TAMPERE UNIVERSITY OF TECHNOLOGY

Näkökulmia tuotannon kehittämiseen

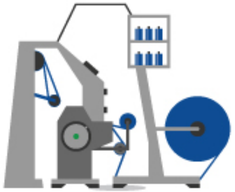
Professori Minna Lanz

Tampere University ~~of Technology~~
Faculty of Engineering Sciences
Mechanical Engineering and Industrial Systems

Savonia, Tuotannon hienosuunnittelu, 31.10.2018

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

“Making the lot-size-1 economically feasible”



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

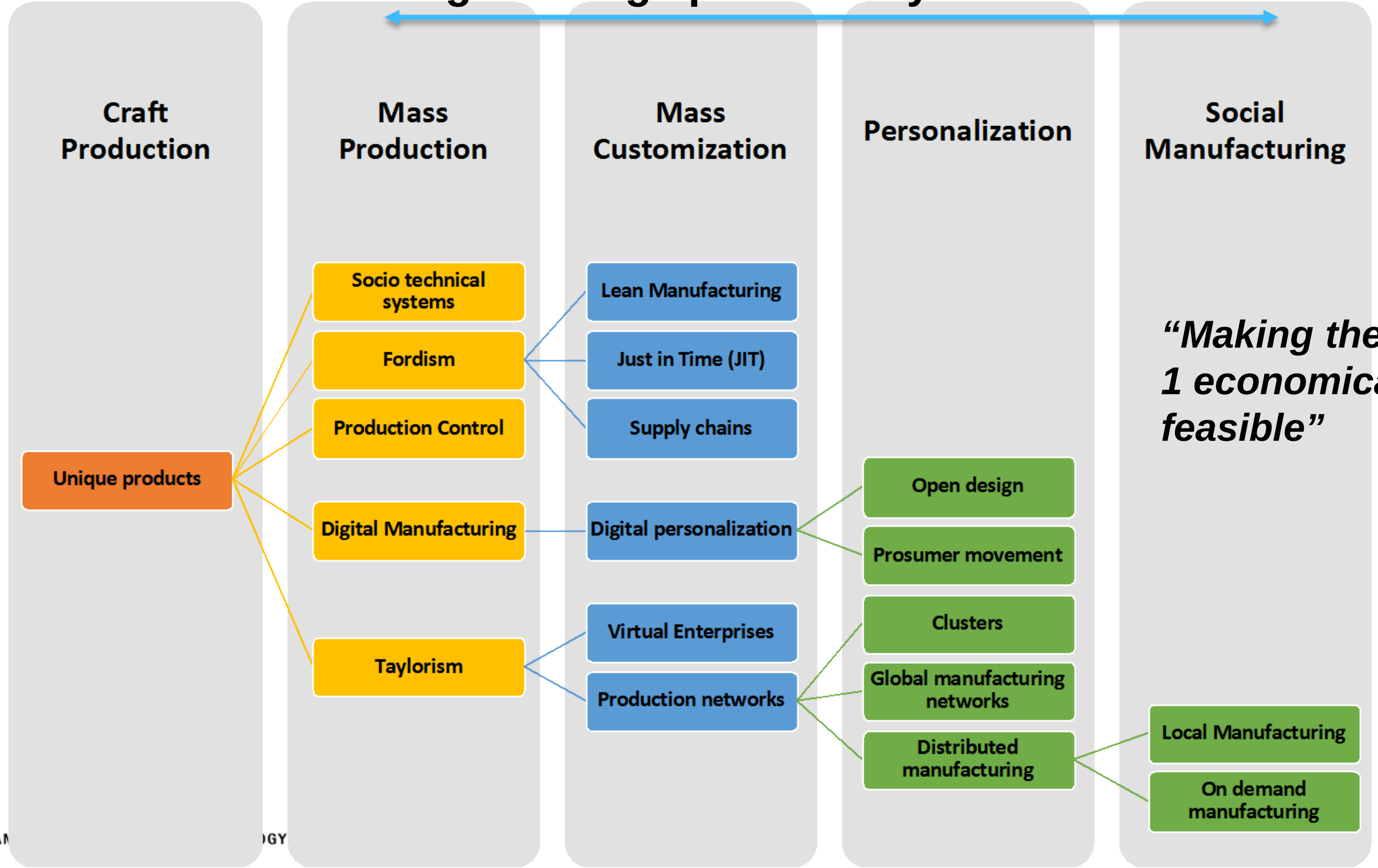
- Development of the first programmable logic controller (PLC) in 1969
- Growing application of electronics and IT to automate production processes

Fourth industrial revolution: Smart automation

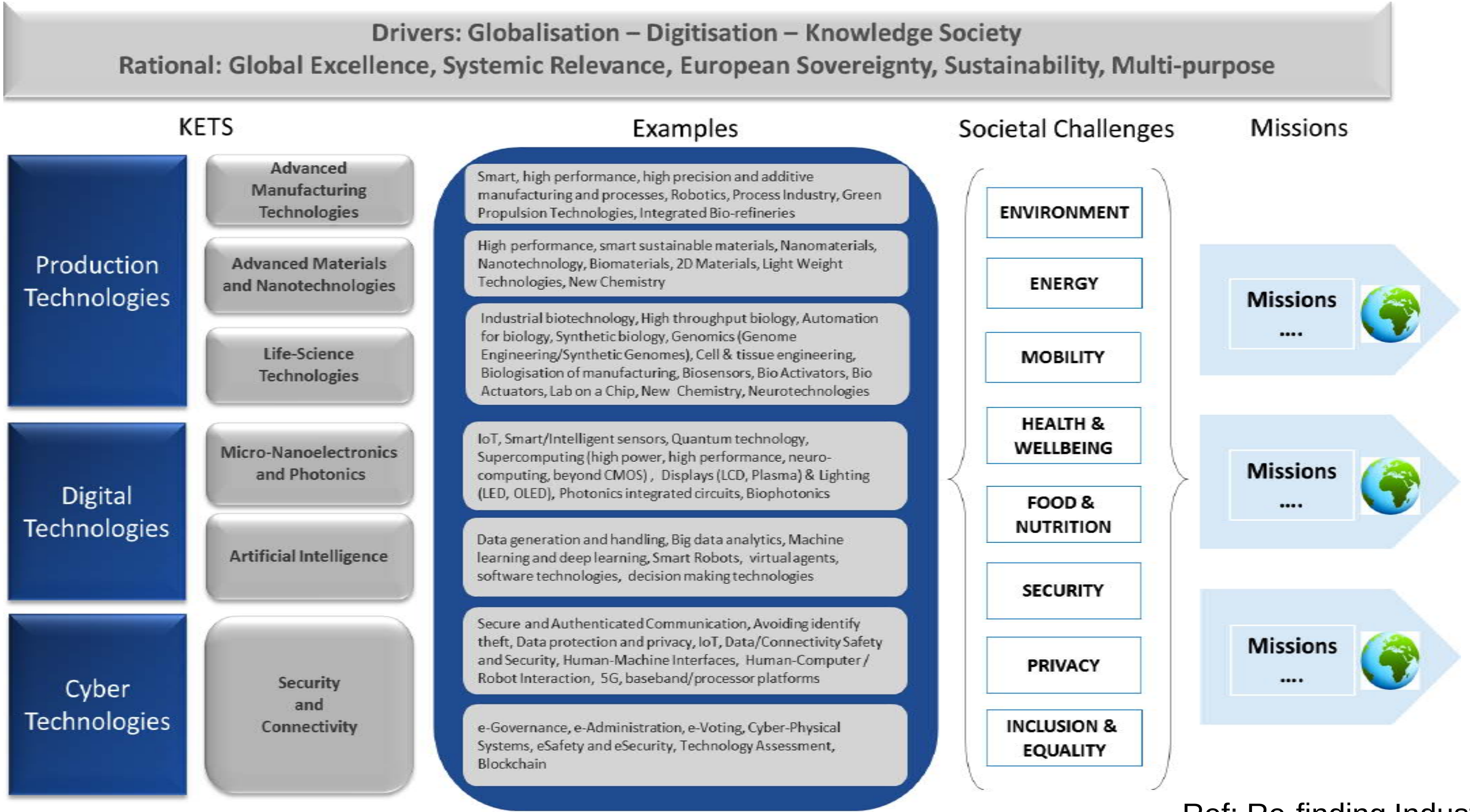
- Increasing use of cyber-physical systems (CPS)
- In January 2011, Industry 4.0 was initiated as a “Future Project” by the German federal government
- With the introduction of IPv6 in 2012, virtually unlimited addressing space becomes available
- Governments, private companies, and industry associations 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.

Paradigm change powered by Industrial revolutions



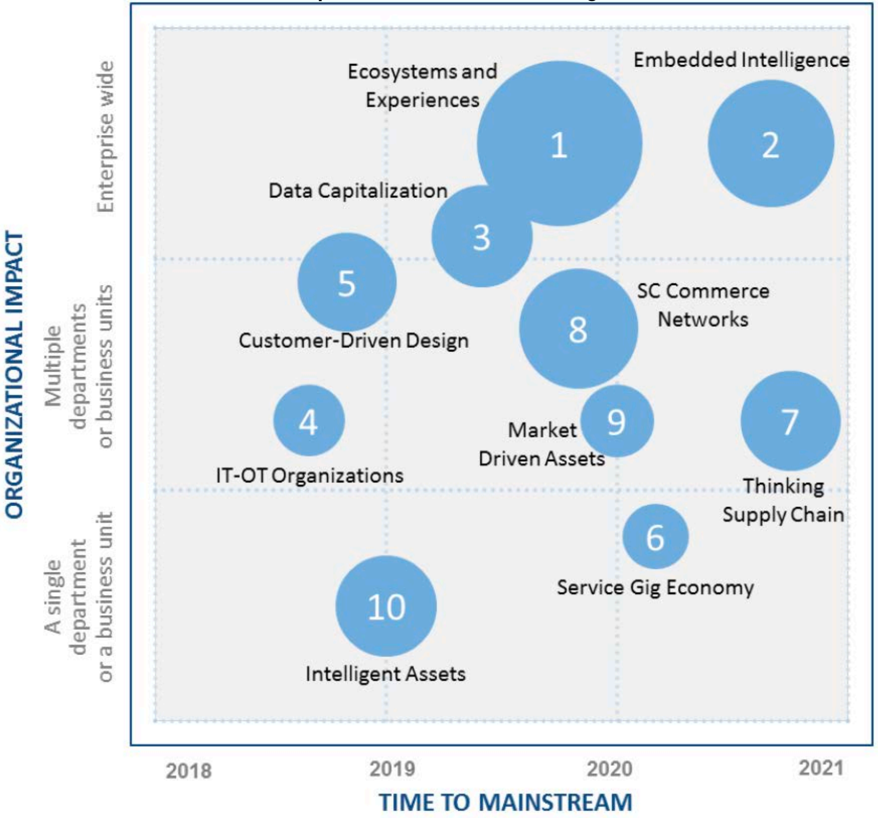
“Making the lot-size-1 economically feasible”



Ref: Re-finding Industry

Predictions2018

IDC FutureScape: Worldwide Manufacturing 2018 Predictions



1. **Ecosystems and Experiences:** By 2020, 60% of G2000 manufacturers will rely on digital platforms that enhance their investments in ecosystems and experiences and support as much as 30% of overall revenue.

2. **Embedded Intelligence:** By 2021, 20% of G2000 manufacturers will depend on a secure backbone of embedded intelligence, using IoT, blockchain, and cognitive to automate large-scale processes and speed execution times by up to 25%.

3. **Data Capitalization:** By 2020, 75% of all manufacturers will participate in industry clouds, although only one-third of those manufacturers will be monetizing their data contributions.

4. **IT-OT Organizations:** By 2019, the need to integrate operational technology and information technology as a result of IoT will have led to more than 30% of all IT and OT technical staff having direct project experience in both fields.

5. **Customer-Driven Design:** By 2019, 50% of manufacturers will be collaborating with customers and consumers on product designs through crowdsourcing, VR, and product virtualization, with up to 25% improvement in product success rates.

6. **The Service Gig Economy:** In 2020, AR and mobile devices will drive the transition to the gig economy in the service industry, with "experts for hire" replacing 20% of dedicated customer-and field-service workers.

7. **The Thinking Supply Chain:** By the end of 2020, one-third of all manufacturing supply chains will be using analytics-driven cognitive capabilities thus increasing cost efficiency by 10% and service performance by 5%

8. **Supply Chain Commerce Networks:** By 2020, 80% of supply chain interactions will happen across cloud-based commerce networks, improving participants' resiliency and reducing the impact of supply disruptions by up to one-third.

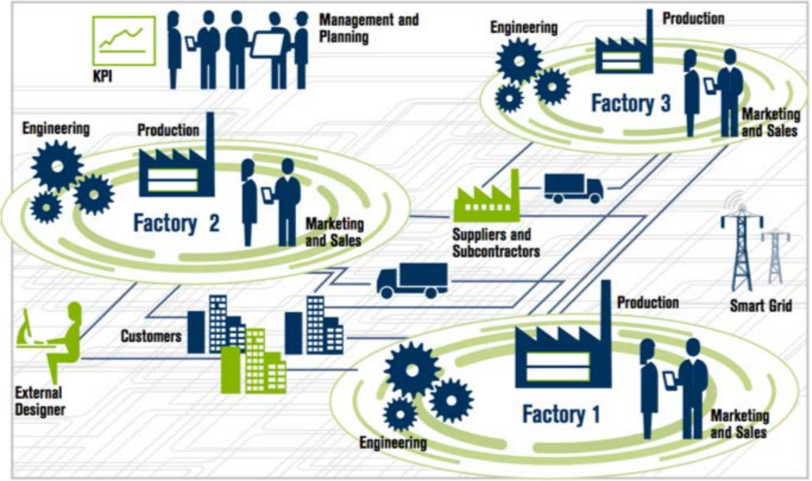
9. **Market-Driven Assets:** By 2020, 25% of manufacturers in select subsectors will have balanced production with demand cadence and achieved greater customization through intelligent and flexible assets.

10. **Intelligent Assets:** By 2019, 15% of manufacturers that manage data-intensive production and supply chain processes will be leveraging cloud-based execution models with edge analytics for real-time visibility and operational flexibility.

Elements for surprises

- Disruptive technologies
- Industrial ecosystems
- Skills development

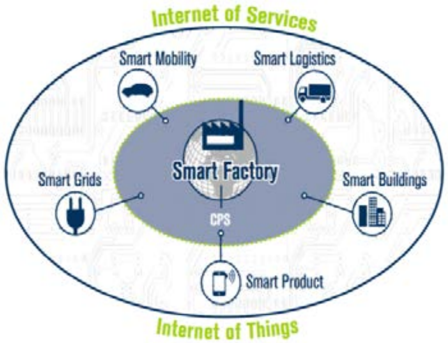
Vision: Industry 4.0



" In the manufacturing environment, these Cyber-Physical Systems comprise smart machines, storage systems and production facilities capable of autonomously ex-changing information, triggering actions and controlling each other independently.

This facilitates fundamental improvements to the industrial processes involved in manufacturing, engineering, material usage and supply chain and life cycle management."

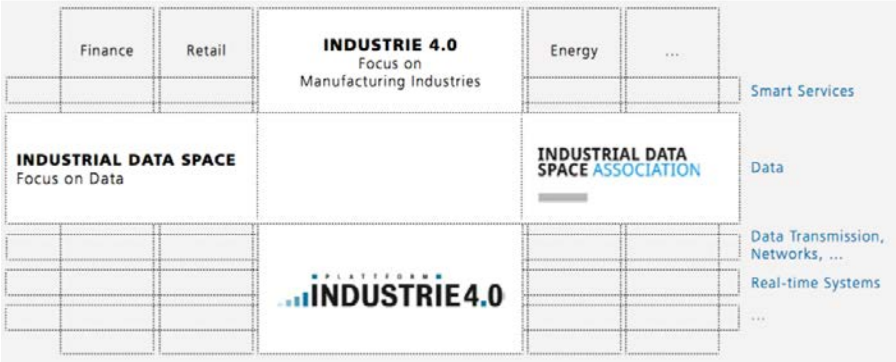
- **Interoperability:** cyber-physical systems (work-piece carriers, assembly stations and products) allow humans and smart factories to connect and communicate with each other.
- **Virtualisation:** a virtual copy of the Smart Factory is created by linking sensor data with virtual plant models and simulation models.
- **Decentralisation:** ability of cyber-physical systems to make decisions of their own and to produce locally thanks to technologies such as 3d printing.
- **Real-Time Capability:** the capability to collect and analyse data and provide the derived insights immediately Service Orientation.
- **Modularity:** flexible adaptation of smart factories to changing requirements by replacing or expanding individual modules



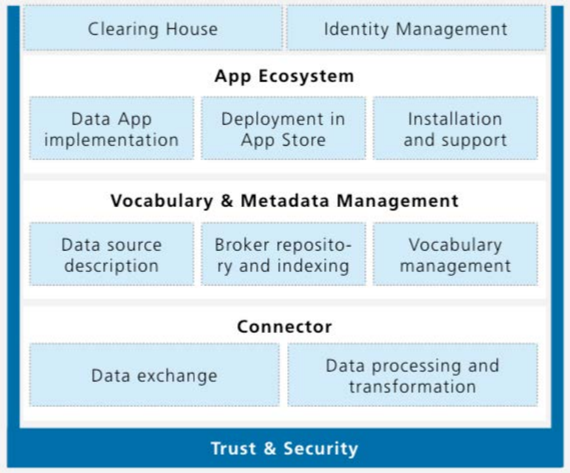
Refs: Industry 4.0; Industry 4.0 Political study

Industrial Data Space

Relations with Plattform Industrie 4.0



Functional Architecture of the Industrial Data Space



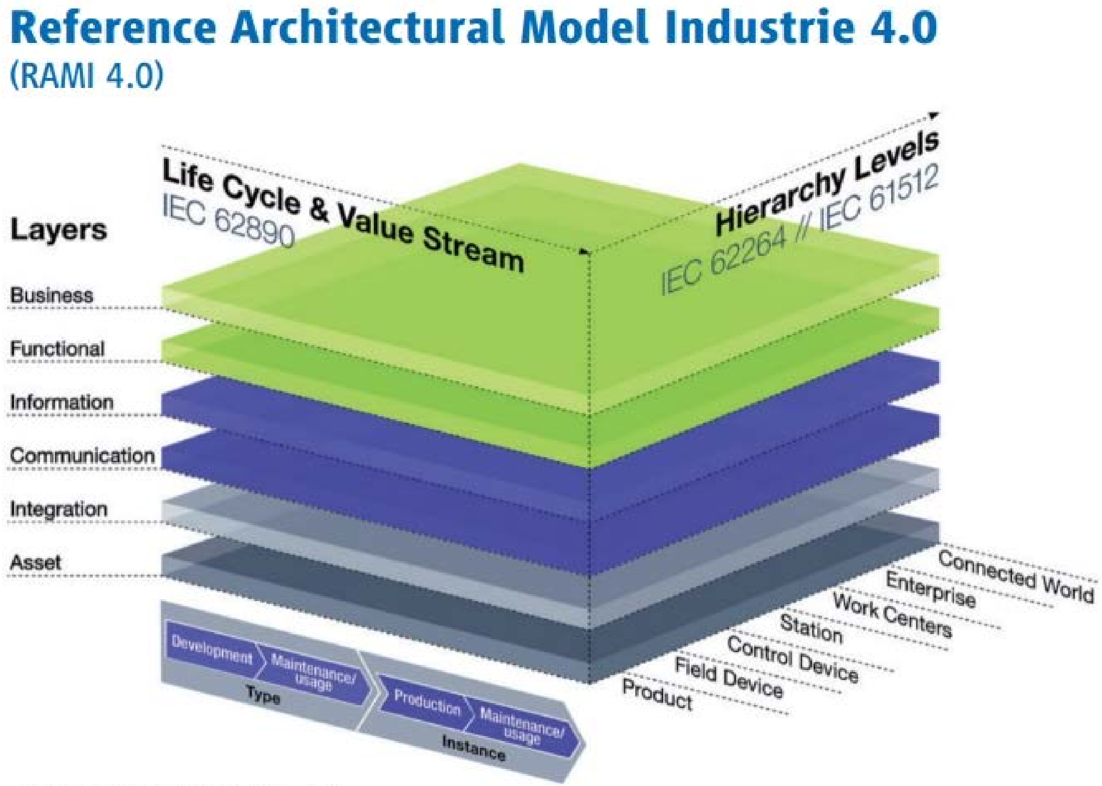
The Industrial Data Space initiative has established, and aims to establish, liaisons with other initiatives, among them

- Big Data Value Association (http://www.bdva.eu)
- FIWARE Foundation (https://www. ware.org/foundation)
- Industrial Internet Consortium (http://www.iiconsortium.org)
- OPC Foundation, (https://opcfoundation.org), and
- Plattform Industrie 4.0. (http://www.plattform-i40.de)

Furthermore, the Industrial Data Space initiative seeks collaboration and exchange of ideas with existing research and standardization initiatives.

https://www.fraunhofer.de/content/dam/zv/de/Forschungsfelder/industrial-data-space/Industrial-Data-Space_Reference-Architecture-Model-2017.pdf

RAMI 4.0

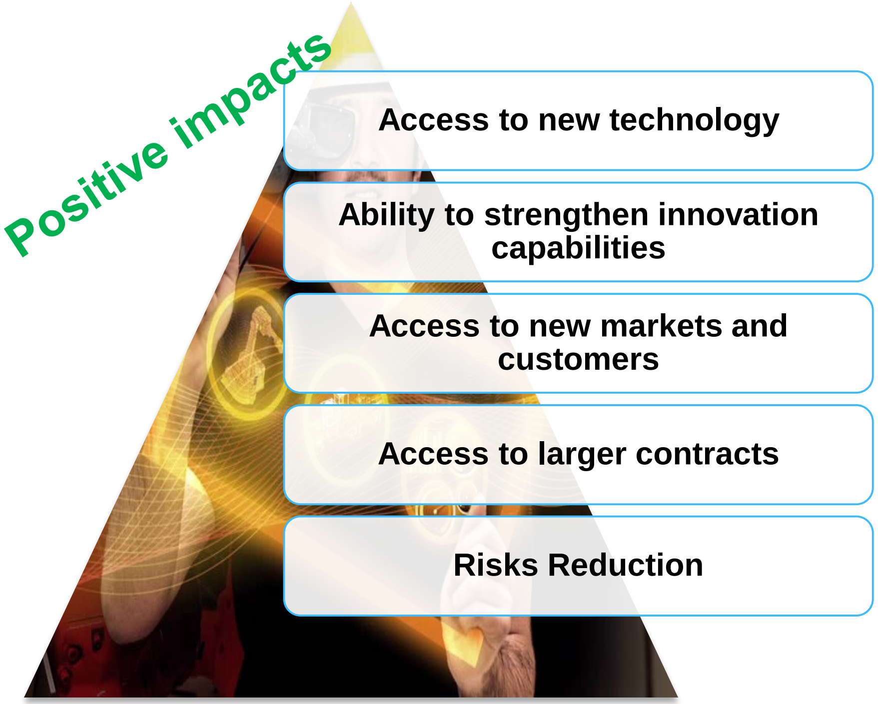


Source: Plattform Industrie 4.0

The German Industrie 4.0 platform, consisting of ZVEI, VDMA, and BITKOM, has jointly reached important milestones in the standardization of Industrie 4.0. The first version of a reference architecture model for Industrie 4.0 (RAMI 4.0) which precisely describes Industrie 4.0-compliant production equipment, has been developed.

https://www.zvei.org/en/subjects/industry-4-0/the-reference-architectural-model-rami-40-and-the-industrie-40-component/

Need for stronger collaboration



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

Negative challenges

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.

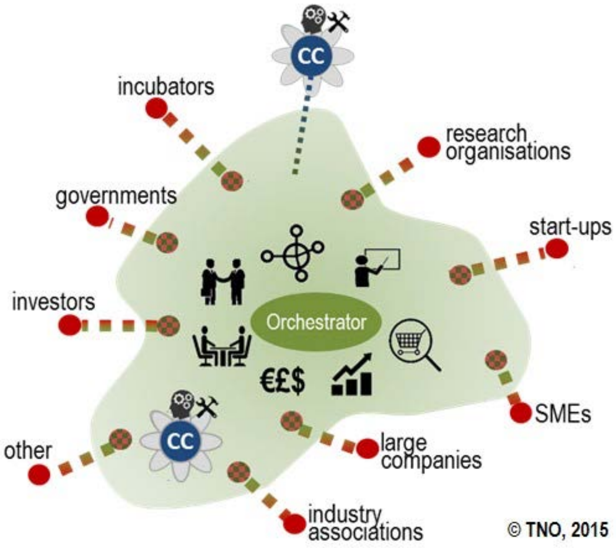
TAMPERE UNIVERSITY OF TECHNOLOGY

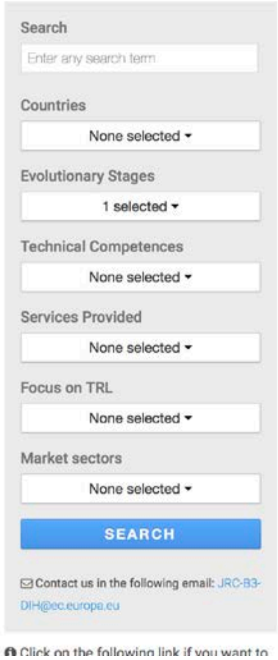
Majuri, M., Nylund, H. & Lanz, M., Analysis of Inter-firm Co-operation in Joint Research and Development Projects, Advances in Production Management Systems: Initiatives for a Sustainable World - IFIP WG 5.7 International Conference, APMS 2016, p. 536-543 8 p. (IFIP Advances in Information and Communication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

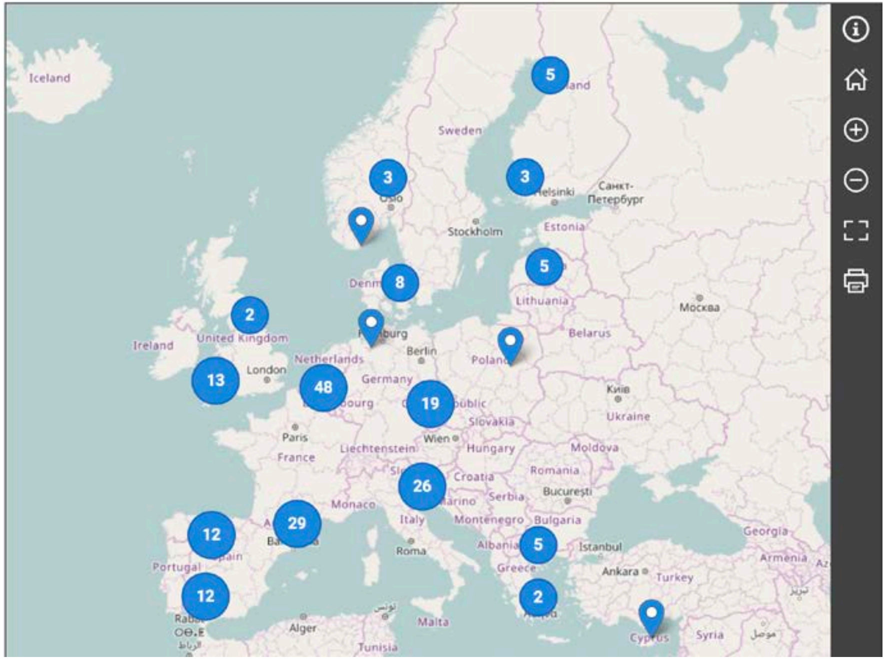
Expectations for emergence of ecosystems

Digital Innovation Hubs

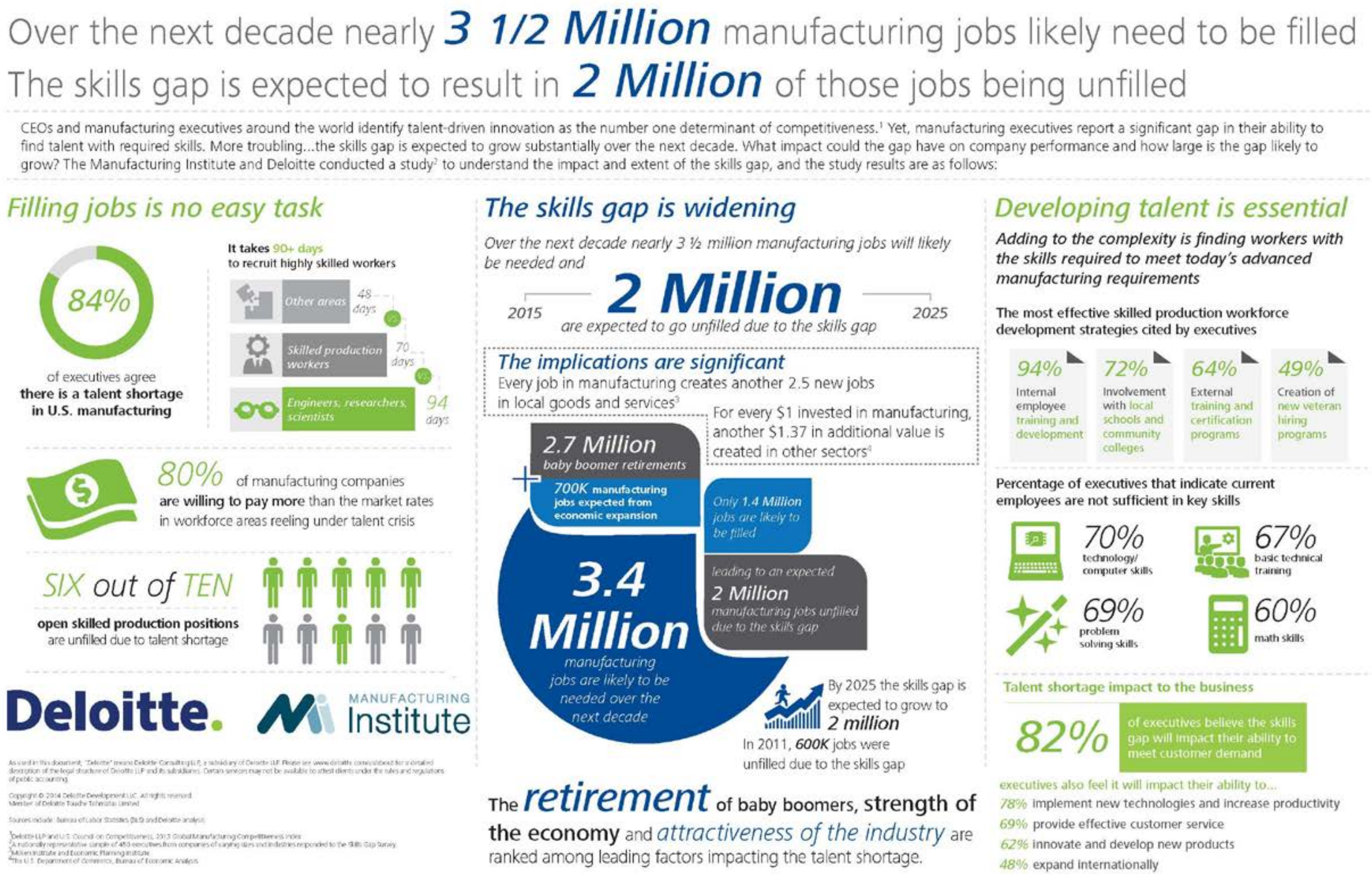
http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool







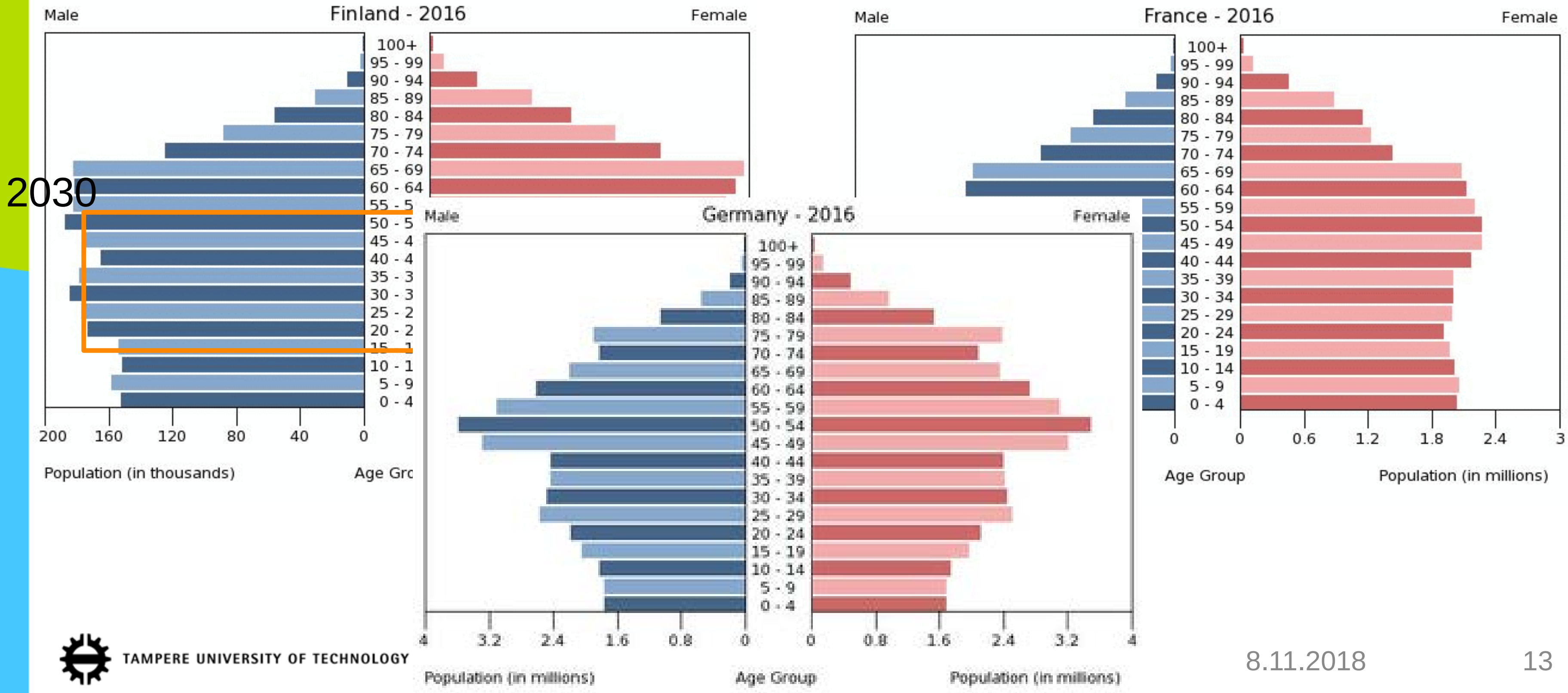
https://www.slideshare.net/StartupEurope/digital-innovation-hubs-in-europe



https://www2.deloitte.com/us/en/pages/manufacturing/articles/boiling-point-the-skills-gap-in-us-manufacturing.html

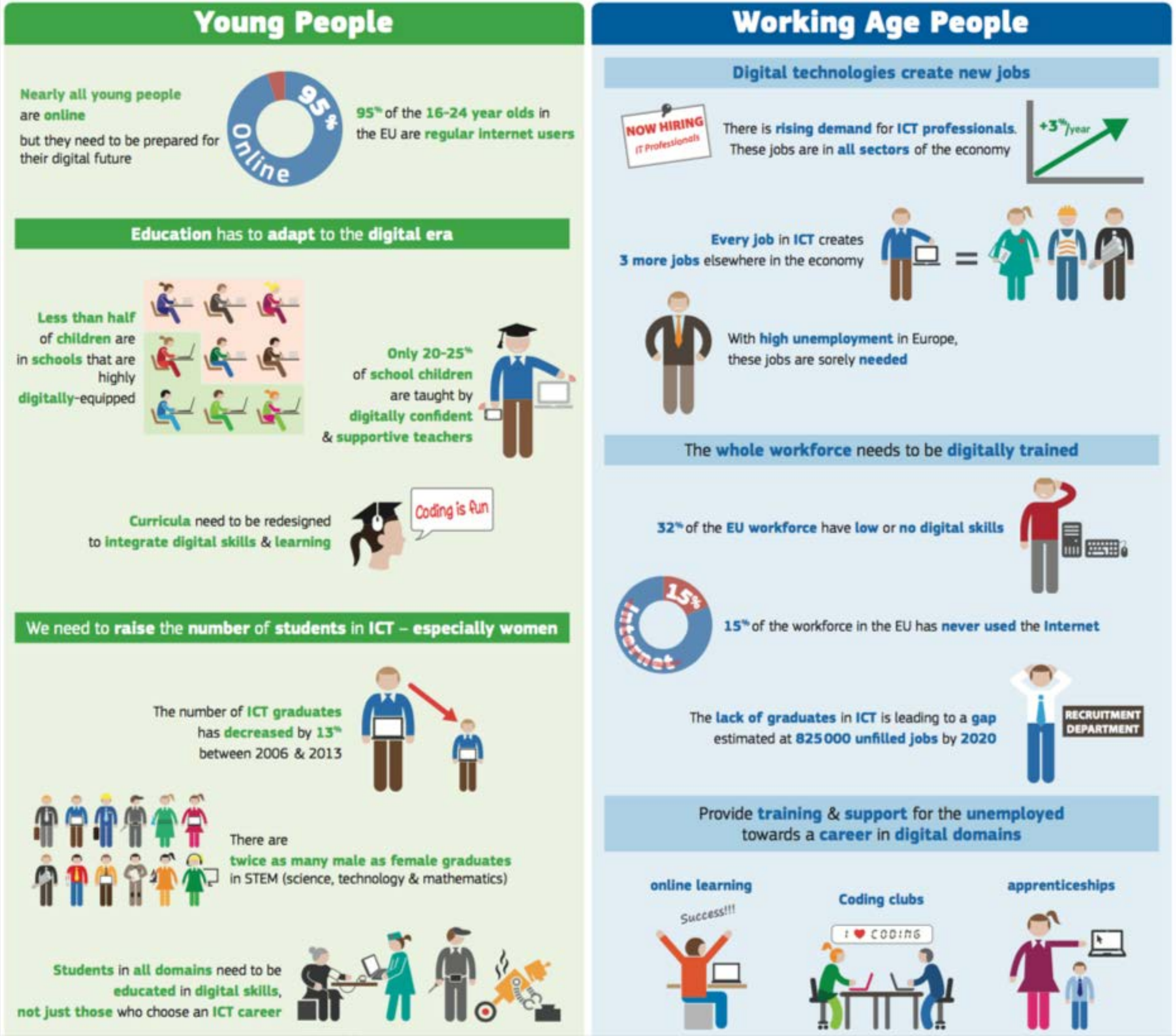
TAMP

Future European workforce in 2030



Lifelong learning

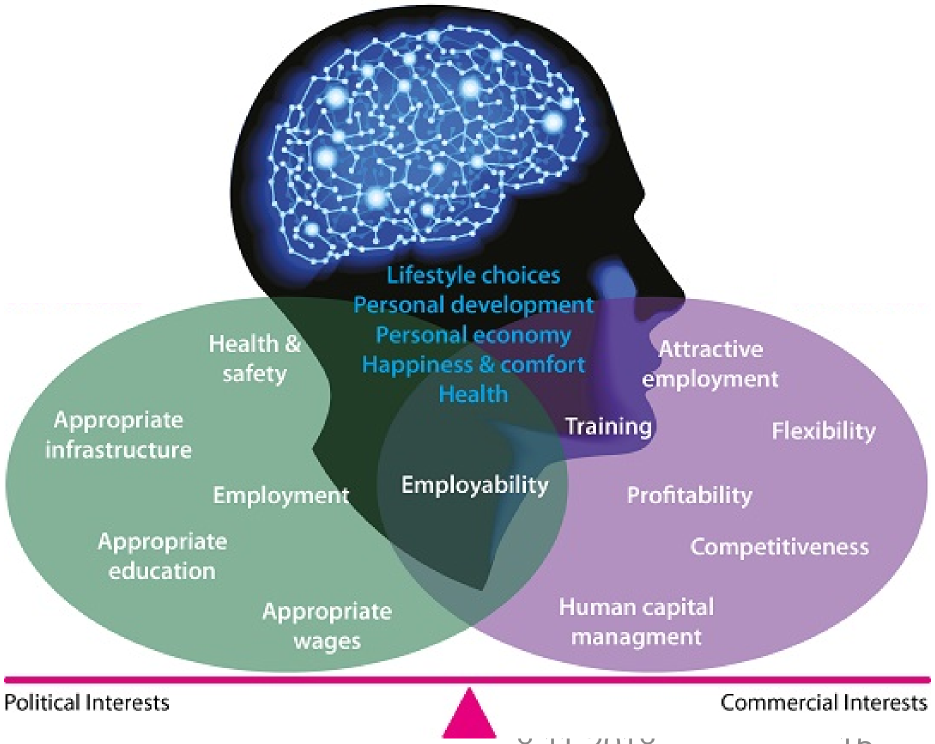
- Technology what we teach is outdated when new employees start
- STEM loses its brand already in the low grades.
- The gap between highly skilled people and low skilled people is widening, and we need the middle class in most cases.

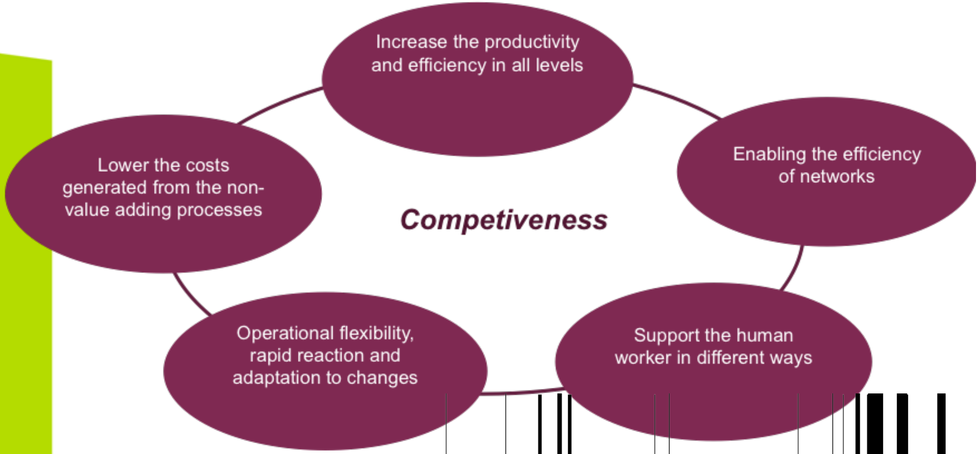


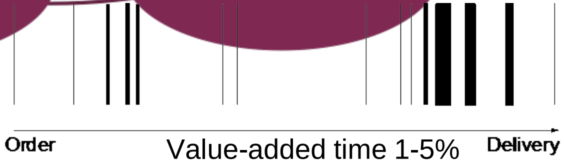
Finding the optimal balance between work and life

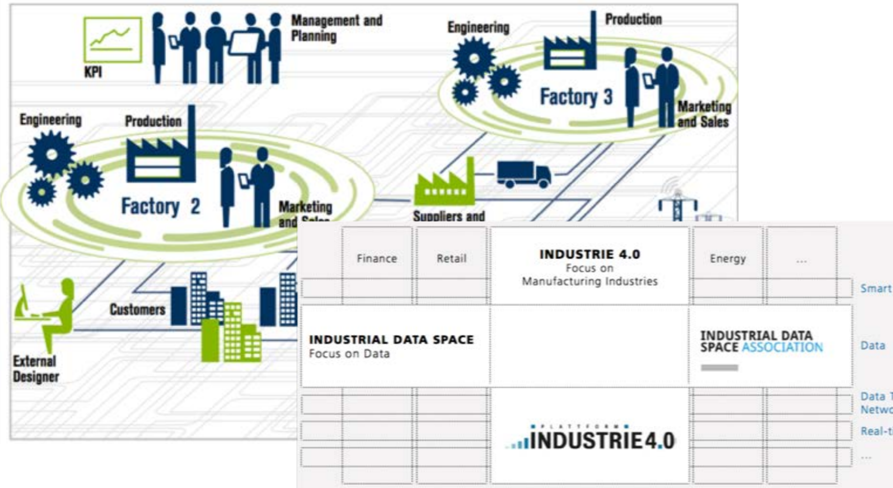
- The European industry's prime mission is to attract and retain highly skilled employees and foster a working context that enables professional and personal growth in order to maximize the capabilities for current value creation as well as the competences for future (SO SMART, D4.2, 2014; International Labour Office, 2018).
- New public-private collaborative forms should be adopted to build, challenge and develop knowledge, skills and attitudes needed in the manufacturing of the future.

- FP7 SO SMART balance drivers:
  - Enabling work and education
  - Promoting a social product culture
  - Boosting the sharing economy
  - Spreading trust in value networks
  - Collaborating with the local community
  - Harmonizing governance and opening policies

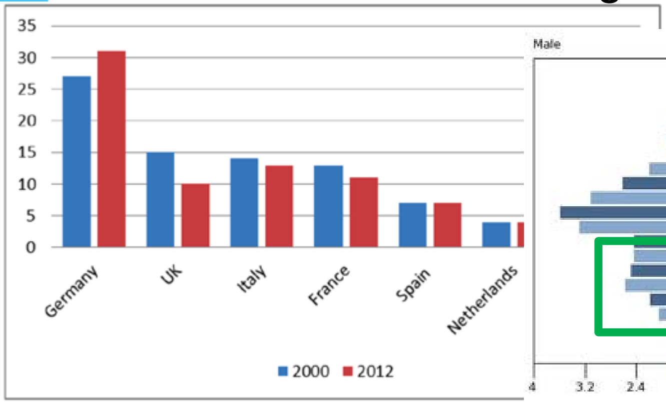


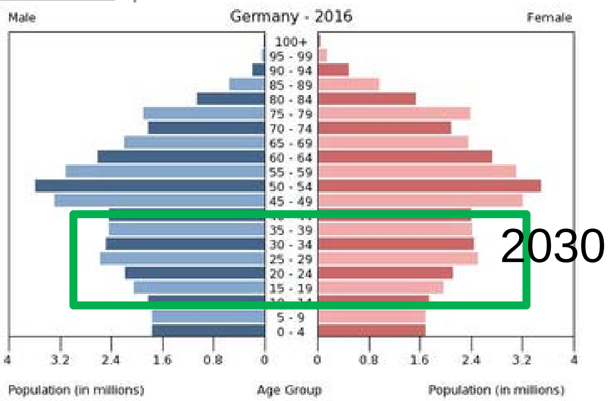






Distribution of Manufacturing in EU





Digitalization benefits are unclear

Distance between 'man and the system'

Lack of visibility
- **Factory**
- **Network**

Low information quality (timing, format, content)

Lack of trust
- **Partner**
- **IT**

Multiple tools – lack of information flow. Complexity

Competitiveness

- Increase of competitiveness over the supply network
- Reduce the non-value added time
- Increase the quality and production capacity by robotics and supplier and real-time data visibility by AI

Digitalization

- Find&Use the right analytical methods in right time and for the right purpose
- Improve the input data (collection, filtering, harmonization)
- “Design for data”
- Creation of digital information flow (concrete examples) to increase transparency and traceability

Ecosystems

- Support the forming of temporal ecosystems among SMEs and Large companies
- Find the experts and share competences more efficiently in future
- Increase the trust among companies to form alliances

Skills gap

- Work-life balance to make engineering more attractive
- Provide transfer education for potential candidates
- Skills gap between high skilled and low skilled persons is widening → formal and non-formal life-long training

LeanMES always up-to-data

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

June 8, 2015 Harri Nieminen

Category: Smart production

Result video | manufacturing execution system | Information flow | traceability

Program: MANU

MANUFACTURING
PERFORMANCE
DAYS

Harnessing the Ecosystem Economy

Tampere, Finland | June 4th – 6th, 2019

Main page | Programme | Partners | Speakers | Info | Registration | MPIDEA | News

The first official strategic partners of MPD 2019 have now been published! Read more from NEWS-section.

https://mes.eventos.fi/event/mpd2019

THANK YOU!
KIITOS!