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THE FOF-DESIGNER:
DIGITAL DESIGN SKILLS FOR FACTORIES OF THE FUTURE

Project Acronym:
DigiFoF

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CONTI

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ULBS

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All Partners

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BOC

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1 Introduction

Digitalization of manufacturing and the Internet of Things (IoT) revolution in industrial sector is revealed by many new concepts like Industry 4.0, Smart Manufacturing, and Factories of the Future. They all describe the ultimate goal which is to interconnect every step of the manufacturing process and seamlessly integrate the physical and digital world. The entire factory lifecycle from parts supply, operational efficiency, optimized manufacturing, quality assurance and delivery is supported by industrial Internet of Things, collaborative and autonomous guided robots. Thus, enterprises must consolidate their product and service development, production logistics and business systems to produce and deliver on a decentralized basis, in a self-directed way in real time.

The main challenge is represented by educational system, how it is prepared to provide students, future employees, the digital competences necessary for the Factories of the Future. Furthermore, technology is constantly evolving, and employees that do not keep their skills up to date will be overtaken at work by tasks and activities based on using new hardware devices and new software tools involving new functions, different abilities, and finally may lose their jobs. Companies cannot implement cutting-edge technologies if their workforce does not have the skills to use that new tech effectively. Without a critical mass of employees with appropriate digital skills, innovation will slow down. The companies will have to exert maximum effort to help employees improve their skills and knowledge.

Digitalization requires that companies, together with Higher Education Institutions and other training institutions work together to develop skill profiles, trainings concepts as well as materials for design aspects of the Factory of the Future (FoF). The process of developing trainings on new skills consist of several steps.

First, the industrial partners need to identify the requirements for education and qualification of employees related to FoF skills. For this, industrial partners must perform a gap analysis. Based on business strategy, new technologies impact must be identified and evaluated. These new technologies will require specific, digital skills that must be identified, then assessed and prioritized. Potential technologies, not fully developed, can be included in this analyse, too.

Second, the skills with highest priority, from top of the list, must be approached with dedicated training concepts. Based on the skill itself, different ways of trainings can be used, like classrooms, digital learnings, workshops, learning projects, etc. This step will require the highest collaborations between HEIs and industrial partners. HEIs will contribute with know-how in developing trainings, in offering “teach the

teacher" programs in standardization and dissemination of these trainings. Industrial partners will contribute with practical examples/projects of these trainings, they will offer to the students the possibility "to see and touch", the possibility to see that specific technology working.

Third, these trainings cases developed previously, must be delivered to employees of the industrial partners in order to increase the skills of the people already working with these new technologies. Last but not least, these new training cases must be included in curricula from relevant engineering universities in order to give to the graduates the right skills they need when they will start there activity, offering them an competitive advantage, and to give companies the possibility to expand usage of new technologies with higher speed of implementation.

2 Content

It is in the scope of Digi FoF project to develop skill profiles, trainings concepts as well as materials for design aspects of the Factory of the Future (FoF). But, which kind of skills and training concepts must be approached with highest priority, still remain a challenge. It is very important, in the fast-changing business environment of our days, to prioritize and to allocate available resources to the skills and trainings with highest impact in European and national industrial partners. Resources are limited and industrial partners need, at least, to maintain the competitive advantage, if not to increase it.

To overcome this challenge, consortium identified over 20 real-life industry cases that took place just recently or are currently ongoing. This approach guarantees that topics described in the cases are of high importance for industry and will provide high added value when used for professional trainings.

In addition to above mentioned skills gap, other factors were also considered while identifying and describing industry cases, like confidentiality or possibility to create an interesting open ended, problem-based learning approach.

Each industry case was described using common template, addressing various aspects in a structured way:

- Case overview/header, with details on country, partner, date
- Digital transformation challenge explaining the challenge from business, conceptual and technical perspective
- Solution
- Key skills and competences required to implement the solution
- Final result
- Conclusions and recommendations, including business benefits
- References and appendices

In the following, we will present the industry-cases to be developed as part of this project:

Lead organization	Industry Case name	Additional description / goal	Status/Case date
AFIL	Complete revamping of materials and product handling systems along the assembly line	Company A is a multinational company operating in electrical and electronical equipment manufacturing and industrial automation sectors. The industrial case focuses on a plant in which Company A works on the manufacture of medium voltage devices and switchgears with a production process characterized by the assembly and testing of configurable products, starting from about ten thousand components purchased from suppliers. In order to improve the efficiency of the production process, Company A has decided to completely revamp the materials and products handling system along the assembly line. In this regard, a combination of innovative methodologies and technologies have been applied.	Solution implemented
AFIL	Systems for complete traceability of assembled components and a guided pipeline in assembly operations	Company B is a SMEs operating in the manufacturing industry, in particular in the machinery sector. Company B has an expertise in the field of mechatronics and is active in the design and realization of solutions for the automatization of the assembling and testing process of several products. The assembling and testing solutions can be either semi – automated as well as fully – automated. The solutions are provided to the customer and placed in the production process line.	Solution implemented
AFIL	Distributed design, planning, monitoring, control and diagnostic system through the cross-application of the Industry 4.0 technology	Company C is a SME operating in the manufacturing industry, in particular in the design and manufacture of machines and modules for the automatic assembly. The machines integrate mechatronic solutions such as robots, vision systems and mechanical processing. Company C develops tailor – made solutions for several industrial applications.	Solution implemented
BOC	Conceptual case: batteries as a service	Both consumers and companies are using large number of various batteries. Traditionally batteries are sold either as a part of a product or independently, used and after they are no longer usable disposed of (which is also an important concern due to the dangers caused by batteries thrown into water or into the garbage (environmental sustainability). High quality batteries have longer life and higher capacity, but their cost is exponentially higher than	2017

		cheaper batteries with shorter time of life. Possible solution for this problem is a digital service for providing, exchanging and decomposing for renewal the batteries in line with the circular economy approach. Instead of selling batteries, company could offer a service for a monthly rent.	
BOC	Automation of production processes for individual (retail) orders and specification	Company B had to master new way of production – mass customization. This way they can produce furniture very fast in comparison with manual preparations of custom furniture, while benefiting from lower costs due to automation.	2018
BOC	Sensor based maintenance of HVAC equipment in large office facilities	Company A is offering Facility Management services for thousands of locations throughout the Europe. Customers of Company A are often retail or production companies as well as service providers (including banks and telecoms). One of the most important aspects of the Company A offer is maintenance of HVAC (Heating, Ventilation and Air Conditioning) equipment.	2018
CIMES	TIPCO – Intelligent traceability for complex products	The main goal of this project is to offer a new solution to trace complex products, more especially metallic high-temperature products evolving in a complex environment. The strategy is to identify automatically every product and to locate each of them. TIPCO is working on big-sized products. This project answers to the needs of metal transformation industry because these products, dealing with thermal and mechanical treatments all along the process of production, cannot fit with traditional RFID sensors.	
CIMES	USITRONIC – Self-adapting production island	The project aims at shaping “zero defect” industrial pieces with a tool-machine equipped with miniaturized wireless sensors and geometric sensors controlling pieces and tools. A central system coordinates the whole and manages 24/7 the production of several sets of pieces. The final machine is equipped with a large capacity of different tools and materials.	
CIMES	From e-spindle and e-machining projects to servitization	This R&D project aimed to develop a smart spindle for machining. The product is now sold. The device gives information while machining such as temperature, pressure, strength. Because of embedded solution it allow to control vibration. E-machining project aims to use the e-spindle to enrich the processing machine in an industrial IoT approach. Based on these technological development, next	

		step is to propose services based on the new capabilities brought by the innovative products	
CIMES	HALL 32 – New approach of the vocational trainings	Thanks to private-public partnership (big companies, SMEs, rectorate, “pôle de compétitivité”, policy makers), Hall 31 wants to offer a new approach of the vocational trainings aiming at creating a program of excellence to train people for the industrial jobs which require high-qualified experts. One of the main goals is to break the negative popular vision of industry and give the youth the possibility to access empowering jobs. This project is now a reality. It stands for a competence center as well as a pilot plant, a vocational training place, a process lab when people can learn by doing.	
CIRIDD	A performing service system for the wood industry	To be the French leader of cutting tools of the wood industry and To develop product service systems including furniture, maintenance, saw blade logistics and tools for an indefinite period of time.	2018
CIRIDD	Improving performance thanks to the economy of functionality	To answer customer needs To find a sustainable, economic and ecologic solution	2017
CIRIDD	Shaping light to gain new markets	To shape new strategy to gain new markets To face low cost competitors	2006
CLEXTRAL	Implementing a “Remote Assistance” service package	The company C sells equipment to the food industry in almost 100 countries and is regularly confronted to the question of equipment or process (equipment use) troubleshooting. Those machines are critical in the manufacturing line of the customers and any unexpected and unscheduled downtime is worth thousands of euros per hour in term of loss of production. It is therefore essential to be able to diagnose rapidly the problem the customer is facing in order to propose the right course of action to alleviate the issue. Some difficulties are obvious when a mechanical failure occurs for instance. However, in many cases, we are not talking about dramatic breakdown but more about the inability to make the	2015-now

		final product, which can be the consequence of raw material quality, equipment setup, wear, etc. or a mix of the above.	
CLEXTRAL	Implementing a CRM – upside, resistance and opportunities		
CONTI	AGV for modern Logistics in industrial companies	AGV implementation is part of Digitalization programs that modern industrial companies need to have to comply with Industry 4.0 concept. The program's intended reason is to provide a good understanding of functionality and usage of AGVs in logistic processes. Integration of AGVs in logistic process contributes to Just in Time manufacturing by increasing efficiency of transportation process, reduce Work in Process levels of materials in production area and allowing to use progressively smaller lot-sizes to improve the materials flow.	2019
CONTI	Rapid implementation of Cobots in industrial environment	Cobots, as human worker replacement, represents the new challenge for industrial companies. In order to install this type of equipment, automation and programming skills are needed for engineers. DIGI FoF provide training materials for installing and programming information needed for a rapid implementation of Cobots in industrial environment.	2019-now
EMSE	The final customer satisfaction of information transmission	An industry case from agricultural machinery on the provision of a technical platform with individualized customer data integrated with CRM system	2017-2018
EMSE	Integrated design of a product service system and the associated economic model	The meat transformation industries are challenged with increasing international competition and changes in customer behaviour. These circumstances compelled professionals in the field to work not only on decreasing production costs, but also and most importantly on improving the quality of their products. The case study consists in designing an innovative Product-Service-System (PSS) answering these industrial cleaning needs. The PSS is designed to be implemented within a meat transformation French enterprise (E1) in order to clean cold storage warehouses. The adoption of PSS thinking is motivated by a desire to unleash the potential of high-added value solutions coupling robotics with service.	2016-2019

IDPC	Optimization of the orders flow process through solutions of the digital workflow of details and interactive warehouses in an additive manufacturing environment.	Industry: additive manufacturing • Improving communication between the client and the contractor, • Simplify of the ordering procedure (time, order warehouse - digital details, quotation), • Optimization: Cost reduction, elimination of human errors in the manufacturing process, • Introducing functionality for the customer: intuitiveness in the ordering process; details flow monitoring and implementation stage	2018
PRELMET	Industry 4.0, change of paradigm within the Company for a greener and sustainable economy using advanced technologies, automation and robotics	Change of paradigm within the Company, manufacture automotive components in conditions of an Industry 4.0 and in condition of a greener and sustainable economy. The need to introduce advanced technologies, automation and robotics. The necessity to implement cloud technologies and IOT. Identification of complex digital data analysis solutions. Professional training of specialists at a high level of skills and digital competences for industry 4.0, design and engineering, automation and integrated systems.	

The industry-cases are curently located on cloud, at:

Lead organization	Industry Case name	Link to Industry-cases folders
AFIL	Complete revamping of materials and product handling systems along the assembly line	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/AFIL&fileid=4552
AFIL	Systems for complete traceability of assembled components and a guided pipeline in assembly operations	
AFIL	Distributed design, planning, monitoring, control and diagnostic system through the cross-application of the Industry 4.0 technology	
BOC	Conceptual case: batteries as a service	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_M

BOC	Automation of production processes for individual (retail) orders and specification	ethods_Tools/T3.4%20-%20Industry%20Cases/BOC&fileid=4272
BOC	Sensor based maintenance of HVAC equipment in large office facilities	
CIMES	TIPCO – Intelligent traceability for complex products	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/CIMES&fileid=4209
CIMES	USITRONIC – Self-adapting production island	
CIMES	From e-spindle and e-machining projects to servitization	
CIMES	HALL 32 – New approach of the vocational trainings	
CIRIDD	A performing service system for the wood industry	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/CIRIDD&fileid=3392
CIRIDD	Improving performance thanks to the economy of functionality	
CIRIDD	Shaping light to gain new markets	

CLEXTRAL	Implementing a "Remote Assistance" service package	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/CLEXTRAL&fileid=3395
CLEXTRAL	Implementing a CRM – upside, resistance and opportunities	
CONTI	AGV for modern Logistics in industrial companies	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/CONTINENTAL&fileid=3400
CONTI	Rapid implementation of Cobots in industrial environment	
EMSE	The final customer satisfaction of information transmission	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/EMSE&fileid=3394
EMSE	Integrated design of a product service system and the associated economic model	
IDPC	Optimization of the orders flow process through solutions of the digital workflow of details and interactive warehouses in an additive manufacturing environment.	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/IDPC&fileid=4550
PRELMET	Industry 4.0, change of paradigm within the Company for a greener and sustainable economy using advanced technologies, automation and robotics	https://cloud.digifof.ulbsibiu.ro/index.php/apps/files/?dir=/DigiFoF%20Project/WP3_FoF_Designer%3AInnovative_Teaching_Methods_Tools/T3.4%20-%20Industry%20Cases/PRELMET&fileid=3401

Most of the industry-cases presented before, if not all of them, will be followed by training packages developed in Task 3.2. Industry cases might be also modified and improved in future, as a result of Task 7.1 (Evaluating the industry cases and providing input for improvement).