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1 Introduction

This report represents the first outcome of task 2.5 “Realizing the business plan for the DigiFoF Design Competence Network” and summarizes the findings with respect to market demands for competences. As an iterative action, this version of the deliverable represents the first release of results on competences and industry needs, building upon the information collected in work package 1 results, documented in deliverable 1.2 “Reports on needs and demands for FoF Design: Findings and recommendations” (Jurczuk, Dębkowska, & Gudanowska, 2019).

The objective of the work performed in this task is to correlate findings from the information collected in the first period of the project (see D1.2 for details, 87 participants in survey from different participating countries) with initiatives and approaches on national level of higher-education institutions and industrial partners/networks. The country-specific expertise of partners is deemed essential to continuously align the work stream and educational material developed with market needs and demands. The series of reports, that are prepared within this task (yearly iterations and refinements), are established to collect these demands, a) align with national initiatives and adapt in a responsive manner to upcoming challenges and b) verify the developments and results of the project continuously.

For this initial version of the report, a common description approach has been applied to harmonize the research results and provide a framework for discussion. This approach is adapted during the upcoming iterations according to the findings on national and European level. This common structure is briefly introduced below.

1. **National insights on FoF-Design Competency Needs:** What are the design skills and trainings in the national market? In this part, refer to national studies and surveys as well as to the results of the DigiFoF survey and report D1.2.

2. **Conclusions on FoF-Design Competency Needs:** What conclusions can be derived from D1.2 for the national market and additional studies on skills and competency requirements for FoF?

3. **National measures to Influence FoF-Design Competencies:** Which national and regional measures and initiatives/actions addresse the FoF competency demands and needs as well as vision and deployment strategy.

The first section of each chapter provides insights on the results of D1.2 and derived design skills. Section 2 focuses on the conclusions derived from the DigiFoF study and their impact is assessed in section 3. An important aspect during the work performed in this task is the alignment of academic institutions with industrial expertise, combining the viewpoint of higher-education and industry needs within the discussion.

In upcoming releases, a refinement of the structure is planned to included business planning aspects on how the results of DigiFoF are fit for application/exploitation on national as well as European level.

2 Market Report France

In this chapter, the initial market analysis and review performed for France is presented. National insights on FoF design competences are discussed, introducing national initiatives contributing to the needs and requirements identified in the DigiFoF project building on the expertise of the French partners in the project, their knowledge on the market situation and the results from the questionnaires in WP1 and its interpretation. The analysis has been provided by DigiFoF partners EMSE, CLEX, VIAMECA, CIRIDD under the coordination of EMSE (Prof. Xavier Boucher, Dr. Elaheh Maleki).

2.1 National Insights on FoF-Design Competency Needs

Industries are today very focusing on the technological dimension of factories of the future. However, the ever-increasing spread of digital tools also has an impact on the structure and nature of employment. Repetitive jobs are expected to disappear in favour of jobs that are more qualified. Deep changes in the work environment are likely to happen. That is why employee's skills and competencies need to adapt and evolve. More generally, there is a trend towards the hybridization of the jobs. Industrialists look for candidates who master multiple competences at the same time. In this context, the training system must be redesigned to respond to the need to permanently adapt, to follow, to accompany and drive change.

In the hurried context of a desire to reindustrialize the French economic system, France launched in 2013 a strategic reflection to identify the industrial priorities on which it is essential to invest and mobilize resources. This reflection is combined with an offensive policy of industrial reconquest aiming at supporting companies in their process of transition and developing an offer of training much better adapted to the new stakes of the «New Industrial France»[1].

Indeed, the industrial metamorphosis operated by mundialization issues and environmental stakes and the opportunities provided by digital technologies comes with fundamental and deep transformations for skills and qualifications[2]. To answer it, the national initiative «Osons l'industrie»(Alliance Industrie du Futur, 2016) (i.e. Let's deal with Industry) was launched in March 2016, coordinated and implemented by the Alliance Industrie du Futur (i.e. Alliance for the Industry of the Future)[3]. The work done by this structure puts the man as a worker and his know-how in the core of the discussions and the answers to bring. In collaboration with several important stakeholders fully involved in trainings such as UIMM (Union des industries et métiers de la métallurgie – Union for Metal industry and jobs), IMT (Institut Mines Télécom), Arts et Métiers ParisTech, ONISEP, and under the aegis of CNI (Conseil National de l'Industrie – National Council for Industry); the initiative «Osons l'industrie» aims at helping the industrial workers in

[1] Name given to the French government strategy aiming at identifying the primary industrial stakes and sectors (Ministère du Redressement productif, 2017)
[2] ONISEP (Office national d'information sur les enseignements et les professions) is a public establishment in charge of elaborating and disseminating information about jobs and trainings to students, parents and staffs (ONISEP, 2019)
[3] Alliance Industrie du futur aims at helping companies, and more specifically SMEs, in their process of modernisation of the industrial tools and transformation of their economic models with digital and non-digital new technologies (Alliance Industrie du Futur, 2019b)

the digital transformation of their jobs and, more generally, to improve the image of industry on the job market.

In operational terms, the initiative is built around five main axes linked to the families of professions in the heart of the French industry of the future:

1. Maintenance,
2. Big Data,
3. Management,
4. Production, and
5. Supply Chain.

Each of these axes hinges on three steps:

1. The development and publication of job sheets linked to the industrial digital stakes and their consequences,
2. The provision of skills kits in order to elaborate new offers of training,
3. The creation of a web portal that is the entrance door to new jobs, new training offers, and job offers (IMT, 2018).

Each of them needs to be seen as a powerful didactical source made up of diverse contents (video presentation, educational sheets, interviews, definitions of technical terms…) that are easily affordable, freely downloadable and largely used by schools beforehand. All these elements – narrowly created with the companies that expressed their real needs for the digital transformation – can help the teaching and training communities to define a new speech on industry and more especially on the industry of the future.

In France, three types of skills are required: hard skill (technical *competencies*), soft skills and skills linked to the industry sector (Auvergne Rhone-Alpes Enterprise, 2019).

According to Association Pour l'Emploi des Cadres (APEC) (APEC, 2017) Industry 4.0 requires the following hard skills:

- Cobotics and exoskeleton;
- Artificial Intelligence (machine-to-machine communication, cloud and big data, reliability of high-power mechatronic system, maintenance optimization and predictive maintenance);
- Cybersecurity;
- Augmented Reality and Virtual Reality;
- Numerical simulation.

Industry 4.0 cannot be driven without soft skills. APEC mentions the following soft skills as the most crucial to develop industry 4.0:

- rigour,
- coordinating with others,

- autonomy,
- team spirit,
- customer service-oriented creativity,
- leadership, and
- flexibility.

Critical thinking skills will be valued within the industry 4.0 to master the challenges of the industry sector.

2.2 Conclusions on FoF-Design Competency Needs

The focus group for the project are French SMEs in manufacturing and machinery. Managers who answered the questionnaire have been in their position for 5 years and less. They mentioned that they evaluate the design skills of candidates during the employment process. They also facilitate access to related training for employees during the work and consider promotions for employees who have improved their skills. The results of the survey are discussed in (Jurczuk et al., 2019)

The training subjects in which the French companies are interested are mostly managerial and technical (strategy level and technical level). There is direct relation between the level of competency of employees and the training they attend. Even though the business process and middle managers have medium competency level in the scope of Factory of the Future, they are the most important groups to attend the training (see Figure 1).

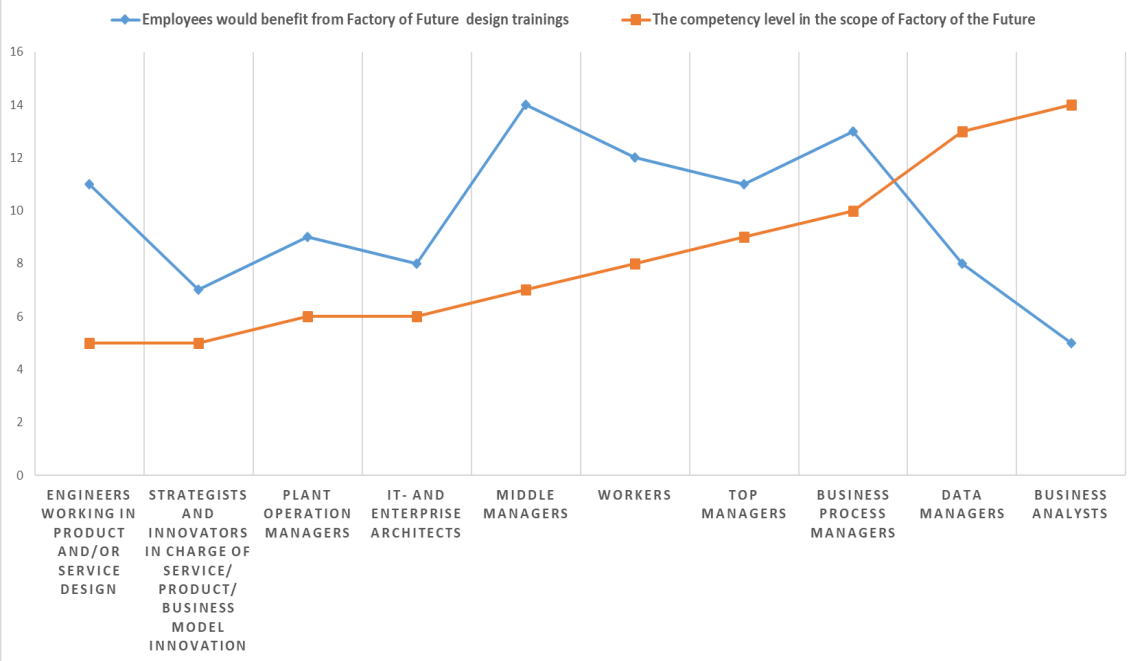

Figure 1 Competency and Training in French Companies
Source: Own representation based on T1.3 results in DigiFoF

Innovation in different subjects (product, service, Business model and process) and Value proposition is well known and used in French companies. However, many tools are not well known for them (see Table 1)

Table 1 Focus on Innovation Techniques

If you use innovation techniques on what do focus now or plan to do in the future	
Business model innovation	Actual state
Future Service innovation	Actual state
Product innovation	Actual state
Business process innovation	Actual state
Value proposition canvas	Known and used
Technology innovation	Not known
Business Model Canvas	Not known
Stakeholder Analysis	Not known
Customer Journey	Not known
Persona	Not known
Brainstorming	Not known
Minimum Viable Product	Not known
Scenario Technique	Not known
Thinking Hats	Not known
After Action Review	Not known
Systematic Inventive Thinking	Not known
Weighted Selection	Not known
Osborn Checklist	Not known
Customer-oriented innovation	Plan
Product-service-innovation	Plan

Source: Own representation based on T1.3 results in DigiFoF

The data collection from the production system is mostly automated. As a result, the design tools are mostly related to the production and design in manufacturing (Computer-aided design, Computer-aided manufacturing, Product data management and Data modelling) as well as some strategic level subject such as Enterprise architecture management (ERP) (see Table 2)

Table 2 Design Tools

What design tools do you use within your company	
Computer-aided design (CAO)	Known and used
Computer-aided manufacturing (FAO)	Known and used
Product data management	Known and used
Enterprise architecture management (ERP)	Known and used
Data modelling	Known and used
Digital Mock-up	Not known
Computer-aided engineering	Not known
Business process modelling (BPM)	Not known
Business modelling	Not known

Source: Own representation based on T1.3 results in DigiFoF

The most interesting result is about programming languages for the automation of cyber-physical systems. All respondents answered that they do not use any programming language. This is to say, they do not develop tools inside the company. They either buy prepared solutions or outsource it to external partners.

2.3 National Measures to Influence FoF-Design Competencies

The French initiative for the industry of the future is part of a national project entitled "New Industrial France". This project is the result of the collaboration between various partners. Since 2015, the "New Industrial France" has entered into its second phase aiming at bringing it into line with the major challenges of the future. This resulted in a transversal program called the "Industry of the Future". Its ambition has been broadened from the modernization of the productive tools to supporting the digital transformation of companies. The steering of the program has been entrusted to different representatives of the economic world, who will be responsible for defining the roadmap. We find today representatives of public authorities, industries and representatives of the alliance for the industry of the future. It brings together numerous players from the industrial and digital worlds, the world of research and training and is open to all trade unions and professional federations wishing to get involved in the project.

National Policy

At the very beginning of the 2010s, France has started up working on a strategic reflection about the industrial policy and the strategic sectors (Nouvelle France Industrielle). In April 2015, a large plan dedicated to Industry of the Future was launched and financed by PIA (Programme d'investissements d'avenir – Investment Program for the Future). Alliance Industrie du Futur (Alliance for the Industry of the Future - AIF) is created in July 2015 with the mission to «support and coordinate, at the national level, the initiatives, projects and works aiming at modernizing and transforming the industry in France» (Alliance Industrie du Futur, 2019c). AIF is the meeting point of the professional federations and unions, engineering schools, applied research centres, pôles de compétitivité and public entities involved in helping companies to innovate and invest. Its action is built around three main strategic axes, each of them composed of different working groups:

1) SMEs, intermediary companies and sectors transformation
   - Promoting the existing technological offer
   - Industry of the Future showcases (« Vitrines »)
   - Deployment within the territories
2) Development and implementation of the technologies of the future and standardization
   - Development of the technological offer of the future (Innovation)
   - Standardization
3) Development of the competencies for tomorrow - human and Industry of the Future

Three examples of the main public and visible outputs from AIF are mentioned below that are relevant for the project:

- The technological catalogue for FoF (list of levers from technologies to business models or organizational mutation) in (Alliance Industrie du Futur, 2019a);
- The National Catalogue of Solutions Suppliers in (Alliance Industrie du Futur, 2019d);
- The initiative « Osons l'industrie » (Let's deal with industry) aiming at promoting industrial jobs and contributing to modifying training for these jobs in (Alliance Industrie du Futur, 2019e).

Deployed at Regional Level

The actions led by AIF are spread and rolled out at the regional level with the help of its members' network as CCI (Trade and Industry Chambers), professional technical centres, federations and unions and *pôles de compétitivité*. In 2019, an ambitious program aiming at supporting 10 000 french SMEs by the end of 2022 is launched.

Each region is then called to adapt this program by taking into account their specificities and more especially their own Smart Specialization Strategy. In Auvergne-Rhône-Alpes, the economic development policy is built around 8 main excellence fields (DOMEX) that elaborate specific sectoral strategies in order to gather the different regional scientific, economic and academic stakeholders. For example, one of these fields is dedicated to Industry of the Future, a second one to Digital Technologies. *Pôles de compétitivité* plays a key role to animate relate and mediate the national and regional initiatives. In Auvergne-Rhône-Alpes, there are 12 *pôles de compétitivité* and 20 clusters. CIMES (formerly ViaMéca) is in charge of the animation of the working group for Industry of the Future gathering almost all the *pôles de compétitivité*.

Auvergne-Rhône-Alpes is also well involved at the European level thanks to the *pôles* and clusters, notably in the S3 platforms. For example, CIMES is one of the members of EFFRA and I4MS. Consequently, the transnational perspective roadmaps are also important and valuable assets for the regional strategies. Finally, CIMES holds the initiative of a DIH focused on manufacturing playing a major role in this regional strategy linked to the national level and Europe in order to share and capitalize on all these sharing practices and to build a transnational network of competencies centres.

Other Initiatives and Good Practices

Other initiatives relevant for the Project, that take into account local specificities other initiatives are introduced below:

- Local call for projects led by CIMES dedicated to traditional SMEs and devoted to innovation in manufacturing fields. Almost 390 k€ founding for 41 SMEs since 2015.
- RELIEF Program devoted to servitization in SMEs lead by CIRIDD. This program aims to train 20 firms from Auvergne-Rhône-Alpes region to develop a functional economy within their business model (Pédron, 2019).
- Hall 32, Industrial Jobs and careers promotion centre. Lead by Private companies (Michelin, Limagrain, Banque de France), rectorate and pôle CIMES, founded by companies, AURA Région and French government (Hall 32, 2019).
- COEF Program aims to help the local authorities to develop public tendering including the functional economy.

3 Market Report Finland

This chapter provides the key facts on the market for FoF-Design in Finland. It focuses on the industry sector relevant to the project and provides insights into the effects of digital transformation on national level. The analysis has been provided by DigiFoF partner University of Oulu (Prof. Juha Röhning, Timo Mäenpää and team).

3.1 National Insights on FoF-Design Competency Needs

Industry is driving force for Finland's economy contributing 28,2 % of GDP. The largest industries in Finland are in order metal industry, chemical industry and forest industry. Metal industry can be further divided to metal products, machinery, electronics and vehicles (Suomen virallinen tilasto (SVT), 2018). Growth of industry has been increasing since 2016 from 1.3 % to 4 % per year in 2018. Growth is expected to slow down in the following years (Berg-Andersson, Kaitila, & Kaseva, 2019). Finland's industry is centralised: ten largest companies represent 52 % of industry's contribution to GDP.

Several export dependent industries have had difficulties in the last years. Interest in forestry product has decreased and manufacturing of IT-devices is smaller compared to previous years. Despite of difficulties in earlier years, Finland has been successful in globalisation. Several companies (for example Kone , Cargotec, Wärtsilä, Outotec) have become leaders in their sector. Specialisation and switching to higher refinement level products have been one way for success in the markets (Elinkeinoelämän Keskusliitto EK.FI, 2016).

Strengths of Finland include high education level. Investments to education, skills, research and innovation have been substantial. Companies innovation is focused on incremental improvements rather than to breakthrough innovations. Historically, enterprise have succeeded in invention, but not so well in commercialisation (Työ- ja elinkeinoministeriö, 2014).

Finland is one of the leading countries in digitalisation of business. Every company employing 10 or more people uses computers and has a broadband connection and over 90 % have a webpage. ERP- and CRM systems are used in around 40 % of enterprises (Pohjola, 2014). According to the Finnish Innovation Survey the importance of digitalisation for enterprises' business activity is less strongly acknowledged in manufacturing enterprises than in service enterprises. 25.34 % of manufacturing enterprises consider one form or another of digitalisation key to the firm's operation compared to 41 of service enterprises.

3.2 Conclusions on FoF-Design competency needs

Importance of digitalisation has increased in companies of all size. In small companies (<50 employees) 44 % feel that digitalisation is at less moderately important. Interest in using cloud computing and robotics in production has increased in last years. In addition, digital design, distribution and marketing have gained importance in industry. In contrast, interest in IoT has stayed low. Computing and data collecting have become relatively easy so interest in big data analytics will continue to increase. Currently around 20 % of companies employing 10 or more people uses big data analytics compared to 15 % few year ago (Ali-Yrkkö, Mattila, Pajarinen, &

Seppälä, 2019). In addition of technical skills importance of soft skills will increase in the future as requirements of industries change rapidly.

Despite Finland's high ranking in digital skills, almost 60 % of Finnish companies reported hard-to-fill vacancies for jobs requiring information and communications technology specialist skills.

3.3 National measures to influence FoF-Design competencies

Finland does not have an e-skills strategy or a national digital skills and jobs coalition. The main policy strategy for information society in Finland is the Digital Agenda for 2011-2020 'Productive and inventive Finland' It identifies e-skills and ICT-related education as a cornerstone for the future of the country and contains a range policy measures to support ICT-development.

In recent years Finland has implemented reforms of vocational education and training system to increase digital and workplace learning. In addition, new curriculum for primary and lower secondary education includes coding as mandatory theme starting from the first grade. As of mid-2018 more than 100 enterprises, education providers and NGO have pledged to reduce digital skills gaps by taking actions such as training courses, matching for digital jobs, certification and awareness raising (European Commission, 2019b).

One project to provide solutions for factories of future is Reboot Finland IoT Factory (Reboot IoT). It is a new corporate and research ecosystem project funded by Business Finland, aiming to covert factories to innovation platforms, enhancing the competitiveness and efficiency in the manufacturing industry. Challenges that Reboot IoT Factory tries to solve are:

1. Cognitive supply network
2. Robotics fusion
3. Labour at digital work environment
4. Digital production

The operative model is based on agile co-creation and experience sharing within real-world production environments. Each forerunner factory commits as a research and development platform for proof-of-concept experiments. Research organizations produce new scientific knowledge, which IoT solution provider can package as proof of concepts in order to test and validate against needs of the factories. Universities can also utilize project in teaching with concrete research problems (Reboot IOT Factory, 2019).

4 Market Report Italy

This chapter introduces the initial market report for Italy, discussing insights on a national level and the relation to the project's objectives. The market size is assessed and relevant programs and directions on national level are discussed. The analysis leading to this chapter has been performed by DigiFoF partner UNIBG and AFIL under the coordination of UNIBG (Dr. Fabiana Pirola).

4.1 National Insights on FoF-Design Competency Needs

Manufacturing is a fundamental pillar for Italy as it generates employment and wealth based on solid industrial skills, encouraging research and innovation activities of huge added value, with effects at all levels of society. The sector represents 15% of the GDP generated in Italy, with a turnover of ~ 900 billion euro (2014) and an added value of 224 billion (2014), created thanks to almost 3 million employees employed in over 387,000 companies. The observation presented in the reports analysed is valid for the project today.

In 2012, Italian manufacturing exports represented EUR 306 billion and, in terms of destination, Italian exports mainly ended up outside Europe. Capital goods in particular are the leading Italian export, putting Italy in a very strong position within the international panorama. Furthermore, it is estimated that, for each job in industry, two supplementary jobs are created in the services associated with it. According to World Bank data (World Bank, 2016), Italy was among the top seven countries in the world for added value generated by manufacturing, with the top ten countries representing 70% of the global added value.

In 2016, Italy continues to play a leading role in the European Manufacturing industry, ranking at the second place after Germany in terms of added value and number of employees. According to a study carried out by Fondazione Edison (Fortis, 2018), in the years 2015 – 2017 the added value of the Italian manufacturing industry has increased regularly in comparison to the main European countries. Figures for 2017 are: Italy + 3.8%, Germany + 2.7%, United Kingdom + 2.3% and France +1.7%. Further, in the 2014-2017 period the added value of the Italian Manufacturing industry has increased cumulatively by 10% that is over two and half times more than the GDP (+ 3.8%).

The "Research and Innovation Roadmap" (Fabbrica Intelligente, 2018) developed by the National Intelligent Factories Cluster (CFI) in 2012 defined the main research priorities of the Italian manufacturing sector.

These research priorities indicate that Italy could stand out by focussing on innovative technologies, machine tools, customised solutions and products with high added value, through the integrated innovation of products, processes and systems in order to provide a competitive edge in the variable market conditions. This can be made possible by the existence of particular environmental conditions in the Italian system, determined by a series of factors including:

- the strong industrial tradition and manufacturing culture rooted in the economy;

- the widespread presence of industrial districts where territorial excellence enhances the uniqueness of each region;
- the presence of universities, research organisations and technological transfer centres that work in conjunction with the industrial sector;
- the international reputation of “Made in Italy” as a concept of quality, design and tradition;
- the contribution of the manufacturing sector, more than any other, to the production of new scientific and technological knowledge;
- the industrial, economic and social conditions that can attract qualified resources.

The CFI roadmap defined the following 7 strategic action lines and the related research priorities:

1. Systems for Personalised Production:
   - Advanced tools for the configuration and design of personalised solutions;
   - Solutions for the efficient manufacture of functional customised products with high added value;
   - Models and tools for the creation of dynamic networks for personalised production;
   - Advanced solutions for the management of customer-driven production;
   - Mini factories: a model for reorganising the production and distribution chain;
   - Production systems for smart materials (sensor-based, bio, etc.) for the customisation of the product/service.
2. Strategies, Methods and Tools for Industrial Sustainability:
   - Integration of design and development processes with a view to life cycle management;
   - Monitoring of the energy footprint of the products;
   - Integrated product-process-system modelling for the optimisation of eco-efficiency (energy and resources);
   - Technologies and processes for the reuse, remanufacturing and recycling of products, components and materials;
   - Technologies and tools for intelligent re- and demanufacturing systems;
   - Modelling and simulation for the sustainable supply chain;
   - Business models for the “Circular Economy”.
3. Factories for Humans:
   - ICT solutions for knowledge management and sharing;
   - New materials and new technologies for safety in the workplace;
   - Technologies and applications of virtual reality/ augmented for product-process-system management;
   - Technologies and methods for trainings.
4. High-efficiency Production Systems:
   - Advanced control for optimization of hybrid systems;
   - “Zero-Defect" production based on solutions for maintenance, quality and logistics integration;
   - Systems for supervision and control of industrial processes;

- Cyber Physical Systems (CPS) for the intelligent factory;
- Advanced motion planning for industrial robots;
- Accurate modelling of industrial robots.

5. Innovative Production Processes:
   - Processes technologies for innovative materials;
   - Advanced solutions for the micro-scale manufacture of products;
   - Hybrid processing;
   - New technologies for additive manufacturing;
   - New materials for additive manufacturing;
   - Technologies for the high-volume production of components in composite materials;
   - Innovative laser-based production processes.
6. Evolutive and Adaptive Production Systems:
   - Intelligent man-machine interaction;
   - Human-robot co-working;
   - Integrated simulation tools for the virtual commissioning of production systems;
   - Smart machines;
   - ICT for model-based machinery development;
   - Integrated digital platforms for the configuration of production systems;
   - Mechatronic modular systems for high flexibility.
7. Strategies and Management for Next-Generation Production Systems:
   - Methods and tools for the strategic product/process assessment in the life cycle engineering perspective;
   - Innovative business models for integrated product-service solutions;
   - Tools for the management of collaborative businesses and dynamic supply chains;
   - Robust planning for risk management in MTO and ETO production;
   - Development of semantic-based operational environments for users;
   - Tools to support decisions in complex environments.

The main skills required at the Italian level are those ones needed to implement the above-mentioned research priorities. These are both technical and soft skills needed to design and manage these new manufacturing systems.

The survey of needs and demands for FoF-design carried out in WP1 and reported in D1.2 (Jurczuk et al., 2019), highlighted these findings, valid also for the Italian context:

1. Knowledge gap exists in the scope of advanced methods and tools supporting the development of innovative products and services;
2. Respondents recognize the need to improve them mainly through organization and participation in additional internal trainings;
3. A lack of skills or a lack of access to necessary infrastructure supporting process modelling and model-based designing for cyber-physical systems;
4. Formal notations of process modelling (BPMN, EPC) are not common in use;

5. Programming languages (Java, C/C++) are widely used for automation of cyber-physical systems;
6. A lack of practical experience within an enterprise architecture management, business modelling and digital mock-up;
7. Process automation and controlling represents mostly low or moderate level.

4.2 Conclusions on FoF-Design Competency Needs

Taking into consideration the research priorities identified by the National Intelligent Factories Cluster and the results of the survey carried out at the beginning of the DigiFOF project, the main skills for the future of Italian manufacturing are the same reported in the World Manufacturing Forum report (WMF, 2019):

1. Digital literacy as a holistic skill to interact with, understand, enable, and even develop new digital manufacturing systems, technologies, applications, and tools;
2. Ability to use and design new AI and data analytics solutions while critically interpreting results;
3. Creative problem solving in times of abundant data and technological opportunities in smart manufacturing systems;
4. A strong entrepreneurial mindset including proactiveness and the ability to think outside the box;
5. Ability to work physically and psychologically safely and effectively with new technologies;
6. Inter-cultural and -disciplinary, inclusive, and diversity-oriented mindset to address new challenges arising from a more diverse manufacturing workforce;
7. Cybersecurity, privacy, and data/information mindfulness to reflect the rapidly increasing digital footprint of the manufacturing value chain;
8. Ability to handle increasing complexity of multiple requirements and simultaneous tasks
9. Effective communication skills with humans, IT, and AI systems through different platforms and technologies;
10. Open-mindedness towards constant change, and transformation skills that constantly question the status quo and initiate knowledge transfer from other domains

4.3 National Measures to Influence FoF-Design Competencies

At regional and national level there are several initiatives related to Factory of the Future (FOF).

At national level, in 2016 the Ministry of Economic Development (MISE) launched the Piano Nazionale Industria 4.0. In order to boost productivity and accelerate technological upgrading the National plan “Industria 4.0” of the Italian Government is focusing on strategic measures to support innovative investments and empower skills, such as: Super and Hyper amortisation schemes, tax credits on R&D and on profits from intangible and patented assets, strengthening of vocational training, creation of I4.0 Technological Clusters and Industrial PhDs. Moreover, complementary measures being implemented are the establishment of Competence Centres and of a network of Digital Innovation Hubs, Ultra Broadband with fibre to the factory approach,

cooperation on IoT open standards and interoperability, easier access to financing and productivity salary taxation exchange.

In particular, regarding DIH, the national industrial associations has created a network of DIH, which objective is to strengthen the level of knowledge and awareness of companies regarding the opportunities offered by digital transformation, also within the framework of the National Industry Plan 4.0 and the European Strategy for the Digitization of Industry (DEI Digitising European Industry). In more detail, DIHs aim is to stimulate and promote the demand for innovation in the production systems and are the "gateway" of enterprises to the world of Industry 4.0. More in detail, directly or through the innovation ecosystem (University, Competence Centre, Cluster, ICT Services, Research Centres; Science Parks and Technology Poles, Start-up Incubators) they offer: support to SMEs in the analysis of needs, opportunities and technological options 4.0; mentoring and factory training; support for the construction of industry projects 4.0; access to the network of national and European Competence Centres and collaborations with technology clusters; consultancy on Industry 4.0 (intellectual property, tax, business modelling, assessment of investment projects); self-assessment of digital maturity; access to public and private, national and European projects and funding.

Considering Lombardy, in 2016, the Region approved “Manifattura Diffusa Creativa E Tecnologica 4.0,” which is an instrument with allocated funding in the amount to €600m coming through the ERDF fund that is aimed at the promotion and development of innovative manufacturing.

A leading role in the advanced manufacturing belongs to AFIL (Associazione Fabbrica Intelligente Lombardia), which is the Technological Cluster for advanced manufacturing of Lombardy. The main goals of the cluster are: i) to set up a stable community by connecting companies, universities, research institutions and associations, thus favouring cooperation by promoting research and innovation projects and initiatives; ii) to be a reference counterpart for the Region for the definition of R&I innovation policies in the manufacturing industry and iii) to support the development of R&I inter-regional networks through the participation to national intelligent factory (CFI) and the connection with different European Regions within the Smart Specialisation Strategy.

AFIL aims at foster research and innovation in the advanced manufacturing sector, promote best practices and enabling technologies to support and develop the leadership and competitiveness of the Lombard production system.

A recent project launched by AFIL is Cento4.0, which aims to reward and recognize the most innovative manufacturing companies in the area. After the first year, Cento4.0 will develop a map of high innovative manufacturing companies, which will provide an indebt overview of the level of competitiveness at national, European and global level and position Lombardy Region in that regard.

5 Market Report Poland

In this chapter, the insights on FoF competencies derived on national level for Poland are presented. Based on the questionnaire information gathered, an alignment to national initiatives is performed, validating the objectives of the DigiFoF project. The results presented in this chapter have been prepared by DigiFoF partner UNIBIAL, BOC, IDPC under the coordination of UNIBIAL (Prof. Arkadiusz Jurczuk).

5.1 National Insights on FoF-Design Competency Needs

With regard to the gathered results of the survey conducted in Poland (mostly members of Metal Processing Cluster) it can be claimed that 72% of enterprises takes into consideration design skills of a candidate during the selection process for employment. Over 60% of employers perceive this type of employees' skills as a factor that has a decisive impact of their promotion. Similar number of polish employers, who have been surveyed (67%) are interested in shaping digital design skills and they provide or facilitate access for their employees to design trainings. The most popular with the employees of the enterprises in Poland according to respondents were those, which addressed the subject of project management[4].

Considering the competency needs of analysed Polish manufacturing enterprises it should be underlined that trainings within shaping digital design skills are most useful for engineers working in product and/or service design, strategists and innovators in charge of service/product/business model innovation (78% indications in both cases), but also for top, middle and plant operation managers (over 60% indications in each case). According to respondents, those groups of employees for whom the level of competencies within the FoF is mainly associated with theoretical knowledge are mostly top managers (61% indications) and middle managers (44% indications), but also business process managers, strategists and innovators in charge of service/product/business model innovation and IT enterprise architects (each role – 33% indications). In the case of other groups, respondents indicated that these competences are not associated with any specific type of knowledge.

Another analysed issue raised in the survey was the aspect of the most important personal digital competencies of the employee of the FoF. In the opinion of respondents from Poland, the most needed are currently the competences of critical thinking (83% indications) and complex problem solving (72% indications), as well as creativity and data protection (61% indications in both cases). Half of the respondents stated that they also needed adaptive learning and information and data literacy. The competences that will be needed in the next five years include digital content analysis & creation (50% indications), but also social networking (39% indications), adaptive learning, information and data literacy (33% indications for both competencies).

[4] Analysis is based on data and results presented in "Report on needs and demands for FoF-design: Findings and recommendations", in the scope of the project No. 601089-EPP-1-2018-1-RO-EPPKA2-KA. (Jurczuk et al., 2019)

Furthermore, the respondents from Poland pointed out the level of competencies from key FoF areas in enterprises represented by them. The highest average score was given to service design and engineering as well as knowledge management competences. The lowest level of Polish enterprises participating in the survey (Jurczuk et al., 2019) was indicated in the scope of additive manufacturing (e.g. 3d printing). Then the lowest score was given for competences in the area of internet of things and cyber-physical systems, computer programming/coding, process design and simulation, cloud technologies and big data.

When respondents were asked about their use of innovation techniques at the level of strategy and product/service innovation, half of them indicated that they use them (50% of answers). The most popular and most willingly used techniques among respondents in creating innovative solutions were customer journey and brainstorming. As known but not used techniques, the respondents' answers were mostly scenario technique, systematic inventive thinking and Osborn checklist. After action review was most often indicated as an unknown technique.

Among the surveyed polish enterprises, 50% declare that they model their business processes (usually as support for decision making and to automate processes within departments or across the enterprise). The modelling of processes in enterprises involves techniques that allow for creating value stream maps (in 4 out of 9 companies that declared they were modelling processes). At the same time 67% among respondents who do not use process modelling, indicated that they would like to implement process modelling in an enterprise. Most of the Polish respondents (78% indications) indicated that they don't apply a model-based design for cyber-physical systems.

In the light of the gathered data the best known and most used tools in designing in Polish companies, are product data management and computer-aided design. On the other hand, the tool most often indicated as known but not used turned out to be a digital mock-up.

With regard to the question on the application solutions, where work piece controls itself autonomously through production in enterprises, almost half of the surveyed provided negative answers (44% indications). Slightly more than 1/3 of the respondents confirmed the existence of such capabilities in their enterprises but only in selected sub-areas, and 17% of the surveyed admit that such a solution is present in the company, but only in the test and pilot phase.

Technological areas that the surveyed considered as proper in the process of company automation are mainly data analysis (78% of answers). Collaborative robotics (72%) and traditional robotic systems (61%) are other technological areas, where their application was considered as vital in striving for automation. The lowest score in the analysed context was attributed to: cyber-physical systems (6%), automated guided vehicles (AGV) (11%), augmented reality (17%) and 3D-printing (17%).

Results of the survey in Polish enterprises and the further research of the market shows that the whole concept of FoF design in Poland is still in early stages of maturity, however FoF and Industry 4.0 are gaining visibility among production companies. Since there is visible demand for

competencies both at a high level (managerial introduction to FoF) and low level (technical implementation of various FoF related technologies) we can assume that FoF design competencies which link those two levels can also be popular since they complement them.

Moreover, while there are many available courses on topics like Design Thinking they are mostly focused on business professionals and not specifically aimed at manufacturing professionals. Number of those courses and analysis of the registration data of the past events (Żebrowski, 2018) shows that demand is visible.

Also there are ample opportunities for people interested in the topic of Industry 4.0 (for example provided via https://przemyslprzyszlosci.gov.pl/) those trainings are mostly serving as introduction for managers showing overview of the topic and providing inspiration and they do not offer much useful information about the topic of FoF design. Analysis of the registration data for the upcoming events show that there is market demand for such events, however with visible regional differences (Jurczuk et al., 2019).

When it comes to more technical competencies related to FoF it is visible that many of those courses come from a tool or service providers and show technical aspects like usage of the plant simulation software or robot programming and do not provide a broader aspect related to FoF design. Number of those events show that there is a market design for them.

5.2 Conclusions on FoF-Design Competency Needs

Research indicates that digital transformation and digital technologies are the driving forces of Industry 4.0 in Poland. These trends coincide certainly with global tendencies, however considered changes are progressing slowly in Poland (PWC, 2017). Polish entrepreneurs perceive very optimistic the opportunities that Industry 4.0 brings and highly assess the level of advancement of digital transformation in their enterprises, both in comparison to direct competitors as well as in relation to foreign companies. Representatives of enterprises forecast a further significant development of their use of digital technologies. However, despite these declarations, they do not have comprehensive knowledge about the latest achievements and solutions implemented all over the world. Most of Polish companies are still at the stage of automating individual working stations (and thus they represent third industrial revolution), instead of creating ecosystems cooperating with each other without human intervention. Nowadays only less than 1/3 of enterprises are assessed as digitally advanced, however the forecasts indicate that in the next 3-5 years this percentage will increase to 70% (Gracel, Stoch, & Biegańska, 2017b, 2017a).

The transformation of industry to the digital 4.0 model will be a significant change from the organizations and processes point of view. Employees will be moved to perform other duties than before, they will have to develop new skills and competencies in the field of, among others processes programming, procedures defining, transferring the initiative to machines, etc., and they themselves will remain the process supervisors. One of the fundamental steps is to create an appropriate digital organizational culture, otherwise as a result many talented employees will

outflow rapidly. Companies should expeditiously redefine their capabilities and identify needs (Gracel et al., 2017b, 2017a).

The leading factor restraining the use of digital technologies in Poland is the ignorance of entrepreneurs and their failure to recognize the usefulness of digital solutions and their impact on the company's competitiveness. The relatively low level of digital competences of business managers is also significant. Research shows that by 2030, the demand for work involving routine tasks in Poland will fall, which will necessitate increasing investment in ICT and robotics, and raising the digital competences of employees. The professional success of employees will be strongly conditioned by the level of their digital competences. Their high level will guarantee competitiveness on the labor market, employment security and the highest salaries. One of the reasons for the relatively low scale of digitization of the Polish economy is the deficiency of specialists in IT professions and misadjustment their competences to the market requirements and needs. This deficit is characteristic of the economies of all 28 European Union countries (Głomb et al., 2019). However, research indicates that Poland is catching up with IT shortages in Europe the fastest (Capgemini, Empirica, & IDC, 2018). In addition, the European Commission drew attention to the need for education combining soft skills with solid digital skills. Research has shown large deficiency among Polish employees both in the field of soft skills (e.g. communication, project and teams management, cooperation skills etc.) and as well as digital competences (European Commission, 2019a).

The rapid civilization changes expected by 2030 will create virtual space for all citizens. It will be necessary to fundamentally define the role and place of digital competences in life and work. The main factors stimulating the emergence of a new economic reality will include robotics, artificial intelligence and digital transformation technologies (e.g. IoT, 5G, blockchain, big data) (Polish Agency of Enterprise Development, 2018).

Building digital competences is a challenge and the proper solution in Poland is to develop appropriate strategies. In 2018 the attempts to elaborate such documents were initiated in the Ministry of Funds and Regional Policy (Responsible Development Strategy 2020 with an outlook to 2030) (Ministry of Funds and Regional Policy, 2019) and the Ministry of Digital Affairs (*Programme* of *Integrated Informatization of State*). The assumptions of these documents indicate that by the 2030 the demand for digital competences will be horizontal, permeating many industries and spheres of economic and social life (Ministry of Digital Affairs, 2018). Moreover, it is worth emphasizing that the need to develop digital competences was recalled in these documents in the context of processes and concepts related to Economy 4.0, the development of mobile technologies and 5G technologies.

The development of digital competences is very important in the perspective of continuous development of new technologies. Currently, the basic barriers to the use of digital technologies are lack of motivation and lack of appropriate skills. The integration of learning to use digital technologies in all forms of education will be the key to the effectiveness of digital transformation. At the same time, it is necessary to educate in a modern way, not only basing on knowledge, but also on unique skills and competences, so that employees are able to

compete with machines and robots. Strategic documents indicate that strong digital competences in society, determine the shape of the market and the competitiveness of Polish employees and enterprises as well as the ability to build social and cultural capital.

5.3 National Measures to Influence FoF-Design Competencies

The analysis of national support for the digital transformation of the Polish economy and raising the competences of a wide range of stakeholders in this process for the benefit of the industry of the future indicates a number of activities.

In Poland, the Foundation Platform for Future Industry, established in March 2019, is currently a dedicated instrument supporting economic entities in the implementation of elements of the industry of the future.

The Future Industry Platform Foundation (the Foundation) was established to strengthen the competences and competitiveness of companies operating in Poland by supporting their transformation towards Industry 4.0. The basic task of the Foundation is to support:

- the process of digital transformation of the Polish economy and enterprises;
- support the process of digital transformation of the Polish economy and enterprises;
- implementation of business models based on the latest solutions in the field of intelligent data analysis, automation and communication of machines and people with machines, process virtualization and cyber security.

The Foundation's activities are addressed to entrepreneurs operating in Poland - entrepreneurs, units managing innovative clusters, entities operating for the innovative economy as well as social and economic partners.

The main areas of the Foundation's activity are:

- training and staff: including carrying out activities to raise human and social capital, in particular in the context of industrial transformation; informing and training entrepreneurs and employees in the field of industry digitization; strengthening employees' competences for the industry of the future through cooperation with organizations that provide technical education.
- technological processes: including building entrepreneurial awareness and promoting the benefits of industry digitization and the use of modern technologies; Supporting raising the technological and organizational level of companies, including processing, logistics, energy and digital integration of these processes; Promoting the use of intelligent systems based on intelligent data analysis by companies; promoting digital transformation solutions, including in the field of change, knowledge and innovation management; promoting integrated technological solutions among entrepreneurs to ensure interoperability, creating trusted data exchange systems and cyber security principles.
- cooperation mechanisms, including creation of cooperation mechanisms, knowledge sharing and building trust in relations between entities involved in the

digital transformation process; Initiating, together with partners and entrepreneurs, research projects in the field of innovative digital solutions; International cooperation, in particular with other platforms from EU countries, through the exchange of experience, knowledge transfer and shaping a coherent approach to the processes of digital transformation of industry.

- law: including giving opinions on draft assumptions and legal acts regarding the area of the Platform's activity; Providing non-financial support for digital transformation.

The second important element of the support system for the Polish economy in the transformation towards industry 4.0 are the activities undertaken by the Ministry of Entrepreneurship and Technology - currently the Ministry of Development (MR).

In particular, two types of actions should be indicated. The first is the accreditation process of innovation centers. The second key activity from the point of view of raising the competences of Polish entities towards the industry of the future are actions to recognize and support the development of the Digital Innovation Hubs network.

In the first type of MR operations, innovation centers are defined as entities involved in technology transfer and the provision of pro-innovative services as well as cooperation with business. The assumed effect of their activity is the development of innovations in the product and process aspect.

As part of innovation centers, it is possible to distinguish support institutions defined as to the manner and scope of functioning, i.e. technology, science, science and technology parks, industrial and technology parks, techno parks;

A separate unit focused on developing the business of entrepreneurs using modern technologies, in particular small and medium-sized enterprises, based on the use of separate real estate and technical infrastructure on a contractual basis. By providing comprehensive support, technology parks also offer entrepreneurs consultancy services in the field of development, technology transfer and transforming the results of scientific research and development works into technological innovations.

Technology Incubators: as entities that provide the business with incubation program. Their main goal is to help the newly established, innovative company to reach maturity and the ability to function independently on the market. To achieve this goal, the incubator in its offer should: have business support services (e.g. financial, marketing, legal, organizational and technological consultancy); provide assistance in obtaining financial resources, including risk funds; provide adequate office and laboratory space for business operations.

Technology Transfer Centers: An entity appointed by universities or institutes of the Polish Academy of Sciences to sell or transfer to the economy the results of research and development work carried out inside institutions - mothers or other entities having permanent contracts with universities or institutes of the Polish Academy of Sciences to support them in the field of technology transfer and knowledge commercialization.

Innovation Centers: Centers that provide clients with specialized information, advisory and training services of a pro-innovative nature. The addressees of comprehensive pro-innovative services are usually already operating enterprises or technological start-ups. Beneficiaries of support do not report the need for usable space in relation to CI, but they need substantive support for their innovative activities. This support may take the form of: pro-innovation services, including the transfer and implementation of innovative solutions, services supporting the effective implementation of innovation, including evaluation of innovative projects, technological, financial, marketing, legal and organizational consulting, associating entrepreneurs with scientific employees, including through contacts with CI, R&D institutions and owners of technology and know-how, services supporting entrepreneurs in the process of obtaining funds and partners necessary to implement their innovative activity. The status of an innovation center is granted by the minister competent in matters of economy upon an application meeting formal and substantive criterion.

The recruitment of applications for accreditation is continuous and is directed to entities providing specialized pro-innovation services supporting the implementation of product or process innovation of a technological nature in the enterprise: consultancy services in the field of innovation, meaning advice, assistance and training in knowledge transfer, acquisition and protection of value intangible assets and their use, use of norms and regulations in which they are embedded; innovation support services, meaning access to office space, data banks, library resources, market research, laboratories, marking, testing and quality certification to develop more efficient process products and services[5].

As part of the ministry's activities to build the competences of the Polish economy and enterprises for the needs of the industry of the future, the project currently being implemented from the reserve of the Ministry of Entrepreneurship and Technology should be indicated. I am talking about the competition "Standardization of services of Digital Innovation Hubs to support digital transformation of enterprises" as part of the Minister's Program for 2019-2021 "Industry 4.0". The goal of the program is to select, expand and supplement the potential of centres that have the ability to act as Digital Innovation Hubs, develop good practices and standardize their support services for entrepreneurs in the field of product, service and organizational transformation, using the latest solutions technology, such as:

- 5G connectivity,
- Learning algorithms (Artificial Intelligence), including autonomous systems,
- Internet of Things (IoT),
- BIM (Building Information Modeling),
- Cloud computing,
- Quantum technologies (Quantum Computing),
- Augmented and virtual reality (AR and VR),
- Automation and robotics (Computer Integrated Manufacturing),

[5] More details at (Ministry of Development, 2019)

- Cyber-security,
- Incremental technologies (3D printing),
- Microelectronics.

The addressees of the program are entrepreneurs who have a need to implement solutions in the area of Industry 4.0. Digital Innovation HUBs, i.e. relationships / consortia concluded between entities such as enterprises, scientific units, innovation clusters and non-governmental organizations are entitled to receive financial assistance under the Minister's Program.

In the Competition "Standardization of Services of Digital Innovation Hubs to support the digital transformation of enterprises" as part of the Minister's Program for 2019 - 2021 "Industry 4.0" during the assessment was recommended for funding Applications submitted by the following entities: Krakow Technology Park, Wrocław University of Technology, University Foundation Adam Mickiewicz University in Poznań, Voicelab.AI and the Institute of Communications - National Research Institute.

In addition, raising digital competences and digital transformation is carried out by other government units, including The Industrial Development Agency, which implements the Open Innovation Network (SOI) project. This is a project dedicated to building a culture of open innovation. Transactions of technology transfer to small and medium enterprises in Poland are created and supported. The purchase of innovative solutions co-financed by entities from around the world is subsidized. As part of this project, SOI technology brokers support entrepreneurs in choosing the best development path and going through the grant application process. SOI offers grants for consultancy services, under which entrepreneurs receive substantive support and assistance in preparing technology transfer transactions and implementing an innovative solution. In addition, technology transfer grants enable partial reimbursement of the cost of purchasing a license, patent or know-how of a solution that makes entrepreneurs more competitive and increase their productivity.

In addition, the Industrial Development Agency runs a Technology Transfer Platform (PTT) that connects owners of innovative solutions, those who want to buy them, and experts willing to share knowledge. All this for one purpose: to commercialize technologies for the benefit of Polish industry. In short, it is animating and associating parties to technology transfer transactions, advisory support and financial transactions of the transfer of innovative solutions. The Platform supports projects organizationally, financially and consultancy as part of the technology transfer process between technology donors (enterprises, research units, inventors) and recipients of innovative solutions (enterprises, in particular from the SME sector).PTT is also a website where registered users can inform about their innovative resources, innovation needs, and search relevant databases (PTT, 2019).

In addition, as part of the Polish Development Fund (PFR) operating in Poland since 2016, a number of programs and projects dedicated to building the competences of the future are implemented.

PFR has also initiated a number of development programs that respond to the growing need for education in the area of future competences, among others: the international educational program PFR School of Pioneers or PFR Innovation Designers - design thinking workshops organized by Google in a strategic partnership with PFR. As part of supporting the construction of the innovation ecosystem, PFR created a startup.pfr.pl - a website where innovators can find in almost one place almost 200 support programs for PFR Group institutions, as well as a subpage dedicated to the Start In Poland program.

As part of its pro-development activities, the PFR Group conducts a number of projects and investments with high development potential. As part of the investment in National Cloud Operator, it supports the digitization of the Polish economy, increasing the availability of cloud services and cybersecurity for entrepreneurs (PFR, 2019, p. 15).

The new PFR strategy "The Strategy of the Polish Development Fund for 2019-2021 assumes, among others next to the other 5 strategic goals of "pro-development activities" and in it next to other activities: digitization of the Polish economy and development of innovation. The abovementioned activities at the national level are to serve the technological growth of the Polish economy, a significant part directly contributing to building competences for the industry of the future, others indirectly. In the near future, the challenge will be to correlate individual national initiatives to achieve synergistic effects of actions taken to improve the competences of the future industry in the Polish economy.

6 Market Report Romania

In this chapter, the initial market analysis and review performed for Romania is presented. National insights build on the study performed, enhanced and elevated by research results from partner ULBS. The combined view elevates and introduces trends the competence and training material development needs to reflect upon. The analysis presented in the following has been prepared by DigiFoF partners ULBS, CONTI and PRELMET under the coordination of ULBS (Prof. Adrian Florea).

6.1 National Insights on FoF-Design Competency Needs

The digital tools and technologies evolution beside economic, demographic, and social factors are driving massive changes across all industries worldwide. One of these changes refers to workforce, which nowadays owns new capabilities such as digital and linguistic skills, automation-savvy, global, mobile and diverse, and social-media skilfulness. The skills sought by the employer can be divided into two categories: professional and soft skills. Professional skills vary from one area of activity to another, while soft skills are applicable in most industries, regardless of the level of experience, both for seniors, as well as for students and graduates. In general, those with soft skills have better job performance and are more likely to follow a successful career path. Therefore, companies want to recruit candidates who have such skills (Florea, Kifor, Nicolaescu, Cocan, & Receu, 2017).

Table 3 Top 10 soft skills sought by Romanian employers in 2018

Skills	Percent
Team work	52%
Customer orientation	50%
Continuous learning	39%
Proactivity	37%
The effective way of communication	35%
Agility and adaptability	30%
Complex problem solving	24%
Planning and organizing	24%
Emotional intelligence	20%

Source: Own representation based on T1.3 results in DigiFoF

Table 4 Top skills sought by Romanian employers in 2018

Skills	Percent
Creativity	17 %
Critical thinking	15%
The ability to analyse information	13%
Team management	11%
Autonomy	11%
Negotiation	11%
Curiosity	11%
Time and priority management	11%
Ability to persuade	2%

Source: Own representation based on T1.3 results in DigiFoF

Recruitment specialists say that professional skills, technical skills specific to a particular field, are the ones that help you get the job you want, while the soft skills are the ones that help you keep it. The professional skills that employers are pursuing for candidates in the selection and recruitment process, are expressed in the Table 5 (Hipo.ro, 2018).

Table 5 Top professional skills sought by Romanian employers in 2018

Skills	Percent
Computer skills (Outlook, Microsoft Word, Microsoft Excel, PowerPoint, etc.)	78%
Foreign languages	54%
Accounting knowledge, Financial reporting	28%
Programming languages (Java, C++, Smalltalk, PHP, .NET, etc.)	24%
Project Management (Waterfall, Agile, SCRUM Methodology, Business analysis knowledge, PMP certifications, PRINCE, etc.)	24%
Writing skills	20%
Specific technical knowledge of engineering (Autocad, Matlab, Catia V5, MathCAD, Etabs, Proteus, Microcontrollers)	17%
Design	15%
Design knowledge - User Interface, User Experience, etc.	13%
Software design solutions	11%
Digital marketing (setting up Google campaigns, SEO campaigns, Facebook/LinkedIn/Instagram campaigns, etc.)	11%

Source: Own representation based on T1.3 results in DigiFoF

Osmosis between industry and academia therefore enables firms to integrate external knowledge and the academic community to study and develop solutions to real-world problems. Collaborations between academia and industry can be framed within the literature on technology transfer and corporate strategic technology alliances.

2018 business year was by no means an easy one. The economic environment for all major markets – in China, the U.S.A. and Europe – worsened significantly around the middle of the year. This was due in part to our customers' lengthy transition to the new WLTP exhaust-gas test procedure, as well as to the U.S. trade conflicts with China and Europe. As a result, global automotive production – which had been expected to grow by two million passenger cars and light commercial vehicles in 2018 – was down by some one million vehicles.2019, also, come with a reduction of volumes worldwide. The European automotive sector essentially followed the overriding market trends in the third quarter of 2019. However, it was negatively impacted by various profit warnings from manufacturers and suppliers. In addition, global production volumes for passenger cars continued to decline and companies lowered their production expectations for the coming years. The EURO STOXX Automobiles & Parts fell by 2.0% to 459.32 points in the third quarter. In the first nine months of 2019, it increased by 8.7%. For the area of Sibiu, the automotive industry as reviewed above is in focus.

At this moment, the automotive industry is facing 4 megatrends that are creating huge disturbance to all actors involved, including Continental: Mobility, Autonomous driving, Digitization and Electrification.

1. **Autonomous driving** - increased safety, more comfort, more convenience, and more efficiency, Automation will bring radical changes to some aspects of driving. In the future, increasing traffic density will give drivers time for other activities in the car that are still impossible today. Stop/start traffic and parking in tight parking spaces will no longer be daunting prospects. Advanced driver assistance systems already allow the owner to hand over vehicle guidance to the vehicle in certain situations. There will be a clear progression from partially automated to fully automated driving. Drivers will never lose the dynamism, passion, and enjoyment of driving – at the press of a button, they can turn the systems on or off as desired.
2. **Digitization** – which is composed of two main areas: connectivity and inform and entertain. Connectivity means Intelligent solutions for information management, new mobility solutions, technologies for increased road safety, more-fuel-efficient drive systems. Infotainment: from “sat navs” to advanced driver assistance systems, modern technologies already enable all the important information in the vehicle to be recorded, provided to the driver, and linked to Internet services. For the driver, this means increased convenience, efficiency, and control over the vehicle environment
3. **Electrification** - In general, vehicle electrification refers to efforts to design mild to full hybrid vehicle to full electric vehicles as well as converting some of the non-electrical vehicle systems like hydraulic suspension-systems to smart electro-magnetic suspensions. In the long term, the electrification of cars and two-wheelers will make an indispensable contribution to more efficient driving with lower emissions. This is because CO2 emissions and exhaust gases can be significantly reduced through the further development of innovative power transmission technologies.
4. **Mobility** - While automated, connected, electric and shared technologies form the foundation of New Mobility’s future, a fifth element – business models and revenue – is the glue that binds them all together. Fair, sustainable, self-maintaining and politically acceptable operating models are key to improving growth and returns for New Mobility stakeholders. “Shared mobility” is one of the new business models from automotive and means any transportation service that is shared by users. It includes all forms of public transit such as buses, metro and trains, all of which are shared by users, but also extends to much smaller vehicles and individual modes of transport. The sharing can take place simultaneously using the same vehicle (for example, ride-sharing and courier network services offering on-demand logistics) or consecutively (for example, bike sharing and car clubs). Taxi and quasi-taxi (sometimes known as ‘ride-sourcing’) services are part of the shared mobility picture, and an area where there has been substantial recent change due to the emergence of Uber, Lyft and others.

In the meantime, the small and medium size companies, especially those with 100% Romanian capital face the miss of a national strategy in digitalization, Industry 4.0. They cannot find governmental or European founds to help them adapt to the new requirements of the future

technologies. The rapid changes in research and development will make the Romanian capital in the automotive industry weaker.

Creating larger associations of SMS companies will help these companies to exist being competitive on this dynamic market.

All these megatrends from automotive industry, will create specific challenges for automotive suppliers:

- Vanishing growth - will put current supplier business models at stake;
- Accelerated change of technologies in focus - require suppliers to invest in new and old technologies in parallel;
- Emergence of software as a key differentiating factor - need to build up competencies;
- OEMs encounter increasing investment needs and margin pressure - suppliers will face even higher cost pressure;
- Valuation levels of commoditized suppliers might come under pressure - commoditized suppliers will be under increasing pressure from their investor base to increase shareholder value.

Continental, as one of the biggest automotive component's suppliers, will need to transform their business model, bur these challenges are, also, an opportunity to continue to grow profitably. Success in new growth areas will require a new set of competencies and capabilities, mainly because new technology growth areas are driven by sensors, electronics and software.

6.2 Conclusions on FoF-Design Competency Needs

For DigiFoF project the target market is mainly the manufacturing industry but not only. In an industrial setting, automated and interconnected systems on the factory floor bring a profound change in production processes, supply, quality control, and organization. The ability to quickly reconfigure, extend, and adapt industrial systems to market needs requires a new set of skills that HEI should include in their curricular programs (Florea, 2019). In future factories, Artificial Intelligence will change the productivity equation, the automation addresses more complex and time-consuming problems, but automation will not replace all jobs but will invent new ones. For example, in 2025 will exist the following jobs: Robot supervisor, Data professional (Analyst Scientist, Engineers), Human to machine UX specialists, Smart City Technology Designers, AI assisted Healthcare Technicians. The coexistence between innovative and traditional business models, as well as the simultaneous presence of digital and legacy production platforms, is also raising unprecedented issues that need to be addressed during the period while new technologies are gradually introduced. With notions like Virtual and Augmented Reality, Artificial Intelligence, Cyber-Physical Systems entering massively the industrial environment, employees should be expected to have at least a basic understanding of those technologies and, most importantly, have a clear awareness of what their limitations are (Fiore, Florea, Kifor, & Zanetti, 2019; WPS, 2017).

6.3 National Measures to Influence FoF-Design Competencies

Transformation towards the Factories of the Future needs a change not only within digital technology skills and knowledge but also needs a strong orientation on innovations as well. There is knowledge gap in the scope of advanced methods and tools supporting the development of innovative products and services. The message sent through this deliverable and the whole project is of awareness the society, especially at the level of organizations and leaders from education, but also of the nowadays workforce about the need to adapt the own competences to the requirements of the society and the world economy based on digitalization. The popularity of digitalization concepts is currently characterised by an upward trend but also, the educational system is not prepared yet with curricula to support the new jobs created by digitalization. The most important conclusion refers to the necessity to accelerate the generation of curricula for qualifications and competencies specific for Factories of the Future (Florea, 2019).

From the perspective of the study programs that provide classical engineering skills, Romania is positioned quite well but did not bother yet to include in the curriculum relevant topics for digitalization to the difference from other European countries. So, there is a need for adapted curricula (at the engineering level but not only) with the inclusion of new topics and disciplines. Europe should continue to invest in training programs for workers at risk of losing their jobs. It should also invest in digital skills to remain competitive, prioritizing machine learning, information security, design thinking, problem-based learning, system design in a holistic way that integrates business and technology issues in the final product.

7 Conclusion

This deliverable represents the first result from T2.6 “Realizing the business plan for the DigiFoF Design Competence Network” with the objective to reflect the outcomes of WP1 results as “D1.2 Report on needs and demands for FoF-design: Findings and recommendations” and align them with a broader market perspective. As such, initiatives and developments on national level have been reviewed and discussed as a starting point for the uptake and business planning.

A common observation on the findings relate to the need of industry of a diverse skill set, beyong the technological aspect of the FoF. Indicatively, the following aspects are deemed relevant for the curriculum, tool and material development:

- Intra-disciplinary skill/competence set: disciplines need to evolve to an extended and open skill/competence set, domain-specific expertise is still important but needs to be understood in the context of a business problems, innovative or disruptive change settings and continuous evolution.

- *Innovation-focused:* considering the transformational aspect in the digitalisation of industry as a key principle in education.

- *Co-Creation/Cooperation:* collaboration capabilities within value networks are required already during the design of innovative solution. This aspect targets openness of solutions on technology and business level for future developments.

Upcoming releases of this report in PM24 and PM36 will extend on these observations and intensify the alignment initially established in the work leading to this report.

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