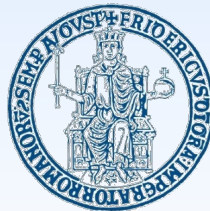


THE GREAT CHANGES IN THE 4TH INDUSTRIAL REVOLUTION

Prof. Luigi Nicolais



AUTOMATICA.IT 2017

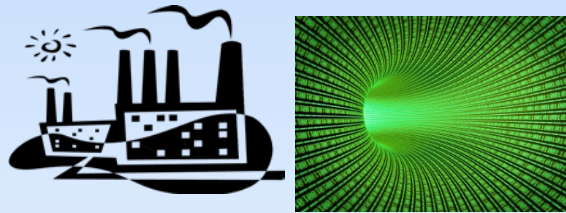
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Politecnico di Milano – Piazza Leonardo da Vinci 32, Milano – Aula De Donato



CHANGES

Production area and technology



Centrality of innovation and knowledge for competitiveness in a global market

Institutions



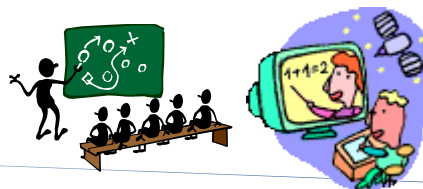
Different distribution of power and responsibilities, supra-national and territorial policies

Economic system



Reduction of the role of raw materials, impossibility of monetary devaluation and the need to start new policies for re-industrialization

Educational area



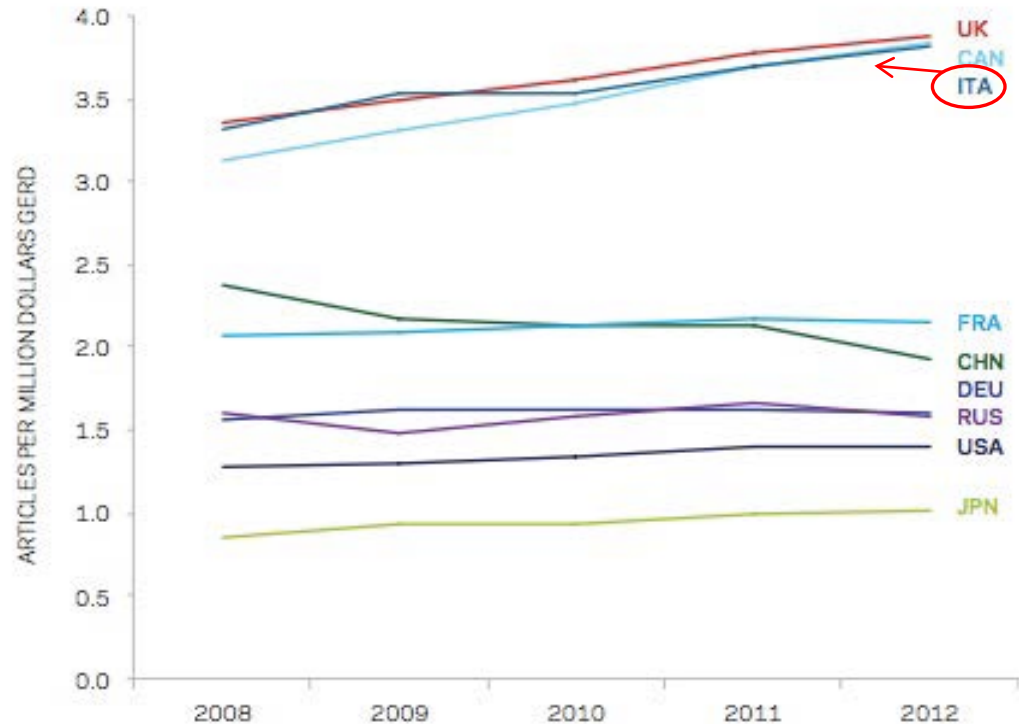
New teaching systems and disciplines; more complexity and differentiation in the curricula; increasing the role of University and public research centers in the innovation policies



ITALIAN SCIENTIFIC PRODUCTION

Data show that productivity of Italian researchers is of a high standard. In fact, **Italy has published 3.5 articles per million dollars invested in research and development**, recording levels of productivity and growth rates very similar to Canada and second only to the UK.

Amount of publications in function of total expenditure on research. (GERD) 2008-2012

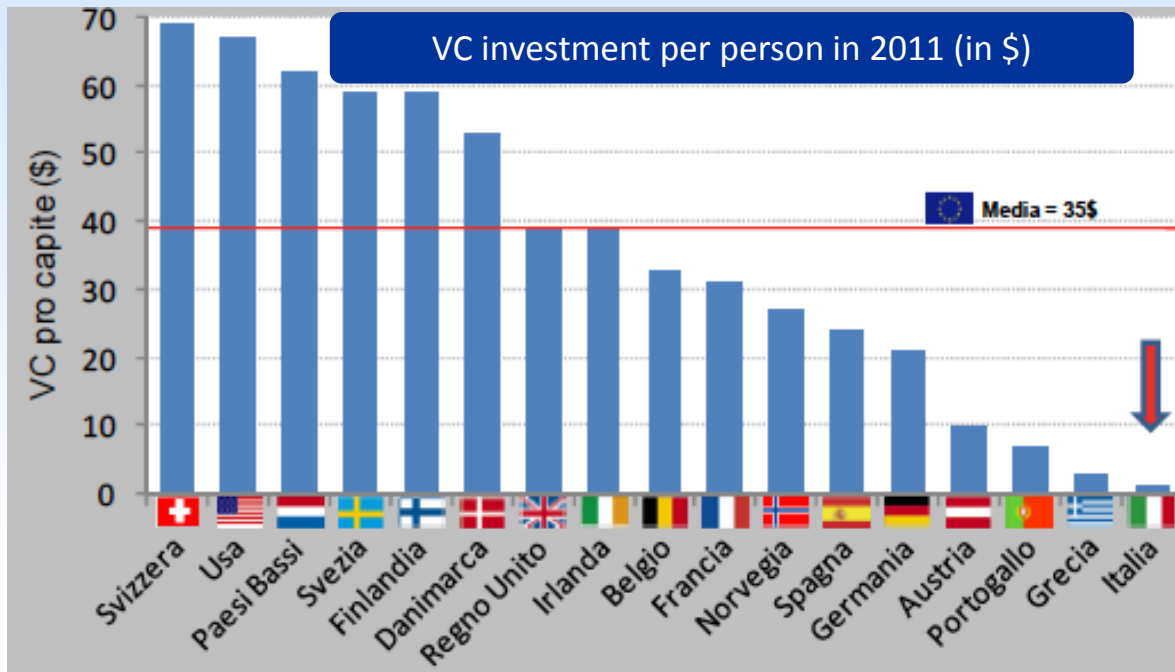


Source: scopus and OECD MSTI 2013/1



INVESTMENT PER PERSON “VENTURE CAPITAL”

Venture Capital (VC) contributes to the development of the country's economy. Venture Capital investments in innovative start-up promote high-profile employment opportunities for young people and industrial development



**Italy is last, with
0.82\$/person**

Source: Steffen Wagner, Lucas Lab (Investiere Venture Capital)



INDUSTRY 4.0

Computerization of business processes, increasingly automated and interconnected production, and the arrival of the *Internet of Things* in the factories, established the beginning of **Fourth Industrial Revolution** from which Industry 4.0 is derived.

Industry 4.0 is “the comprehensive transformation of the whole sphere of industrial production through the merging of digital technology and the internet with conventional industry” (German Chancellor Angela Merkel - *Organization for Economic Co-operation and Development*, 19 February 2014). **The Fourth Industrial Revolution is above all a SOCIAL CHANGE OTHER THAN TECHNOLOGICAL.**

This process of transformation is driving companies to seek and train professional profiles with **transversal skills** and **knowledge in emerging technologies and innovation management.**



INDUSTRY 4.0

INDUSTRIAL REVOLUTION	TIME PERIODS	TECHNOLOGIES AND CAPABILITIES
First	1784 – mid 19th century	Water- and steam-powered mechanical manufacturing
Second	Late 19th century – 1970	Electric-powered mass production based on the division of labour (assembly line)
Third	1970 – Today	Electronics and information technology drives new levels of automation of complex tasks
Fourth	Today – Future	Sensor technology, interconnectivity and data analysis allow mass customization, integration of value chains and greater efficiency

Source: European Parliamentary Research Service (EPRS), Industry 4.0 – Digitalisation for productivity and growth, 2015



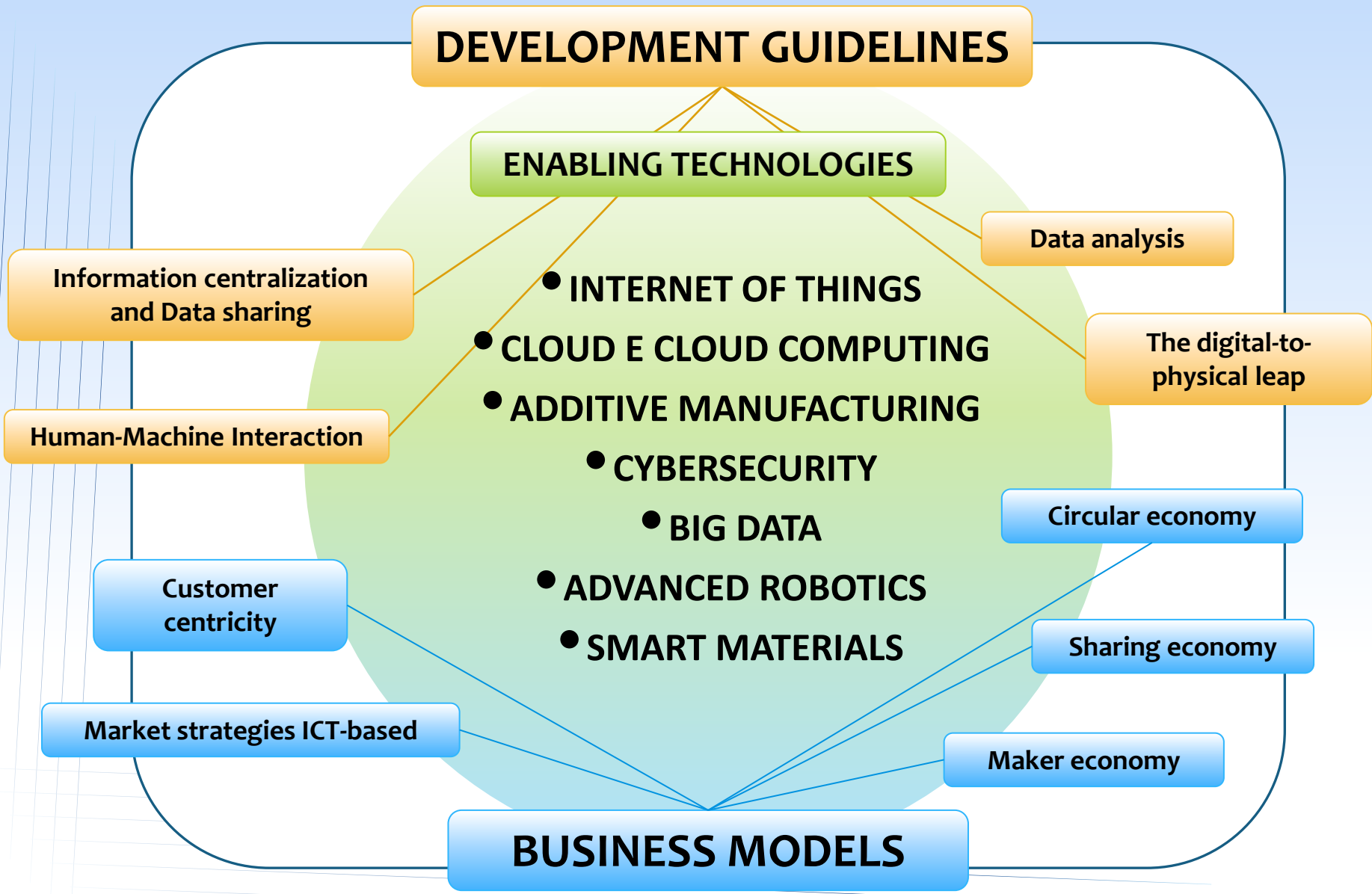
INDUSTRY 4.0

STRENGTHEN RELATIONSHIP BETWEEN
ACADEMIA AND INDUSTRY





INDUSTRY 4.0

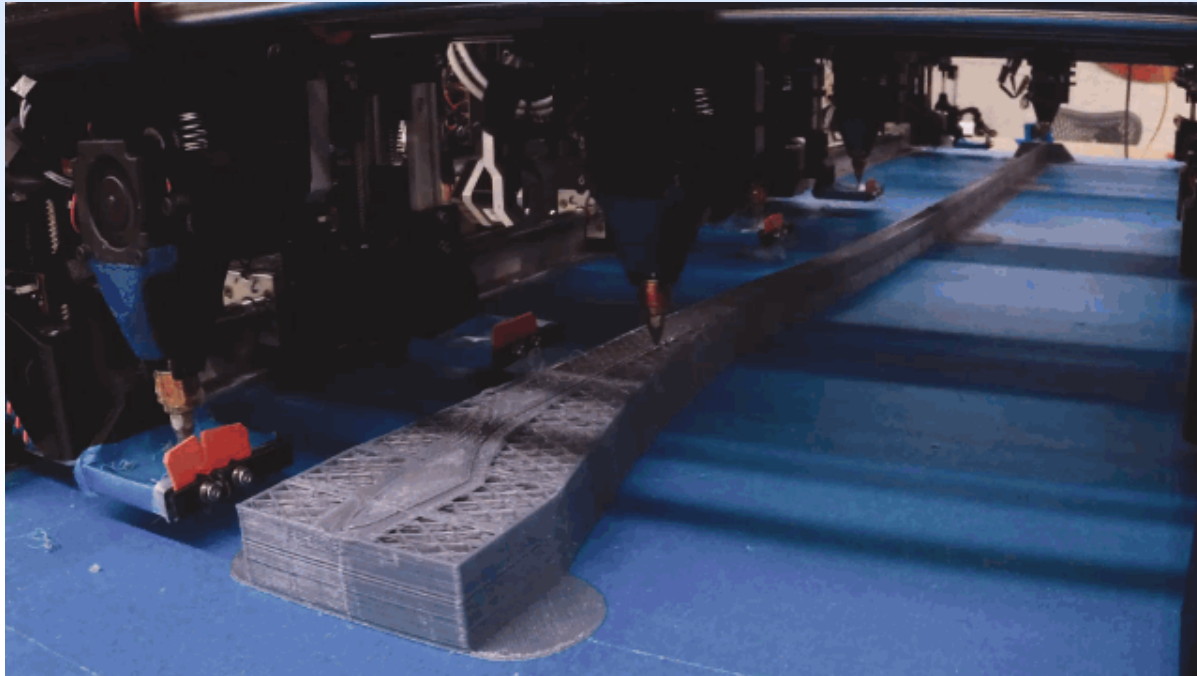




INDUSTRY 4.0 – ENABLING TECHNOLOGIES

ADDITIVE MANUFACTURING/3D PRINTING

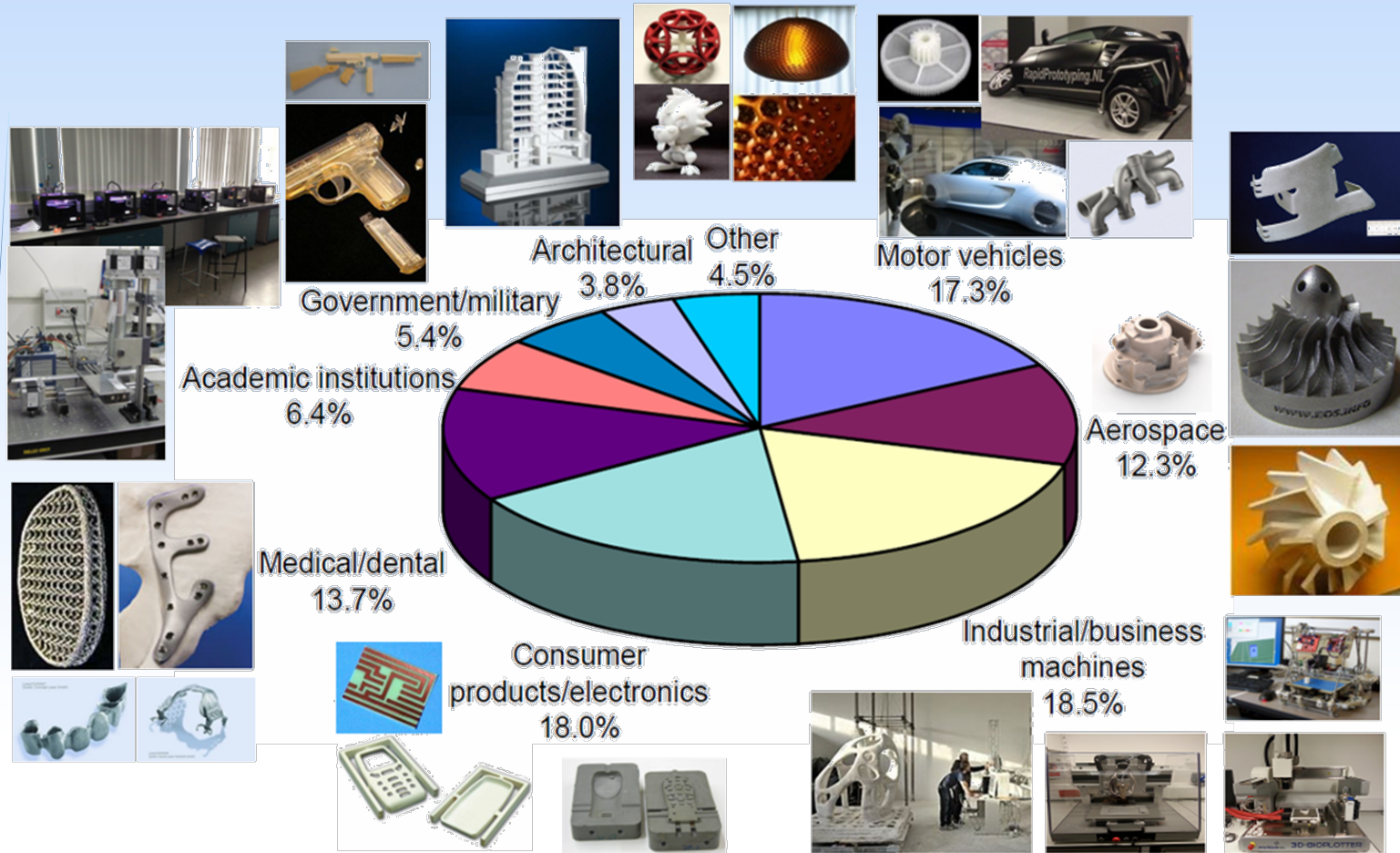
A process for the **production of three-dimensional objects/articles with different shape and waste reduction**, starting from a digital model; it allows costs optimization throughout logistics chain and distribution process.



Autodesk's Project Escher - 3-D printing of slice of turbine



MAIN APPLICATION FIELD OF 3D PRINTING



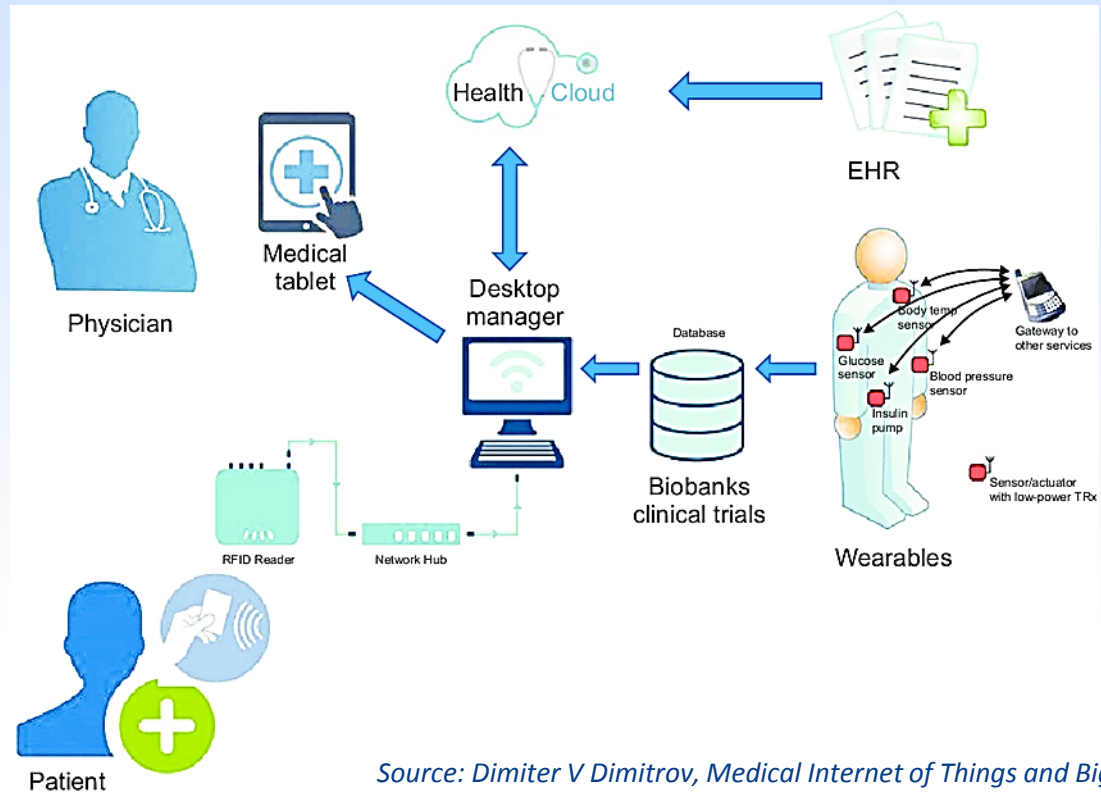


INDUSTRY 4.0 – ENABLING TECHNOLOGIES

INTERNET OF THINGS

Medical Internet of Things and Big Data in Healthcare

"Internet of Things" means a **device capable of detecting and processing quantities in the real world** (temperature, lighting, humidity, etc.) in order to achieve a function or added value **by sharing such information with other devices or machines.**



Source: *Dimitar V Dimitrov, Medical Internet of Things and Big Data in Healthcare, Healthcare Informatics Research, 2016*



INDUSTRY 4.0 – ENABLING TECHNOLOGIES

ADVANCED ROBOTICS

In the field of industrial robotics, collaboration between man and machine will be the future trend with **collaborative robots** or “**cobots**”: systems able to work side by side with man and in total security without the traditional separation barriers, equipped with sensors and vision devices that can perceive the external environment. Through **Artificial Intelligence technologies** it's possible to build synergy with collaborative robots **to contain error margins, simplify controls, and optimize production processes.**



AURA Comau's innovative proposal for advanced robotics: the robot perceives the proximity of objects and people through specific sensors, identifies the work area using a laser scanners and transmits to a central server collected data thanks to an integrated vision system.



INDUSTRY 4.0 - DEVELOPMENT GUIDELINES

INFORMATION CENTRALIZATION AND DATA SHARING

The advantages of a combination of **centralized information management system** with a **distributed system** (operational delocalization), **provide the possibility to control and track resources from anywhere in the company**, creating a consistent and efficient environment.



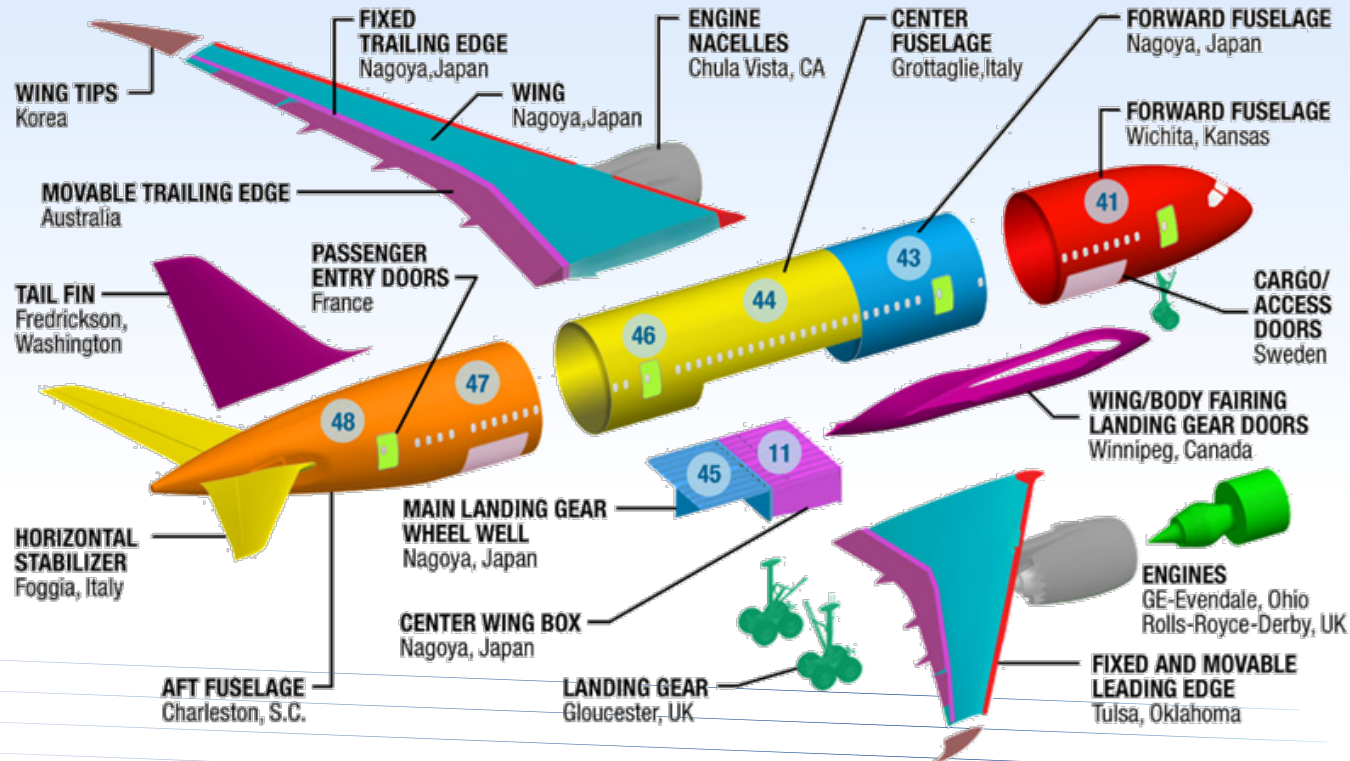


CENTRALISATION OF INFORMATION AND DATA SHARING

The aeronautic case: BOEING 787

THE COMPANIES

U.S.	CANADA	AUSTRALIA	JAPAN	KOREA	EUROPE
Boeing	Boeing	Boeing	Kawasaki	KAL-ASD	Messier-Dowty
Spirit	Messier-Dowty		Mitsubishi		Rolls-Royce
Vought			Fuji		Latecoere
GE					Alenia
Goodrich					Saab



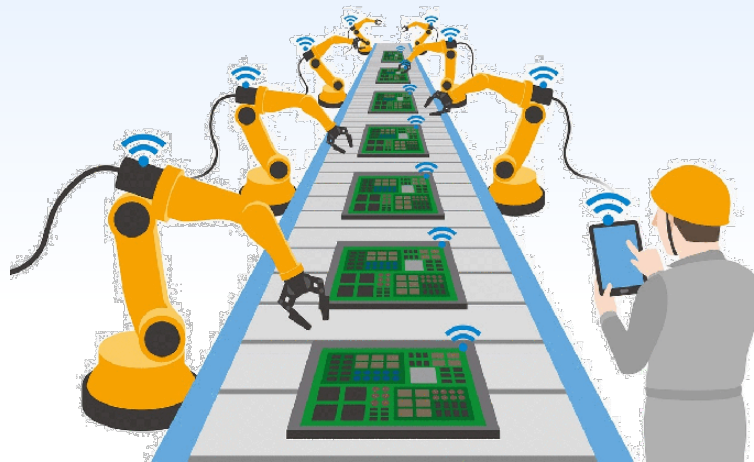


INDUSTRY 4.0 - DEVELOPMENT GUIDELINES

HUMAN-MACHINE INTERACTION

Large-scale industrial use of machines and robots has led to a substantial **increase in productivity, lowering production costs**. Along with advances in technology, it has been possible to obtain machines that are increasingly independent from the human operator and able to operate more autonomously within the working environment.

Such technological solutions will **not reduce employment**, but will lead companies to **select more and more qualified staff**.





INDUSTRY 4.0 – BUSINESS MODELS

Industry 4.0 is based on **two fundamental aspects**:

- **the improvement of company through the use of new technologies;**
- **a new competition models based on disruptive business models that were unworkable in the past due to lack of proper technology development.**

The main disruptive business models of I4.0 are:

- customer centricity**
- circular economy**
- sharing economy**
- market strategies ICT-based**
- maker economy**



INDUSTRY 4.0 – BUSINESS MODELS

CUSTOMER CENTRICITY

The customer is more and more at the center of industrial value chain. Companies respond quickly to service requests or complaints, anticipating customer's needs and desires in an innovative and proactive manner.

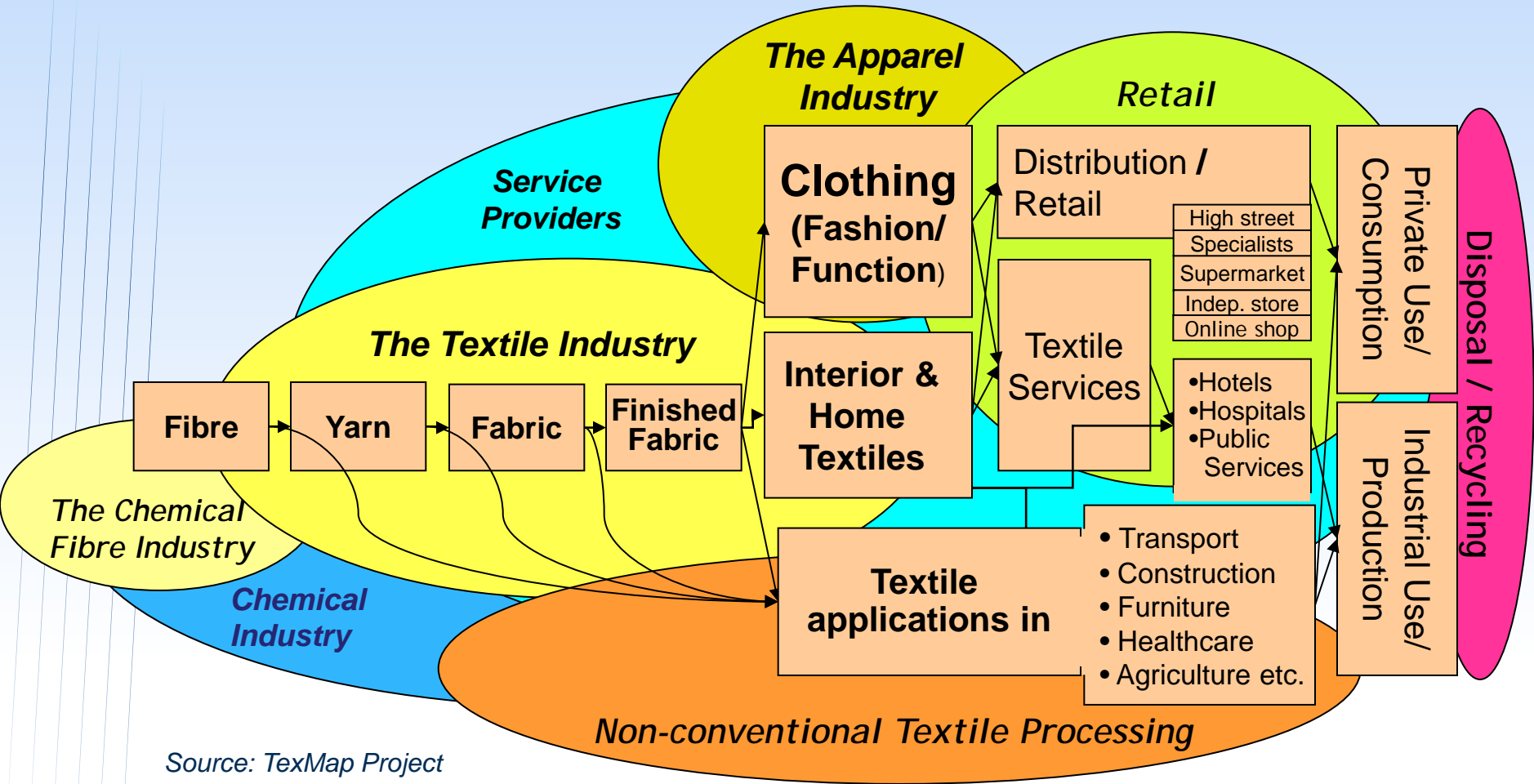
This business model is already used by some of the best companies: Cisco Systems has among its main values the customer centricity; Allianz the customer focus and Yahoo! the customer fixation.





CUSTOMER CENTRICITY

THE CASE OF TEXTILE INDUSTRY



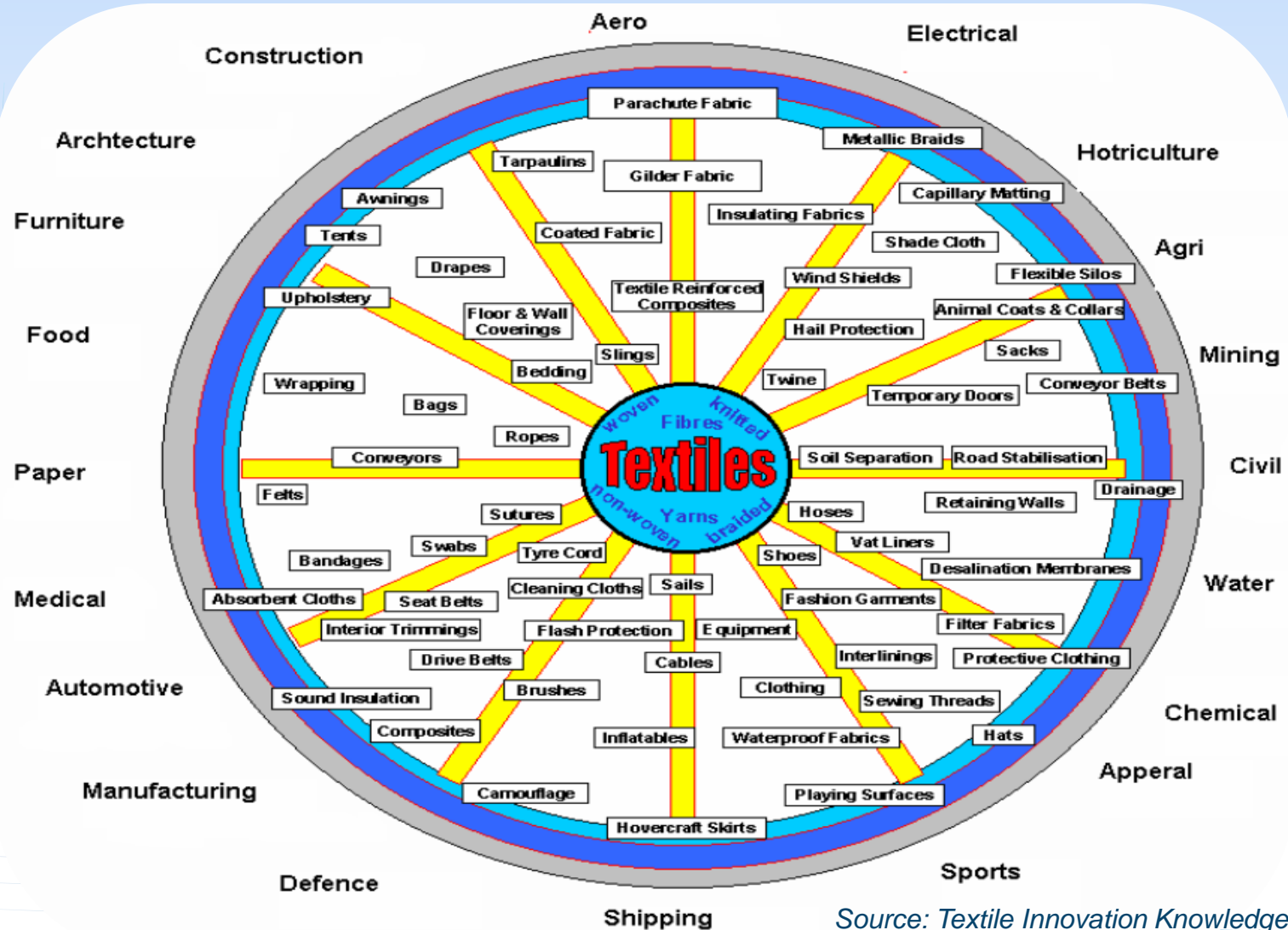
in addition:

- machinery and production equipment suppliers
- suppliers for testing and control equipment
- software providers; other services and intermediaries



CUSTOMER CENTRICITY

THE FUTURE OF TEXTILE



Source: Textile Innovation Knowledge Platform



INDUSTRY 4.0 – BUSINESS MODELS

CIRCULAR ECONOMY

The need for a gradual, but inevitable, shift from linear economy (extremely expensive in terms of resource usage) to circular economy entails a paradigm shift in defining products and manufacturing processes that need to be designed, managed and monitored to be re-used.

The concept of "**design-use-recycling-reuse**" responds to two requirements:

- **reduction of environmental impact** of economic activity
- obtainment of savings by **avoiding waste and reducing raw material supply costs**.





CIRCULAR ECONOMY

POLYMER RECYCLING



There are several strategies for polymer recycling and realization of high quality products:

- Depolymerization
- Rebuilding of molecular structure through reactive polymerization
- Addition of fillers
- Polymer blend formation by compatibilizing agents



NIKE™: recycled PET plastic bottles for superior performance apparel



INDUSTRY 4.0 – BUSINESS MODELS

MARKET STRATEGIES ICT-BASED

Technologies that drive Industry 4.0 make available in real time a large amount of information, resulting in an improvement in efficiency and in the emergence **of new market strategies that bring the product closer to the consumer**, based on even more symmetrical information on the use of that product, making possible a business model in which the manufacturer, instead of selling the good, rents it to the consumer and cares for maintenance.



Some of these strategies are the **global online virtual stores**, services and products for new needs and lifestyles (**telemedicine, e-learning, digital music, digital publishing**, etc...), Infrastructure as a Service (**CPU rental, storage, network and other resources**), **leasing** and more.



INDUSTRY 4.0 – BUSINESS MODELS

SHARING ECONOMY

New business models also include sharing economy, **the economy generated by optimized and shared allocation of space, time, goods, services and resources through digital platforms.**



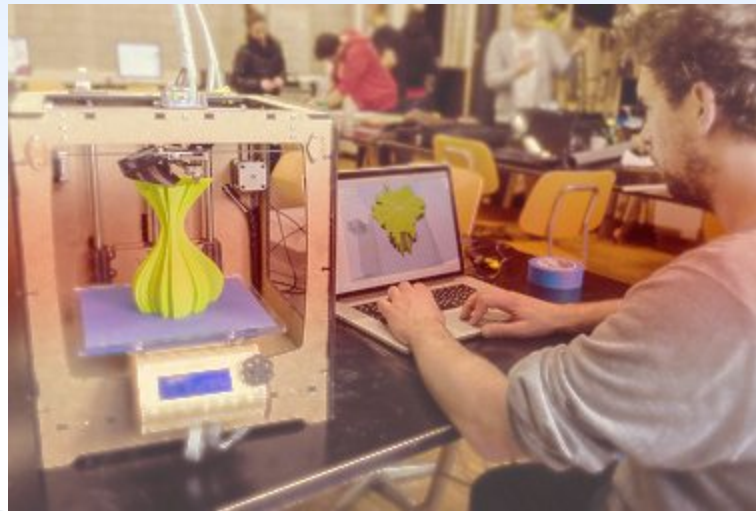
Some collaborative network models are:

- Mobility: **car-sharing, car-pooling, bike-sharing;**
- Travel: couch-surfing, co-farming; **Blablacar;**
- Accomodation: **Private-Rented Airbnb Platforms,** co-housing;
- Social Eating;
- Work: **coworking.**

INDUSTRY 4.0 – BUSINESS MODELS

MAKER ECONOMY

The maker economy is a form of economy that comes from the bottom (**digital craftsmanship**), and represents the horizon of reference for artisans who are evolving into digital artisans. Basically, these are **hand-made forms of self-production that exploit and integrate innovative technologies and ideas**. The **digital maker can create revolutionary prototypes and control robots and especially 3D printers**, symbol of the ongoing revolution.





INDUSTRY 4.0

DEVELOPMENT GUIDELINES

ENABLING TECHNOLOGIES

- INTERNET OF THINGS
- CLOUD E CLOUD COMPUTING
- ADDITIVE MANUFACTURING
- CYBERSECURITY
- BIG DATA
- ADVANCED ROBOTICS
- SMART MATERIALS

Data analysis

The digital-to-physical leap

Information centralization and Data sharing

Human-Machine Interaction

Circular economy

Sharing economy

Customer centricity

Maker economy

Market strategies ICT-based

BUSINESS MODELS



THANK YOU

La Luce della Scienza cerco
e 'l beneficio (Leonardo da
Vinci)

*I'm looking for the Light of
Science and its benefit*



Leonardo da Vinci

CNR (Rome), Sala Marconi – A. Achilli 1936-1937