Cornelia HULLA & Human Dynamics: Industry 4.0, a New Deal for European countries and companies?

Part I. Industry 4.0: the revolution Europe needs

a) The importance of manufacturing in Europe despite trend of deindustrialization

Manufacturing is an essential sector of Europe's economy. During the first and second industrial revolutions, new manufacturing processes were put in place, and have led to a surge in production and productivity, in a scale that was never seen before. At the beginning of the 20th century, the "old" European continent was dominating the world's economy, with almost 50% of the world's global GDP, largely attributed to the industrial boom. Today**, the industrial sector still accounts for €7.000 billion in turnover, 80% of EU exports and of R&D expenditure, 30 million direct jobs and 60 million indirect jobs in the EU.**

However, it seems as if manufacture is no longer Europe's "**comparative advantage**" as emerging countries have become more competitive. The share of emerging economies has doubled in 20 years, from 21% to 40% of global manufacturing share, and with 31% concentrated in Asia (excluding Japan), against only 8% in 1991. In comparison, Europe's share has kept decreasing, from 36% in 1991 to 25% in 2011. All of the traditional industrialized countries experienced a decline in manufacturing employment, while the number of manufacturing jobs in China and Brazil increased by 39% and 23% respectively. We were lucky and steadily rising productivity for much of the 20th century, Prof. Brynjolfsson from MIT Sloan concludes: "Many people, especially economists, jumped to the conclusion that it was just the way the world worked. I used to say that if we took care of productivity, everything else would take care of itself; it was the single most important economic statistic. But that's no longer true." He adds, "It's one of the dirty secrets of economics: technology progress does grow the economy and create wealth, but there is no economic law that says everyone will benefit." In other words, in the race against the machine, some are likely to win while many others lose. The **ghost of deindustrialization** is still very much haunting the European collective mind. It seems as if industry is no longer a source of prosperity in the old continent. Even if the decline had been steady since the 1990s, the economic crisis has accelerated it. **The EU has lost 3.8 million jobs in the sector since 2008**. Production levels have still not retrieved their pre-crisis state. With 11.3% unemployment rate in the EU as of February 2015, and 21.1% youth unemployment rate, it remains a key issue that needs to be addressed. Is manufacturing part of the problem? Should Europe turn its focus on services to restore growth and employment? We believe manufacturing does not belong to Europe's past; it is part of its future.

b) Industry 4.0 and what needs to be done to achieve 4th industrial revolution

Europe needs is a **reindustrialization**, in the form of a **fourth industrial revolution**. "**Industry 4.0**" is one component of the German high-tech strategy for 2020. It is a strategic initiative to champion industrial IT which is currently revolutionizing the manufacturing engineering sector. It is allowing Germany to stay a globally competitive high-wage economy. We will briefly present 6 key features of Industry 4.0:

- **Cyber-physical systems** (CPS) improve resource productivity and efficiency and enable more flexible models of work organization. These can be controlled in real time and make it possible to flexibly replace machines along the value chain and change production processes
- **Smart robots and machines** will be able to adapt, communicate and interact, to allow productivity leaps. In Industry 4.0, robots and humans will be working together, interlinking tasks and using smart censored human-machines interfaces.

- **Big data** will also change the production processes, as the new plants of the future will save, process, analyse and leverage the amount of relevant information available.
- Industry 4.0 creates a **new quality of connectivity** between physical and digital worlds: machines communicate between each other to signal that they have finished their part of the process. Products themselves communicate to the ordering system to signal that they are produced.
- **Energy efficiency and decentralization** is another important aspect of Industry 4.0, which addresses climate change and scarcity of resources. Using renewable energies and carbon-neutral technologies will become increasingly financially attractive.
- **Virtual industrialization**: every process will be simulated virtually and only once it is ready will the physical mapping be done. Some initial trials have showed that setting up an automotive part production unit can be done in only 3 days as opposed to the 3 months it requires today!

Not only is this model a way for Germany to keep its competitiveness, but is can also be **a new European model of growth**. Industry is critical to ensure a balanced and highly-skilled labour market. Deindustrialization does not only impact the industry sector but has spill over effect on the economy as a whole. Industry 4.0 is the solution to reindustrialize Europe**: innovation, automation and sophisticated processes are the root of industrial success strategies** and have proven to be critical in maintaining a leading position.

The **Europe 2020 strategy** and the **Juncker Plan,** with **€315 billion investment** foreseen for **2015-2017**, are also putting a lot of emphasis and hopes on industry to revitalize the economy. The goal is that, **by 2020, manufacture should represent 20% of total GDP of the EU**, against 15% in 2014. It would mean that Europe would have to create **€500 billion in value added** and **6 million jobs** which represents grossly the current employment figures in the industry sector (including construction) of Italy (5,9 million jobs), the UK (5,6 million jobs) or France (5,2 million jobs)[1].

c) <u>The changing demands for companies, what European states are doing to address the situation, and who are the frontrunners</u>

As a result from these changing trends, companies need to adapt to three different demands: **personalisation**, **regional diversity** of consumer choice and rationalization of "**Big Data**". These can be achieved through ICT-enabled intelligent and high performance, flexible manufacturing. Some examples of tools can be **advanced sensors** or **3D printers**. In addition, investment in sustainable manufacturing technologies such as process control technologies, efficient motor systems or novel sustainable process inputs, is necessary.

At the moment, countries such as Germany, as we have seen, but also Austria, Finland, Sweden and Ireland are **frontrunners** in high-tech industry. For example, **Finland**'s innovation agency Tekes focuses R&D&I in manufacturing to ICT-enabled manufacturing and sustainable manufacturing.

Countries such as Spain, France, and the UK have the full potential to develop Industry 4.0 initiatives and are starting to implement reforms:

- In **Spain**, in spite of high labour costs, a fashion manufacturing and retail chain has become a world leader with flexible manufacturing and a high degree of automation of the production processes. It has created 30,000 jobs between 2008 and 2012, as well as the High-Value Manufacturing Catapult.
- **France** has included factories of the future and robotics in 34 initiatives for reindustrialization, including "Industrial Plant of the Future", which will enable France to rise to the challenge of rapid prototyping, convergence of social networks, corporate hyper connectivity, human-machine interfaces, robotics, augmented reality, digital technology, 3D printing, artificial intelligence and design. It plans to create 480,000 jobs in France in the next 10 years.

[1] Last OECD figures (first quarter, 2015)

- The **UK** is also starting to act in this regard: the government has undertaken a growth review on advanced manufacturing and launched the Advanced Manufacturing Supply Chain Initiative funding R&D and skills development.

Part II. The implications for organisations, education and skill building

a) Education, training & skill-building

Globalisation and international trade create incentives for countries to specialise in areas where they have a comparative advantage. In a 'resource-scare, skill rich' EU context, this implies the **continued development of high knowledge and technology intensive activities.** ICT skills are therefore at heart of jobs growth. The trend towards international production based on subcontracting to specialist firms impacts on job content, **creating demand for both high-level, specialist ICT skills and transversal skills** driven by outsourcing within Europe that is enabled by technology (e.g. customer service skills). The dominant technologies of Industry 4.0 will be **IT, electronics and robotics**. But it will also embrace other knowledge areas such as **biotech and nanotech**. There will be a shift toward design thinking instead of production thinking. To give some examples of jobs that will flourish: **analytics specialists, engineers and programmers working in engineering centres, IT centres and virtual laboratories; data scientists or cyber safety guards** will emerge as new job titles. They will work in big data centres, or in a control tower of a plant network.

The focus on innovation means that alongside **maths, science, technology, engineering and ICT skills**, there is **demand for problem-solving skills, collaborative skills and entrepreneurial skills.** There needs to be an increase in number and competences of graduates in these fields. Both social and technical skills need to be enhanced. New competency fields need to be embedded in education: **software programming, data analysis or scientific computing.**

Commitments made at EU level towards a **greener economy** are also a catalyst for technological innovation. This supports developments such as the manufacture of cleaner vehicles and a more sustainable use of raw materials, which both creates new jobs and impacts on the skill requirements of existing jobs. More environmental and energy specialists need to emerge.

Europe 2020 promotes a multi-stakeholder approach and **public private partnerships** to better coordinate policies and innovation efforts. European Technology platforms have been put in place since 2004. 3 PPPs: "**Factories of the future", "Energy-efficient buildings" and "Green cars**".
New skills and jobs are part of the Europe 2020 strategy: although there is high unemployment, there are still a lot of vacant positions in industry as there is a skills shortage. Education policies need to address this issue. This is why better coordination is need between public and private stakeholders, to fill the gaps.

Support to entrepreneurship is also crucial. The Juncker Plan wants to support SMEs. It should turn its focus specifically on facilitating the **creation of young, high-growth firms, predominantly knowledge-driven**, responsible for a disproportionately large share of the net job creation. The **European Social Fund** can also be reinforced and used to support the implementation of such initiatives within the member states.

b) The role of corporations: strategies & investments

Not only do institutes and universities need to provide adequate programmes to ensure development of skills in the long term; **companies and human resources need to also invest in special recruiting actions or development of appropriate trainings for current employees**, to allow career shifts. Corporate cultures with continuous training and development in the workplace and lifelong learning are becoming a core competency.

European firms need to invest €90 billion each year until 2030. Currently the level is at €30 billion. Players in the corporate sector include equipment & technology suppliers, infrastructure providers & financing, and

industrial users (pharmaceuticals, automotive, aerospace, manufacturing, etc.). They should focus on 3 objectives: a) Set conditions for the 4.0 ecosystem b) Boost industry 4.0 offering c) Promote fast adoption as competitive player.

To achieve these goals, companies must regularly review their strategic alignment, which will result in new methods of entering new stages of the value chain, elaboration of technology roadmaps across Europe and set-up of research communities. Consistent investment in R&D programs is also crucial. Companies should identify cross-border partners (corporate and science) and collaborate with them on research projects. They must also develop a **technology strategy** and possibly consider mergers and acquisitions. Infrastructure providers can contribute by developing standards for data transfer and security procedures. Industrial users can invest in the transition to Industry 4.0 or funding for infrastructure development. Companies should also develop **tailored manufacturing strategies** that best leverage the new 4.0 technologies. Finally, companies have to allocate special investment for the transition, for example, by setting up phased programs to facilitate site reconfiguration. They may want to consider incentivizing the **launch of pilots** as well.

We have mentioned pioneer states. But here are also some good examples from companies. For example, **Siemens** is implementing an Industry 4.0 solution in medical engineering. Siemens can now produce an implant within 3 to 4 hours. **Rolls-Royce** is using 3D printing technology to produce components for its jet engines. **Dassault** in France is using a 3D platform designed as a common work environment for the company.

The Second Machine Age, as it is now called, is different than the 18th century industrial revolution. In the past technologies were complements to human labour and increased the demand for the skills and capabilities of the average workers. In the future technology will substitute human labour reducing demand for some types of workers' skills and abilities. Professors recommend to reframe the relationship of computers to humans as one of augmentation instead of automation. Augmentation means that human strength are combined with machines in order to perform what none of them could do separately. As teams composed of humans and robots become more common organisations need to rethink the way they organize and manage work. Given the high level of connectivity of humans and machines organisations need to learn how self tuning will help them in managing this complex dynamic environment. Other questions need answers: How do you convince your employees to trust artificial intelligence? Will morale suffer if you replace a robot in the team?

c) Public outreach & communications campaigns

Ultimately these new careers must be made attractive to the public, and for that to happen, fears about job scarcity because of machines' takeover need to be addressed. More publicity should be made regarding the availability of such highly-skilled jobs. Public communication is crucial.

In France, the French Robotics Association has launched its "**Robocaliser**" program. Since French unions still perceive robotization as a job killer, the program promotes the idea of using robots as a way to avoid delocalization.

To also show that delocalization can be overcome, some vulgarizing campaigns can be launched with catchy phrases such as: "a product currently manufactured in China will be manufactured by a European robot or machine which is itself programmed and managed by a European engineer". In that way, the public can overcome fear of robotization and of competition with emerging markets.

To conclude, Industry 4.0 is compatible with Europe's tradition of social welfare and high wages and its industrial historic base, as well as with necessity to compete in a global world. But for it to happen, investments must be met with development of adequate skills through education and trainings.