TAMPERE UNIVERSITY OF TECHNOLOGY

MANUFUTURE 2017

Collaboration as a driver for success in the digital era

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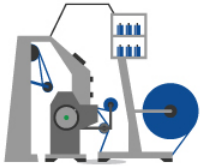
Tampere University of Technology

Manufuture 2017 conference 25.10.2017

Industrial Revolution towards Industry 4.0

Late 18th century | Beginning of 20th century | 1970s–2000s | 2010 onward



First industrial revolution: Power generation

- Introduction of the power loom in 1784
- Mechanization of production facilities with water and steam power

Second industrial revolution: Industrialization

- Introduction of the assembly line in slaughterhouses in 1870
- Electrification drives mass production in a variety of industries

Third industrial revolution: Electronic automation

- Development of the first programmable logic controller (PLC) in 1969
- Growing application of electronics and IT to automate production processes

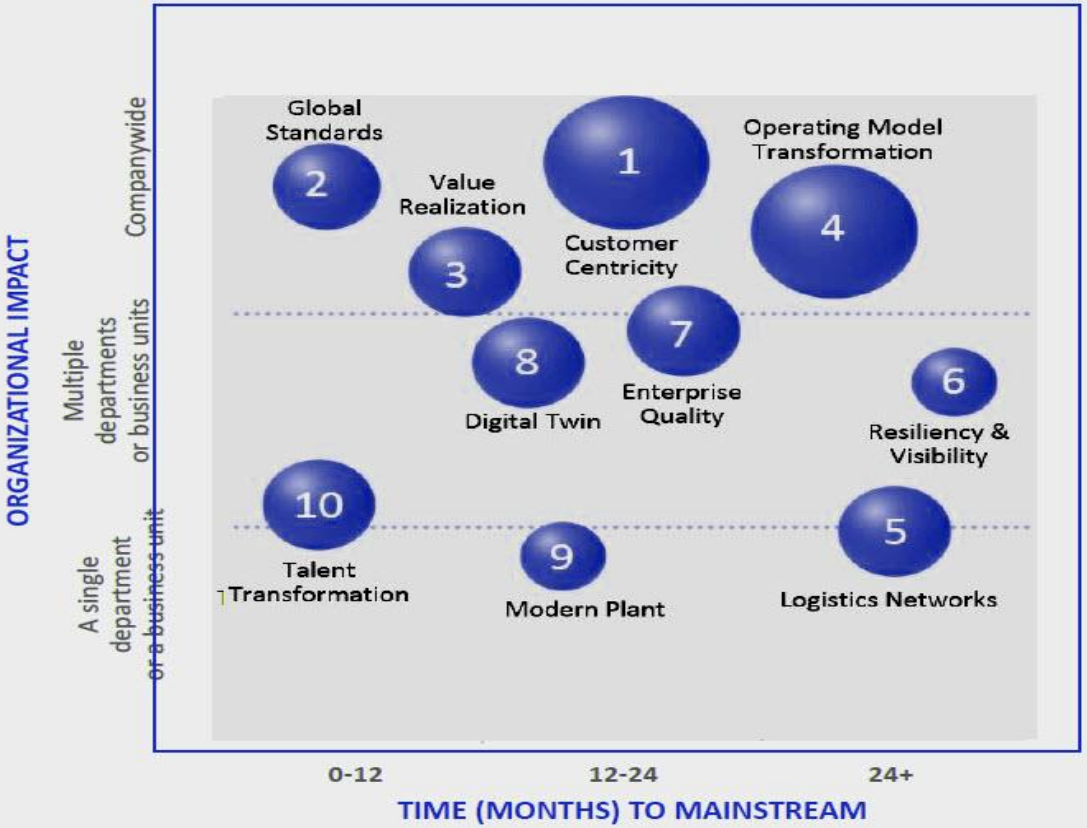
Fourth industrial revolution: Smart automation

- Increasing use of cyber-physical systems (CPS)
- In January 2011, Industry 4.0 was initiated as a "Future Project" by the German federal government
- With the introduction of IPv6 in 2012, virtually unlimited addressing space becomes available
- Governments, private companies, and industry associations have been focusing on Industry 4.0 and making investments since the 2010s

Sources: Germany Trade & Invest, "INDUSTRIE 4.0—Smart manufacturing for the future," July 1, 2014; National Academy of Science and Engineering, "Securing the future of German manufacturing industry: Recommendations for implementing the strategic initiative Industry 4.0," April 2013; Deloitte analysis.

IDC Worldwide Manufacturing 2016 Top 10 Predictions

http://www.forbes.com/sites/louiscolumbus/2015/12/19/idcs-top-10-manufacturing-predictions-for-2016-the-cloud-enables-greater-customer-centricity/#15c8c7f92e5e

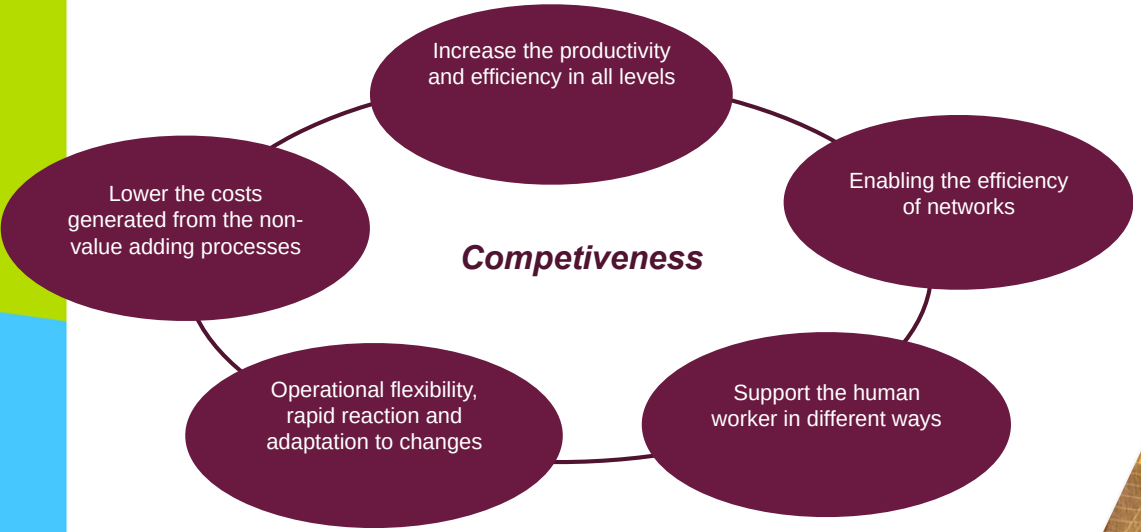


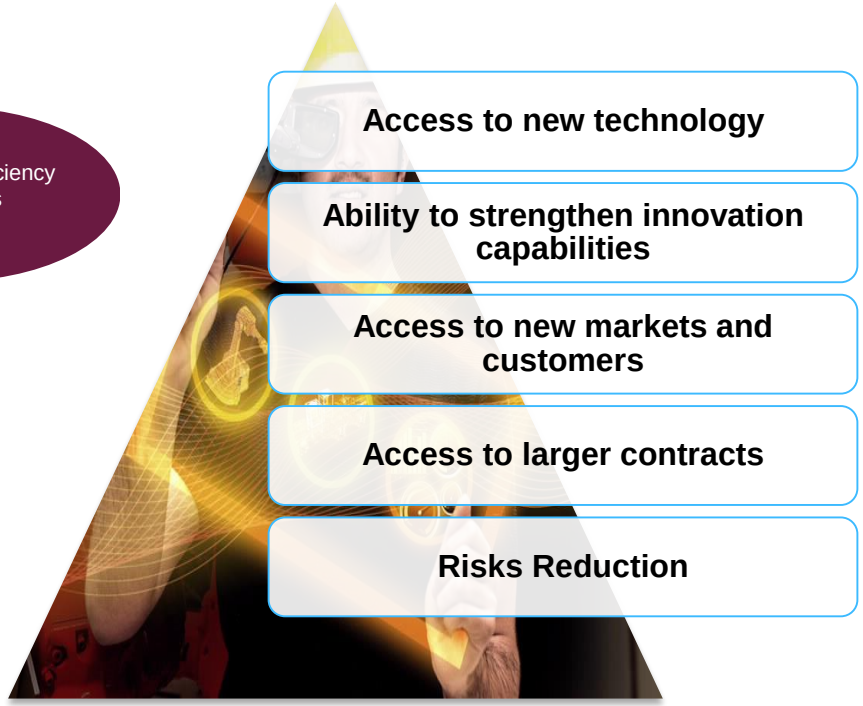
Note: The size of the bubble indicates complexity/cost to address

1. By the End of 2017, Those Manufacturers That Have Leveraged Customer-Centricity Investments Will Gain Market Share Growth in the Range of 2–3 Percentage Points.
2. In 2016, 90% of Manufacturers Will Impose Their Global Standards on All Operations, Including Outsourced Operations, and Suppliers, to Decrease Risk and Increase Market Opportunities.
3. By the End of 2016, 65% of Manufacturers Will Have Metrics in Place to Evaluate and Drive Pervasive Changes in the Workplace with Their New Technology Investments.
4. By 2019, 75% of Manufacturing Value Chains Will Undergo an Operating Model Transformation with Digitally Connected Processes That Improve Responsiveness and Productivity by 15%
5. By 2019, 50% of Manufacturers Will Have Modernized Their Logistics Network to Leverage 3D Printing, Robotics, and Cognitive Computing to Support Innovative Postponement Strategies.
6. By the End of 2019, Enterprise-wide Improvements in Resiliency and Visibility Will Render Short-Term Forecasting Moot for 50% of All Consumer Products Manufacturers and 25% of All Others.
7. By 2018, 60% of top 100 Global Manufacturers Will Be Using a Product Innovation Platform Approach to Drive Enterprise Quality Throughout the Product and Service Life Cycles.
8. By 2017, 40% of Large Manufacturers Will Use Virtual Simulation to Model Their Products, Manufacturing Processes, and Service Delivery to Optimize Product and Service Innovation.
9. By the End of 2017, 50% of Manufacturers Will Exploit the Synergy of Cloud, Mobility, and Advanced Analytics to Facilitate Innovative, Integrated Ways of Working on the Shop Floor
10. In 2016, 20% of Manufacturers Will Begin to Break Down Organizational Silos, Reshape IT Portfolios, and Import New IT Talent in the Plant for Digitally Executed Manufacturing.


5GEM

Collaboration drivers





Järvenpää, E., Lanz, M., Tokola, H., Salonen, T. & Koho, M. 2015, Production planning and control in Finnish manufacturing companies – Current state and challenges, Proceedings of the 25th International Conference on Flexible Automation and Intelligent Manufacturing. 8 p.

Ref: https://www.linkedin.com/pulse/collaboration-key-driver-organisational-success-peter-westbrook/

Characteristics affecting to the quality of inter-firm collaboration

Distance between 'man and the system'

Digitalization benefits are unclear

Lack of visibility
- Factory
- Network

Low information quality (timing, format, content)

Lack of trust
- Partner
- IT

Multiple tools – lack of information flow. Complexity

Negative Impacts

C1	Company with synergetic business interests left the project in early stage. This was possibly due to financial challenges.
	Other companies were distant.
C2	Other companies had different focusses in their R&D.
	Company, that was considered as a potential partner, focused on different technology.
C3	Big customer, that encouraged C3 to participate, did not participate the "group project". The customer was not able to reach an agreement with other participating companies.
	Other companies were already in their own networks, and P3 was not able to fit into them.
C4	Other companies were interested in C4 part, but did not want to allocate resources to collaboration. From business perspective the times were difficult and this affected the resourcing.
	One potentian company to do collaboration with left out just before project started
C5	Project topic in C5 was different. Other companies focused on product development when C5's aim was to develope ther risk management processes.
	Insufficient resources in C5.
C6	R&D subjects were close, but not close enough to do collaborative development
C7	Lack of resourcing in C7. Collaboration would have required human resources from wide range of functions in C7)
	Scope of R&D was such that it did not lead to collaboration.
C8	Desired results were delivered with very little collaboration. Knowledge exchange between companies happened through research organization.

Järvenpää, E., Lanz, M., Tokola, H., Salonen, T. & Koho, M. 2015, Production planning and control in Finnish manufacturing companies – Current state and challenges, Proceedings of the 25th International Conference on Flexible Automation and Intelligent Manufacturing. 8 p.
Majuri, M., Nylund, H. & Lanz, M., Analysis of Inter-firm Co-operation in Joint Research and Development Projects, Advances in Production Management Systems: Initiatives for a Sustainable World - IFIP WG 5.7 International Conference, APMS 2016, p. 536-543 8 p. (IFIP Advances in Information and Communication Technology)

Characteristics affecting to the quality of inter-firm collaboration

- **Positive impact**
  - Common vision
  - Partner was showing trust
  - Encouragement by the partner
  - Desire to help
  - Honest and straight dialogue
  - Good relations
  - Openness
  - Experienced appreciation
  - Similar commercial goals

Emergence of a modern community of practice

Ref: Majuri, M., Nylund, H. & Lanz, M., Analysis of Inter-firm Co-operation in Joint Research and Development Projects, Advances in Production Management Systems: Initiatives for a Sustainable World - IFIP WG 5.7 International Conference, APMS 2016, p. 536-543 8 p. (IFIP Advances in Information and Communication Technology)

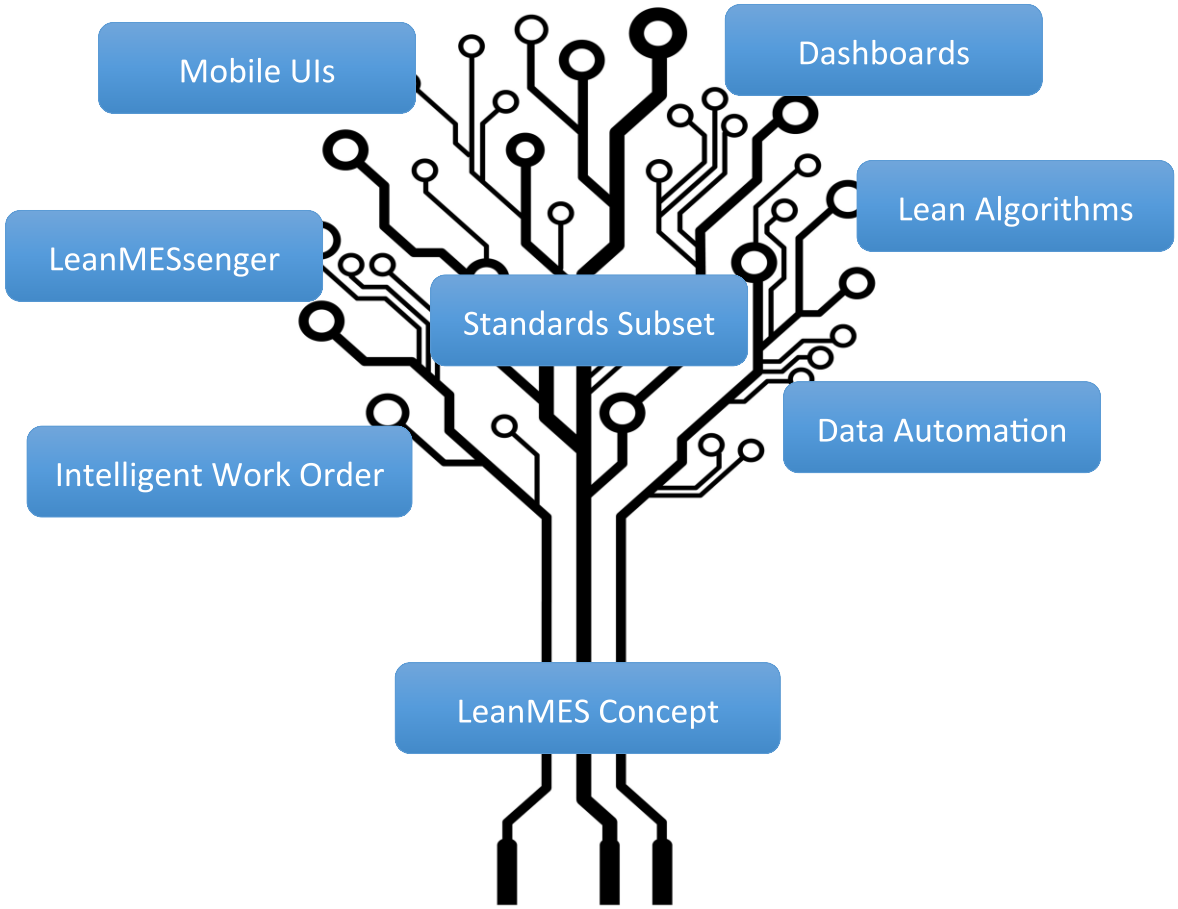
DIMECC – MANU: FUTURE DIGITAL MANUFACTURING TECHNOLOGIES AND SYSTEMS 8/2014-12/2016

MANU/LEANMES

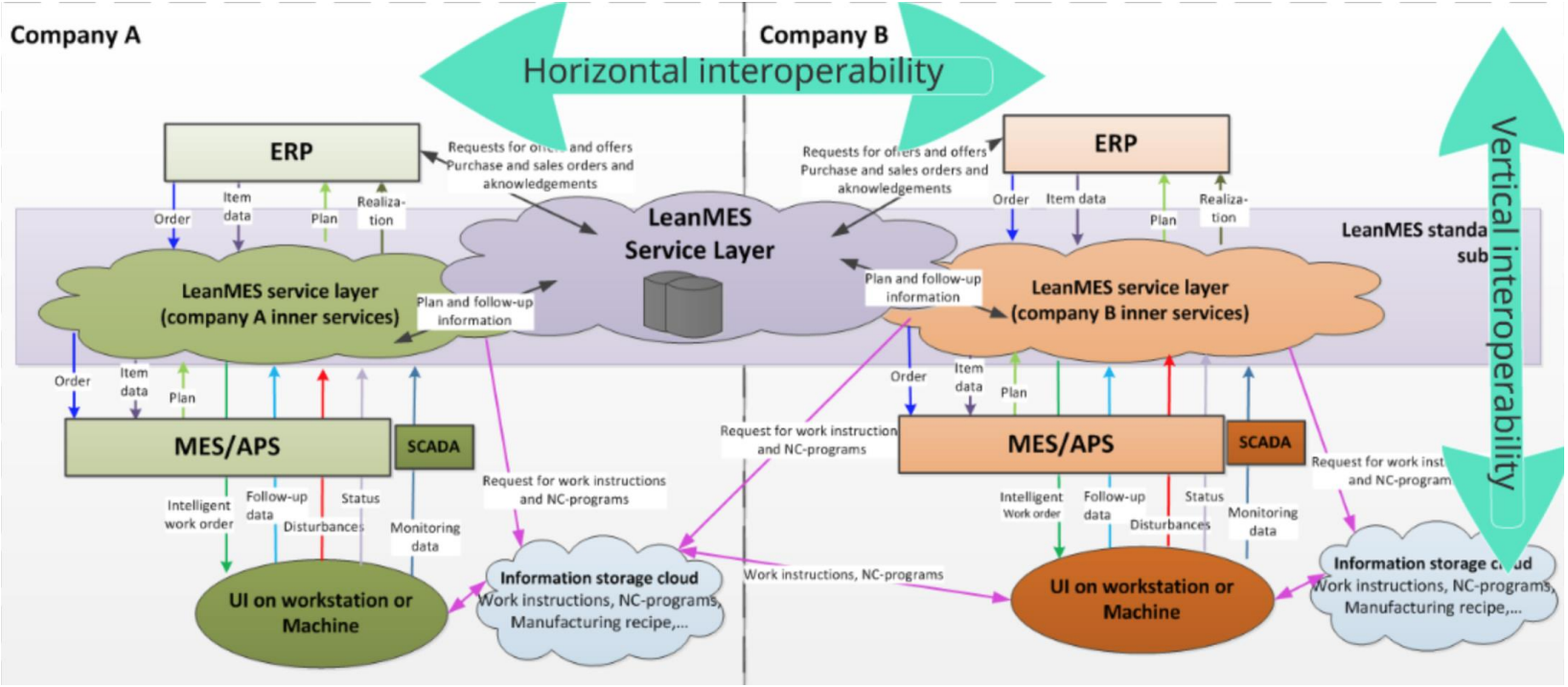
LeanMES mission

‘The ultimate goal of the project is to provide lean, scalable and extendable concept for new type of MES that supports the human operator in a dynamically changing environment’

Fastems FACTORY AUTOMATION
logistic.fi
Prima Power
DELFOI IT WILL BE
OK-VISE
HTT LASER
PONSSE
KONECRANES Lifting Businesses
VTT
TAMPERE UNIVERSITY OF TECHNOLOGY
Aalto University School of Science and Technology


Mobile UIs
Dashboards
Lean Algorithms
LeanMESsenger
Standards Subset
Data Automation
Intelligent Work Order
LeanMES Concept

LeanMES - Common understanding of each position



DIMECC MANU/LeanMES:
http://hightech.dimecc.com/results/leanmes-always-up-to-data

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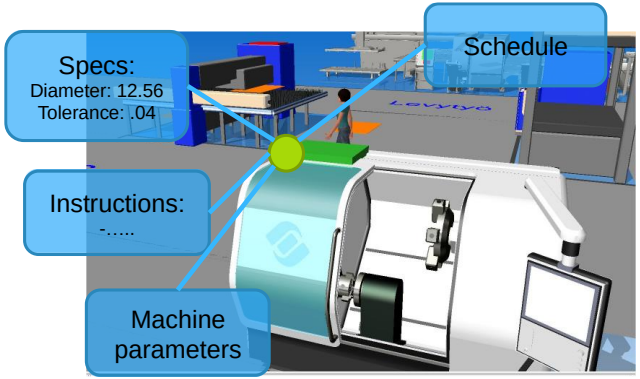
Digitalisation of the Production



Intelligent Workorder concept

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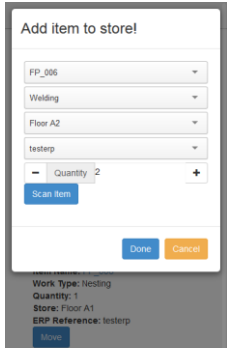
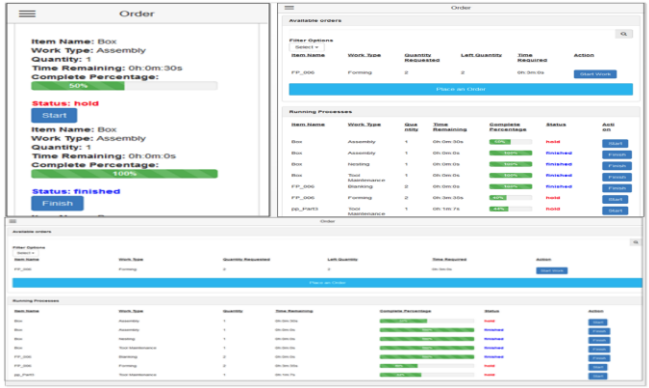
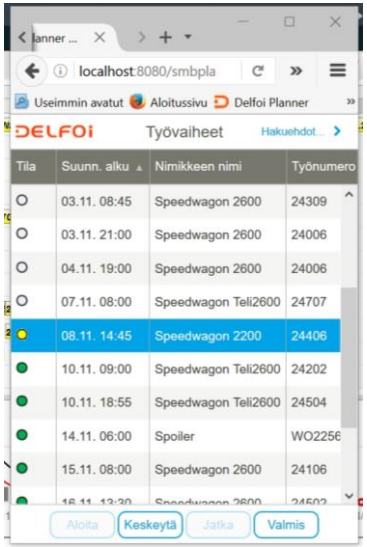
Mobile user interfaces

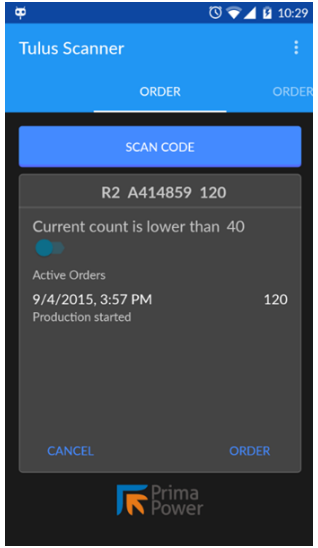


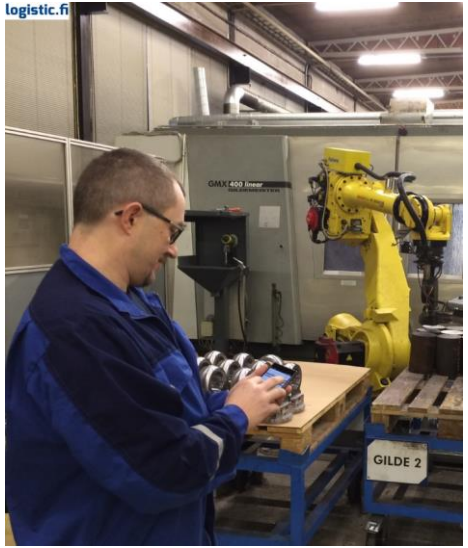


Dashboard Prototypes

LeanMES results in Companies







DIMECC MANU/LeanMES:
http://hightech.dimecc.com/results/leanmes-always-up-to-data

H2020-FOF-2015 (GA NO.: 680750), 11/2015 – 10/2018

RAPID RECONFIGURATION OF FLEXIBLE PRODUCTION SYSTEMS THROUGH CAPABILITY-BASED ADAPTATION, AUTOCONFIGURATION AND INTEGRATED TOOLS FOR PRODUCTION PLANNING

ReCaM

Rapid reconfiguration of flexible Production Systems

ReCaM Goals and Approach

Project Goals

To develop and demonstrate the next generation of versatile production systems based on reconfigurable modular production resources.

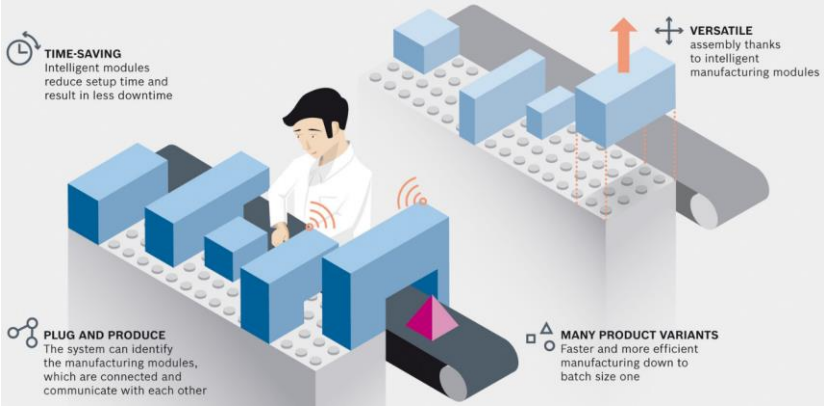
- Economic production of smaller lot sizes and higher number of variants
- Reduction of the set-up, changeover times and costs
- Reduction of average energy consumption

The ReCaM Approach

The approach is grounded on the development of techniques for the design, reconfiguration and management phases of production systems.

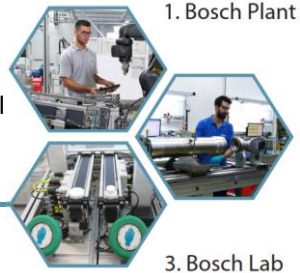
- Rapid capability-based system reconfiguration according to product requirements
- Automatic adaptation of resource capabilities
- Auto-programming of mechatronic objects (MOs)
- Engineering methods for the integrated reconfiguration and production planning

Image provided by Robert Bosch GmbH



Demonstration Environments

The ReCaM solutions will be implemented and demonstrated on two industrial environments and one lab demonstrator.



1. Bosch Plant Demonstrator
2. CESA Plant Demonstrator
3. Bosch Lab

www.recam-project.eu

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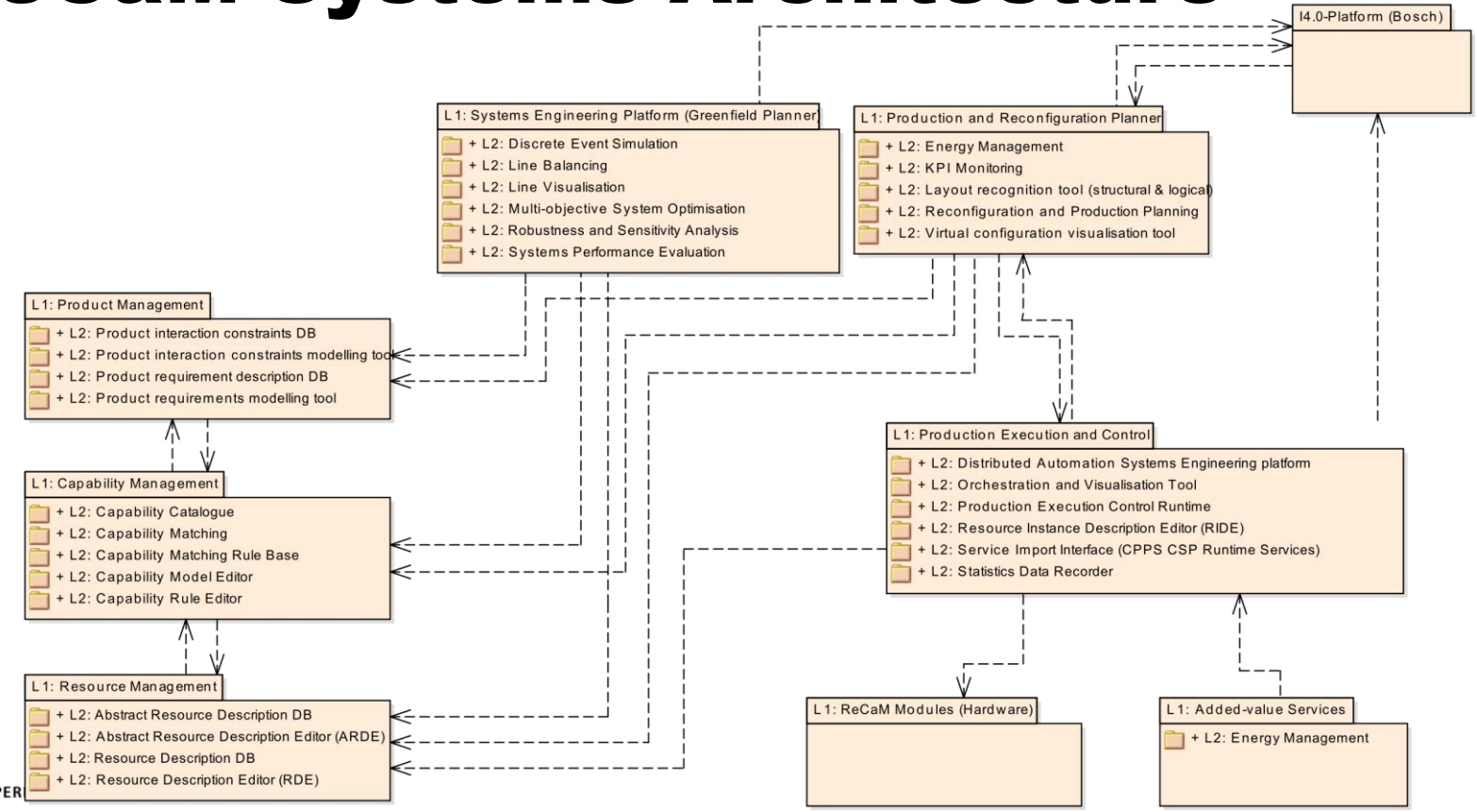
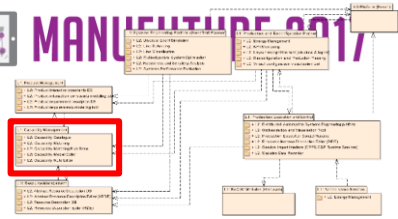
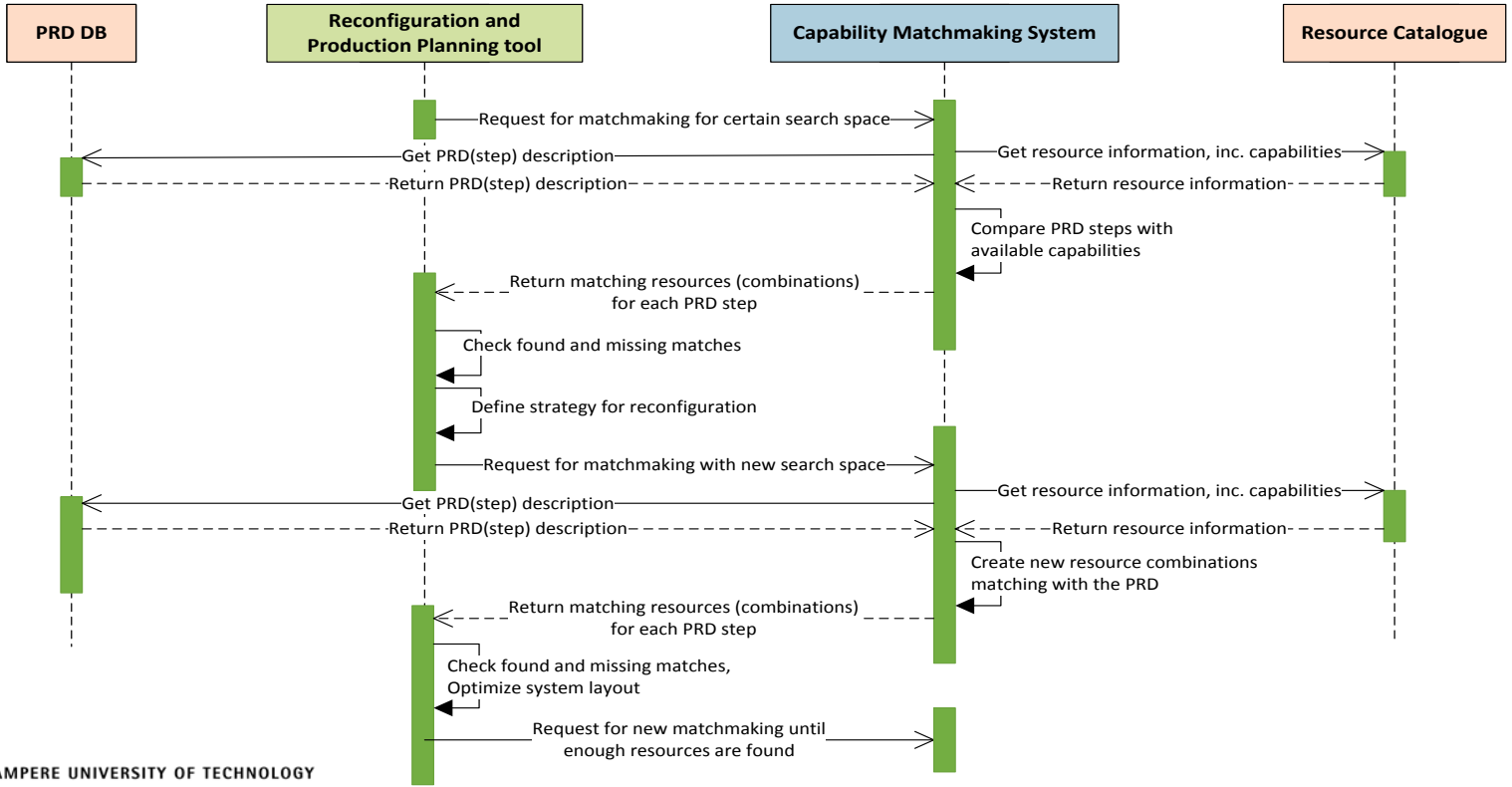
ReCaM Systems Architecture

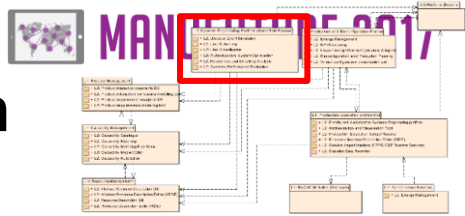


Capability matchmaking – Interactions between the associated SW





Flexible System Engineering Platform (FSEP)

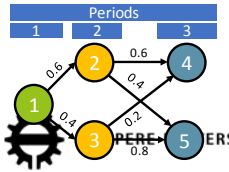


Resource catalogues

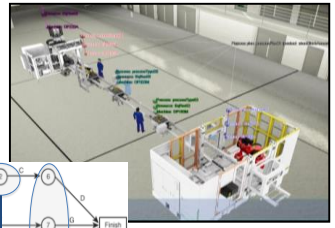
Matching algorithms

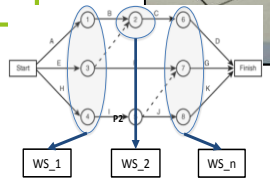
Product requirements

Multi-period:
- Product mix
- Demand



- Assembly system model generation
- Transportation modelling
- Processing station modelling
- System visualisation tool





- Reliability parameters
- Cycle times
- System topology

Performance evaluation tools

System configuration

Performance

mode FRONTIER

Multi-objective optimiser

Optimised layout and parameters → Robustness and simulation analysis

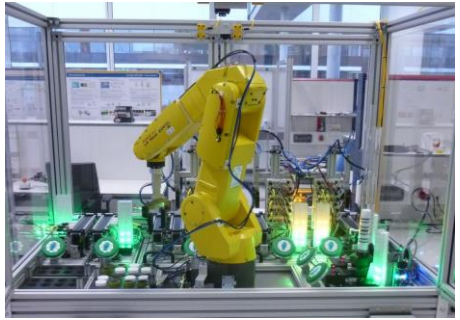
User– Platform Interaction

Optimal System Configuration

✓MOs
✓Optimal Configurations
✓KPIs

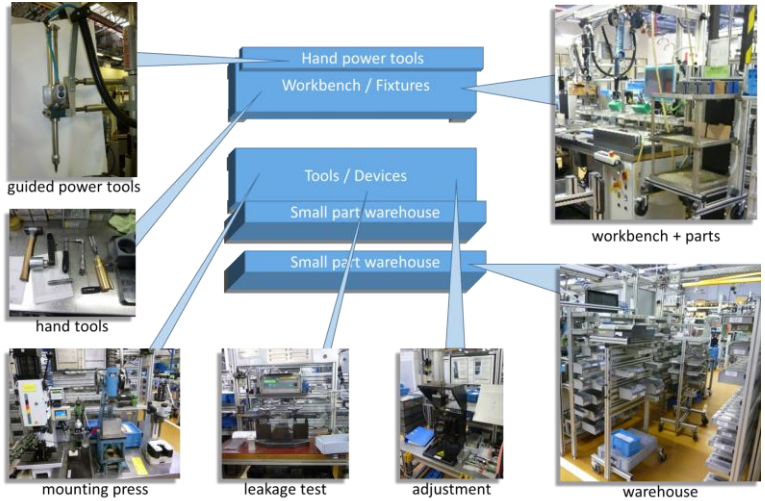
- Installation and testing of design solutions (WP4)
- Engineering Integration (WP5)
- Demonstrators (WP6)

ReCaM joint demos



Use Case 1: Bosch Lab Demonstrator for testing the concepts

Use Case 2: Bosch Hydraulic Valve Assembly



Use Case 3: CESA Retraction Actuator Assembly

Conclusions

Common vision of ”ToBe” in long term

Assessment of capabilities & Building of strengths together

Visibility to the strategies and drivers is essential

Trust takes time, and it is not a technical problem

Development is not a project

THANK YOU!