



Industry 4.0

Value Chain and Enabling Technologies

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Bologna, 20th of March, 2017



Agenda

1. A short brief about Leonardo
2. Introduction about Industry 4.0
3. Product Line Efficiency and Value Chain
4. Technologies, tools and capabilities for Industry 4.0
5. Industry 4.0 for Aerospace and Defence
6. Challenges and Opportunities
7. Potential Disruptions

LEONARDO

SECTORS



Helicopters



Aeronautics



Electronics, Defence and Security Systems



Space

DIVISIONS



Helicopters



Aircraft



Aerostructures



Airborne &
Space
Systems



Land & Naval
Defence
Electronics



Security &
Information
Systems



Defence
Systems

ATR
SuperJet International

DRS Technologies
MBDA

Telespazio
Thales Alenia Space



owned company



joint venture

Innovation and Technology Governance

- ✓ Identify the required technologies to face market challenges, foster their development and timely adoption to sustain current products and develop new products
- ✓ Secure the continuous improvement of the Engineering efficiency and effectiveness

Technology Innovation

- Coordination of the activities aimed at **technological scouting** adopting "**open innovation**" approaches
- Definition of the **Group technological strategies**, pinpointing e enhancing emerging innovative technologies
- Fostering and coordination of **R&D initiatives** at Group level
- **Intellectual property** valorization

Product Policy

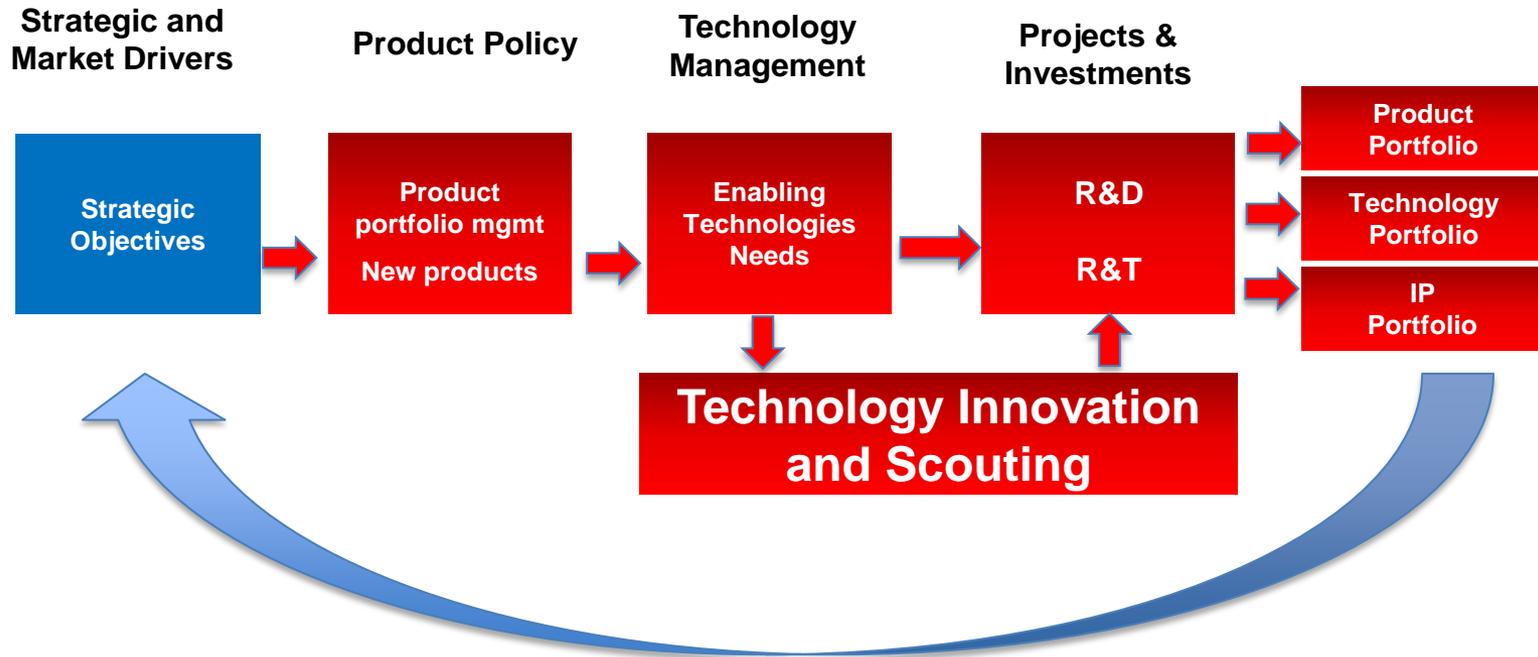
- Coordination of technological development of **strategic platforms**
- **Investment assessment** by area of competence

Engineering Excellence

- Identification of **metrics and measures** to secure the continuous improvement of Engineering
- Sharing of excellent **processes, experts, methodologies and tools** among our engineering departments

Product & Technology Innovation Plan (P&TIP)

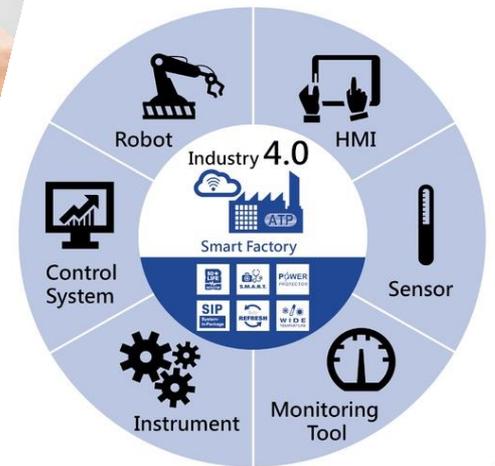
Process to support the **Leonardo Technology Governance** defining and driving the capture of the strategic objectives, enhancing our technological and product competitive advantages



Industry 4.0 - Introduction and Terms of Reference

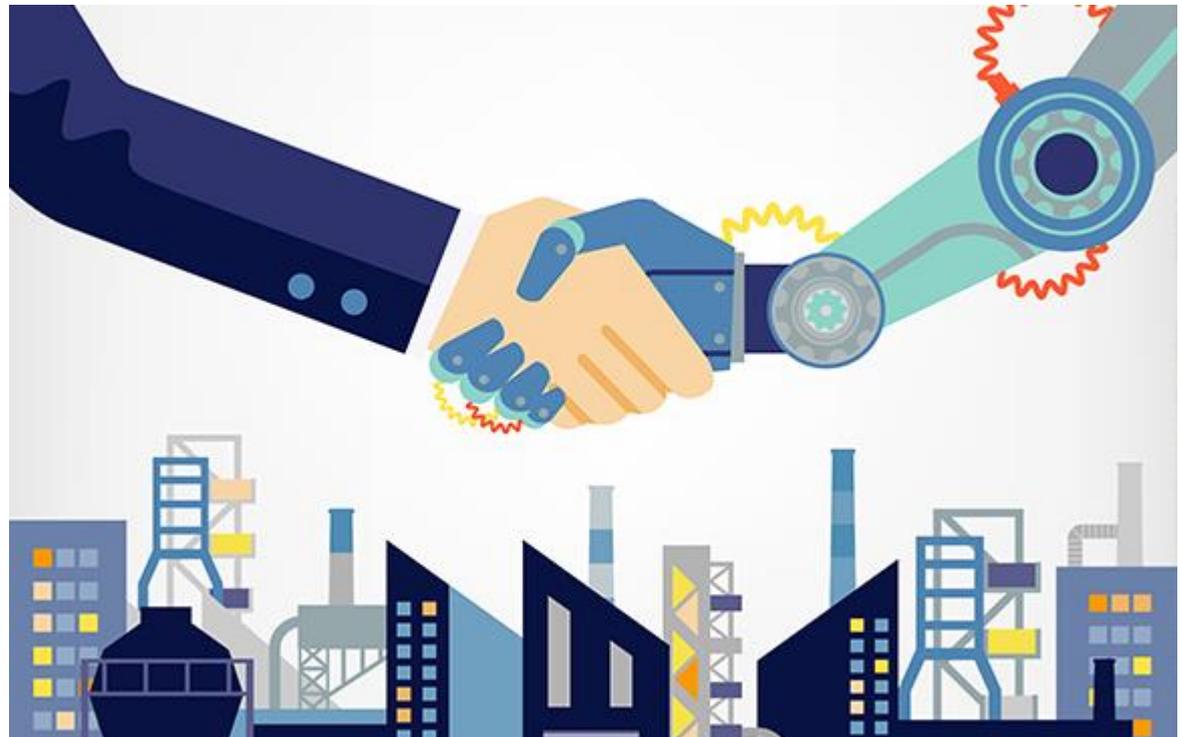


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German Chancellor Angela Merkel defined 'Industry 4.0' as

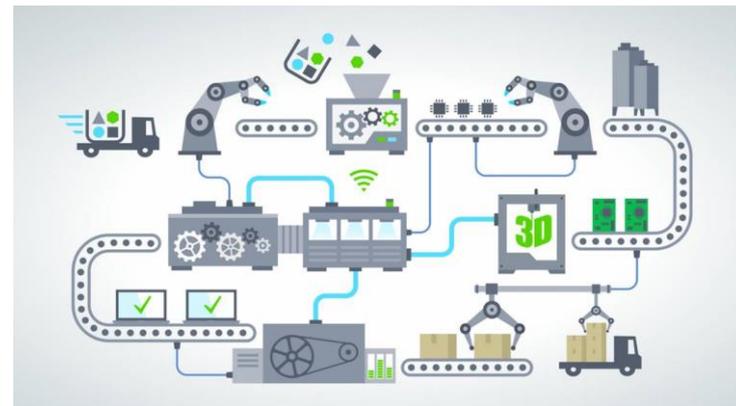
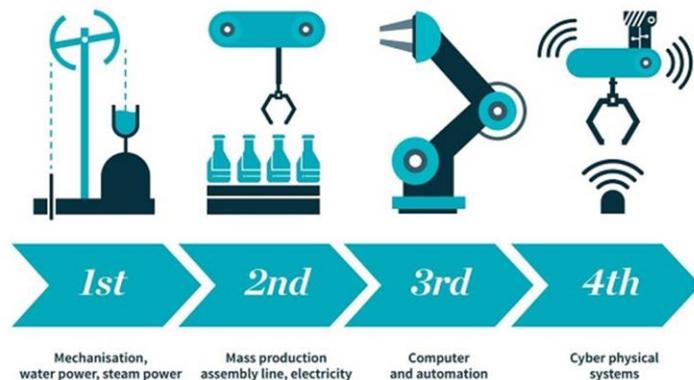
*“the **comprehensive** transformation of the **whole** sphere of industrial production through the **merging** of **digital** technology and the **internet** with **conventional industry**”*



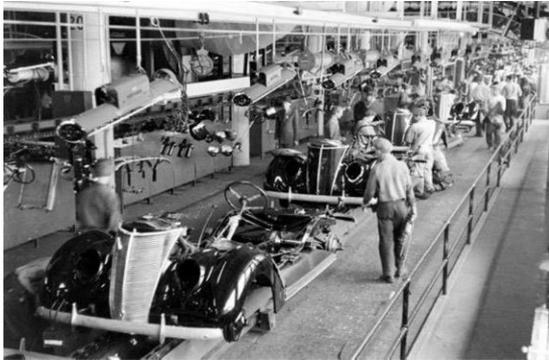
The 4th industrial revolution

According to Philippe Bartissol, VP Industrial Equipment at Dassault Systèmes, the **fourth industrial revolution** is characterized by:

- a **social production** that brings **all stakeholders together** to boost productivity and competitiveness;
- a **flexible production** schemes that enables to deliver **exactly what consumers want** and still control costs and make a profit;
- a **smart production** systems that **connects** products, machines, plants and people;
- **producing services** that provide consumers with the best **experiences** and ensure a better **margin** for producers.

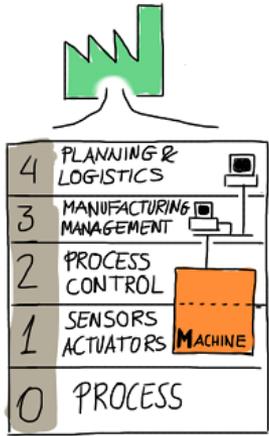


Product Line Efficiency and Value Chain (1/2)

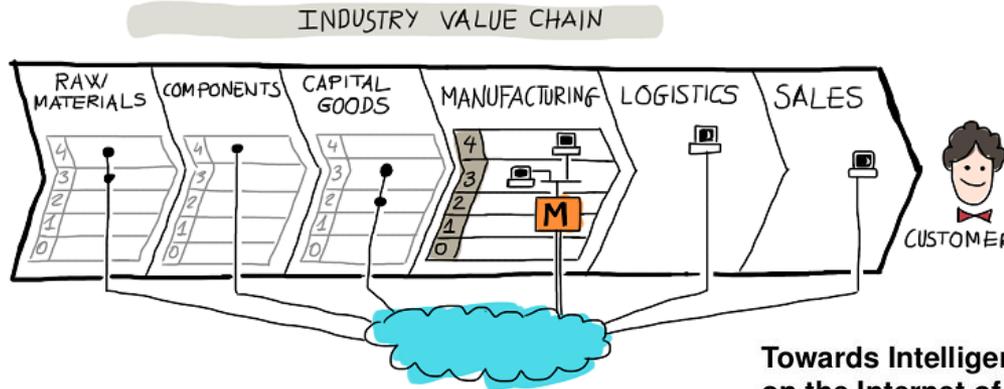


1. Batch **size** tends to be **one** without any impact on production efficiency,
2. Through the Internet, **the customer enters into the design phase** of “one-of-a-kind” products matching individual requirements,
3. Through the Internet, **the customer negotiates** product **delivery details**,
4. Through the IoT, the **entire product lifecycle is kept under control**,
5. A whole set of IoT-based and data-based **additional services (XaaS)** beyond the product can be made available,
6. Consumers becoming “**Prosumers**”,
7. Data as the **most valuable asset**,
8. Integration and **cross-fertilization** of different sectors as a success key.

Product Line Efficiency and Value Chain (2/2)

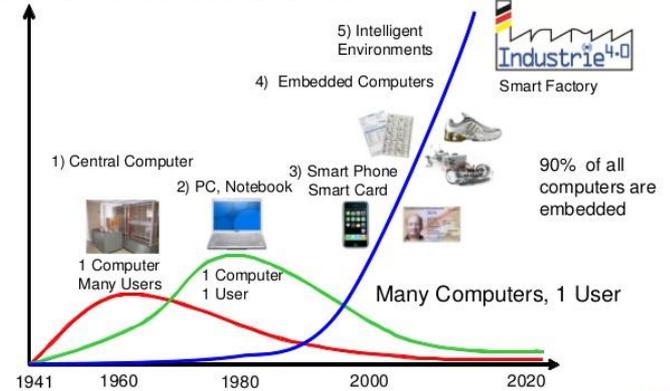


INDUSTRY 3.0

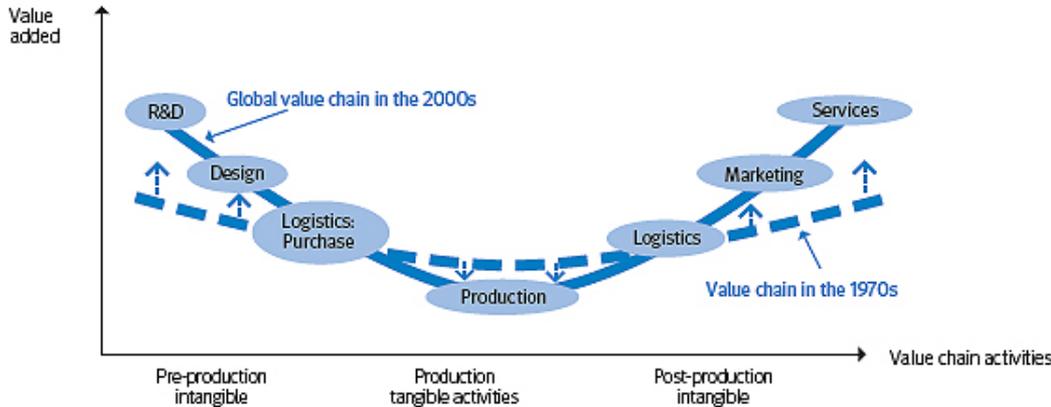


INDUSTRY 4.0

Towards Intelligent Environments based on the Internet of Things and Services



The smiling curve Value distribution along the global value chain



Source: "Interconnected Economies Benefiting from Global Value Chains", OECD 2013.

**BIG DATA
VS
RIGHT DATA**

Technologies, Tools and Capabilities for Industry 4.0 (1/2)

Industry 4.0 is grounded on a proper 'blend' of underlying technologies, tools and capabilities, effectively integrated with manufacturing:



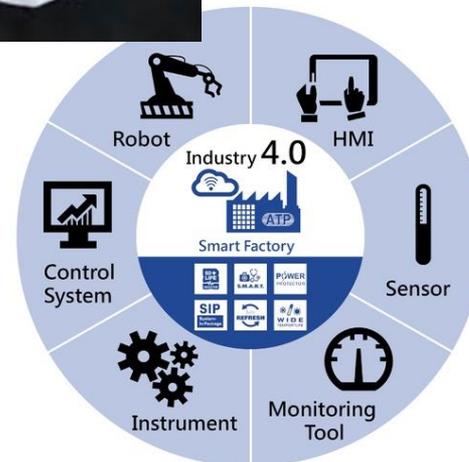
- **Microelectronics & Materials**
- **Power supply (Batt., Harv., ...)**
- **Ubiquitous sensing & computing**
- **Internet of Things**
- **Big Data and Analytics**
- **Machine Learning**
- **Processing (Multicore, FPGA, ...)**
- **Cloud computing**
- **Digital fabrication (3D Printing, ...)**
- **Advanced Manufacturing**
- **Systems Integration**
- **Augmented Reality**
- **Robotics (Cooperative Robotics)**
- **Artificial Intelligence**
- **Autonomy (Drones, ...)**
- **Communications (4G, 5G, ...)**
- **Cyber security**
- **Personal devices (wearable...)**
- **Modes of collaboration (Integration, Open Source, Open Innovation, Crowdsourcing)**
- **Customer interaction (Social Networks, Communities of Interest, ...)**

Technologies, Tools and Capabilities for Industry 4.0 (2/2)

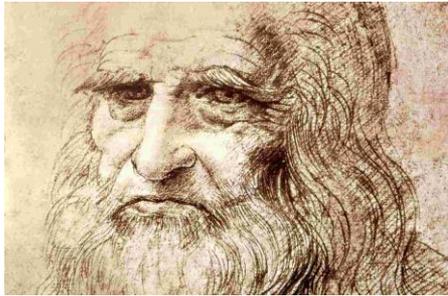
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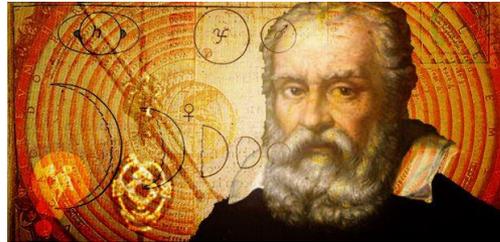
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The Right Mindset for steering Industry 4.0 change (my very personal opinion)



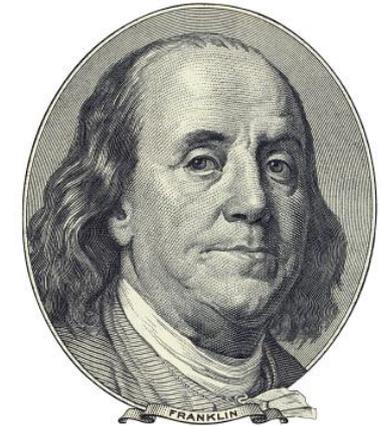
Universal genius, prime exemplar of the Renaissance man, he was an individual of unquenchable curiosity and feverishly inventive imagination. Credited with the inventions of the parachute, helicopter and tank



He played a major role in the scientific revolution of the seventeenth century. He used experiments as a research tool. He also worked in applied science and technology inventing an improved military compass and other instruments. He was tried by the Inquisition and found "vehemently suspect of heresy"



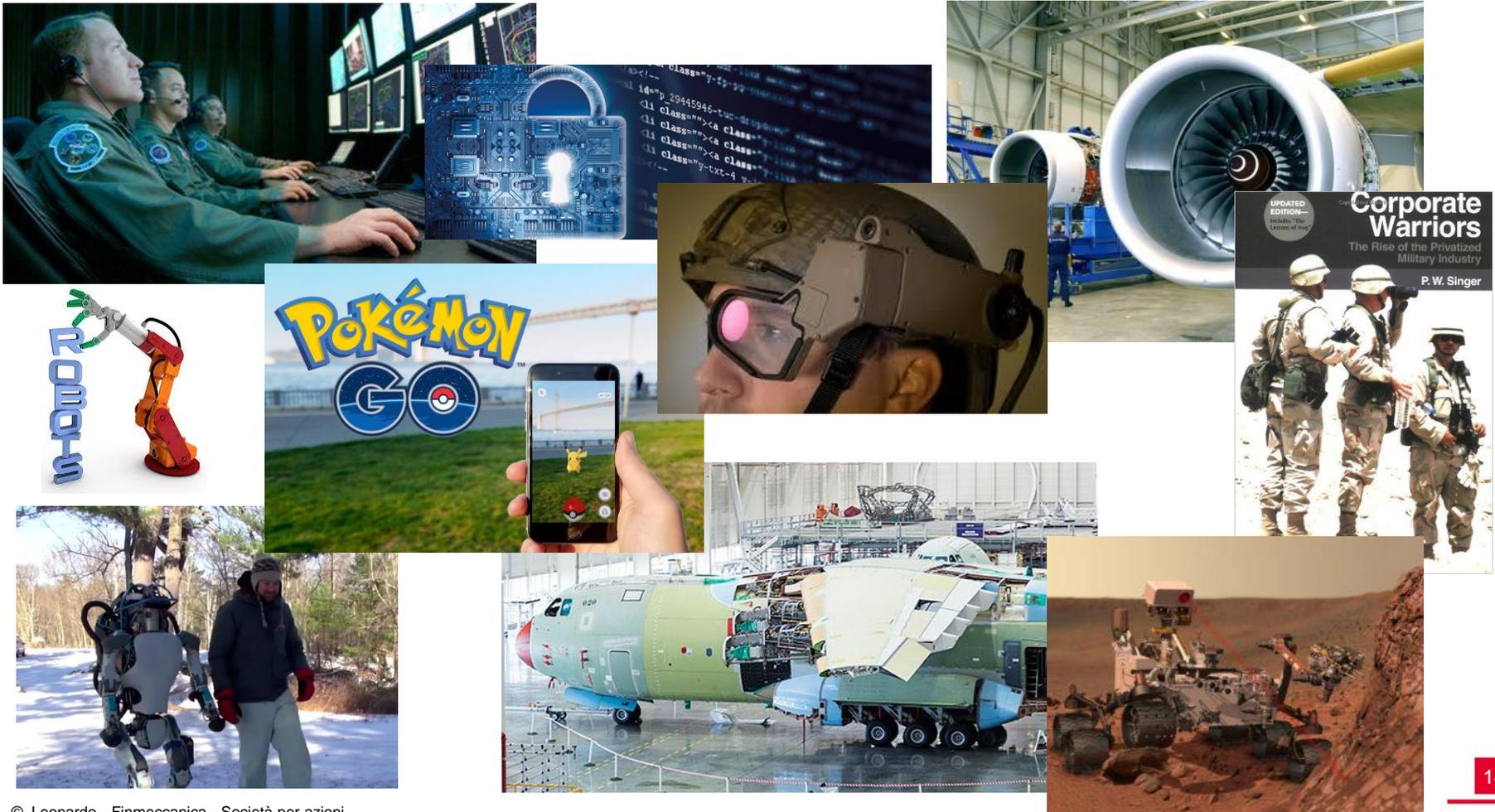
He held that passion rather than reason governs human behavior and argued against the existence of innate ideas, positing that all human knowledge is ultimately founded solely in experience



He was one of the Founding Fathers of the United States. He was a renowned polymath and a leading author, political theorist, politician, scientist, inventor, civic activist, statesman, and diplomat

Industry 4.0 for Aerospace and Defence

Aerospace, Defence and Security Sectors are among the most receptive ones to the change brought by Industry 4.0.



Example 1: Big Data and Predictive Models for Maintenance

Leonardo's co-innovation with SAP

- The innovation project about Big Data for Predictive Maintenance carried out with SAP has been awarded with a special mention in the category “ideas”
- It could have a significant impact on the business, as the first example of predictive maintenance of a Leonardo system
- It could enable a shift toward “servitization”, transforming products into services (pretty the same model Rolls Royce adopted for jet motors)



Roma Tiburtina, 9 Novembre 2016

RaaS - Radar as a Service - SAP HANA e Predictive Analytics per la Manutenzione Predittiva di Radar e di Apparatii Complessi

CATEGORIA: IDEA
MENZIONE SPECIALE

Team Leader: Alessandro Garibbo

Team: Enrico Boccola
Gianfranco Caminale
Andrea Canziani
Giovanni Di Marco
Valentino Di Prisco
Massimiliano Filippi
Elio Giusto
Vincenzo Guarino
Luigia Paccio




Lorenzo Mariani
Division Managing Director



Example 2 : Additive Manufacturing in Leonardo



Microwave waveguides for **Radar** system



Ducts for **M346** trainer



Antenna Pedestal Arms for **Radar** system



Winch case for **Helo** equipment

Challenges and Opportunities

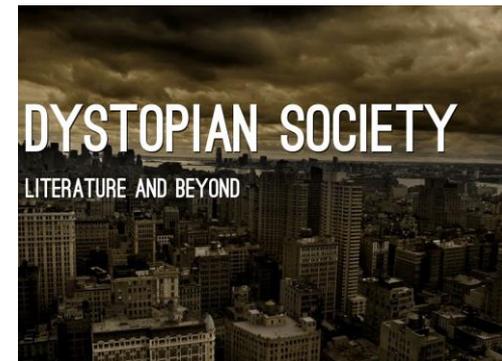
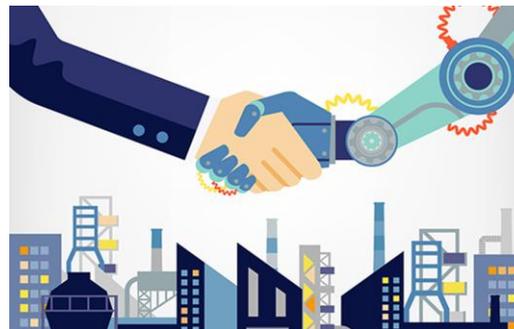
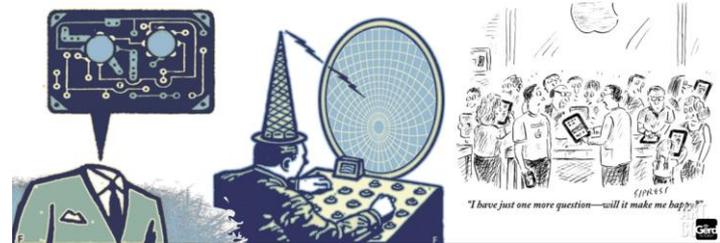


Industry 4.0

- The future of work
- Networks
- Renewable energies
- Resource efficiency
- Automatisation
- Smart grids
- Sustainability
- Flexible production
- IT skills
- Individualised mass production
- Digitalisation
- Emissions

Sources (f. l. t. r.): www.prodesignmet.de, KUKA Robotler GmbH, iStock/adventli, StralaSYS, iStock/Ontliner

Machine Thinking & Internet Centristm: all that's missing is **human** happiness!



New business models

- ❑ The potential uses of Industry 4.0 go **far beyond** the **optimisation** of production technologies. In fact, **new business models** are emerging. According to McKinsey's Cornelius Baur and Dominik Wee, new business models created by Industry 4.0 can be classified in four categories:
 - Platforms,
 - Pay-by-use and subscription-based services,
 - Licensing intellectual property,
 - Businesses that monetize data.

- ❑ However, social issues Industry 4.0 would introduce on a global scale are even more challenging, because this fourth industrial revolution is likely to **increase the gap** between the richest and the poorest countries, worsening income inequality.

What are the developments we should expect

- ❑ The majority of business models related to manufacturing and maintenance will be **reinvented**.
- ❑ The emerging concept, known as ‘**product-as-a-service**’ (→ XaaS, Offer as a Service) transforms service from a standalone function within a manufacturer to an integrated product and service offering that delivers value as the product is in use.
- ❑ Probably, a **limited number** of machinery suppliers will gain the Industry 4.0 standards competition and will impose their network-enabled products on the global market anticipating the obsolescence of most of legacy machinery.
- ❑ Countries, or regions, where SMEs have been ‘vertically’ grouped and organised in so-called ‘**Productive Districts**’ will enjoy a conspicuous advantage in implementing Industry 4.0 concepts, since - in general - Productive Districts are endowed with shared ITC infrastructure and common data bases.

Potential Disruptions (1/4)



Potential disruption (2/4)

- ❑ A world of **customer experiences**, data-based services, and asset performance through analytics requires new forms of **collaboration** and interaction, evolving at the speed at which innovation and disruption are taking place.
- ❑ This will produce conspicuous **effects at societal level**, the same way social networks have changed individual and collective habits and customs.
- ❑ Business leaders and senior executives, as well as policy-makers, need to **understand** and properly deal with this restlessly changing environment.
- ❑ One aspect to be kept in mind is the necessity to **protect individual aspirations** against their consolidation into groups' behaviour, needs and requirements.
- ❑ The ability of **government** systems and public authorities to adapt will determine their success.

Potential disruption (3/4)

- ❑ The fourth industrial revolution will surely affect the **labor market**. The majority of jobs created by Industry 4.0 in developed countries will probably be 'freelance', **temporary jobs** rather than full-time permanent ones.
- ❑ The trend toward a 'gig economy' , or – pretty equivalently - toward an 'Uber-ization of the workforce', has begun, resulting in a **shrinking of the middle-class**.
- ❑ A mobile, global, free-floating workforce can mean talent shortages, **intense competition** for top talent and a workforce where the expectations of one generation may be opposite of those of previous generations.
- ❑ Disgruntled workers could put in place a sort of '**neo-Luddism**' characterized by forms of sabotage from inside the system, with effects even more devastating than those provoked by the practice of 'hacking' and 'hacktivism' on computer systems.

Potential disruption (4/4)

- ❑ Concerning **sabotage and terrorism**, it is apparent that data security is crucial for all industries. This is even more concerning in an Industry 4.0 context, given the sharing of multiple industries' data on the same system of systems and the massive level of interconnection.
- ❑ A **single** well-targeted cyber-attack may succeed in taking the control of an entire nation level industrial system.
- ❑ Therefore, the acceptability and operability of Industry 4.0 depends on how robust security standards are, while Industry 4.0 infrastructure should be considered, managed and protected - as **a critical national** (or transnational) **infrastructure**.

Emerging Countries

Emerging Economies: Dramatic Gains

Ranking by share of global nominal manufacturing gross value added

Rank	1980	1990	2000	2010
1	U.S.	U.S.	U.S.	U.S.
2	Germany	Japan	Japan	China
3	Japan	Germany	Germany	Japan
4	UK	Italy	China	Germany
5	France	UK	UK	Italy
6	Italy	France	Italy	Brazil
7	China	China	France	South Korea
8	Brazil	Brazil	South Korea	France
9	Spain	Spain	Canada	UK
10	Canada	Canada	Mexico	India
11	Mexico	South Korea	Spain	Russia
12	Australia	Mexico	Brazil	Mexico
13	The Netherlands	Turkey	Taiwan	Indonesia
14	Argentina	India	India	Spain
15	India	Taiwan	Turkey	Canada

Relative Role of Manufacturing

Manufacturing as a percentage of national GDP in 2010



Source: McKinsey Global Institute, IHS Global Insight, United Nations Statistics Division, BEA

Source: Mc Kinsey

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