Industrial automation and robotics

Introduction to automation

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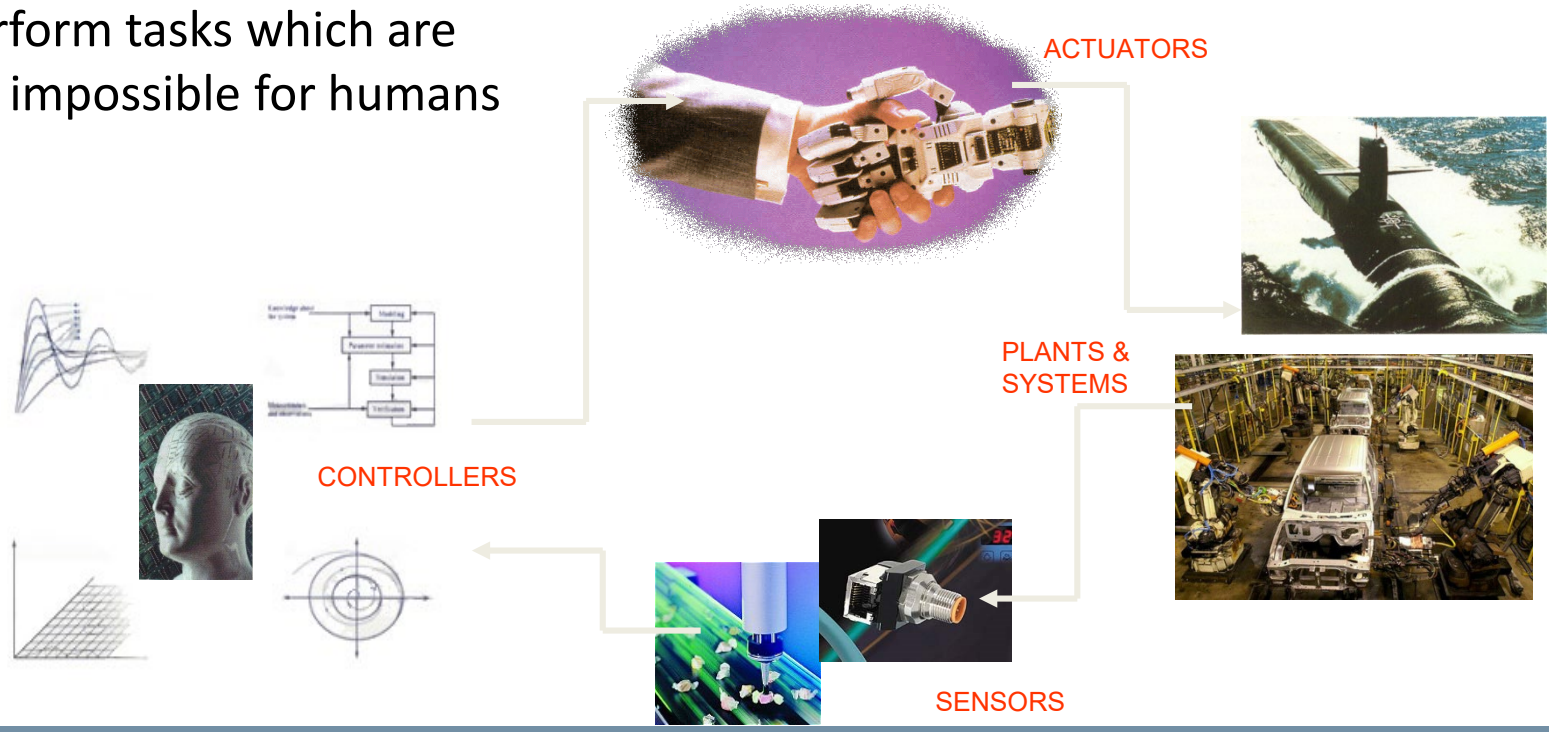
What is automation?

- It is the science and the technology whose aim is to design automatic control systems, i.e.:

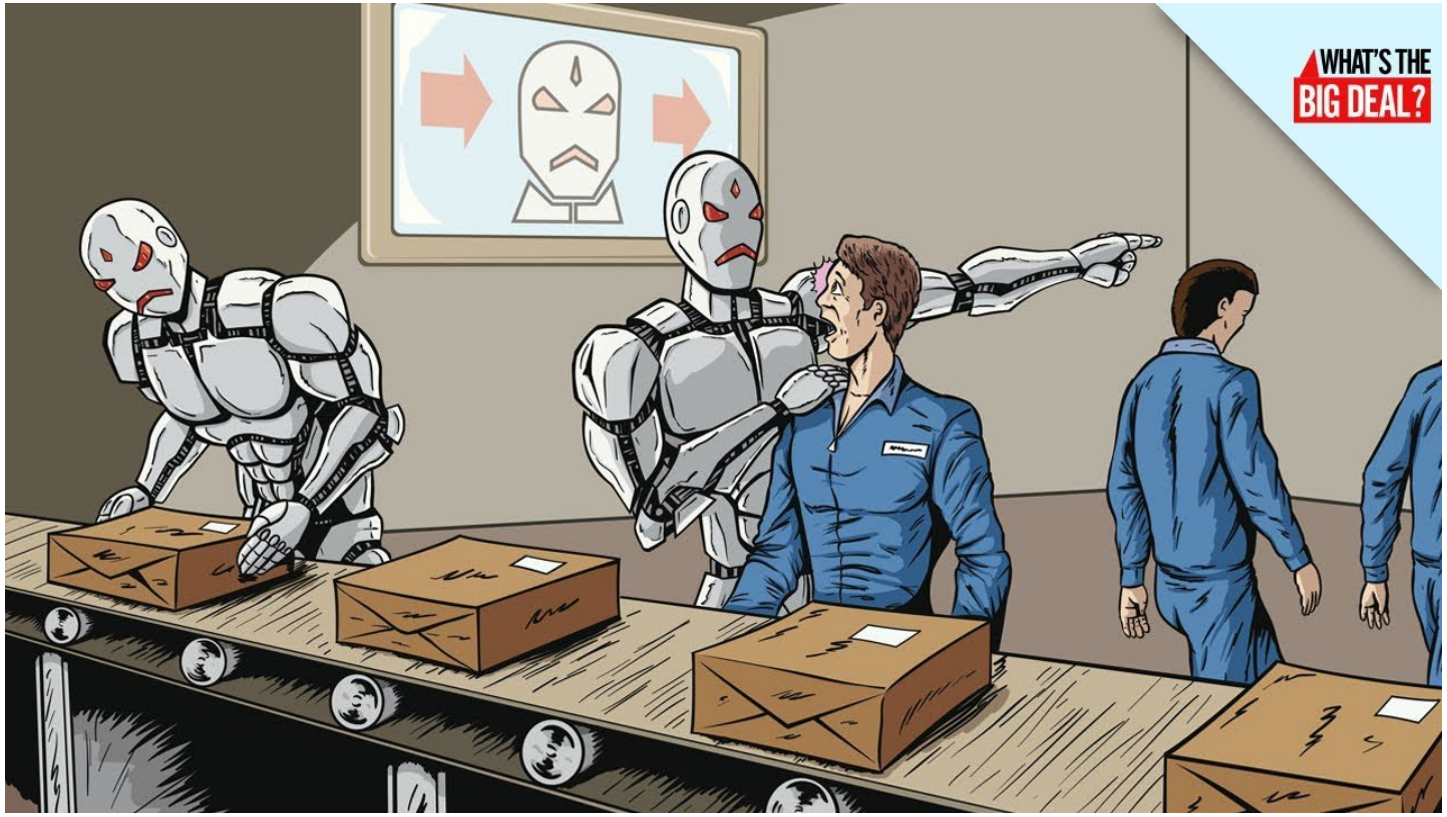
➢ endowed with increasing autonomy

➢ able to perform tasks which are difficult or impossible for humans



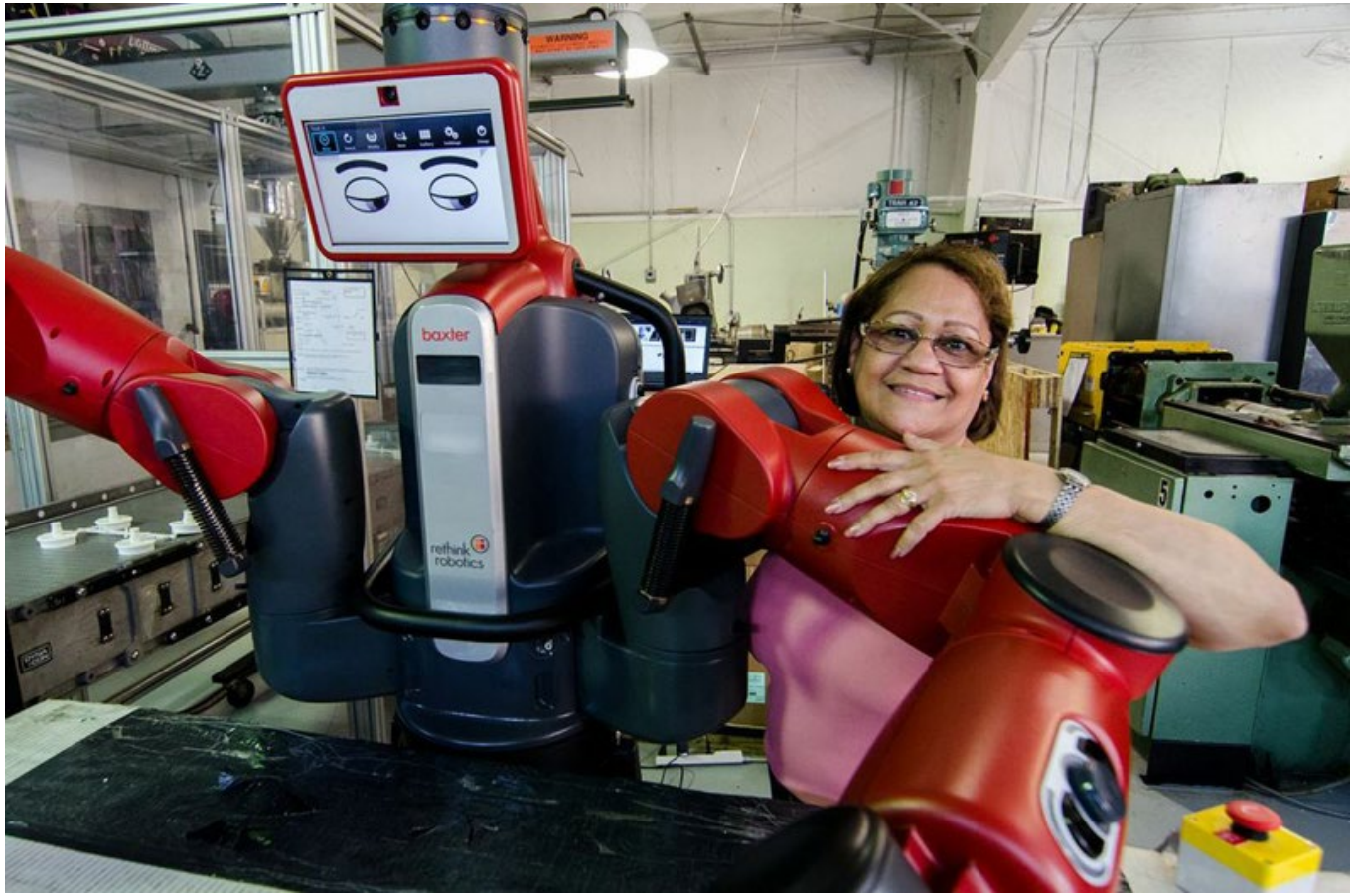
What is automation?

Every time we have a machine or a device performing a task that can be otherwise made by a human we are making automation:

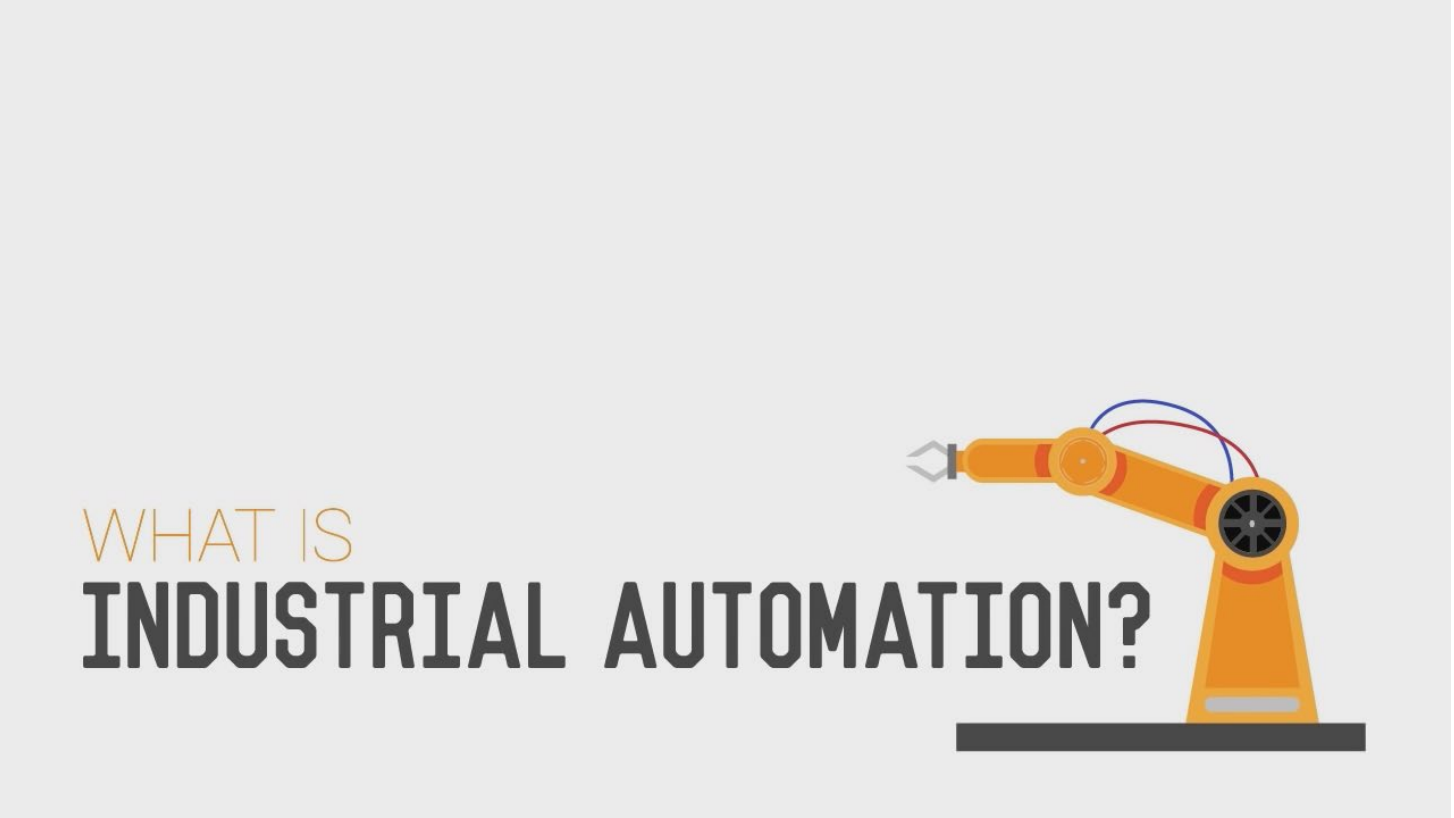


What is automation?

Well, automation systems can also co-exist with humans:

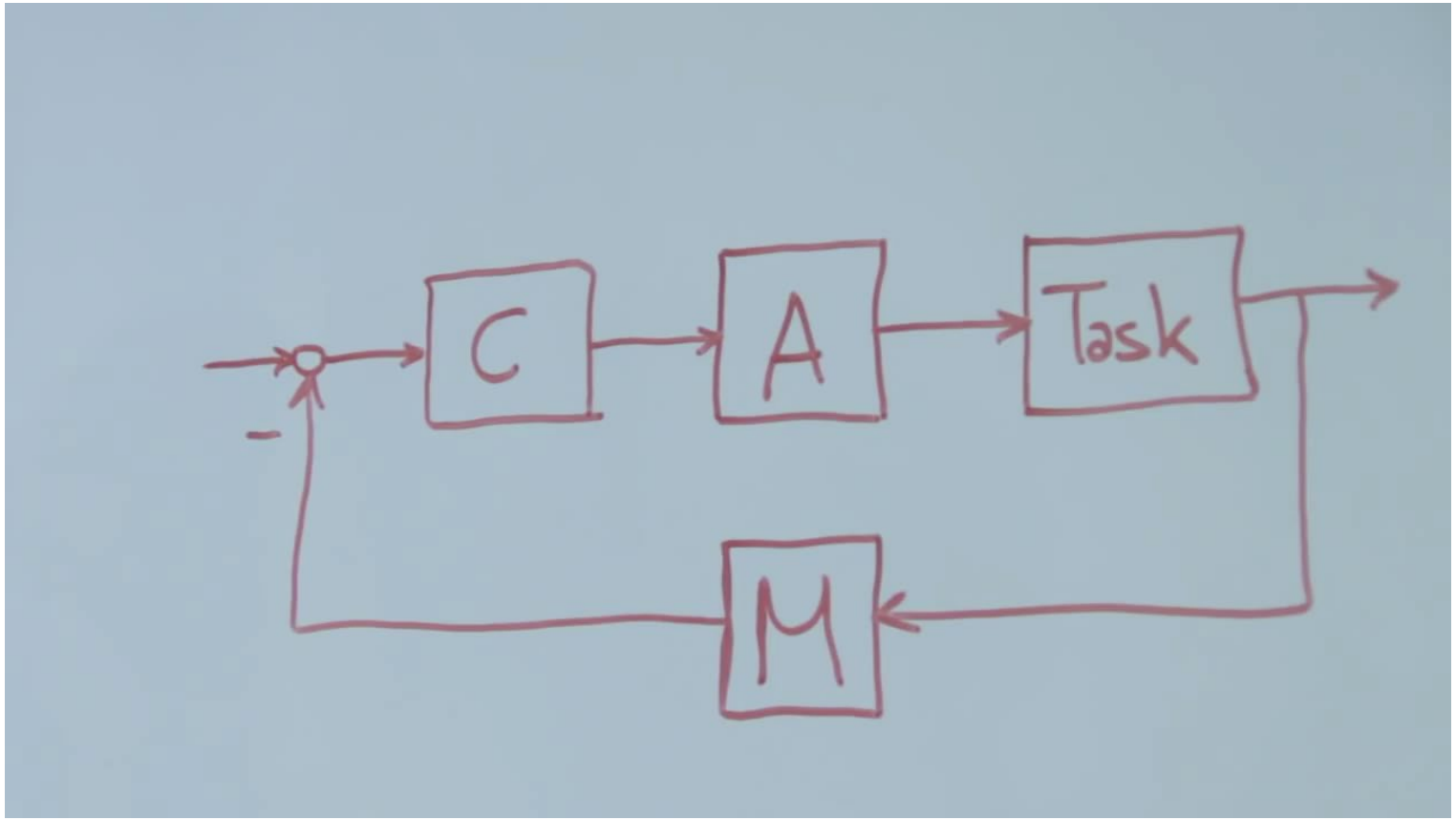


What is automation?



https://www.youtube.com/watch?v=6f-uChX5CVc

What is automation?



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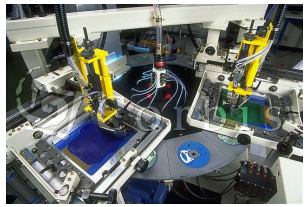
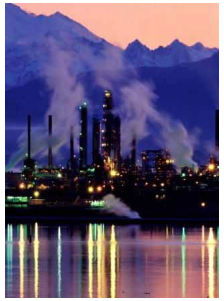
Automation is pervasive

Automation in industry

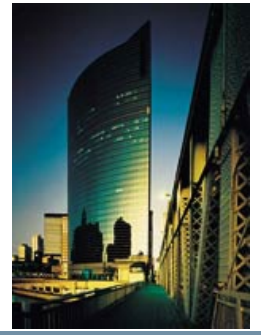




Automation in vehicles

Automation in utilities and networks

Home automation



Automation in industry

Rigid automation

- The sequence of operations is fixed
- Production process composed of a sequence of simple operations
- Large production with very small variations

Pneumatic/electrical actuation

Programmable automation

- The sequence of operations can be changed
- Medium-low production batches
- Between batches the production plant has to be reconfigured

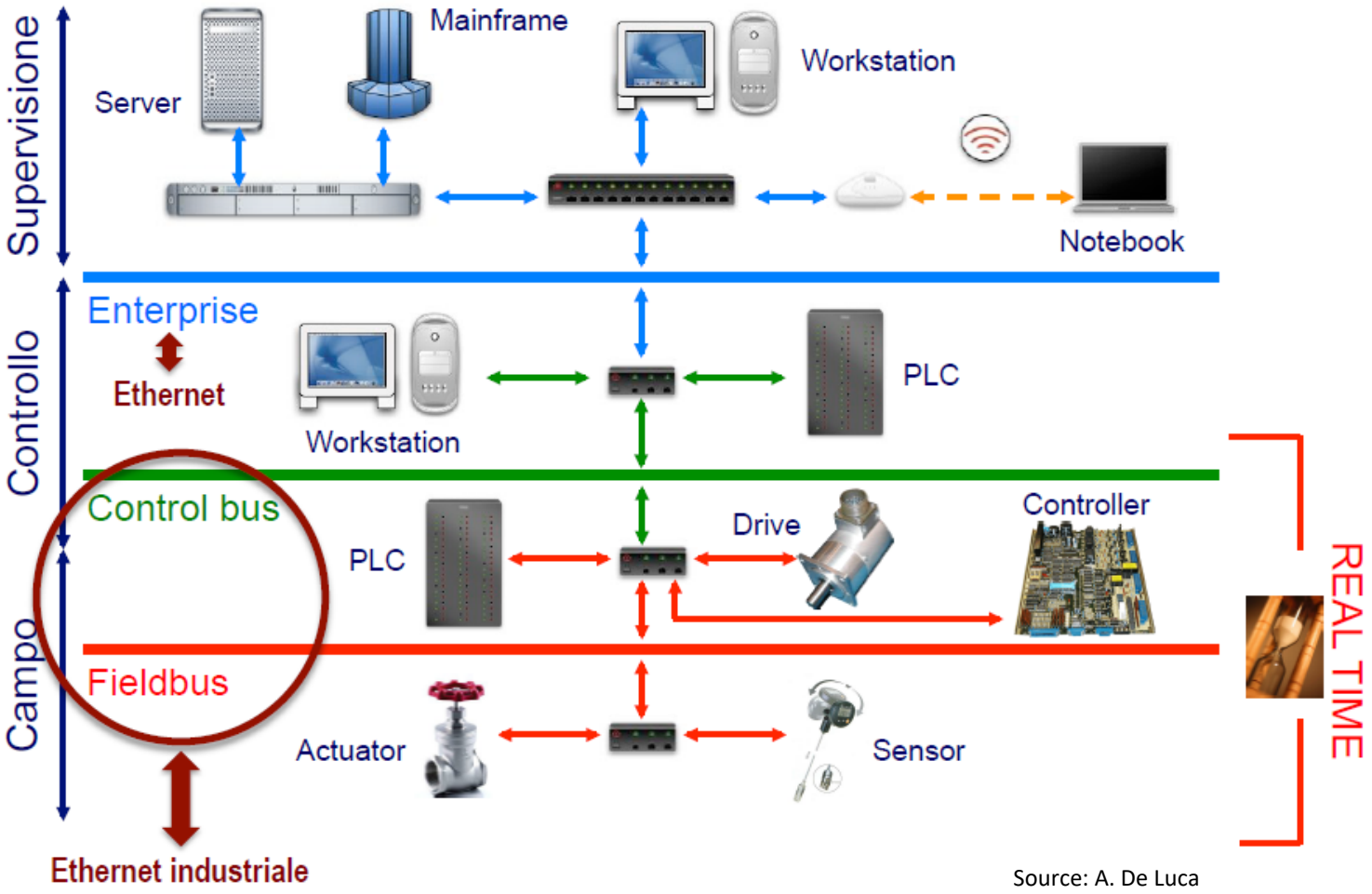
PLC

Flexible automation

- Production can be varied without idle times for conversion
- Machine characterized by high flexibility and configurability (**FMS**: Flexible Manufacturing Systems)

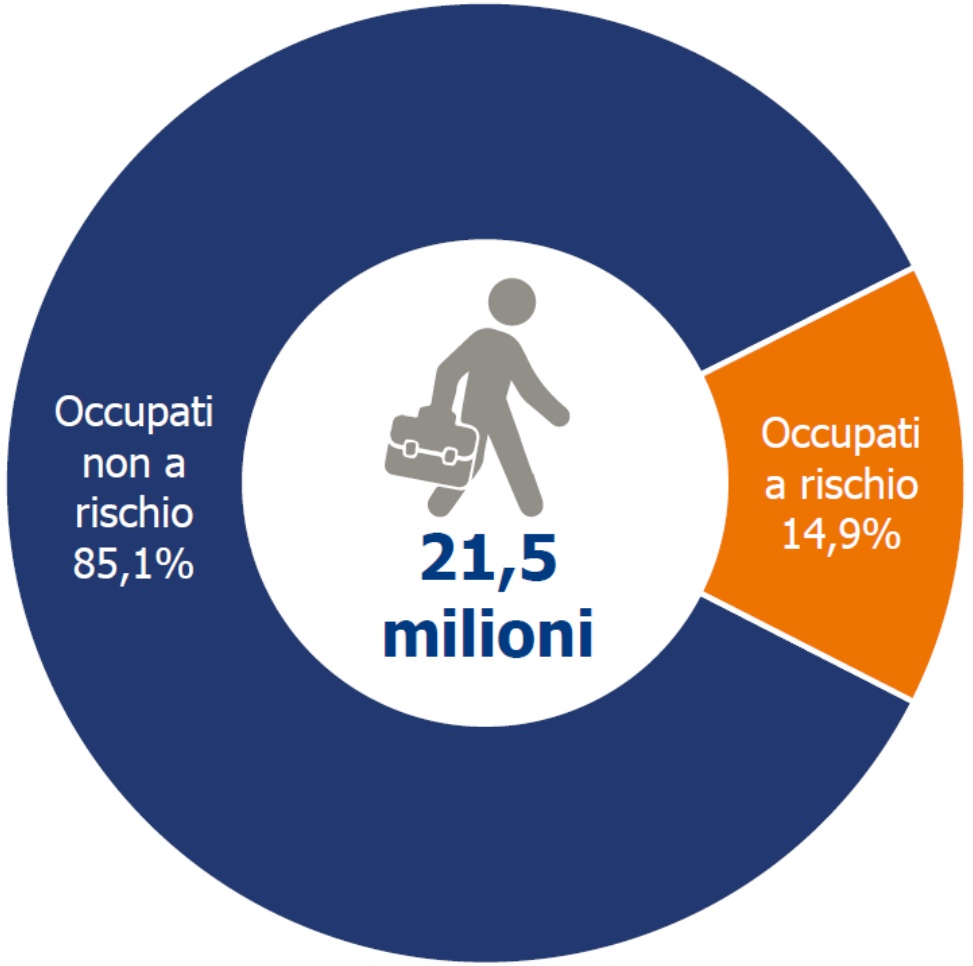
Robot

Automation in industry: elements and networks



Source: A. De Luca

Automation, a risk or an opportunity?



Fonte: The European House - Ambrosetti

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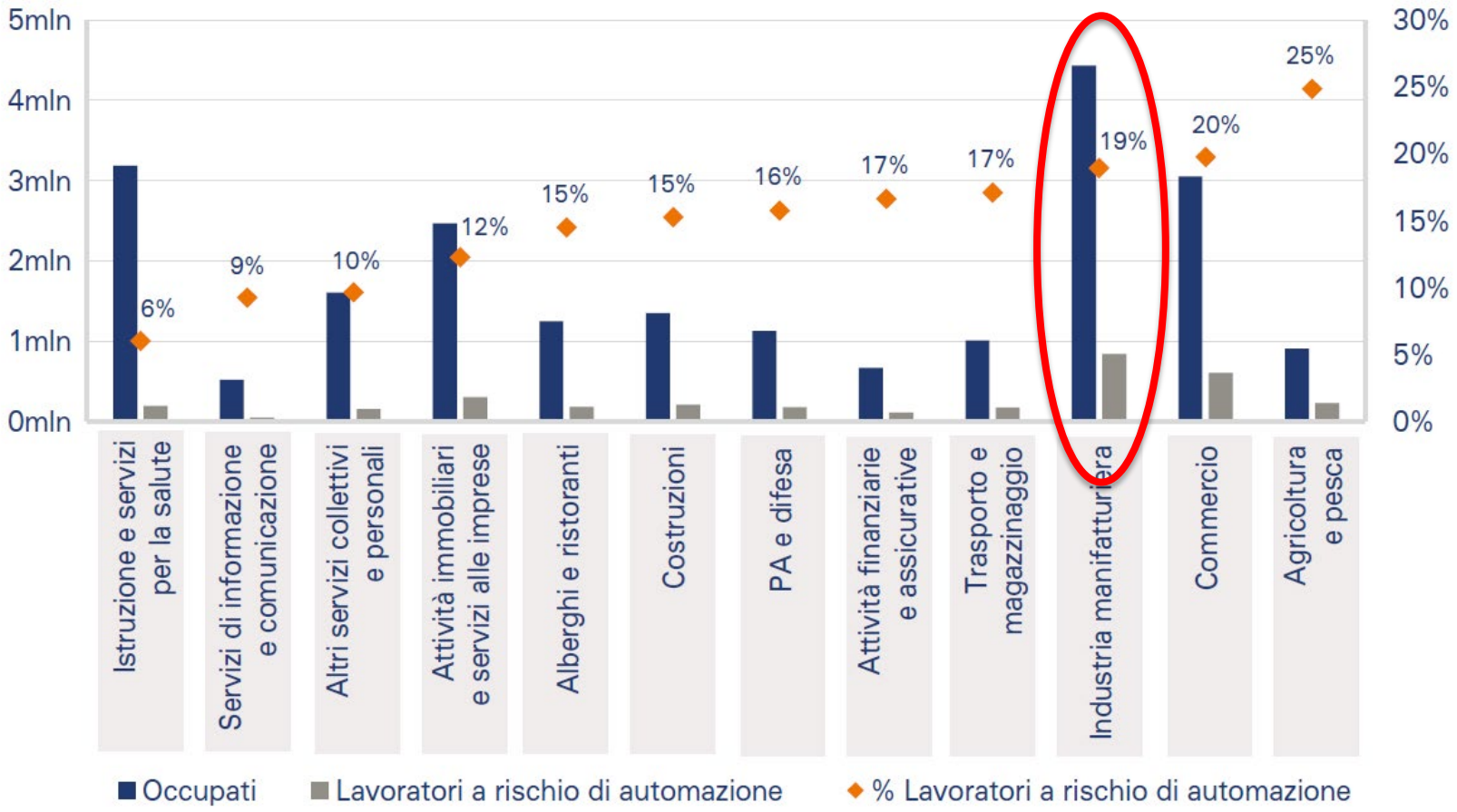


A recent comprehensive study on automation

Source: McKinsey Global Institute

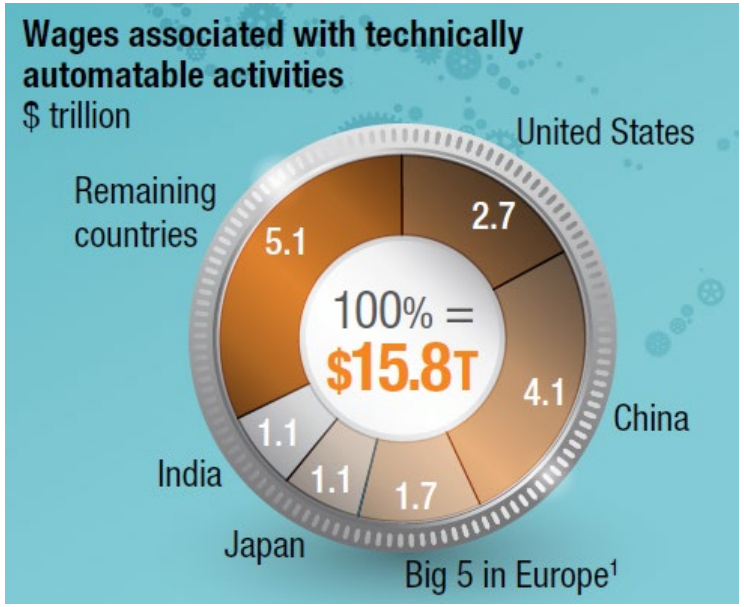
Automation and productivity growth

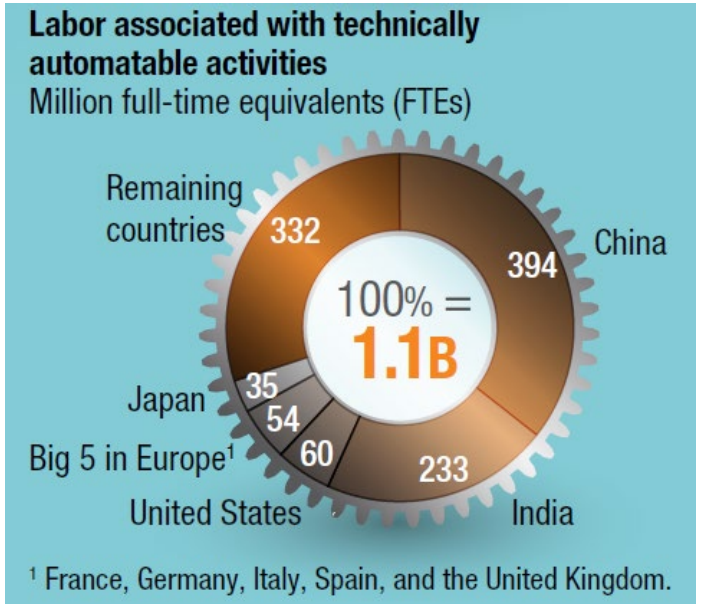
- Automation of activities can enable businesses to improve performance, by **reducing errors and improving quality and speed**, in some cases beyond human capabilities.
- Automation also contributes to productivity, as it has done historically.
- This would give a needed **boost to economic growth** and prosperity and help offset the impact of a declining share of the working-age population in many countries.
- It is estimated that automation could **raise productivity growth globally by 0.8 to 1.4 percent annually**.

Source: McKinsey Global Institute

Potential of automation of the activities

Almost half the activities people are paid almost $16 trillion in wages to do in the global economy **have the potential to be automated** by adapting currently demonstrated technology.

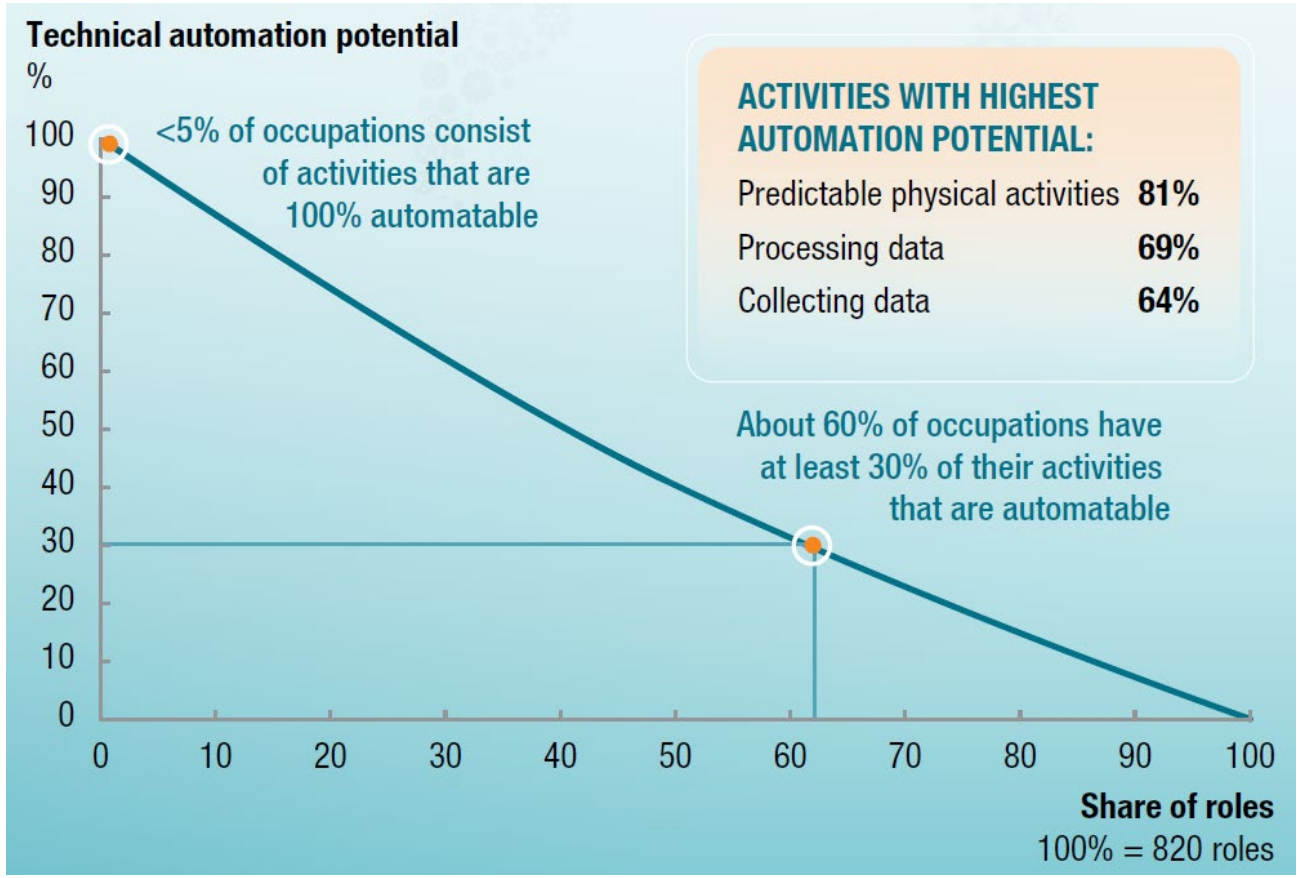




Source: McKinsey Global Institute

Potential of automation of the activities

While less than 5 percent of all occupations can be automated entirely using demonstrated technologies, about **60 percent of all occupations have at least 30 percent** of constituent activities that **could be automated**.



Source: McKinsey Global Institute

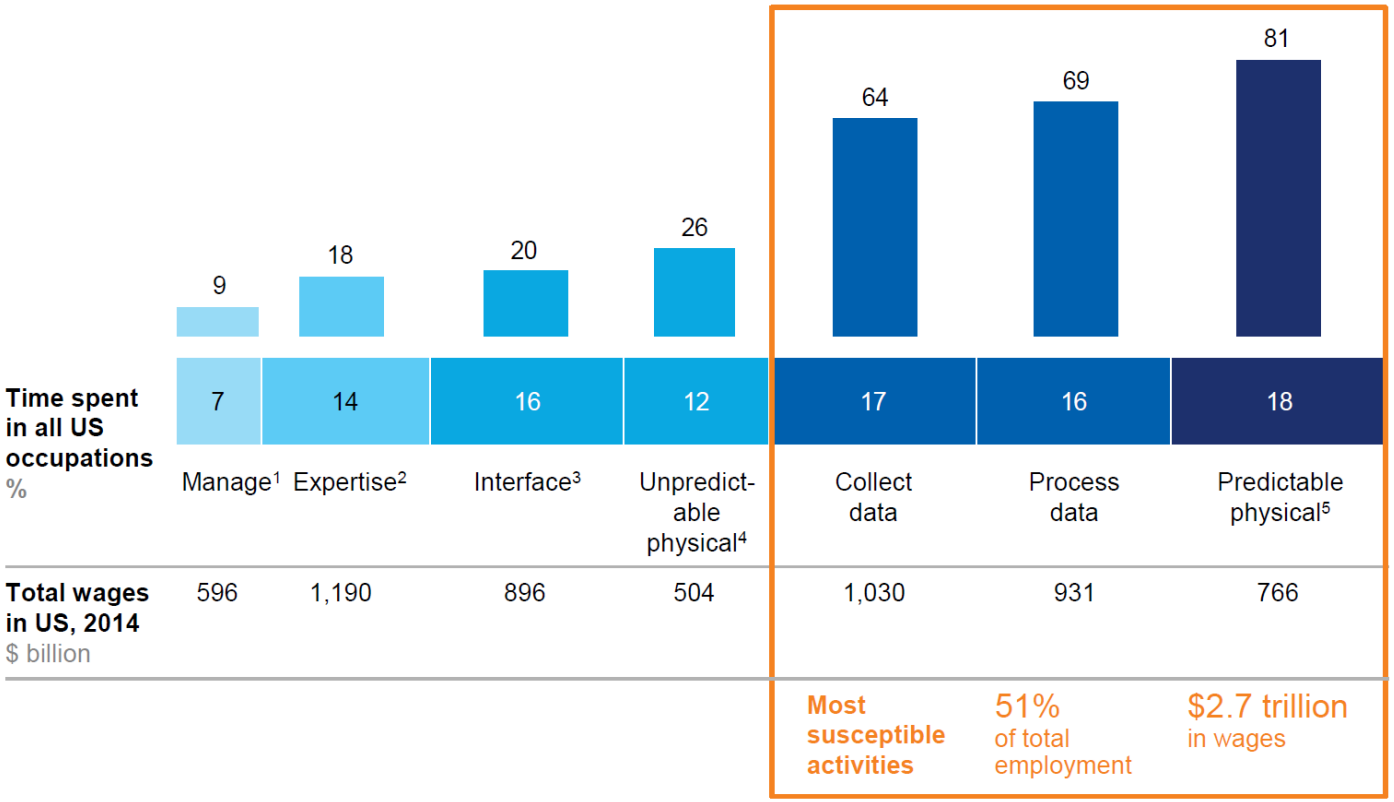
Activities most susceptible to automation

- Activities most susceptible to automation involve **physical activities in highly structured and predictable environments**, as well as the collection and processing of data.
- In the United States, these activities make up 51 percent of activities in the economy accounting for almost $2.7 trillion in wages.
- They are most prevalent in **manufacturing**, accommodation and food service, and retail trade, and include some middle-skill jobs.

Source: McKinsey Global Institute

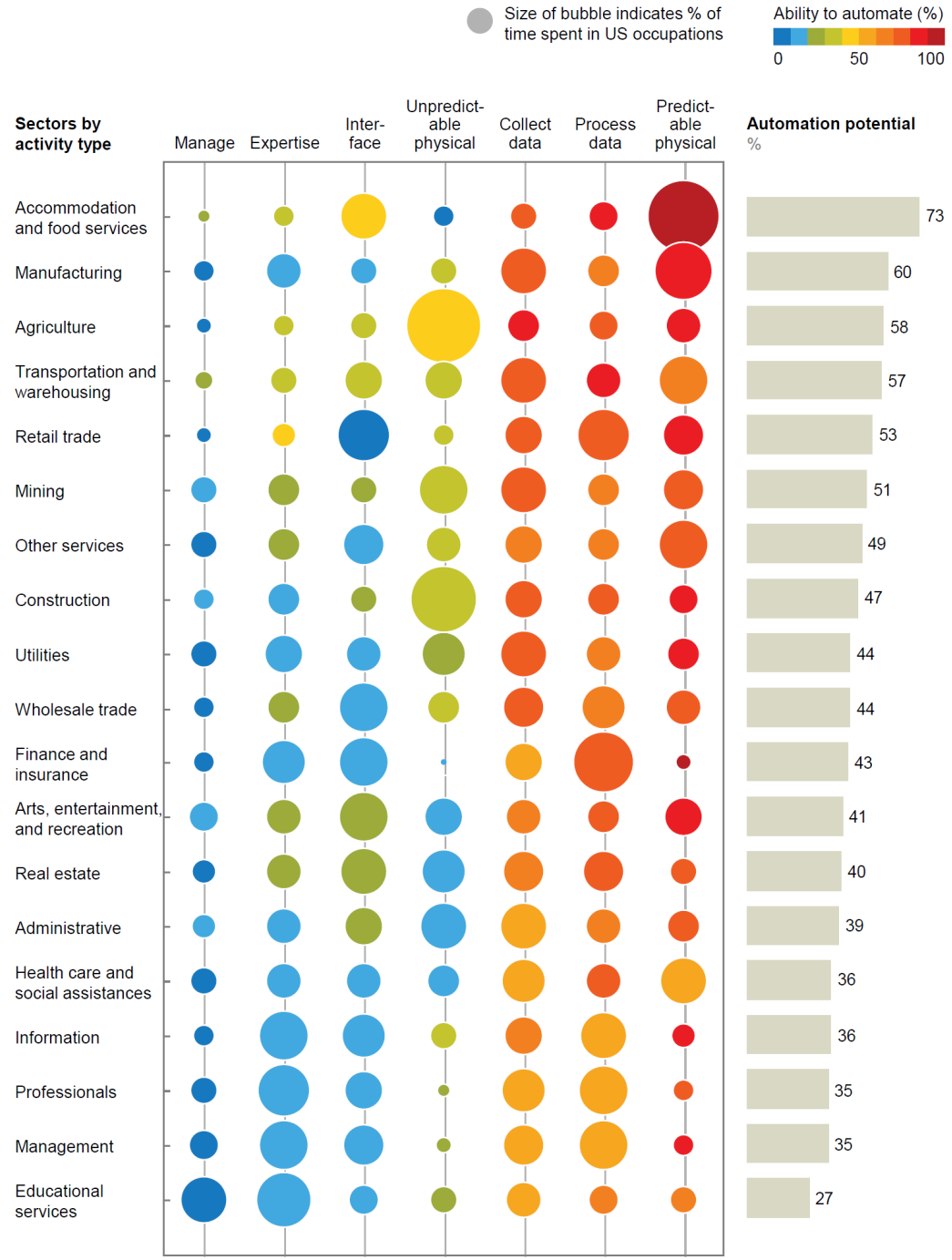
Activities most susceptible to automation

Time spent on activities that can be automated by adapting currently demonstrated technology
%

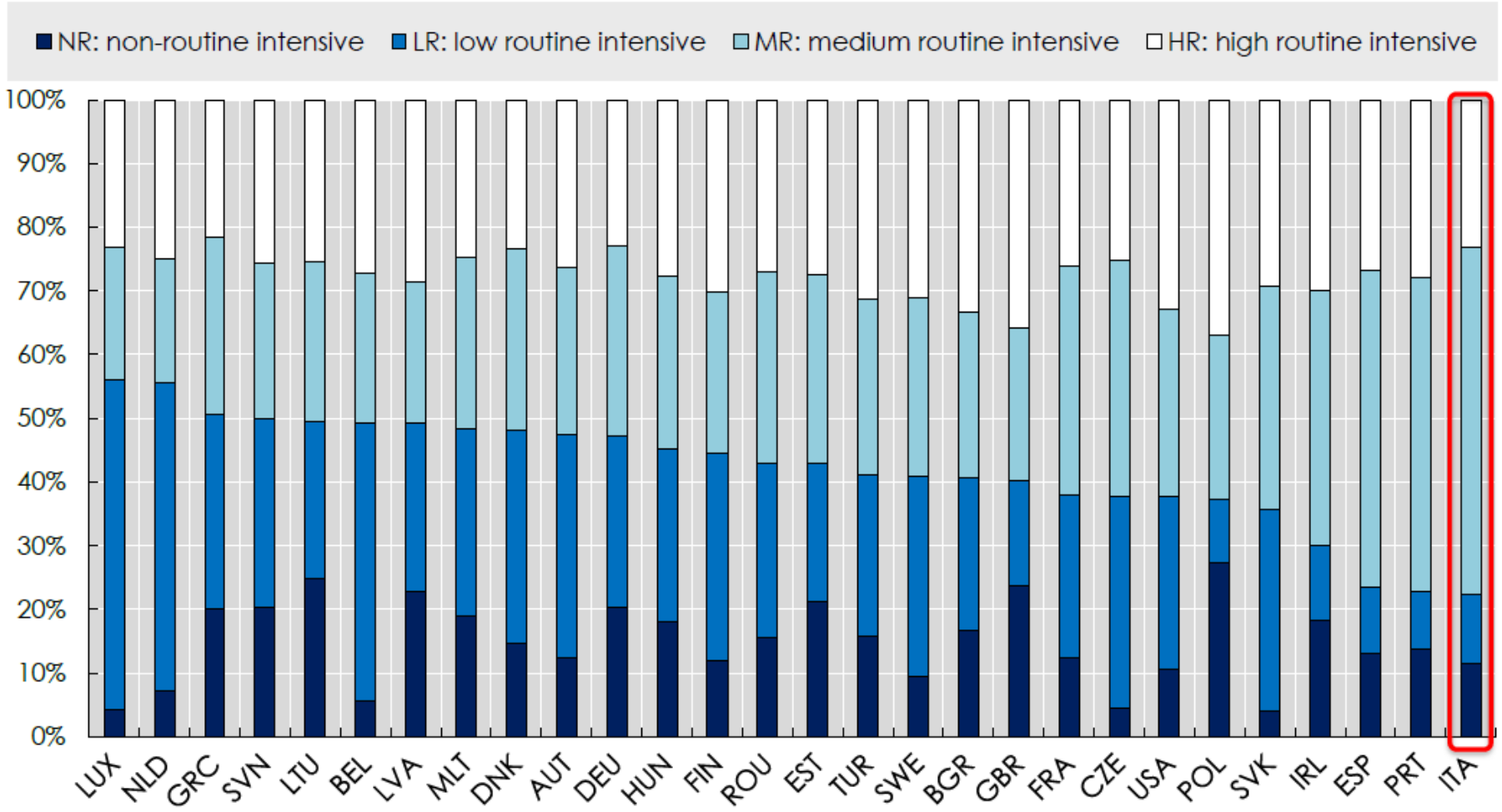


Source: McKinsey Global Institute

Technical potential for automation across sectors varies depending on mix of activity types



“Risk of automation” in the different countries



Source: OECD

Factors influencing the growth of automation

- Technical, economic, and social factors will determine the pace and extent of automation. Continued **technical progress**, for example in areas such as **natural language processing**, is a key factor.
- Beyond technical feasibility, the **cost of technology**, competition with labor including skills and supply and demand dynamics, **performance benefits** including and beyond labor cost savings, and **social and regulatory acceptance** will affect the pace and scope of automation.
- Half of today's work activities could be automated by 2055, but this could happen up to **20 years earlier or later** depending on the various factors

Source: McKinsey Global Institute

Automation and workforce

- People will need to continue **working alongside machines** to produce the growth in per capita GDP to which countries around the world aspire.
- People displaced by automation will find other employment.
- The anticipated shift in the activities in the labor force is of a similar order of magnitude as the long-term shift away from agriculture and decreases in manufacturing share of employment in the United States, both of which were accompanied by the **creation of new types of work** not foreseen at the time.

Source: McKinsey Global Institute

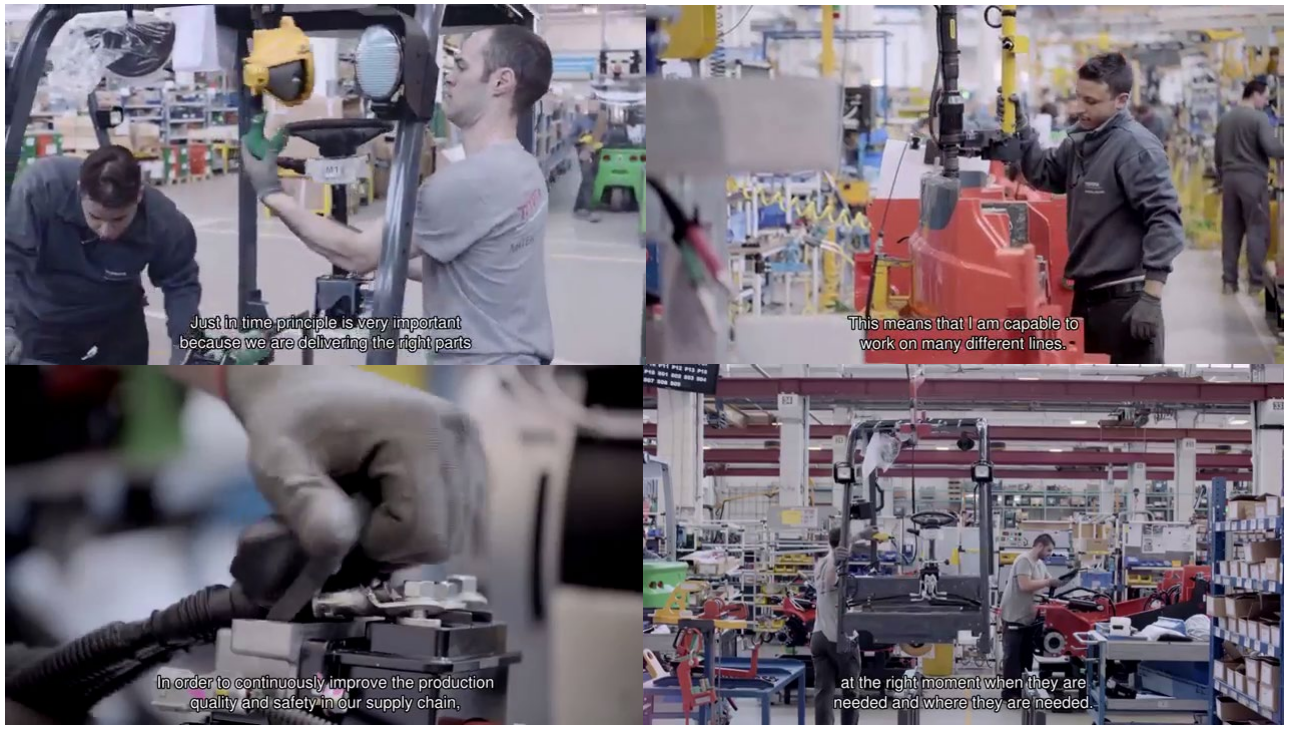
Automation and policy-makers

- Policy-makers should embrace the opportunity for their economies to benefit from the productivity growth potential and **put in place policies to encourage investment** and market incentives to encourage continued progress and innovation.
- They must evolve and innovate **policies that help workers and institutions** adapt to the impact on employment: rethinking education and training, income support and safety nets, transition support for those dislocated.
- Individuals in the workplace will need to engage with machines as part of their everyday activities, and **acquire new skills**

Source: McKinsey Global Institute

Exercise

Consider a few production processes in a company you know:

- Are they, at least partially, automatable?
- What are the skills required to the human workers?
- Do you think that they can be transferred to a machine?

Source: Paperblog