OUTPUT 1

A research on innovative skills and best practices to enhance HE students employability, flexibility and transversal capabilities and develop effective digital workbased approaches

2022

Digital Transformation, Industry 4.0 and Human Resources Management: Innovative skills to enhance HE students' employability, flexibility and transversal capabilities

INTRODUCTION

The concept of Industry 4.0 is a highly topical topic, especially in the context of digitization and the use of ICT. From the perspective of the project, it is necessary to monitor developments in how the workload of new jobs changes and how new knowledge is implemented in the curriculum in relation to the use of new technologies, the digitization of business and administrative processes, as well as monitoring and evaluating the possible impacts of the Industry 4.0 concept to increase employability. It is obvious that the results of the research will bring a number of factors that will influence the orientation and depth of the subsequent activities and outputs of the DigiWorks project. The project will thus create an educational platform with current topics for education in the field of digitization and Industry 4.0, on the basis of which the graduates of this course will become immediately applicable in practice.

1. TOWARDS DIGITAL TRANSFORMATION AND INDUSTRY 4.0

The term "industrial revolution" is explained as a technical advance that fundamentally changed the way production was done in the past. The Industrial Revolution brings new technologies that change the way people work and live.

Over time, the Industrial Revolution created more job opportunities, increased efficiency, and in many ways, served to make people's lives easier in the long run.

Now the fourth industrial revolution is coming, which is based on the third, and we can call it the digital revolution. It is characterized by combining technologies that blur the boundaries between the physical, digital, and biological spheres. It is referred to as Industry 4.

Industry 4.0 offers a more complex, connected, and holistic approach to production. It connects physically systems with digital ones and enables better collaboration and access between manufacturers, suppliers, products, and

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people. Industry 4.0 is a label for the current digitization trend, the related automation of production, and the changes in the labor market that it will bring.

Digitization is an information-intensive transformation of production and non-production processes (and related industries) in an interconnected environment of new technologies, which guarantees the successful implementation of the technological pillars: Internet of Things, Big Data, Simulation, Additive Manufacturing, Cloud Computing, Augmented Reality, Autonomous robots, Cyber security, and people as a way and means of realizing intelligent industries and ecosystems of industrial innovation and cooperation.

2. PRINCIPLES OF INDUSTRY 4.0

Industry 4.0 takes the digital technologies of the past decades to a whole new level by connecting through the Internet of Things, accessing real-time data, and introducing cyber-physical systems. Industry 4.0 includes eight design principles:

1. Interoperability: Objects, machines, and people must be able to communicate through the Internet of Things and the Internet of People. This is the most important principle that makes the factory truly intelligent. This ability to connect everything in the company, everywhere, and with everyone is essential for using the insights provided by data to increase efficiency and improve processes.
2. Virtualization: The ability to create a virtual view of operations, or virtual copies of everything, to see how new devices or processes will affect operations. Digital twins, or 3D models, are used to optimize machine performance, allowing what-if scenarios to be run and the impact of new equipment to be tested.
3. Decentralization: The ability of cyber-physical systems to make decisions independently and perform their tasks as autonomously as possible. This

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creates a more flexible environment for production. In case of failure or conflict of objectives, the problem is escalated to a higher level.

4. Real-time monitoring: A smart factory must be able to collect data in real time, store it or analyze it and make decisions based on new findings.
5. Orientation to services: Production must be focused on the customer. People and smart objects/devices must be able to connect effectively through the Internet of Services to create products based on customer specifications. This is where internet services become essential.
6. Modularity: In a dynamic market, the ability of a smart factory to adapt to a new market is essential.
7. Transparency of information – the transparency provided by Industry 4.0 technology provides operators with comprehensive information to make decisions. Interconnectivity allows operators to collect vast amounts of data and information from all points of the manufacturing process and identify key areas that can benefit from improvement to increase functionality.
8. Technical assistance - technological devices of the systems help people in decision-making and problem-solving and have the ability to help people in solving complex or dangerous tasks.

3. THE REQUIREMENT OF ACQUIRING DIGITAL SKILLS IN THE PROCESS OF HIGHER EDUCATION

The shortage of workers with the necessary digital knowledge and skills affects all industries and companies regardless of size. Without skilled workers with digital technologies, it is highly likely that no public and industrial sector will be able to fulfill and exploit the potential of the new industrial revolution. A Deloitte study estimates that nearly 4.6 million manufacturing jobs requiring digital skills will need to be filled over the next decade. However, up to 2.4 million of these jobs may remain vacant due to a shortage of workers with these skills.

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Success in digitization starts at university, where students must learn to be prepared for the ever-changing technological challenges they will face after graduation. Universities are criticized for providing graduates who do not meet the requirements of the labor market. It seems clear that a diploma alone is not enough for practical application. The future workforce needs to acquire the skills that smart practice needs.

In the ever-changing landscape of digital transformation, students will need to see education as a lifelong endeavor that does not end at school. In order to become active participants in this transformation, students will need to constantly update their skills and knowledge and develop and improve. This is the mindset that every university should instill in its students, preparing them to take more responsibility for their education.

Digital skills acquired in school and in real projects must become the key to getting your dream job. When students leave university, a good understanding of Industry 4.0 technologies and the ability to work in a digital world will lead to greater job prospects and the ability to make a difference.

It is indisputable that the entire educational infrastructure, content, and didactics, as well as the teachers' teaching, must undergo a transformation. Curriculum must be planned, developed, and implemented in line with industry developments. Students will not be prepared to work in new positions unless educational programs are aligned with the needs of the evolving workplace.

In changing approaches to education for the digital era, universities should focus on:

- The need to constantly update students' skills to make them relevant in the long term.
- Reevaluation of teaching and training methods so that students become competent
- Changes in approach, what the student should remember and what he should "know"

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- To teach students to navigate a large amount of information and evaluate the quality and accuracy of this information
- Prepare students to solve critical situations, e.g., when networks or resources go down because it means you can't access your online library or resources
- Teach students to work with real-time information and online processing
- Innovate education and qualifications so that they are reflected in a specific career and income.

In general, every student must already be ready to work with digital technologies, and vocational school students must already acquire knowledge of the basic technological pillars of Industry 4. With higher qualification requirements, demands for so-called soft skills increase. These soft skills are increasingly important, as new employees will already be forced to solve new production problems and independently decide on the next course of action.

"Worker 4" is the new term for an employee who will have these new required skills.

4. THE MOST IMPORTANT SOFT SKILLS FOR THE DIGITAL ERA AND INDUSTRY 4

Soft skills are character traits and interpersonal skills that characterize a person's relationships with other people. Soft skills have more to do with who people are than what they know.

Industry 4.0 increases the demand for interdisciplinary collaboration, and soft skills are also increasingly required. Analyzes show that by 2030, the demand for cross-cutting soft skills in Europe will increase by 22% across all sectors. With the creation of new jobs for the implementation of the Industry 4.0 concept, employers will require new, especially digital skills and competencies

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from employees due to the rapid advancement of technology and artificial intelligence.

In a competitive job market, employees who demonstrate a good mix of hard and soft skills often see more demand for their services. In the era of digitization and the effective application of the philosophy of the Industry 4 concept, soft skills are considered irreplaceable.

Among the most in-demand soft skills that are gradually entering the profiles of employees in individual industries, there are the following:

Adaptability

The ability to adapt to different situations and planned or unexpected changes is one of the most critical skills a future worker in production should have.

Cooperation

Changes in the production environment will also bring a higher share of teamwork. It develops not only within the department but also across departments. It requires working and integrating with different co-workers and colleagues within different levels of the company's internal management chain, as well as the external environment.

Communication

Communication skills are a key factor in the success of cooperation. However, many, especially managers, underestimate the importance of improving their communication skills. They believe that technical skills are the only ones that matter in their profession.

Ability to motivate others

This is especially desirable in leadership positions. Leaders or team leaders must constantly look for ways to encourage others to pass on their enthusiasm for achieving a set goal.

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5. THE IMPACT OF COVID-19 ON INDUSTRY 4 AND ON THE EDUCATIONAL PROCESSES OF UNIVERSITIES

Digital transformation in the COVID era has proven to be the key to moving up the value-added curve. Indeed, business models firmly based on digital technologies clearly indicate an opportunity to increase the flexibility of working time organization and create a competitive advantage for long-term growth in the so-called new normal.

Covid-19 has accelerated Industry 4 processes by making companies more focused on implementing new technologies and choosing to invest in information and operational technologies that will enable and help organizations solve problems and inefficiencies. The coronavirus pandemic has therefore highlighted the global shortcomings and weaknesses of automation and digitalization.

In addition to legislation, the trends in the digitization of education were also accelerated by the COVID-19 pandemic by creating several portals aimed at making digital educational content available. Several teaching staff of schools and pupils had to learn to work with online educational tools.

It has been shown that knowledge acquisition cannot be fully achieved through a transmissive approach alone but through a participatory model with a solid collaborative knowledge creation process.

However, conventional learning through face-to-face instruction is more effective in improving students' communication and interpersonal skills. Disciplines that require laboratory work, practical experience, and external collaboration were more demanding for distance learning. In distance learning, students must become highly independent and autonomous and capable of self-monitoring and maintaining high motivation in order to progress.

6. WHAT WILL THE 5TH INDUSTRIAL REVOLUTION BE?

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Ready or not, Industry 5.0 is here. The potential of the fifth industrial revolution (5IR) lies in the merging of digital, physical, and biological technologies that promise to increase the well-being of society in all directions. This integration represents a future where "people and machines work synergistically." This harmonious embrace of human-machine collaboration distinguishes 5IR from the Fourth Industrial Revolution (4IR), which focuses primarily on achieving efficiency through technology. In Industry 5, the personal participation of people with their cognitive characteristics is added to the technological pillars of Industry 4.0.

To be ready for Industry 5.0 and its impacts, there are three key elements of the initiative that we need to understand:

1. Industry 5.0 is aimed at supporting – not replacing – people. Don't mistake the advent of robotics as an opportunity to eliminate headcount and replace workers who perform repetitive tasks on assembly lines.

2. Industry 5.0 is about finding the optimal balance between efficiency and productivity and cooperative interaction between people and machines.

3. The expansion of robotic automation is essential. A European Union (EU) advisory body has acknowledged that Europe is lagging behind the United States and China in advanced technologies such as artificial intelligence (AI) and called for accelerating the development of AI and robotics in the region.

In Industry 5.0, machines will be responsible for routine tasks, while employees will take on higher-level tasks, managing and supervising such systems to make real-time decisions and look for opportunities to improve quality and production processes.

7. POSITION OF INDIVIDUAL EU COUNTRIES ACCORDING TO DIGITAL ECONOMY AND SOCIETY INDEX

The state of digitization in the European Union is compiled on the basis of Eurostat information sources and the Digital Economy and Society Index. The

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Digital Economy and Society Index (DESI) is a composite index that measures the progress made by EU Member States towards the digital economy and society, summarizes relevant indicators of Europe's digital performance, and monitors the evolution of EU Member States' digital competitiveness.

The state, according to DESI 2021 in the digital economy and society, is mainly based on data from 2020.

7.1 Human Capital

Since 2015, the level of digital skills has continued to grow slowly, reaching 56% of individuals with at least basic digital skills, 31% with above basic digital skills, and 58% of individuals with at least basic software skills. Skills indicators are strongly influenced by socio-demographic aspects. For example, 80% of young adults (aged 16-24), 84% of individuals with high formal education, and 87% of students have at least basic digital skills. In contrast, only 33% of people aged 55-74 and 28% of pensioners and inactive people have at least basic digital skills.

In tomorrow's world, we must rely on digitally equipped and capable citizens, a digitally skilled workforce, and digital professionals. The EU has set itself the target of reaching 20 million employed ICT specialists with a convergence of women and men by 2030.

In the current circumstances, this is particularly important for staff working in health systems and public administration staff, as well as for teachers and professors, and their students.

7.2 ICT Graduates

A view of industry is crucial because industry as a whole in the European Union generates 24% of EU-28 GDP and provides employment for around 50 million

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people, i.e., around one-fifth of employed individuals in EU Member States (European Commission, 2017).

Employers in the EU are looking for employees with the necessary digital skills and workers able to use digital technologies properly. In 2019, 3.9% of Europeans graduated with an ICT degree.

7.3 Adoption of digital technologies by enterprises

Businesses are becoming increasingly digital, with large companies playing a leading role. 38.5% of large companies already rely on advanced cloud services, and 32.7% said they use big data analysis. However, the vast majority of SMEs do not yet use these digital technologies, as only 17% of them use cloud services, and only 12% use big data analysis. In terms of e-commerce, only 17.5% of SMEs sold products or services online in 2019, after a very slight increase of 1.4 percentage points compared to 2016. In contrast, 39% of large companies used online sales in 2019.

7.4 Digital Public Services

Digital technologies are increasingly placing new demands and expectations on the public sector. Unlocking the full potential of these technologies is a key challenge for government organizations. Effective eGovernment can provide a wide range of benefits, including greater efficiency and savings for governments and businesses. It can also increase transparency and openness. The Digital Decade aims that all key public services for businesses and citizens should be fully online by 2030.

8. POSITION OF INDIVIDUAL EU COUNTRIES ACCORDING TO THE INDUSTRY 4.0 RELATIVE PERFORMANCE INDEX

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In the field of Industry 4.0 measurement, there are a relatively large number of academic studies that focus on composite indicators that try to capture this phenomenon statistically.

This index is calculated according to the methodology of the World Economic Forum. The calculation of the own composite indicator makes it possible to record the development of Industry 4.0's performance over time and thus evaluate the relative positions of the member countries.

A cluster analysis was performed for 2011 and 2019, and data were extracted from Eurostat and World Bank statistics. The results of this evaluation can be used to compare the state of implementation of Industry 4 in individual partnership countries and with the EU average as well as in the area of Industry 4.0 support, which may contribute to strengthening the position of the EU economy as a whole in the future. Industry 4.0 is a complex phenomenon and cannot simply be statistically recorded using a single indicator, so there is a need to calculate these so-called composite indicators.

The results:

Table 1 shows the calculated values of the Industry 4.0 relative performance index (score) for the years 2011 and 2019. The table also shows the order of countries in individual years and the change in order between 2011 and 2019.

Tab. 1 Industry 4 relative performance index

State	Code country	Score 2011	Rank 2011	Score 2019	Rank 2019	Change Rank 2019 vs.2011
Austria	AT	0.48	7	0.53	11	-4
Belgium	BE	0.55	3	0.73	4	-1
Bulgaria	BG	0.18	28	0.25	27	1
Cyprus	CY	0.25	24	0.31	25	-1
Czech Republic	CZ	0.45	9	0.51	12	-3
Germany	DE	0.51	6	0.54	10	-4
Denmark	DK	0.51	5	0.73	3	2
Estonia	EE	0.30	19	0.42	17	2
Greece	EL	0.36	14	0.38	20	-6

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Spain	**ES**	**0.33**	**18**	**0.45**	**16**	**2**
Finland	**FI**	**0.54**	**4**	**0.75**	**2**	**2**
France	**FR**	**0.35**	**15**	**0.51**	**13**	**2**
Croatia	**HR**	**0.28**	**22**	**0.35**	**22**	**0**
Hungary	**HU**	**0.29**	**21**	**0.30**	**26**	**-5**
Ireland	**IE**	**0.58**	**2**	**0.79**	**1**	**1**
Italy	**IT**	**0.27**	**23**	**0.34**	**23**	**0**
Lithuania	**LT**	**0.30**	**20**	**0.55**	**9**	**11**
Luxembourg	**LU**	**0.47**	**8**	**0.50**	**14**	**-6**
Latvia	**LV**	**0.23**	**25**	**0.31**	**24**	**1**
Malta	**MT**	**0.44**	**10**	**0.62**	**6**	**4**
Netherlands	**NL**	**0.44**	**11**	**0.69**	**5**	**6**
Poland	**PL**	**0.21**	**26**	**0.37**	**21**	**5**

CONCLUSION

Companies have already understood the massive impact of Industry 4.0 and the role of digitization and technology in the fundamental transformation of business and production models and processes. The challenge is to find the steps they need to take to reap and realize the benefits of the future of Industry 4.0. It is not just a matter of creating a technology plan, but mainly of having people with the necessary knowledge and skills to work with these technologies.

Businesses consider the lack of experts with specific knowledge in the field of IT to be obstacles to the implementation of new technologies.

The project will create high-quality study materials necessary for the education of a new type of engineers and especially developers who will master not only digital technologies, but will be able to develop new products and industrial components for Industry 4.0.

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