

Master in Management Engineering

Industry 4.0

Bianca Maria Colosimo
(biancamaria.colosimo@polimi.it)

Marco Taich
(marco.taisich@polimi.it)

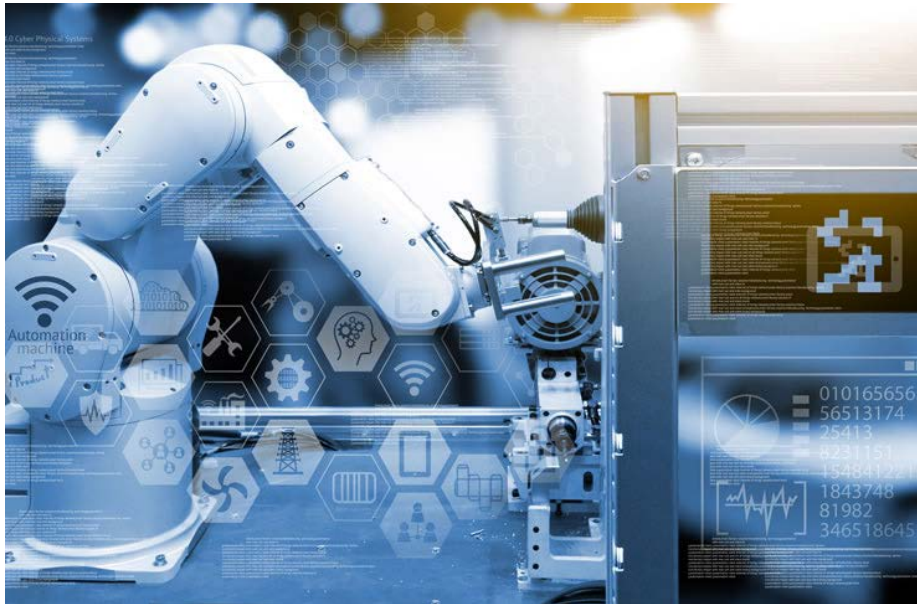
AY 2019-2020

European Manufacturing

Manufacturing is the backbone of the European economy. According to Eurostat [1], 9.0 % of all enterprises in the EU-28's non-financial business economy were considered as manufacturing companies in 2014, a total of 2.1 million enterprises employing nearly 30 million people and generating EUR 1 710 billion of value added. This represents 22.1% of employment (14.2% of the total European workforce) and 26% of the value added of the EU-28's non-financial business economy.

Manufacturing is a complex ecosystem steering many high value-added services, justifying the creation of up to two jobs in other sectors for each direct job in manufacturing [2, 3, 4]. Manufacturing companies, including SMEs, are part of local societies where workers and their families can live because of direct and indirect manufacturing, challenging and well-paid, jobs.

The ongoing 4th Industrial Revolution (Industry 4.0) is impacting manufacturing at global level, starting with developed and progressively spreading to emerging countries. Europe is presently the global leader in the supply of Industry 4.0 technology and it is also a leader in its implementation [5, 6].

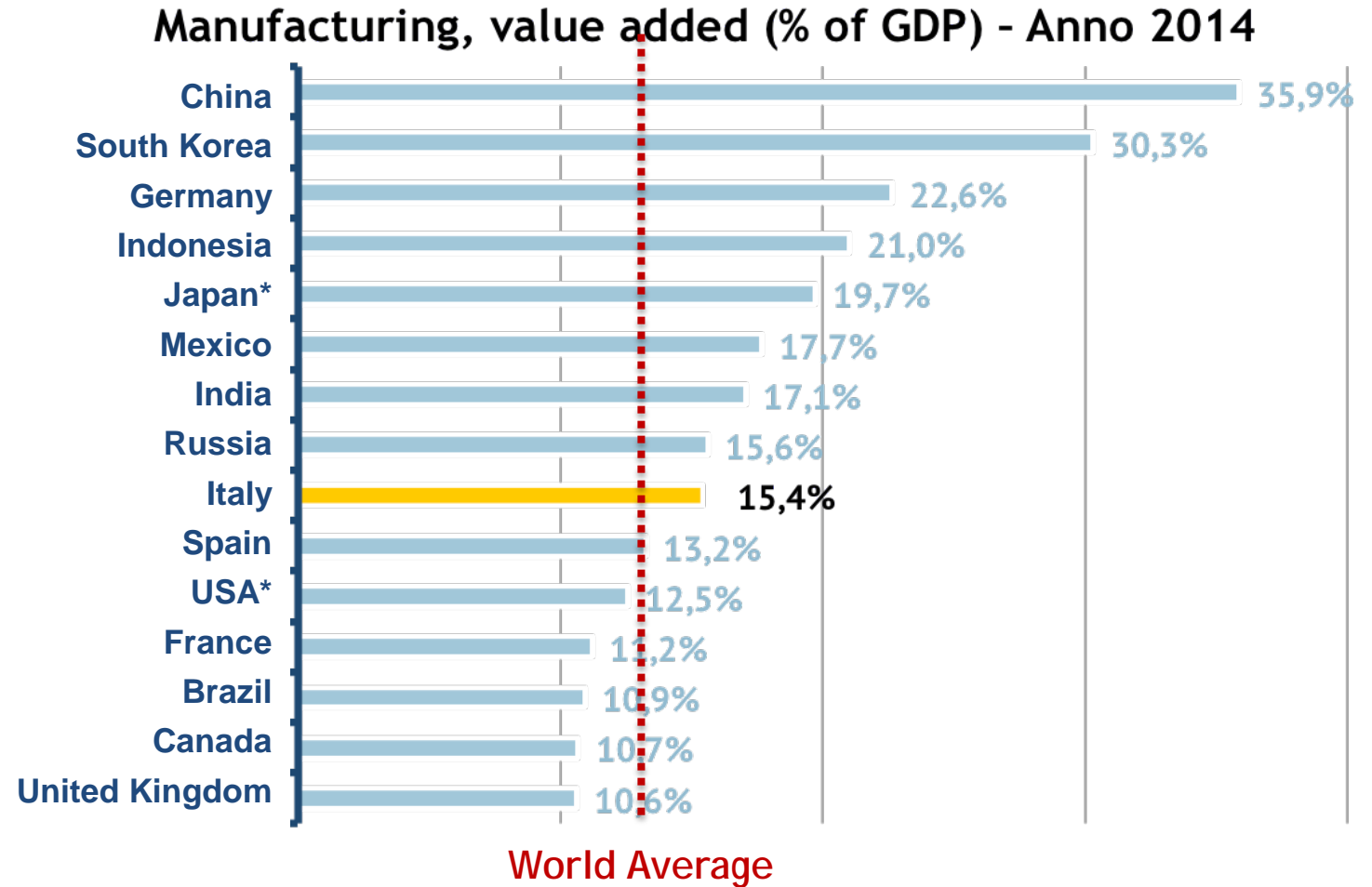


MANUFACTURING VALUE ADDED BY (% of GDP) – YEAR 2014

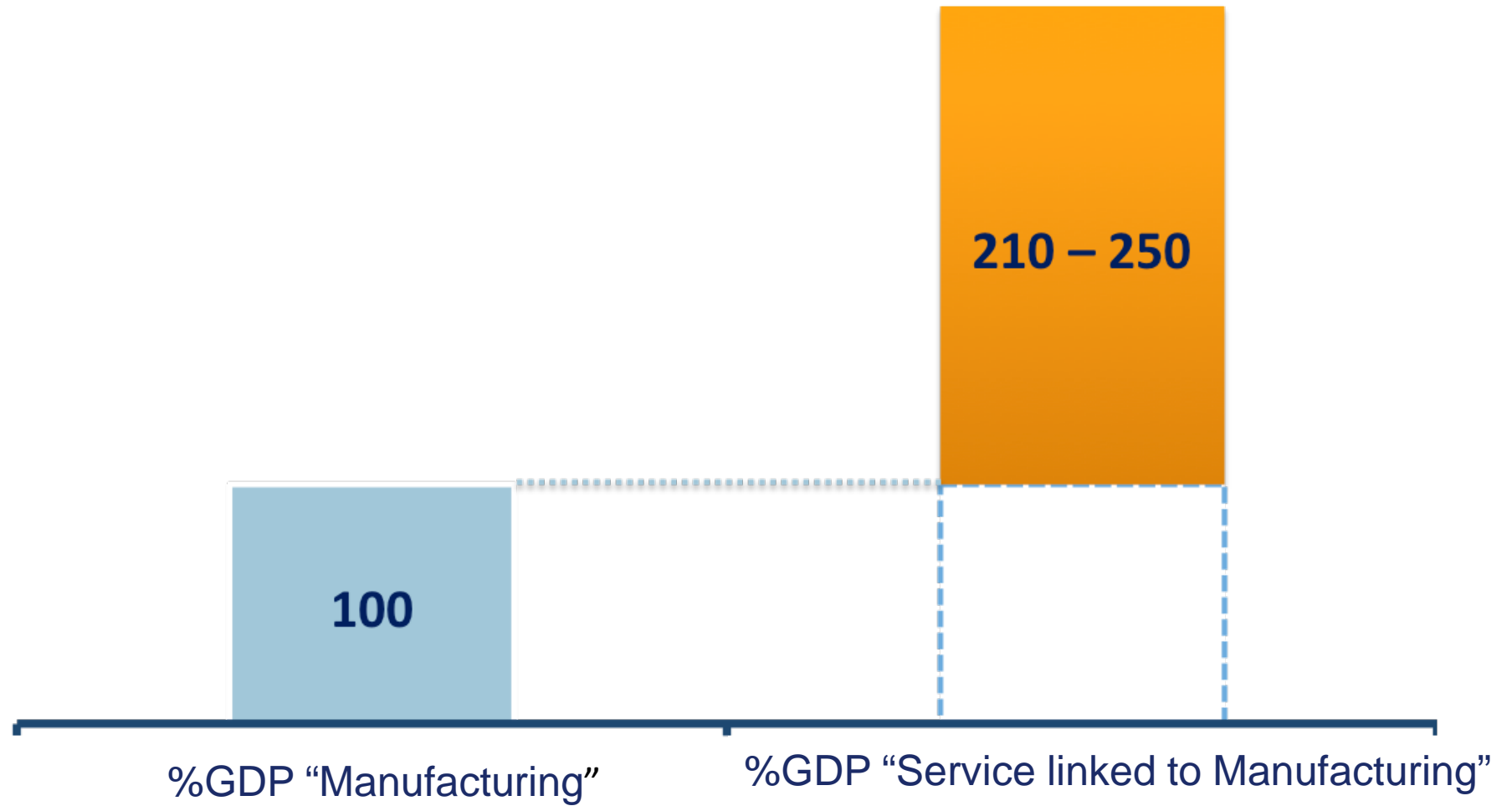
Manufacturing Value Added by % of GDP – year 2014

Source: The World Bank

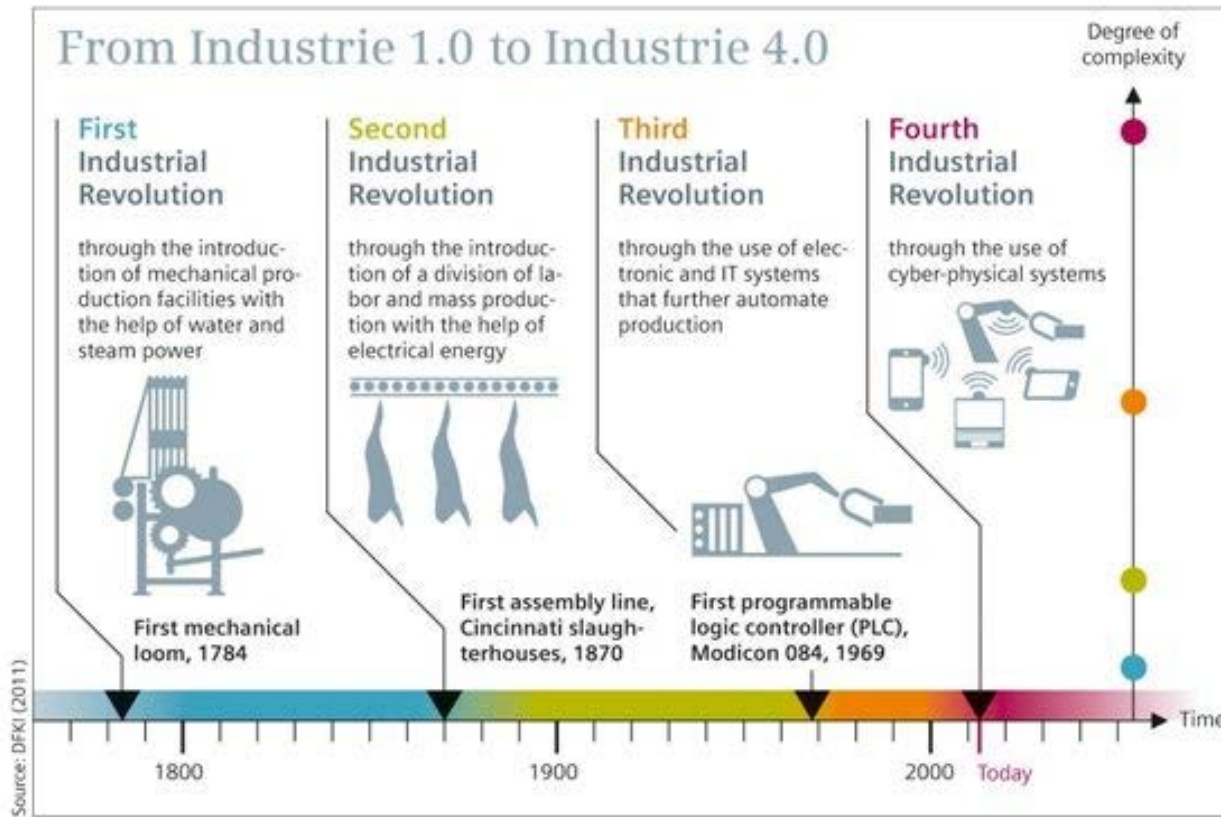
*Last period with available information



The Manufacturing sector as the powerhouse of the economy



Industry 4.0



1st: water and steam power in production of products

2nd: Taylorism division of labor, assembly lines, use of electric energy

3rd: Automation-electronics - Numerically controlled machines; PLC

4rd: "cyber-physical systems"- pervasive use of real and virtual data in the whole product life cycle

The enabling technologies



BIG DATA



INTERNET OF THINGS



AUTOMATION
ROBOTICS



CLOUD COMPUTING
& CYBER SECURITY



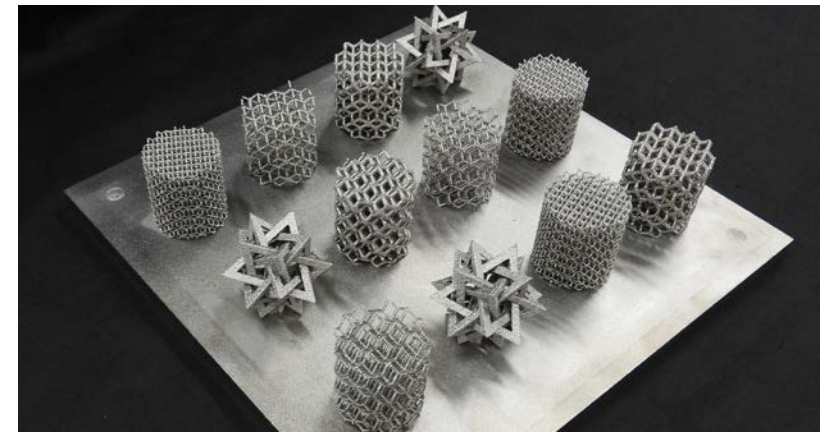
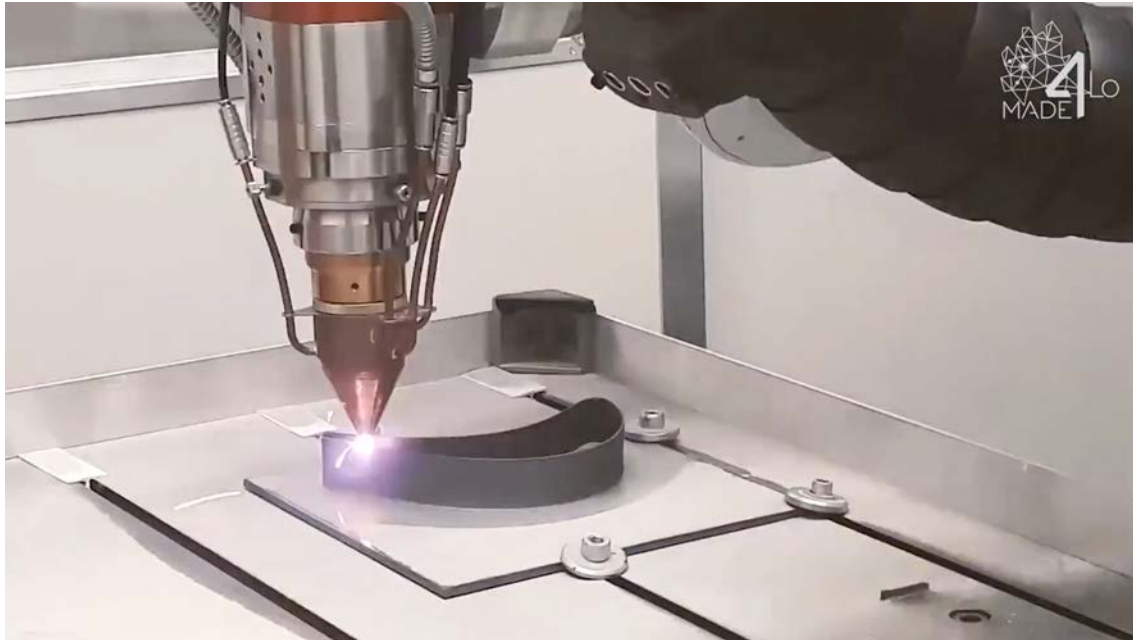
HUMAN MACHINE
INTERFACES



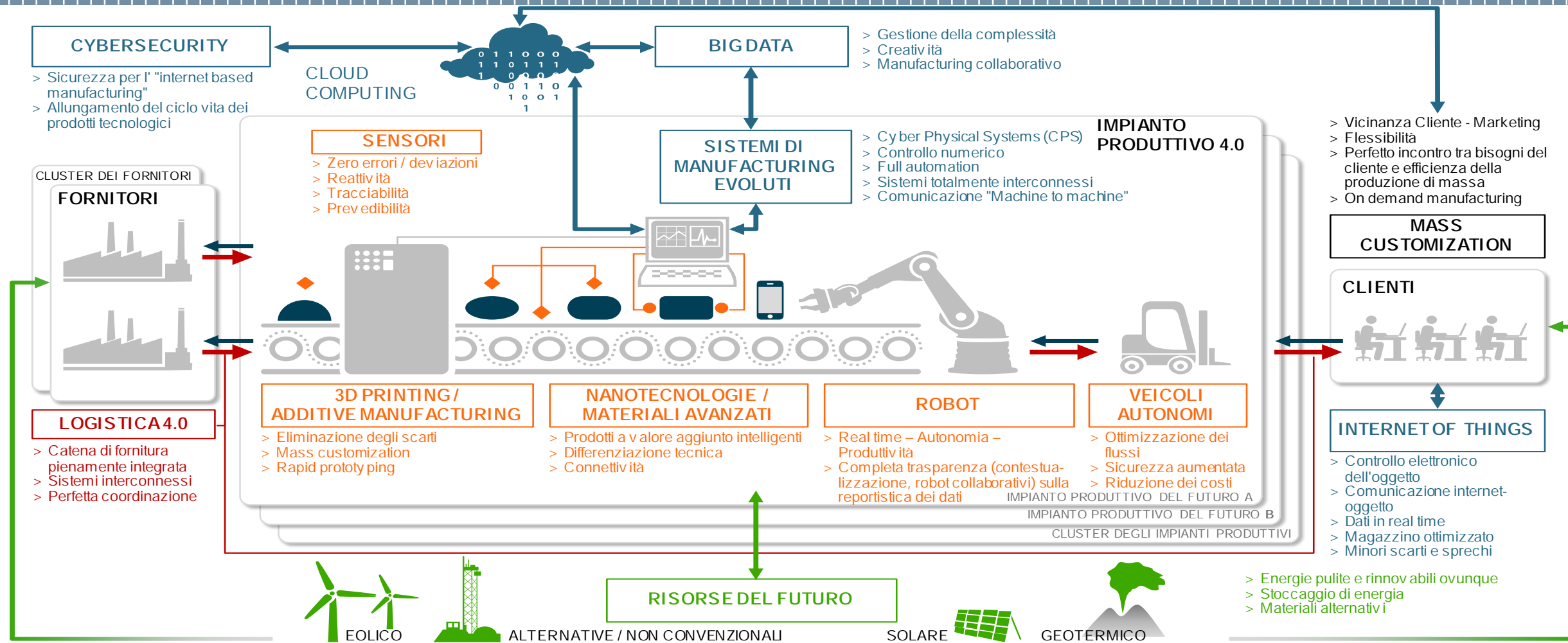
ADDITIVE
MANUFACTURING



New technologies – New challenges



The Factory 4.0. new technologies, new challenges



* ROLAND BERGER

Building an Industry 4.0 Competency Framework

BY TALENTTALKS ON FEBRUARY 5, 2019

“Power is competence” – Jordan Peterson

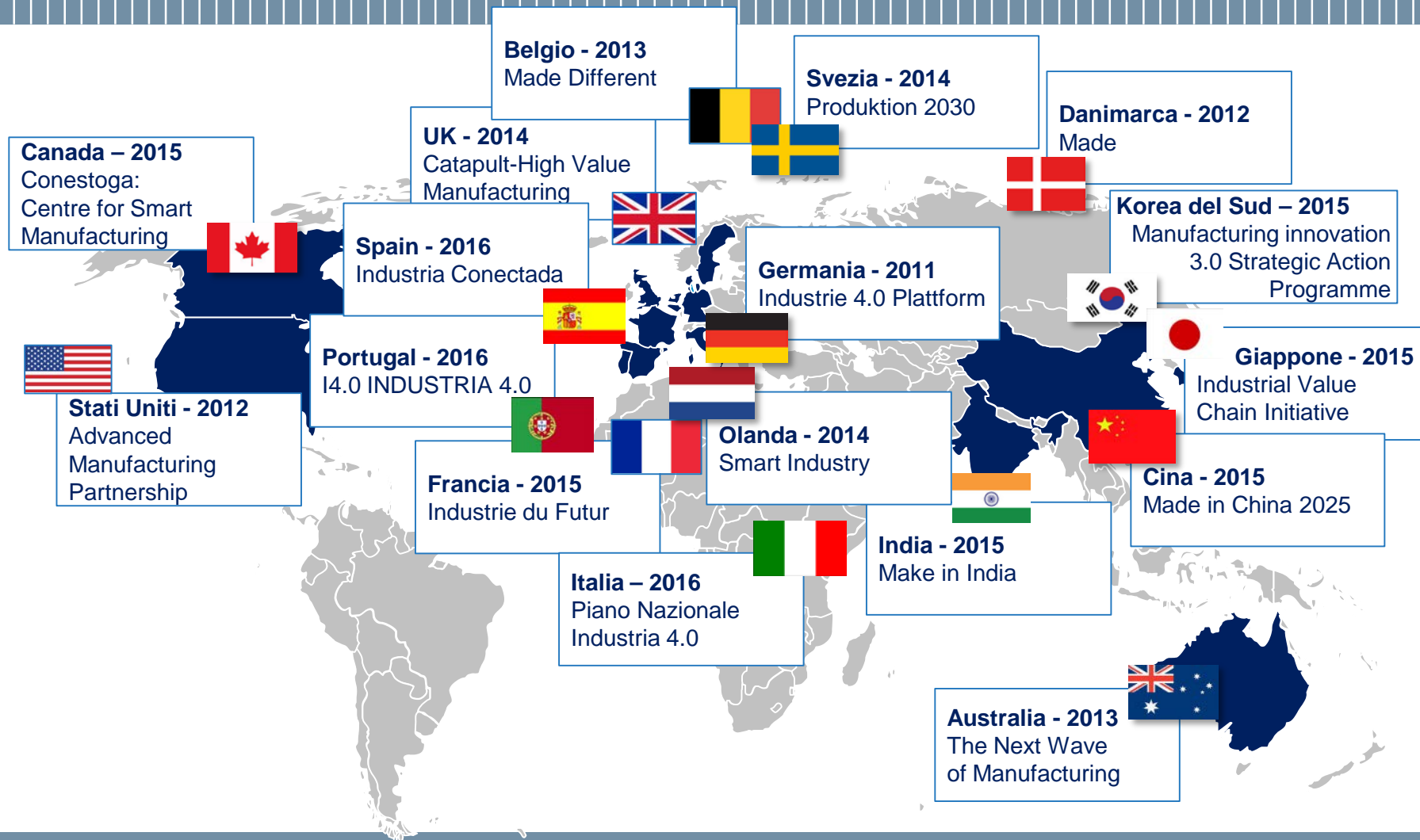
The transformational impact of Industry 4.0 (I4.0) means that employees will need to adapt on every front.

“I4.0 will influence our working environments significantly. E.g., it will change processes in purchase, production, manufacturing, sales or maintenance by including concepts as smart manufacturing, smart maintenance as well as a high degree of automation and integration in all enterprise processes. It will have far-reaching implications on business value creation, business models, downstream services, and work organization. As a consequence, employees will be confronted with transformed work processes and business models as well as with new technologies. The model of work organization will transform due to the disruptive nature of emerging technologies and modified structures for communication and collaboration. Processes will become interconnected and more complex. The technical, organizational and social spheres of work activities will overlap. The way we work will be one of the most affected changes in I4.0.

I4.0 will not only affect technology and production, but the way we will work in all its dimensions.

Due to these transformational impacts to adapt and flourish employee's competencies need to adapt and evolve.

Industry 4.0 in the world



1st year

- Accounting, finance and control (10 CFU) – semester:1
- Strategy and Marketing (10 CFU) – semester:1
- Leadership & Innovation (10 CFU) – semester: 2

3 out of 4 among:

- Industrial Technologies (10 CFU) – semester: 1-2
- Quality Data Analysis (10 CFU) – semester - 2
- Logistics management (10 CFU) – semester: 1-2
- Operations management (10 CFU) – semester: 1-2



2nd year

- Manufacturing System Engineering I (5 CFU)
- Advanced Production Systems (5 CFU)
- Industrial Automation, Communication and Data Management (5 CFU)

- Smart Manufacturing Lab (15 CFU)

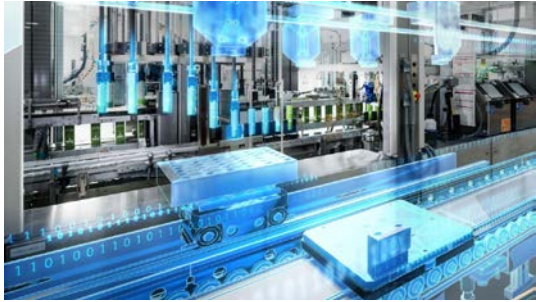
5 credits among:

- Additive Manufacturing
- De-Manufacturing
- Safety Engineering and Management
- International Distribution
- Management of Design and Innovation Projects

14 CFU – Free LM

15 CFU: Final Thesis





MANUFACTURING SYSTEMS ENGINEERING I

The course provides a framework, quantitative methods and relevant competences to design manufacturing systems and to manage their lifecycle in coordination with the lifecycle of products and processes in order to enhance the industrial competitiveness.



ADVANCED PRODUCTION SYSTEMS

The students will learn how the automation and digital technologies (i.e. Industry 4.0) are effecting the future manufacturing systems, both in the process industry as well as in the discrete manufacturing systems



INDUSTRIAL AUTOMATION, COMMUNICATION AND DATA MANAGEMENT

The goal of this course is to provide the students with a general view of the current methods and tools offered by the Information Technology for the smart factory: industrial automation, industrial and collaborative robots, IoT protocols, platforms; data integration and analysis


The course aims at giving the students the opportunity to face real problems in a real manufacturing environment

The Smart Manufacturing Lab will pursue this perspective to tackle relevant manufacturing problems concerning cyberphysical systems, digital twins, simulation, IoT based maintenance, (big) data analysis for I4.0

The students will work in strict contact with the manufacturing companies (**internship**) pursuing the “action-based learning” approach used in the “learning factory”, interacting in a professional environment in a responsible and constructive way, working in a group, planning and coordinating roles and activities within the group.

Management Engineering – Track Industry 4.0

Integrated Plan for Semester I and II

	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	Maj-20	Jun-20	Jul-20
	ADVANCED PRODUCTION SYSTEMS (Prof. M. Taisch)										
 September 20th 2019 8:30 – 11:00 Room B8 0.1			SMART MANUFACTURING LAB		EXAMS SESSION		SMART MANUFACTURING LAB			EXAMS SESSION	
	MANUFACTURING SYSTEMS ENGINEERING I (Prof. T. Tolio)										

The Smart Manufacturing Laboratory is organized on two semesters, from November 13th 2019 to June 5th 2020.

The students will be required to take an internship in a company.

There will be two options for the internship:

1. From November 2019 to March 2020
2. From March 2020 to May 2020