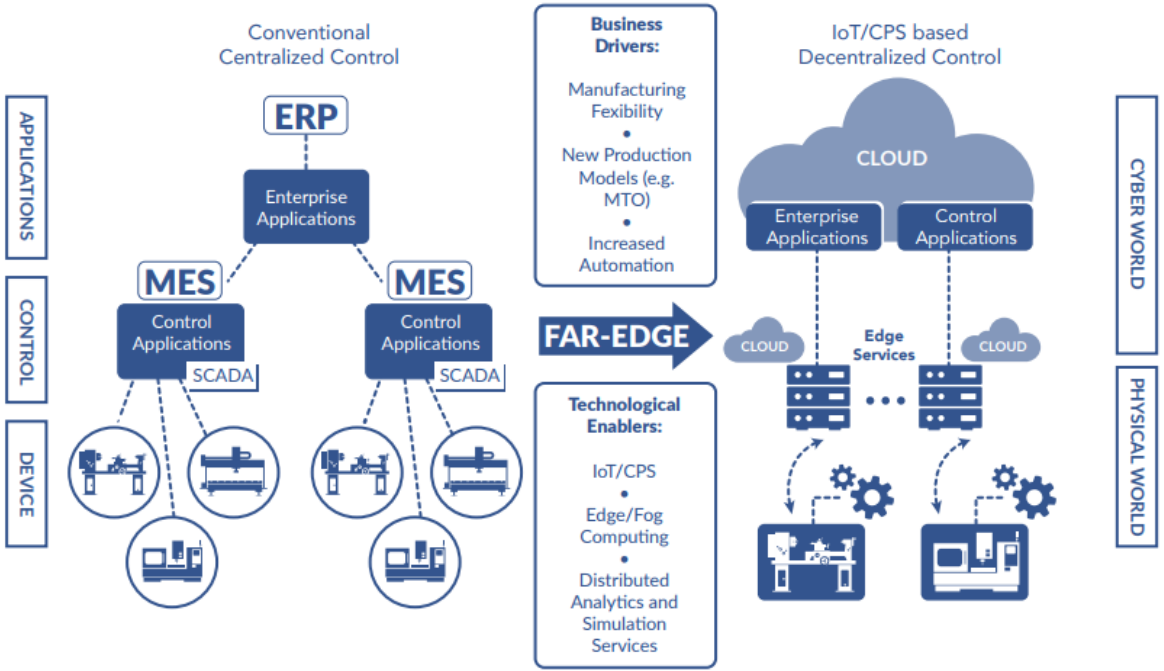
- **ADAPTABILITY** to changing production environment
- **OPENESS** to new features and functions
- **FLEXIBILITY** to different processing tasks
- **MODULARITY** to enable quick and economical changes

Source: Digital Factory: Smart manufacturing in the U.S. (siemens.com)

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

The FAR-EDGE Project - Objectives

The FAR-EDGE Platform will lower the barriers for manufacturers (including SMEs) to move towards the Industry 4.0

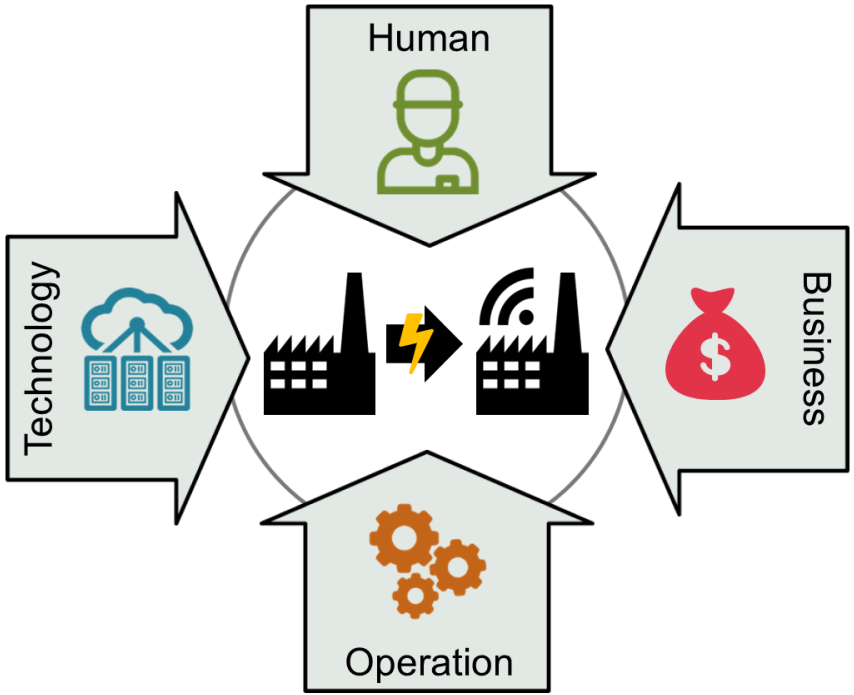


- ► Flexible and fast integration of new technologies and devices
- ► Reconfiguration and optimal production scheduling
- ► Implementation of highly scalable solutions
- ► Validation and testing of alternative strategies for migration

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

Challenges for Migration

The digital transformation is not only a technological journey.



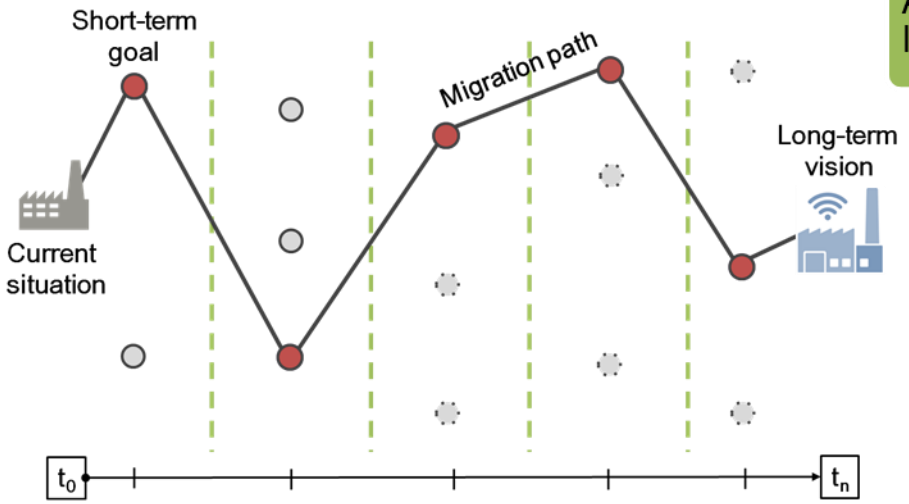
- The digital transformation has a big impact on different dimensions of the factory

- **Holistic migration approaches are needed but have been neglected within research until now**

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

The FAR-EDGE Migration approach

Stepwise migration approach to support continuous improvement, adaptation to changes and incremental innovation towards digitalization by means of FAR-EDGE solution



Assessment of the AS-IS
Identification of the TO-BE

Definition of migration scenarios
Gap analysis AS-IS → TO-BE

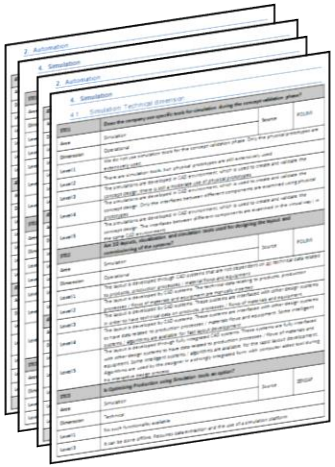
Evaluation of business goals and KPIs

Definition of optimal migration strategies and architectural blueprints

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

The Assessment Questionnaire

The **Assessment Questionnaire** supports context analysis and goal definition.



Goal of the interview:

- Assess the current production system
- Identify potential of digital improvements according to the business strategy

Technical dimension

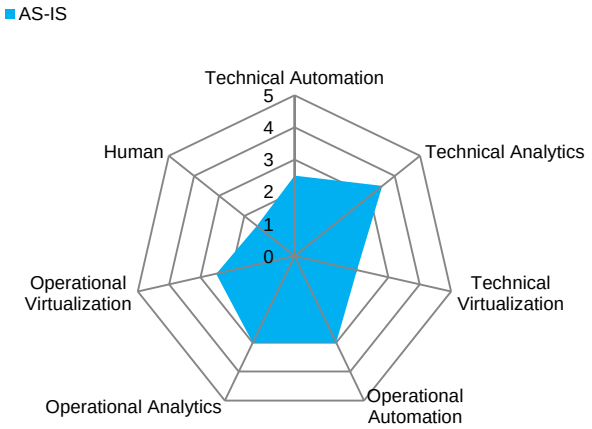
Operational dimension

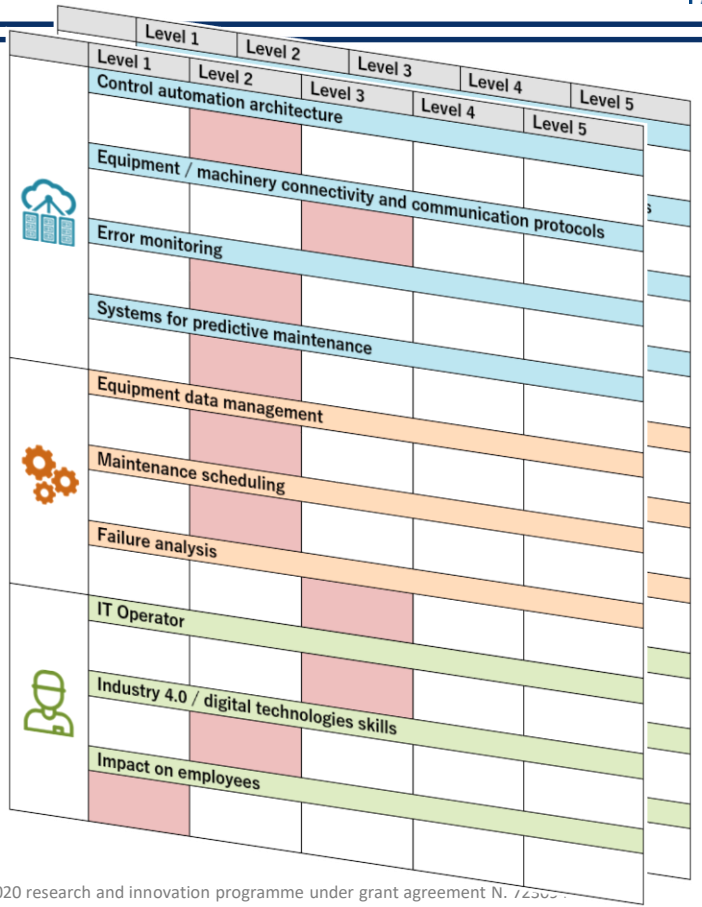
Human dimension

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

The Migration Matrix

The **Migration Matrix** supports the identification and evaluation of migration alternatives towards a higher level of digital maturity by means of FAR-EDGE solution.



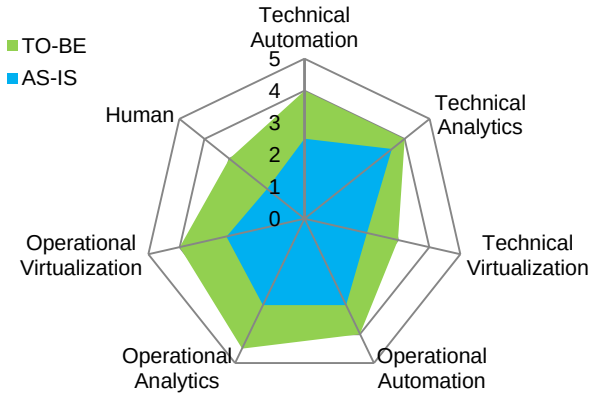


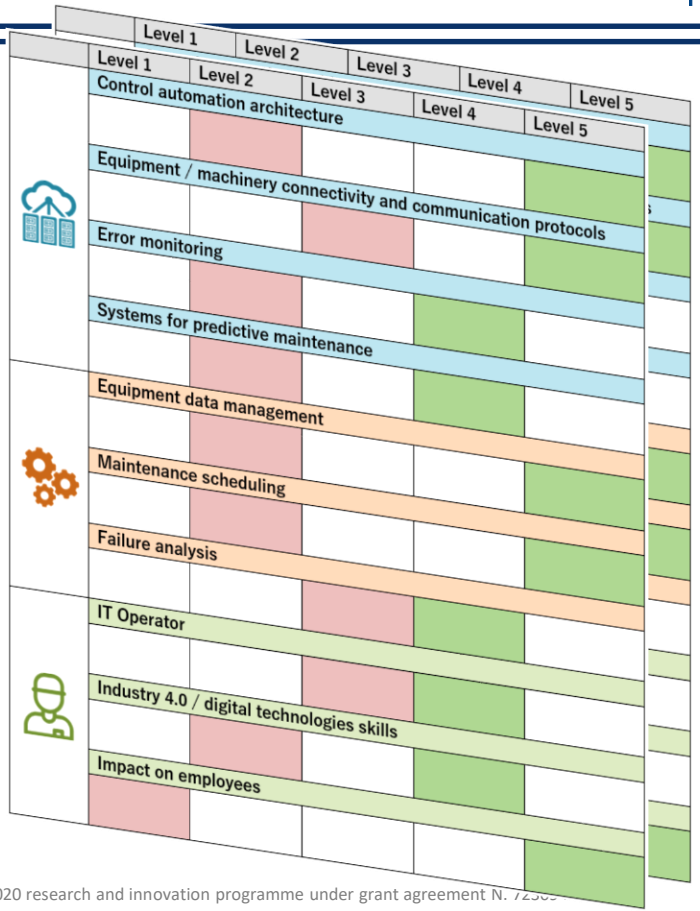
H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 72

The Gap Analysis

Definition of migration scenarios:

- Analyze the gap between AS-IS and TO-BE
- Identify and evaluate possible migration scenarios

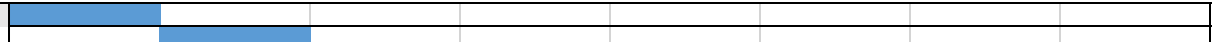




H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 72

The Roadmap to FAR-EDGE

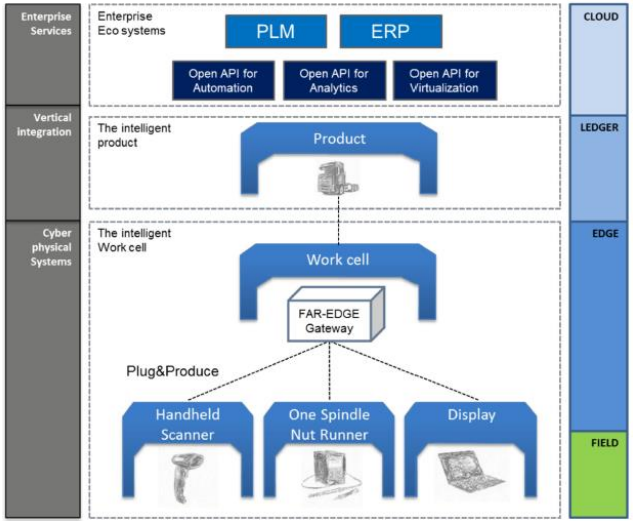
Example of implementation roadmap of the FAR-EDGE Automation for plug-and-produce equipment reconfigurability.

Field Abstraction Edge Automation Service	1	Virtual machine installation on the equipment	
	2	EAS for Edge Adapter development	
	3	Implementation of the maintenance plan for Edge Infrastr.	
	4	Edge Training for technical and maintenance staff	
	5	Edge Training for operational staff	
Edge Gateway	6	VM installation on the work cell (Edge Gateway)	
	7	Pull- and event-based SCADA, DCS and PLC functionalities	
	8	Edge Training to platform manager	
Connectivity	9	Ensure LAN connectivity to the Field	
	10	Connect Edge Adapter to equipment	
	11	Connect Edge Adapter to Edge Gateway	
Ledger	12	Ledger integration in the factory network	
	13	Connect Ledger with Edge Nodes / Edge Adapters	
	14	Implementation of the maintenance plan for Ledger Infrastr.	
	15	Ledger training / new specific role	
Cloud	16	Cloud installation on a computer	
	17	Migrate ERP/PLM services to the Cloud server	
	18	Define cloud identity manager for Ledger	
	19	Implementation of the maintenance plan for the Cloud	
	20	Further training for Cloud maintenance and management	

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

Example: PnP Reconfigurability

Business goal: versatile production in a **mass-customization** scenario



FAR-EDGE

MP 1 Automation	Level 1	Level 2	Level 3	Level 4	Level 5
	Equipment/Machinery connectivity and communication protocols				
	Not available	Basic connectivity (RS232-RS485)	Local network through LAN/WAN	Networked with vendor specific API, integrable with other systems	Networked with standardized mechanisms and standard API
	Physical production process control				
	Not available	Locally, per station / equipment	Centrally available through SCADA	Available and analyzed through MES at Factory level	Available and analyzed through the Cloud
	Cyber-Physical System characteristics of the product				
	No identification or serialization available	Simple identification (e.g. Barcodes or RFID tags)	Sensors and actuators attached to the product	Sensors readings are processed by the product	The product exhibits CPS functionality
	Reconfiguration of shop-floor equipment				
	Only manual reconfiguration	Supported by HMI at machine level	Configuration managed through central supervisor system	Configuration centrally managed by MES or MOM	Centrally managed according to ERP through the Cloud
	Production IT department				
	Not available	External service provider for traditional IT systems	Internal for traditional IT systems	External service provider for all digital systems from field to cloud	Internal for all digital systems from field to cloud
	Production employees' skills				
	No experience with digital technologies	Little experience with digital technologies	Digital skills in some technology focused areas	Digital and data analysis skills in most areas of the business	Cutting edge digital and analytical skills are prevalent all across the factory

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

Example: PnP Reconfigurability

Expected impact at each dimension:

- Increased flexibility
- Decreased configuring costs and effort

- Increased factory automation level
- Increased production data monitoring

- Improved operation quality
- Reduced human error

- Better instructions
- Fewer skills needed

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

FAR-EDGE migration blueprints

The **migration blueprints** are based on the use cases developed within the project with reference to FAR-EDGE domains:

- Automation
- Analytics
- Simulation

The aim is to provide a reference for deployment configuration variants of the FAR-EDGE architecture

"*TO-BE*" Scenarios:

- Plug-and-produce equipment automatic reconfiguration
- Operator support for smart sequencing
- Analytics for improved accuracy of assembly times
- Predictive maintenance
- Secure order execution system
- Analysis and certification of KPIs for production modules
- …

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

Conclusions

The proposed **migration approach** leads to the definition of migration strategies towards the digital manufacturing automation.

Benefits for manufacturers

- Understand the value of digital transformation
- Shape targeted strategies
- Improvement in innovation
- Prioritization of value-reach opportunities

H2020 Research and Innovation Action - This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N. 723094

For more information:
https://www.edge4industry.eu/product/migration-services/

THANK YOU!

Dr. Ambra Calà
Siemens AG
Corporate Technology
ambra.cala@siemens.com