

Interreg



EUROPEAN UNION

ADRION

ADRIATIC-IONIAN

European Regional Development Fund - Instrument for Pre-Accession II Fund

FUTURE 4.0



MANUFACTURING EDUCATION AND TRAINING GOVERNANCE MODEL FOR INDUSTRY 4.0 IN THE ADRIATIC-IONIAN AREA

FINAL PUBLICATION



future4.adrioninterreg.eu/



twitter.com/FUTURE_4_0



www.linkedin.com/company/future-4-0-project/







<https://www.youtube.com/watch?v=u8--dzQYLI0>

INDEX OF CONTENT

INTRODUCTION	7
PROJECT PARTNERS	9
1.1 SCIENTIFIC METHODOLOGY AND CONTENTS OF THE TERRITORIAL ANALYSIS	15
1.2 INDUSTRY 4.0: MAIN CHARACTERISTICS	29
1.3 INDUSTRY 4.0 IMPACTING TRENDS	33
1.4 COMPETENCES AND PROFESSIONAL PROFILES FOR INDUSTRY 4.0	37
2.1 THE IMPACT OF INDUSTRY 4.0 ON THE NAVAL SECTOR AND PARTNERS' TERRITORIES	45
2.2 TOWARDS FUTURE 4.0 LEARNING MODEL	49
2.3 CHARACTERISTICS OF THE FUTURE 4.0 LEARNING MODEL	53
2.4 THE FUTURE 4.0 LEARNING PLATFORM	59
3.1 THE LOCAL ACTION PLANS AND THE REVISION OF THE PROFESSIONAL PROFILES	65
3.2 THE BEST PRACTICES FROM THE LOCAL ACTION PLANS AND THE VALIDATION PROCESS	73
4.1 POLICY RECOMMENDATIONS	81



INTRODUCTION

This document is the final publication of the Interreg - Adriatic-Ionian project Future 4.0. The aim of this publication is to bring out and present the main results of the project from a scientific and an industrial policy perspective. Future 4.0 has been working for three years with a handful of ambitious objectives. In fact, the challenges brought about by the Fourth industrial revolution are at the very heart of the project. The further developmental stage in the organisation and management of the entire value chain process involved in the manufacturing industry is radically changing even the concept of enterprise, since cyber-physical production systems are tearing down the boundaries between the real world and the virtual world. Adriatic-Ionian societies and economies are affected as well by this transformation, which has effects on production, intercompany relations, and human capital development. To face this, and having as specific focus the shipyard & nautical logistic supply chain, the project intended to design an Industry 4.0 model to enhance shipyard competitiveness in Italy (Veneto & Apulia), Croatia, Greece and Albania; the envisaged model - that encompasses effective industrial education and training governance - aimed at supporting competent regional and national administrations in designing framework conditions for advanced manufacturing. Future 4.0 partnership is multi actor and includes public and private bodies, universities, business support organisations, HE institutions active in Industry 4.0. Main expected outputs included the involvement of 105 companies (mostly SMEs) of the Blue economy in a knowledge and technology transfer tailored process and the production of tools and methods to facilitate smart industrial change in related areas. As a matter of fact, 132 enterprises were involved. The project met its objectives and produced planned outcomes. Results are now addressed at Adriatic-Ionian companies, human capital developers, public administrations and knowledge producers. Involved regions shared the same challenges about the shipyard sector, as they faced the same transformations and the need for their productive systems to be more integrated. One of the most original outfits of the project is the combination of model design, learning actions, local action plans, profiles upskilling, within a topic - Industry 4.0 - which is brand new.

LEAD PARTNER



REGIONE DEL VENETO

PARTNERS



CONFINDUSTRIA
Veneto SIAV S.p.A.



Since 1836



LMS

Laboratory for
Manufacturing Systems
& Automation

ASSOCIATED PARTNERS



CONFINDUSTRIA
Bari e Barletta-Andria-Trani



UNIVERSITY OF RIJEKA
FACULTY OF ECONOMICS



REGIONE PUGLIA



UNIVERSITETI



**PROJECT PARTNER
FUTURE 4.0 WAS CARRIED
OUT BY 9 PARTNERS FROM
4 COUNTRIES**

THEY ARE:

**VENETO REGION
CONFINDUSTRIA VENETO SIAV
POLYTECHNIC UNIVERSITY OF BARI
CHAMBER OF ACHAIA
UNIVERSITY OF PATRAS
PRIMORJE - GORSKI KOTAR COUNTY
UNIVERSITY OF RIJEKA
CHAMBER OF COMMERCE AND INDUSTRY OF TIRANA
MESHDEU CENTER**

VENETO REGION

Veneto is one of the 20 administrative intermediate bodies Italy is articulated in. The Region is the lead partner for Future 4.0 and is represented by the Industry and Craft Unit that is part of the Department for Economic Development. The Unit coordinates different actions in order to promote entrepreneurship and handicraft, through the implementation of measures aimed at boosting creativity and innovation. In a medium - long perspective, the Region expects the spread in the territory of new manufacturing models, as well as the transfer of knowledge, that will enhance the competitiveness in the economic system of the region.

<https://www.regione.veneto.it/web/attivita-produttive/progetti-europei>

CONFINDUSTRIA VENETO SIAV

SIAV is the operational company of the Industrial Federation of the Veneto Region, representing ca. 11.000 companies, mainly SMEs (both traditional manufacturing and New technology based firms). SIAV is composed of 5 operational areas: Associative Structures, Companies, Knowledge & Innovation, Events and Administration, offering integrated services support in innovation, eco-sustainability, knowledge and technology transfer, training funded by EU and regional/national Programmes.

From the participation to the project, SIAV expects the generation and development of specific methodologies for Industry 4.0 in manufacturing, in order to transfer knowledge and technologies even beyond the sectors targeted by FUTURE 4.0. Results will moreover feed the Factory of Knowledge initiative, contributing to applied research for companies and stimulating reactions from the Factory's community composed of enterprises and experts at regional and EU level.

<http://www.factoryofknowledge.net/gate/contents/community?openform&id=0717B8D03>

POLYTECHNIC UNIVERSITY OF BARI

The Polytechnic University of Bari (POLIBA) is a university located in Apulia, Italy. It was founded in 1990 and is organized in 3 Faculties: Faculty of Architecture; Faculty of Engineering - Bari; Faculty of Engineering - Taranto. The Department of Electrical and Information Engineering represents the Polytechnic of Bari in consortium with the Laboratory of Control and Automation (LCA). The mission of LCA is the investigation, the promotion and the dissemination of scientific research with Italian and international, private and public partners. The experience gained in implementing research and innovation projects both at regional, national and EU level, addressing the topics related to Industry 4.0 and the deep knowledge of the shipbuilding industry and the related service sectors (logistics, etc...), represent a plus. The



POLIBA network, involving the main regional and national stakeholders (private and public), will ensure the project impact and sustainability in the medium-long term.

<http://lca-projects.poliba.it/lca/>

CHAMBER OF ACHAIA

the Chamber of Achaia aims to facilitate the industrial transformation of the Achaia region through the proper integration of modern manufacturing processes with ICT technologies, which are a significant asset of the region. The most important expected benefit for the regional community and economy is to be able to support competent regional and national administrations to redesign an Industry 4.0 suitable and effective Education and Training governance model in order to facilitate the manufacturing system enhancement.

<http://www.e-a.gr>

UNIVERSITY OF PATRAS

the University of Patras is represented in this project by the Laboratory for Manufacturing Systems & Automation (LMS). The Laboratory for Manufacturing Systems & Automation is oriented on research and development in cutting edge scientific and technological fields, such as energy efficiency, robotics, virtual reality in manufacturing, design techniques, software and artificial intelligence. LMS aims to introduce the new and emerging concept of educational curricula referred to knowledge workers into Achaia area and establish the basis for the uptake and diffusion of such in the regional manufacturing SMEs.

<http://lms.mech.upatras.gr/>

PRIMORJE - GORSKI KOTAR COUNTY

Primorje - Gorski Kotar County is a regional authority in the western part of the Republic of Croatia which includes the Bay of Kvarner with islands of Krk, Cres, Lošinj and Rab, the surrounding Northern Croatian Littoral and the mountainous region of Gorski Kotar. It is competent on regional issues, especially regarding spatial and urban planning, economic development, infrastructure, planning and development of a network of educational, health, social and cultural institutions. From the participation to this project, the County aims at supporting competent regional administrations to redesign an Industry 4.0 suitable and effective Industrial Education and Training Governance Model in order to facilitate the manufacturing system improvement.

https://www.pgz.hr/projekt_program/future-4-0/



UNIVERSITY OF RIJEKA

the University of Rijeka is represented by the Faculty of Economics. The University operates in the international business and scientific environment, and in cooperation with the local community, by educating and developing entrepreneurially oriented and socially responsible leaders, managers and researchers, thus contributing to the development of society and science. The University aims at the integration into the European area of higher education and European research area accompanied by overwhelming support for development of the economy. Integration can be seen through competitiveness of the study programmes, student exchange, academic and administrative personnel, joint international study and research projects. Lending support to the economy is achieved through drawing up useful educational programmes for the economy, joint, mutually advantageous, research projects as well as widespread inclusion of student capacity.

www.efri.hr

CHAMBER OF COMMERCE AND INDUSTRY OF TIRANA

CCIT provides different courses on management, quality management, tourism, procurement, intellectual property, etc., in cooperation with internationally known organizations, such as WIFI IKT of the Austrian Federal Economic Chamber, the German Society for Quality - DGQ and GTZ (Germany), USAID. Thanks to its institutional function, CCIT is able to involve SMEs, handicrafts and other operators and to empower the project impact. Its action is based on a network strategy, connecting private and public organisations involved in industry, research and local development in order to develop competitiveness through innovation.

www.cci.al

MESHDEU CENTER

the Mediterranean University of Albania was created in 2007. Even in its first steps it has created its own high level profile by trying to mix the high demand for science, technology & innovation. By participating in this innovative project the Mediterranean University of Albania expects to have the following benefits: to serve as the stepping stone to bring Industry 4.0 to Albania; to offer workshops and seminars to SMEs and relevant institutions throughout Albania to facilitate and innovate the manufacturing system enhancement; to set up think tanks and incubators to promote and develop the ideas of Industry 4.0, not just in theory, but implement it in practice through its own students.

<http://umsh.edu.al>

This document is articulated in four sections that follow the main typologies of actions carried out by partners and of outcomes produced. The challenge is to integrate the Research approach with the findings of the Local Action Plans into the Industrial policy perspectives.

The publication will therefore include: - the scientific methodology and contents developed by analysing the technological megatrends of each Region; - the impact of Industry 4.0 concepts on Professional profiles of the shipbuilding industry to support the Blue Growth; - the results of the experimentations of the Knowledge Delivery Hub as a tool to support the Smart Learning Strategy.

The last section is about policy recommendations based on scientific results.

This document represents the living patrimony of the project, the heritage that partners want to share with those key actors - in Europe and in the Adriatic-Ionian countries - who are sharing the same challenges and transformations.





**SCIENTIFIC METHODOLOGY
AND CONTENTS OF
THE TERRITORIAL ANALYSIS.
FROM LOCAL
TERRITORIES' CONDITIONS
TO INDUSTRY 4.0 SKILLS.**

1.1

The very first goal of the Future 4.0 project was to investigate the state of art of the smart industrial changes, the technologies and the future jobs in the Adriatic-Ionian countries. The state of art map dealt with the shipyard and nautical logistic supply chain at the level of involved regions; it was carried out as a general analysis of the economic situations of the ADRION regions to pave the basis for the analysis of the economy of each territory from several and different perspectives: **productivity, professional skills and improvement of sustainability**. Each of these criteria was examined according to further sub-criteria: demographic change and labour market, new emerging markets, scarcity of resources, climate change, acceleration of technological progress and financial environment.

As for the territorial economic analysis, region by region the following aspects were investigated:

- general trend of local economy (including information of main productive sectors and emerging sectors);
- import - export balance;
- overall conditions of the labour market (employed, unemployed and tendencies);
- credit market and investments;
- a focus on the manufacturing sector;
- investment in research and development;
- attitude towards innovation and creativity;
- characteristics of the Smart specialisation strategy;
- presence of technological districts;
- effects of the global downturn.

In general terms, and as one could expect, considering existing differences in local markets, the situation is not homogeneous as for the economical structure, the attitude towards innovation and enterprise demography. That is why partners analysed in detail the already mentioned three perspectives crossing them with the mentioned seven sub-criteria. In the following pages, a synthesis of main findings is proposed referring to each involved country.

To begin with, productivity is a strong point for the **Veneto region** - an industrial area that is outstanding for wealth production. Labour productivity recovered from the 2008 downturn while capital productivity is stabilised. As for demographic change and the labour market, Veneto showed considerable growth of employment and a dynamic structure of the market. Almost all sectors are lively and resilient, with the exception of the textile and wood sectors. The global economy is not growing at exceptional rates, with a deceleration that unites all main areas. In terms of emerging markets this

may result in weakness referring to the capacity to address new markets. As for the acceleration of technological progress, this is partly favoured by the National Industry 4.0 plan that has two key directions referred to innovative investments and development of competence. Key directions encompass also the development of infrastructure enablers and the development of public support tools in terms of investments. Within this context, the development of a competence center and of a Digital Innovation Hub is supporting the regional innovation process along with the activity of several networks - such as the University of Triveneto network (which is an agreement between all the universities of the area) and VEGA. In particular, VEGA is a network between the University, the research centers and the productive sector aimed at developing scientific research initiatives to facilitate the transfer of knowledge in favor of technological growth and the competitiveness of companies. In Venice the SMICT is a competence centre that is focussed on the following specialisations: social networks, mobile platforms, advanced analytics, Big data, Cloud, Internet of things. SMICT mission is to make any company also a lab for 4.0 innovation, and any lab for 4.0 innovation also a company. The Centre offers training for digital transformation, and supports projects for innovation, research and development. These networks provide opportunities for businesses for the optimization of production processes (higher quality of the final product and reduction of the operating costs of production plants), product improvement and innovation (with greater speed from prototype to production and to the market) and the innovation of business and organizational models in favour of company competitiveness globally. Companies involved in internationalization processes need high-quality skills. In particular, the development of articulated projects of overseas presence puts new challenges for companies in the field of human capital.

In recent years many companies in Veneto region have been involved in total or partial production offshoring processes or have made foreign direct investments even in emerging markets. At the same time, Veneto has been subject to important flows of investments from abroad. Besides internationalisation, the green economy area is another field for development. In fact, in Italy the green economy is worth almost three million green jobs (workers that own and use 'green' skills) and generates a contribution for the national GDP of 190.5 billion euro, 13% of the total amount. Environmental engineering, bioarchitecture, solar plant design, eco-brand management and energy saving are just some of the most requested green skills areas. Veneto confirms itself to be a region particularly sensitive to green issues, with 37,210 green businesses, behind only Lombardy, which has almost twice as many.

And besides the green skills, digital skills are the other area for developing human capital that cannot be set aside. In fact, Italy, as the majority of the rest of the world, is dealing with the transition to the Fourth industrial revolution, that is characterized by a greater and growing connection and integration between virtual systems (infor-

mation systems, internet of things and services, artificial intelligence, etc.) and real systems (production plants, supply chain, distribution, products and services). Digital transformation creates a disruption with the past, and introduces a new production paradigm and new organizational models. These innovations have influence on the workforce as well as on the demand for new professional skills and new jobs. According to a survey made with companies, the skill that records the highest frequency of requests by enterprises (57.7% in Italy, and 55,7% in Veneto) refers to “digital skills” defined through the “use of internet technologies and the ability to manage visual and multimedia communication tools.” These are followed by “the ability to use mathematical and computer languages to organize and evaluate qualitative and quantitative information” (50.9% in Italy, and 49,1% in Veneto) and the ability to “manage and apply 4.0 technologies” (34.2% in Italy, and 32, 8% in Veneto). In terms of employment, in comparison with other regions in Italy and with other areas abroad, the employment situation in Veneto is not bad and was able to resist the effects of the global crisis. However, it must be underlined that the regional population is characterized by a progressive ageing which affects the labour force as well. Moreover, the natural growth rate is negative and this highlights a population contraction due to a higher number of deaths than births, which is not balanced by a total migration balance. The result is negative, and it is emphasized by a population reduction of 8.000 units in 2017. Demographic trends can have direct implications for labor markets through three main channels: labor supply, labor productivity and labor demand. The latter is influenced by the change in demand for goods and services resulting from the change in the population structure. Moreover, the population ageing increases the demand for service for the person.



As for the financial environment, the regional bank system was greatly affected by the 2008 crisis. Besides that, the local system was “shaken” by the serious troubles faced by two local banks and by companies working with them. However, also in consideration of the transformation induced by European laws applied to the saving sector and with aggregation and merger of banks operating on the territory, a process of stabilisation of the activity of loans to business was established, after a long period of decline.

As for **Region Apulia**, the varied manufacturing industry is rapidly moving towards a future where inclusion, sustainability, responsibility and innovation are the levers for growth. The regional model for economic development aims at the creation of a local economy that takes into account the need for social responsibility and environmental sustainability. In the wide - ranging system for manufacturing excellence, traditional manufacturing set-ups have been transformed into modern business clusters based on the ability to bring together tradition and innovation, as well as a strong push towards applied research in all sectors. As far as productivity is regarded, Apulia has a broad and varied economic structure, with great margins for improvement in the fields of human capital development, broadband access, digitization of business and Public Administration. The production structure is supported by a developed credit system and is strongly oriented towards foreign markets. The coexistence of a widespread entrepreneurship and some of the larger southern companies is a favorable factor for the establishment of new production activities. On the other hand, the long-lasting crisis of the steel industry concentrated in Taranto is still an element of feebleness for the whole regional economy. Despite that, technological innovation and the globalization of the economy are influencing the long-term dynamics of the labour market. In fact, technological innovation requires more and more qualified work with increasing knowledge content. Globalization, through the international reorganization of work, can push towards a lowering of professional work required. In fact, the conditions of competitiveness of the regional productive system, with the contribution of the knowledge economy as a paradigm of the new paths of development, are confronted with the evolution of services and activities with a low qualification content. With reference to new emerging markets, the region offers a lot of advantages to potential investors who aim to have an ideal location for the development of business opportunities within the European Union, with easy access to the emerging markets of the Far East. In fact, the regional government takes benefits from a high level of autonomy and thanks to the significant commitment of recent years to local development and investments in training, research, innovation and internationalization, it allows to offer to potential investors an attractive mix of elements to localize and grow their activities in the region. With reference to the dimension of scarcity of resources, in recent years Apulia,

although poor in energy resources of fossil origin, has become home to major power plants thanks to its location and its geomorphological characteristics. From 1996 to date, the regional electricity balance is constantly in surplus. As for climate change, strategies for reducing greenhouse gases include various types of interventions, including the application of technologies that optimize production processes, significantly reducing energy consumption. However, central is the role of Taranto and the already mentioned steel industry ILVA, one of the largest in Europe in the sector and at the center of stormy economic and social dynamics due to the obvious negative impact of the city's industry, from an environmental point of view. Taranto is a city that is a victim of pollution. Apulia, in general, is one of the major producers of Co2. With reference to the acceleration of technological progress, Apulia produced some outstanding experiences in the field of digital transformation in companies through the introduction of platforms to manage company processes, which led to measurable improvements that turned out into increased competitiveness on the market. This operation is relatively simple, especially when these technologies are well integrated with the information systems already present in the companies. Apulia is also protagonist of innovation in the aerospace sector. The region intends to be a context where aerospace, thanks to the presence of the local aerospace district and airport infrastructures constantly enhanced, lives strongly of the synergy between companies and research centers, and where the regional policies, on the front of the facilities, insist in particular on research and development. Lastly, for the financial environment, the process of reconfiguring the territorial network of banks in the region continued in recent years. Bank branches decreased further in 2016, reaching a level of around 15% lower than pre-2008 crisis levels.



As for Greece, the region of **Western Greece** was greatly affected by the economic downturn of 2008. This reduced the economical capacity of the region and increased unemployment. There is a significant lack in participation in Lifelong Learning (LL) programs with a downward trend. In 2013, only 1.3% of the population aged 25-64 participated in education or training programs (regardless of whether they are related to the current or potential future job), which is a very small percentage compared to Greece (3%), the Eurozone (10.4%) or the European Union (10.5%). The Region of Western Greece is in the top three regions of the country and 9th in Europe (among 272 regions) in the field of the agricultural sector (which encompasses Agriculture, Livestock, Fisheries, and Forestry). More in detail, Western Greece shows an overall high production concentration in the primary sector and moderate-to-high concentration in the commercial-transport-storage-tourism sector, while its individual regions are highly concentrated in the primary sector, tourism and the production of some minerals. Western Greece Region belongs to the country's regions with a positive balance in exports, while its contribution to the total exports of the country is 2%. Exports in the food sector present a particular strong dynamic, covering a fraction of 2/3 of the total exports of the region. In particular, in the Region of Western Greece and specifically in the area of Aitolokarnania, aquaculture is now established as the most dynamic sector of the primary production of the area and is ranked among the top places in the value of exports of agricultural products. The Region owns 48% of the country's lagoon and 25% of the lakes, while the aquaculture production activity covers 25% of the domestic production, that is over 12.5% of the European production of sea bream and sea bass aquaculture. As for demographic change, the Region's population amounts to 679.796 people, accounting for about 6.3% of the total population of the country. During the period 2001-2011, there was a clear shrinking of the Region's population at a more intensive level compared to the rest of the country. The calculation of the aging index for the Region shows that in the year 2012 for every 100 children there were 144.7 elderly people, while for the country this ratio was 137. This indicator is significantly higher for women (165.9 elderly women for every 100 girls). Referring to new emerging markets, besides the primary sector, the IT sector is also important, maintains research activity and presents significant synergies with the other industries. The developments in the mining and exploitation of hydrocarbons in Katakolo and in the Patras Gulf redefine the position of Region in Western Greece in the Energy map and give to the Region a geopolitical importance and new prospects. It is also important to emphasize that the Strategy of Smart Specialization includes energy technologies as a horizontal sector that will serve (along with the IT and communications sector) the development of the three remaining sectors (Agri-Food, Tourism-Culture, Materials-Microelectronics). As for scarcity of resources, one has to note that the situation about rail and road network is a brake on the fast service of transport as well as on the direct connection

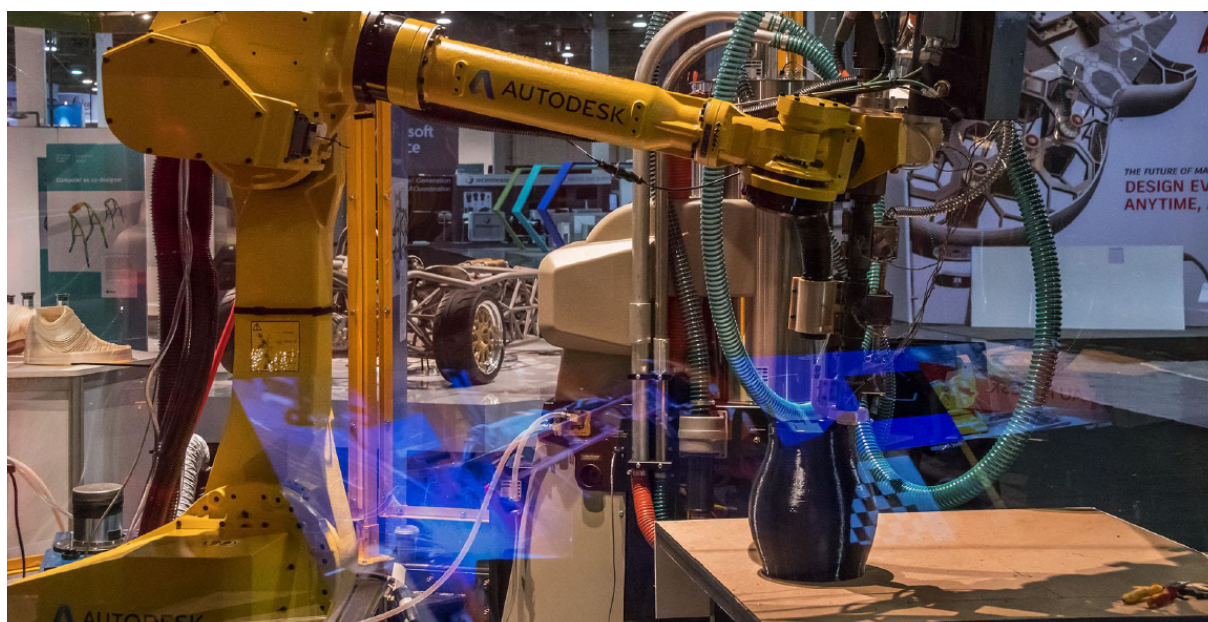
with the rest country's network. This prevents the region from the opportunity to operate as a hub of combined transportation. Furthermore, the absence of an airport infrastructure has been detrimental to the tourism development of the Region. Moreover, the secondary sector is characterized by a scattered and unsettled installation of facilities in both urban and off-plan areas. Regarding the acceleration of technological progress, the expenditure of Greece in research and development is one of the lowest in the EU; however, in the West Greece region, research is carried out mainly in higher education institutions and less in companies. The largest part of the approved public funding for research is concentrated in the materials and microelectronics sector (59%) in which the mi-cluster is active. The second most important area of interest is health (13%), followed by agriculture, fisheries, livestock, food and biotechnology (8%), and computer science (7%). Several incubators are operative; two of the most important may be mentioned: the Patras Science Park incubator was established according to the "Incubator" model for new technology-based businesses. The main purpose is to provide high-quality infrastructure and cooperation to appropriate economic and social conditions that will support and promote the creation, operation and development of innovative businesses through spin-off / spin-out processes and cooperation between University, Research Centers and Industry. The second one is named Corallia innohub: established in 2011, it operates as a bridge in high technology, research and innovation. This innohub helps accelerate the development of innovative companies in Western Greece. It has facilities and services for start-ups and early-stage businesses, and simultaneously large businesses can be established, gaining access in the markets of the region and in the talented local scientific potential.

Then, with reference to the financial environment, the regional strategy for smart specialization is based on the mobilization of all funding sources that can be



used for implementation of innovation and ICT actions. In terms of human capital development, the aim of the Western Greece region is to become a center of research and innovation for newly entered scientists, researchers and business taking advantage not only of its location but also of the wealth of its innovative assets that characterize it. As a consequence, educational and research infrastructures make the constant production of new scientists and researchers a reality. In this context, high capability entrepreneurship, the support of transportations that faces the expansion problem as well as the widening of clusters development or categories of companies that have a positive outlook and present a great potential are promoted. After the primary sector, the Region of Western Greece is highly concentrated in the field of entrepreneurship and SMEs. It is therefore a strategic priority to strengthen the competitiveness of enterprises through restructuration, modernization and economic diversification of the regional economy, mainly focusing on the technological, sectoral and cross-sectoral priority of areas of smart specialization in the RWG as defined in the Smart Specialization Strategy.

In Croatia **Primorje-Gorski Kotar County** is one of the largest and most populated counties in Croatia, although still small compared to other EU regions. The county is located on the north-west, coastal part of Croatia, is known for tourism, shipbuilding industry, and as a port, and port logistic centre. The greatest manufacturing specialisations are found in the manufacturing of food products, medicines, and metal products, and also in maritime engineering. Labour productivity varies widely being lowest in agriculture and highest in the services sector. Most of the engineering companies work for big multinational engineering and shipbuilding companies abroad. The region in recent years is losing population and workforce because of labor force movement



towards the EU, but at the same time with increasing local demand for skillful labor which led to salary increase. In terms of employment, the largest number of unemployed people in the Primorje-Gorski Kotar County make up to 29 years of age (31%), indicating one of the biggest problems facing the region, as well as the Republic of Croatia, whose unemployment rate for young people up to 29 is 34 %, while the EU-28 average is 23.4%. Here, the necessity to harmonize vocational education programs with the needs of the economy and the interests of students is emphasized in a way that will enable them to acquire the relevant knowledge and skills that are required in the labor market and which will enable them to become employed. The strongest industry in the County is shipbuilding, driven by an extremely competitive environment and business problems to the edge of survival, and the wood industry that stagnates in development. This group of activities is characterized by problems of insufficient degree of entrepreneurial connectivity and clustering and insufficient level of investment in research and development. Climate change, i.e. global warming of 0.8°C, has already led to some changes in ecosystems throughout the County. Sea ecosystems will mostly change if sea temperature rises. In general, it can be said that ecosystems are vulnerable, and already endangered.

For environmental protection, it is necessary to continuously carry out research and to improve the monitoring system of all environmental components. As a consequence, there is a need to strengthen institutional and human capacity which, by informing and educating the public on environmental protection and sustainable development, will influence the development of environmental awareness in general. County entrepreneurship infrastructure is relatively developed but it is necessary to improve the work of entrepreneurial support institutions that will in particular aim at: the development of a society based on knowledge and innovation; their exploitation and application; strengthening the linkage between the economy and institutions of higher education, science and research; strengthening the vertical and horizontal links of entrepreneurship. Entrepreneurial support institutions, as intermediary bodies, should be able to ensure the consistency of education systems and the needs of the economy as well as an efficient exchange of ideas, knowledge and technology between the sector. Local government units, primarily the City of Rijeka, had the largest participation in funding sources for development measures / projects, with 37% of total funds spent. The labor market in the Primorje-Gorski Kotar County marks on the one hand the lack of jobs and the high unemployment and on the other, the lack of workers in certain sectors. At the same time, young people find it difficult to find the right job and there are also large numbers of discouraged and poorly motivated people who are long-term unemployed. County institutions invest continuous efforts in strengthening their management capacities, mutual coordination and improvement of work efficiency, which is a prerequisite for effective management of the development

of all parts of the County. County administration is rapidly adapting to the demands of modern administrations in line with EU standards. This is particularly evident through the introduction of a quality management system, continuous professional training of managers and employees, and organizational and professional adaptation to the requirements of an improved regional development system. Regarding the competitiveness of the economy in the County, it is of particular importance to strengthen the activities that drive innovation and the application of new technologies, namely professional, scientific and technical activities, besides information and communication activities. Indices of specialization, trends in professional, scientific and technical activities, as well as in information and communication activities indicate an inadequate level of quality, as these are activities that should provide economic growth and development in the knowledge-based economy and society in the future. The County also promotes the development of social entrepreneurship, co-operative and self-employment of young people. Social entrepreneurship and co-operatives, besides being an important model for employment of disadvantaged groups, also contribute to the provision of social services for the community. Social benefits created by social entrepreneurship contribute to an increase in the overall quality of life. In terms of climate change, the objective of the region is to improve the environment protection by reducing Co2 and other greenhouse gas emissions in production but also in other sectors through the gradual decarbonization of the County. This is planned to be achieved by the following measures: reducing the dependence of all subjects in the County on fossil energy sources, providing greater reliance on own resources and renewable energy sources and energy efficiency in all sectors. Finally, the County also strives to develop the cultural/creative industries in the direction of development, less unemployment and the County's contemporary recognition. This is planned to be achieved through: greater involvement of creative industries in the cultural and other relevant policies of the County; stronger infrastructure development as support to the growth of cultural / creative industries, better access and use of financial support for the development of cultural / creative industries and awareness of the importance of cultural / creative industries.

Eventually, in **Albania** the country's economic transformation continues to build on its huge potential and opportunities. However, the global financial crisis brought out the weaknesses of its growth model and highlighted the need to shift from consumption-fueled to investment- and export-led growth. Key drivers in recent years were private investment and consumption. Two examples of investment dynamics are two large energy projects financed by foreign direct investment (FDI), the Trans-Adriatic Pipeline and a hydropower plant. Private consumption was supported by a recovery in employment, wages, and credit. Public consumption made a small contribution to growth, reflecting the increase in public sector wages. The business environment, in

spite of the new legislation of recent years and other measures, remains a constraint in Albania's competitiveness and growth performance. Reforms in the electricity sector have improved its finances, but getting electricity remains lengthy, complicated and costly for users. Redundant regulatory and procedural hurdles constitute another significant impediment for business. Access to formal finance, especially in the start-up phase, remains a challenge for firms.

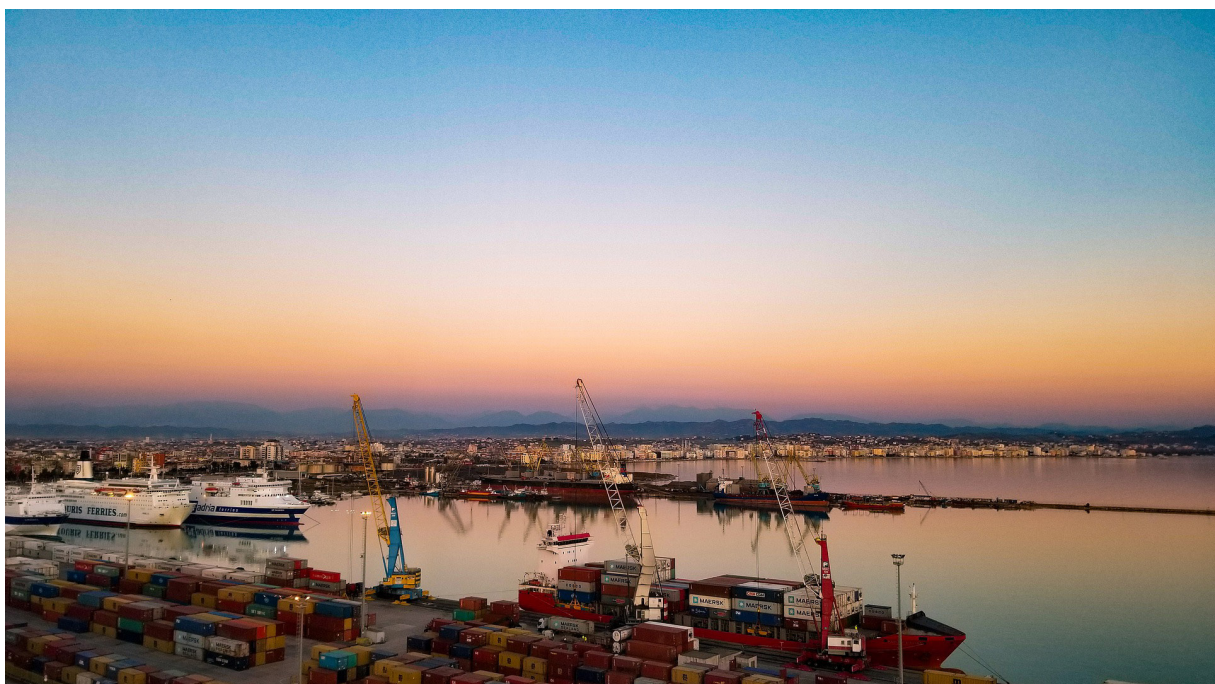
As for productivity, the Albanian productivity is led by the services sector, but agriculture still retains an important role. Industry (13.3 %) has gradually increased its share of the economy over the past 10 years, mainly as a result of rising crude oil production. Within industry, manufacturing is relatively small (6.4 %) and mainly produces low value added and labour-intensive products such as textiles and footwear. Construction (10.5 %) has seen its share of the economy decline sharply over the past 10 years. In the last years, Albania still has been one of the growing economies in Europe. Growth has been the result of a structural transformation, based largely on the movement of labour from low productivity agricultural occupations to services, construction, and– to a lesser extent – manufacturing. In the period 2001-2011, Gross Domestic Product (GDP) per capita increased twice (to US \$ 4.555) to reach 31 per cent of the European Union average. This economic growth was accompanied by stable macroeconomic and fiscal policies, structural reforms to improve the business environment and investment in infrastructure, technology and human resources. As a result, labour productivity increased by an average of 6.4 per cent on an annual basis. In 2010, the stock of Albanian citizens abroad was estimated at 1.4 million individuals. The age structure of the Albanian population has changed significantly in the last two decades, although Albania remains a country with the population of younger age in Europe. In the period 2001-2011 the population decreased by 8 per cent, with an estimated half a million individuals migrating abroad. However latest trends show increased return migration especially from Greece, related to the Greek financial crisis.

Census 2011 data show that there have been a total of 139,827 return migrants since 2001. Return migration is important in skill formation, since many return migrants have formed different skills through their experience in the host countries. These skills may be beneficial when they return home in terms of labour as well as entrepreneurial initiatives. Return migrants may also bring additional financial resources such as their savings contributing to the Albanian economy. Women in the labour market have on average about 1.3 years of additional education compared to men. Nonetheless, they receive lower wages of about 20%. In recent years, the Government of Albania has embarked on a broad-based program focused on macroeconomic and fiscal sustainability, financial sector stabilization, energy concerns, pensions, and territorial administration. Significant progress, propelled by the ongoing reforms, has created the conditions for rebounding business confidence and domestic demand, including early

signs of increased investment and an export-led recovery.

Opportunities exist for foreign exports of equipment and services, including energy efficient technologies, to the electricity generation, transmission, and distribution sectors. Oil and gas sector development creates potential for exports of equipment and services.

The sea resources, if managed in a sustainable manner, represent an important and durable opportunity for the economic development of the country. However, the marine environment along the Adriatic and Ionian seacoast faces several threats. Besides the preservation of biological and geographical diversity, the main challenges include: the depletion of fish stocks, the realization of municipal infrastructures, such as water supply, sewage and waste water treatment infrastructure and waste management infrastructure. The digitalisation of the economy is gradually being developed. Major advances have been the establishment of online platforms for business registration, licensing, tax filing, e-banking, e-commerce, e-signature, mobile payment of bills, and issuance of civil registry-related certificates. Broadband coverage and users have increased. However, the capacity for technological absorption, research, development and innovation remains low. Before the financial crisis, the labour market in Albania was thriving. The demand for top executives was high, both foreign and domestic, but as the economy slowed, recruitment followed the same trend. Albania is the State Party to all the three *Rio Conventions*, on climate change, desertification and biodiversity. However, a national strategy on climate change consistent with the EU 2030 framework on climate and energy policies still needs to be adopted. On the other hand, Albania has adopted a good Legislative Corpus on Environment and Sustainable Development. As integration into the European Union is the main strategic and



political objective of the country, national legislation has been developed in line with the *acquis communautaire*. This framework is very important to ensure that new laws in Albania are compatible with the principles of sustainable development.

On research and innovation policy, the national strategy for scientific research, technology and innovation for 2017-2022 was adopted following broad public consultation. The strategy's action plan is designed to promote the EU research and innovation programme Horizon 2020. Within this context, there are a number of organisations that actively support innovative start ups and existing SMEs. As an example, the ProTIK ICT Resource Center was established in 2012 by the combined efforts of the government, USAID, the Albanian American Development Foundation, Microsoft, Cisco, and Albtelecom to catalyze the development of the ICT sector in Albania. Pro TIK aims to become the Albanian ICT hub, a connection point for those seeking the latest and most innovative ideas, products, and services.

Among other programs, Pro TIK has an accelerator programme for startups. Other innovation supporting initiatives include ADRIA-Tinn (a cross-border business ecosystem in the Adriatic area supporting energy, bio-economy and wellbeing SMEs in innovating, networking and growing). Foreign Direct Investments are the main factor to the growth of the competitive ability of the Albanian products in the international markets, for the support of the economic growth, productivity and competition in its domestic markets. FDI-s bring advanced technology, knowledge and modern management, contacts with foreign clients and make possible the country's economy to profit from the free labour market. The level of entrepreneurship in Albania is generally considered to be low. The legacy of state ownership is still there. Many Albanians prefer a stable job working for somebody else (e.g. the government, banks, large enterprises) rather than owning an enterprise.

Even if unsuccessful with employment, starting a business is not always seen as a good opportunity due to various reasons including low self-confidence and fear of failure, which comes from a lack of entrepreneurial knowledge. In an attempt to promote entrepreneurship, the government introduced the 'basics of entrepreneurship' module as a compulsory subject in vocational education curricula.



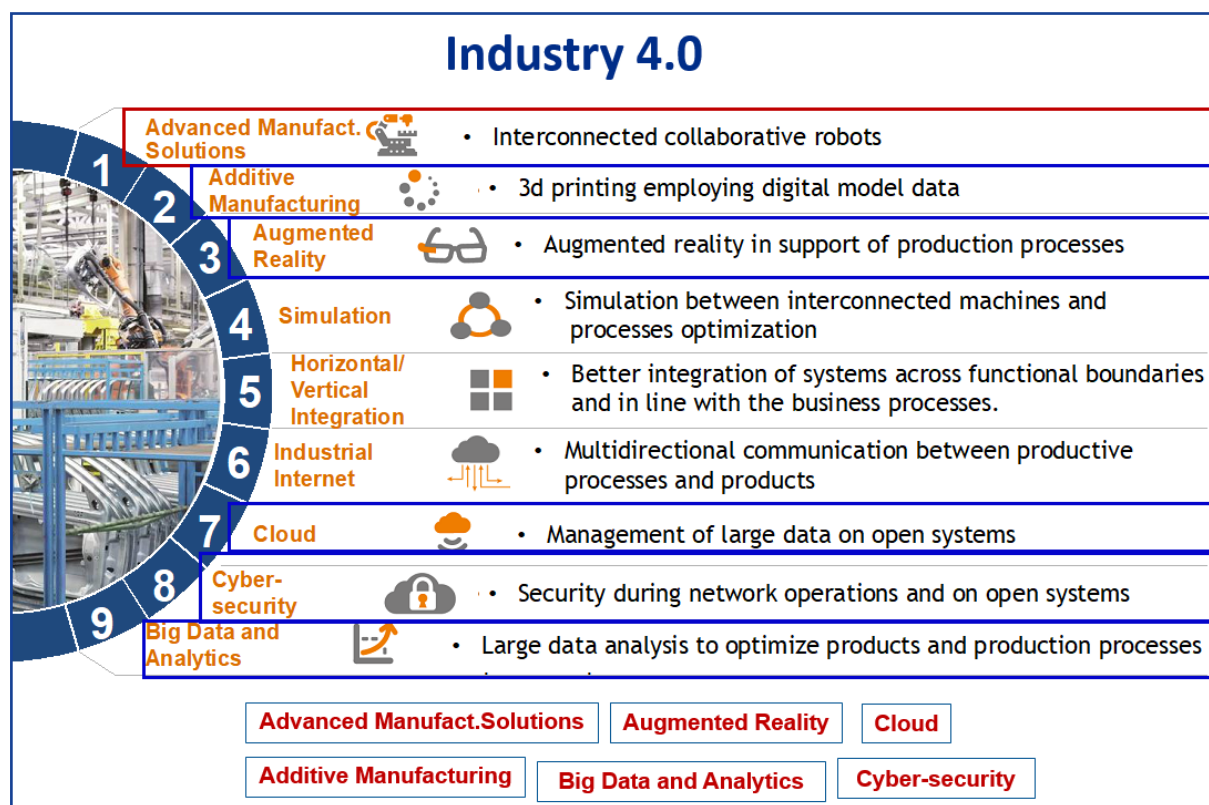


INDUSTRY 4.0: MAIN CHARACTERISTICS

1.2

After describing in brief the economical and productive scenario of partner regions, this section of the first chapter shortly summarizes the concept of Industry 4.0 and brings out some elements that are used in the following chapters: the emerging industrial needs and competences related to I 4.0 and the impact on professional profiles. In fact, digitalisation is having diverse effects on job dynamics, on the development of new products and machines as well as on increased competitiveness. This situation creates new professional needs and these needs lead to the development of new skills, new roles, and jobs related to the transformation of current jobs.

The Fourth industrial revolution defines the new age of digitally enabled manufacturing, where computers can control automated production lines with the coupling of physical and digital technologies such as analytics, artificial intelligence, cognitive technologies and the Internet of Things (IoT). Artificial intelligence's role is to monitor and improve the physical process of a factory, even solving problems before they occur. This can generate abundant opportunities for new products and services, better ways to serve customers, new types of jobs and, hence, a whole new business model. The Industry 4.0 revolution is constituted by a number of disruptive technologies that enable the digitalisation of the manufacturing sector. The Additive Manufacturing technology, the Advanced Manufacturing, The Internet of Things, Big Data and Analytics, Virtual and Augmented Reality, Cloud technologies and Cyber security



Industry 4.0 & six selected KETs enabling technologies

aim to integrate and analyse data across sources and companies, sharing outcomes across the value chain, ensuring the integration with physical production assets, and rethinking the design of classical production systems. Benefits that are expected from the realisation of Industry 4.0 are many: improved productivity and resource efficiency; increased knowledge sharing and collaborative working; improved agility and flexibility of the manufacturing sector; eased customer satisfaction; supported cost reduction and profitability; improved innovation. As far as the maritime sector is specifically regarded, expected benefits refer to the creation of efficient operation and processes; a more efficient use of fuel and energy; the coordination of communication and information management; the improvement of ships safety; trade improvement; and knowledge and experience sharing. Future 4.0 partners have also analysed existing roles in the maritime industry and have found that the following professional figures are the most affected by the changes introduced by I.4: engineers (marine, mechanical, electrical, electronic, piping); naval architects, designers, technicians and workers. Referring to these figures, the Fourth industrial revolution brings new requirements in terms of skills and competences: technical skills, technological skills, adaptability, flexibility, computing skills, learning and self development skills, complex problem-solving and critical thinking, interpersonal and social skills.

A further categorisation on skills brings out four competence clusters for the maritime industry:

- **Technical competencies**, i.e. the ability and the knowledge to perform specific tasks that are related to IT, mechanical, electrical tasks.
- **Methodological competencies**, that is the ability for general problem-solving and decision making.
- **Fundamental competencies**: it includes attitudes, behaviour and social values.
- **Interpersonal competencies**: it refers to better communication and interaction with the others and more and better relations with colleagues. Let us now see how these skills clusters can be organised into professional profiles for the maritime industry.



A decorative graphic in the top right corner consisting of a cluster of triangles in various shades of orange, grey, and blue, arranged in a geometric pattern.

INDUSTRY 4.0: IMPACTING TRENDS

1.3

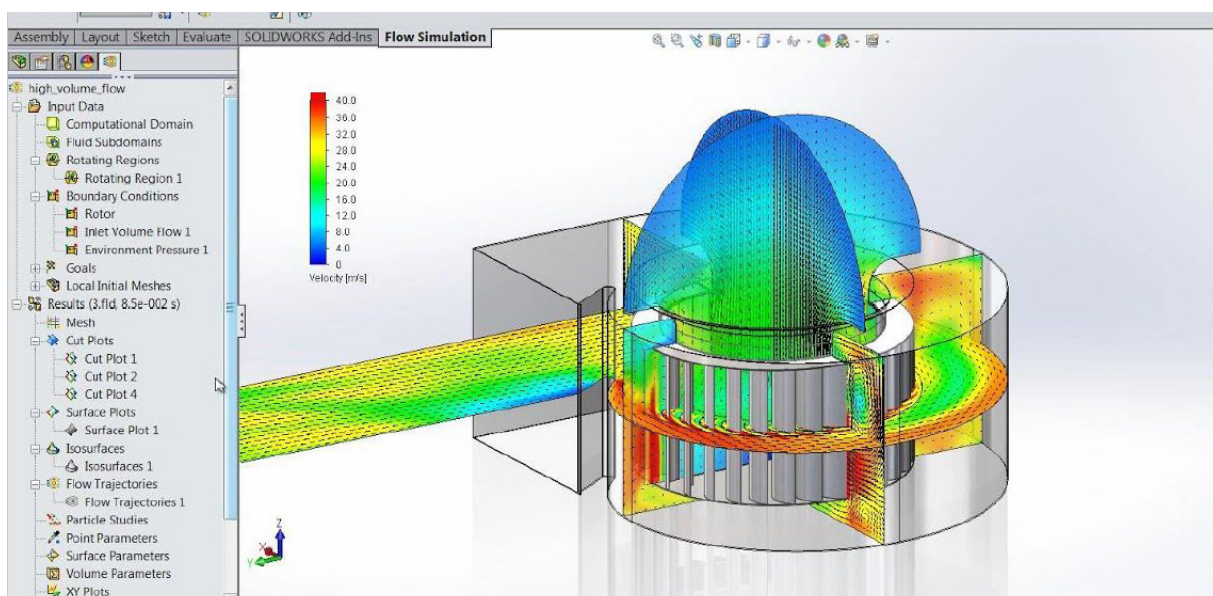
In the pre-Internet era, the competences, assets and skills that were needed to participate in any industrial sector were unique and varied significantly from industry to industry. With the Fourth industrial revolution and digital innovation these boundaries are disappearing; traditional industry is giving way to a new open industry network that offers the opportunity to companies from different sectors to collaborate forming ecosystems. Companies from different areas come together giving their perspectives, experiences, and competences in order to benefit the ecosystem as a whole. There are three main forces that are not new: technology, globalisation and demographics. They have been existing for centuries and they evolve in successive waves and those waves generate megatrends. Examples of trends are: demographic change (global population increase, ageing society, urbanization); new emerging markets (globalisation, exports growth, growth of developing countries); scarcity of resources (energy, water, raw materials); climate change (Co2 increase, global warming); technological progress (potential growth of technologies, costs reduction, pervasiveness); more flexible working environment.

Due to all the above demographic, market, technological and climate driving forces that affect and change industry rapidly, the skills and competences that companies require are rapidly evolving and in some cases much faster than the current training systems. As a result there is a lack of experts in fields such as Big data or cyber security, etc. Future 4.0 findings indicate that the skills that make employees more efficient are a mix of technical, transferable and professional skills. Due to the rapid increase of technological change, transferable skills and competences - or, in other words, the ability to learn - are becoming more important because employees will have to be capable of using new, disruptive technologies successfully. As we have seen, the core set of current manufacturing needs in terms of human capital competences and skills includes: digital technology knowledge and familiarisation; technical & manufacturing skills and equipment familiarisation; learning skills; innovation skills; systems thinking; design thinking; entrepreneurial thinking; cyber security skills; analytical skills; coordinating skills; people management; organisational skills; flexibility; motivation; communication; responsibility; research skills; knowledge transfer; critical thinking; negotiation skills; quality control; service orientation; decision making; active listening; creativity.

To understand how these needs can be satisfied, one has to consider what are existing professional profiles in industry and which are the most strategic figures. Future 4.0 has investigated this aspect and found that the transformations that are taking place in the industrial world, have produced new areas of work, new specialisations and roles, new professionals. More than in the past, these transformations have generated changes to the organisational and professional level that require the commitment of innovative figures that are not always readily available in the local

context. Computer scientists, software engineers, electronic engineers, mechanical engineers, mechatronic and automation engineers are some frequently quoted strategic figures. This technological transformation also generates the requirement for hybrid jobs that demand the combination and integration of technical, management and professional skills with more or less high levels of digital and ICT skills as well as knowledge to communicate through social networks and abilities to interact with other people through the use of digital technologies. As for the existing roles in the maritime industry, as we have seen, the most required professions are: engineers (mechanical, electrical, marine and piping engineers), naval architects or designers, technicians and specialised workers.

How these roles change with reference to the Fourth industrial revolution ?







COMPETENCES AND PROFESSIONAL PROFILES FOR INDUSTRY 4.0

1.4

First, this section describes the way project partners used to deal with qualitative and quantitative analysis concerning Smart Industrial Change, Technologies and Future Jobs in the context of Industry 4.0. This procedure included four techniques for data acquisition and analysis used synergistically:

i) *Desk Studies* to collect data in the existing literature (referring to the state of art of the smart and green features of the industry connected to the Blue economy in partner countries, to the trends related to technology developments and to the needs of the shipyard and logistic industry, as seen in the paragraphs above

ii) multi criteria decision methods such as the *Analytic Hierarchy Processes* to derive quantitative data from the Desk Studies,

iii) interviews with companies

iv) and a *Card Game* specifically designed to analyse the perception of companies. As for the Analytic Hierarchy Process (AHP), this multi criteria method provides objective mathematics to analyze a problem from a qualitative and quantitative point of view. This methodology was applied to desk studies in order to obtain quantitative data and considerations.

The first step in AHP, as applied to understand how economic and technological megatrends influence the manufacturing sectors, is the Structure of the Problem. The defined criteria considered in the analysis - as we have seen - are: Professional skills, Productivity and Improvement and sustainability. In addition, the alternatives of the problem are the phenomena that influence the defined criteria.



Such alternatives are:

- 1) demographic change (global population increase, ageing society, urbanisation);
- 2) new emerging markets;
- 3) scarcity of resources (energy, water, raw materials, others);
- 4) climate change (eg. CO₂ increase, global warming);
- 5) acceleration of technological progress (exponential growth of technologies, cost reductions, pervasiveness);

6) and financial environment. Then, for each territory and each criterion, the most important parameters were identified. Parameters were ranked in a summary of priorities in order to determine how the alternatives globally influence the manufacturing sector.

Main findings referring to the criterion of professional profiles are: in Italy (Apulia and Veneto region), and Croatia the acceleration of technological progress was the most important parameter that has influenced the professional skills evolution.

In Greece and Albania the demographic change and the labour market were the most important parameters that have influenced the professional skills evolution.

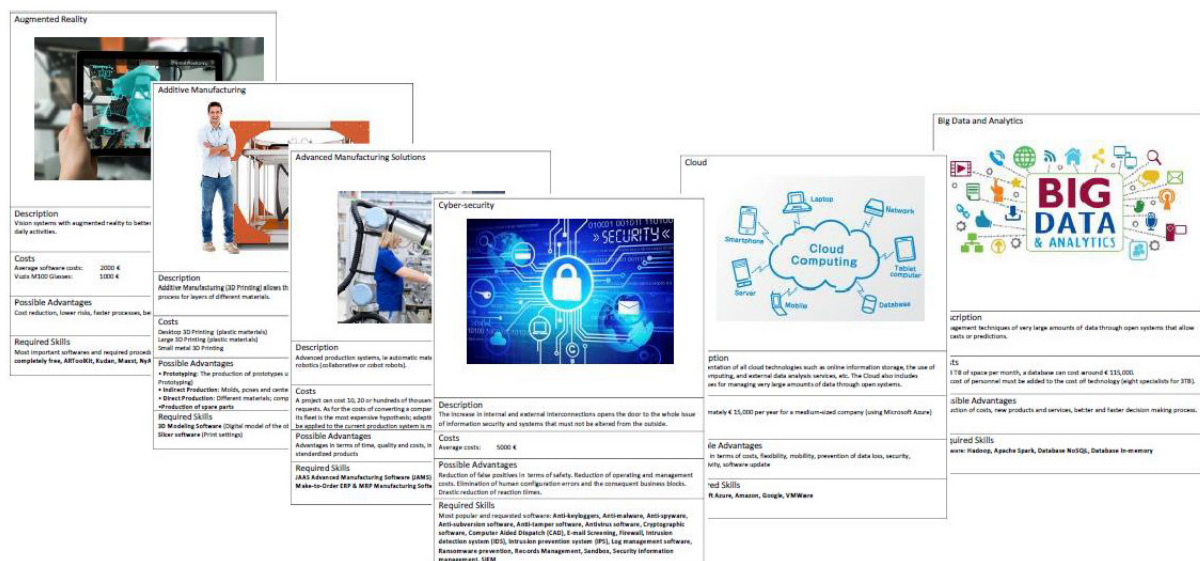
Main findings on productivity are:

- in Italy both Puglia and Veneto regions have undergone the same evolution. The financial environment and the demographic change and labour market are the parameters that have influenced the productivity evolution;
- in Croatia the three important parameters are demographic change, scarcity of resources and financial environment;
- in Albania climate change is the most important parameter that has influenced productivity;
- in Greece acceleration of technological progress and the demographic change and labour market are the parameters that have influenced the productivity evolution.

As for Improvement of sustainability, main findings are: in all regions the financial environment is the most important parameter that has influenced the sustainability, the second parameter is on average the acceleration of technological progress.

In a decision aiding context, knowing the preferences of the Decision Maker (DM) and determining weights of criteria are very hard questions.

Several methods can be used to give an appropriate value to the weights of criteria. One simple method encompasses the use of a set of cards, allowing indirectly



The Card Game Analysis (Polytechnic of Bari)

numerical values for weights. More in detail, the cards technique consists in the following three steps: first, it is necessary to give the person being tested a set of cards: the name of each criterion is written on each card. The user receives also a set of white cards of the same size. Second, the user has to rank the cards from the least important to the most important.

The first criterion is the least important and the last criterion in the ranking is the most important. So, it is possible to obtain a complete pre-order on the whole set of criteria. Finally, the user has to think about the fact that the importance of two successive criteria in the ranking can be more or less close. In the Future 4.0 case, the card game was structured as follows: first of all, the problem was structured in Goal, Criteria and Alternatives. The goal is “understand the company perception of the enabling technologies of industry 4.0” by considering advantages and disadvantages of the six main enabling technologies (the alternatives of the problem):

- i) Advanced Manufacturing Solutions;
- ii) Augmented Reality;
- iii) Cloud Computing;
- iv) Additive Manufacturing;
- v) Big Data and Analytics;
- vi) Cyber-security. In addition, the analysis was performed on the base of six criteria.

In particular the enabling technologies were analysed on the base of the following six aspects:

- 1) Professional skills;
- 2) Short-term economic benefit;
- 3) Long-term economic benefit;
- 4) Initial costs;
- 5) Operating costs;
- 6) Improvement of sustainability.

During the companies interviews, the card game was made with companies to understand their desirability and perception on the Enabling technologies of industry 4.0. The requests posed during the card game are listed as follows:

- Order the technologies from the one that requires less Professional Skills to the one that provides more Professional Skills
- Order the technologies from the one that provides less Short-term economic benefit to the one that provides more Short-term economic benefit
- Order the technologies from the one that provides less Long-term economic benefit to the one that provides more Long-term economic benefit
- Order the technologies from the one which implies less Initial Costs to the one that provides more Initial Costs
- Order the technologies from the one which implies less Operational Costs to the one that provides more Operational Costs
- Order the technologies from the one which implies less Improvement of sustainability to the one that provides more Improvement of sustainability.

In total, 29 companies were interviewed in the 4 partner countries.

Once territories have been analysed and companies have been interviewed to investigate their priorities, partners proceeded to realise a Road Map of the education for technologies 4.0. This was prior to the work on Future 4.0 professional profiles. First of all, the road map was designed pointing out a set of data taken from the desk analysis and the company interviews. Data referred to the professional skills and competences required for each I.4 technology and on regional basis. The analysis defined the lack of professional skills in every region. In particular, the ranking considered the following characteristics of each professional skill: the fact that the skill is not provided in the region; the skill can be acquired through training in company, in a doctorate, at the university, at a technical college, at the high school. Then, a weighting of the technologies that require more professional skills is obtained from the AHP methodology applied to the desk study. Also in this case a ranking is obtained for every region and such a ranking is used to provide the second level of classification. By exploiting synergistically the result of the first two steps it is possible to define the priorities of the education for technologies 4.0. A first thing to say refer-

ring to the Industry 4.0 competences and profiles, as they emerged from the analyses and companies interviews, is the coexistence of traditional professional figures and new specialised figures. In fact, figures as engineers are requested along with more technical and practical professionals, such as carpenters, upholsterers, technicians in mechatronics and mechanics, people with nautical skills, project developers. The focus is therefore on traditional trades, especially on the boom of mechatronic profiles and, as well, on the great demand for software engineers (also Engineer of Information Technology Development specifically in the field of transport). However, it is possible to identify a common thread that unites all these professions: the need to have highly developed IT skills. Having said that, project partners elaborated four short descriptions of the new profiles, identified on the basis of the information coming from the analyses and the companies:

The cloud broker, that is a professional who deals with the intermediation between a company and a cloud computing service provider, allowing to reduce the costs related to the management of cloud technologies;

The network programmer, who is a professional figure whose task consists of the realization of programs that allow the collaboration between processes connected through a network;

The robot coordinator, who has to take care of the robot supervision and solve any problems and malfunctions in a short time, also through collaboration with other technical figures to minimize the inconvenience for the production chain;

The data scientist, whose tasks are closely linked to the innovations made from the 4.0 industry. This professional figure is esteemed fundamental for the exploitation of data that can be collected.

These four professional figures have been dealt with, discussed and improved during the local action plans, eventually producing the validated profiles (see pages 49 - 50).







THE IMPACT OF INDUSTRY 4.0 ON THE NAVAL SECTOR AND PARTNERS' TERRITORIES.

**FROM THE NEEDS ANALYSIS
TO THE LEARNING MODEL
AND THE KNOWLEDGE HUB**

2.1

The main characteristics of Industry 4.0 have been summed up on pages 24 - 25. This section is about the consequences that the emerging trends of I.4 may have on the skills and the professional profiles, especially in the maritime and shipbuilding sector.

To begin with, as I.4 is characterised by an increasing digitalisation, and interconnection of products, value chains and business models, its implementation is esteemed to create major benefits and opportunities. Partners identified the following: improved productivity and resources efficiency; increased knowledge sharing and collaborative working; improved agility and flexibility; easier compliance; better customer satisfaction; cost reduction and increased profitability; improved innovation; increased revenues; high Return on Investment.

With specific reference to the maritime and shipbuilding sector, this is esteemed very important for the development of the economy, as ships today carry 90 % of international trade. In general, for all coastal countries, the sea has been a source of well-being, economic development and international reputation. The key innovations that digitalisation and I.4 bring will also affect all aspects of connected and automated marine transport processes.

The evolution and transformation of the maritime sector can be defined continuous and differentiated. Just to consider recent times, the sector has been significantly affected by the 2009 crisis which coincided with the global downturn, when the number of ship orders fell dramatically worldwide and had a major impact on the demand for products in the various areas of expertise of the European maritime industry. This sector encompasses thousands of heterogeneous companies which are affected by change taking place on them.

The European maritime industry is differentiated both in the structure and in the company dimension. Moreover, in addition to shipyards it is connected to network companies, such as design agencies, suppliers of systems, equipment and materials and offshore industry. The focus of this sector is also on different targets: some European shipyards are specialised in the construction of innovative ships, while others on repair and maintenance of shipyards. In the first half of the 20th century, 80 % of the world's ships were built in Europe, while today the share of European shipbuilding has fallen to only 15 %. About 150 large shipyards operate in Europe, 40 of which are active on the international market, building merchant ships for maritime transport.

Approximately 120 thousand people are employed directly by these shipyards.

The maritime industry presents some particular facets that distinguish it from the other sectors involved in Industry 4.0; as a consequence, the challenges for implementing I 4.0 in shipyards must be carefully analysed.

First of all, let us consider the availability of product and process information. The design of a ship is a complicated process: the initial part of the process starts off with a very general concept of the type of ship that is required; this requirement is received from the customer. Next, general measures and principal functional characteristics are determined, and the process continues. As soon as every cycle is completed, modifications can be applied to prior cycles. For instance, in calculating the required power to achieve a particular speed, you may find out that you require a bigger engine; in this specific case, you would need to change structural supports to fit this bigger engine. Thus, many iterations are done in order to achieve the preliminary design of the ship.

Second of all, product complexity. The processes involved in shipbuilding consist of several work stages consisting of the design segment, manufacturing, assembly of prefabricated blocks, pre-erection, and quay. In the design stage, the ship is divided into several blocks. Each block is produced and designed with specific characteristics that fit to its unique structure and functionality. Consequently, the blocks are aggregated into the primary structure of the ship. Thus, it is essential for a shipyard to have a reliable and capable scheduling system that accurately estimates the minimum man-hours for each activity that is scheduled.

Third, structural changes often have the negative impact of making a large number of persons whose skills are not up to date with the new situation unemployed from the sector struck by the change. From an individual perspective, the most important ways of managing the negative impact of structural change are measures related to training and competence.

The training offered can include further training or retraining. However, the most important thing is that the training offered is targeted according to the person's own wishes and needs, as otherwise, the results are easily insufficient.

Another educational challenge is how to keep the trained employees during an economic downturn in the sector. In Germany and the Basque Country in Spain, for example, the maritime industry faces this exact challenge: how to get skilled employees and how to keep them in the trade ?



A decorative graphic in the top right corner consisting of a cluster of triangles in various shades of orange, grey, and blue, arranged in a geometric pattern.

TOWARDS FUTURE 4.0 LEARNING MODEL

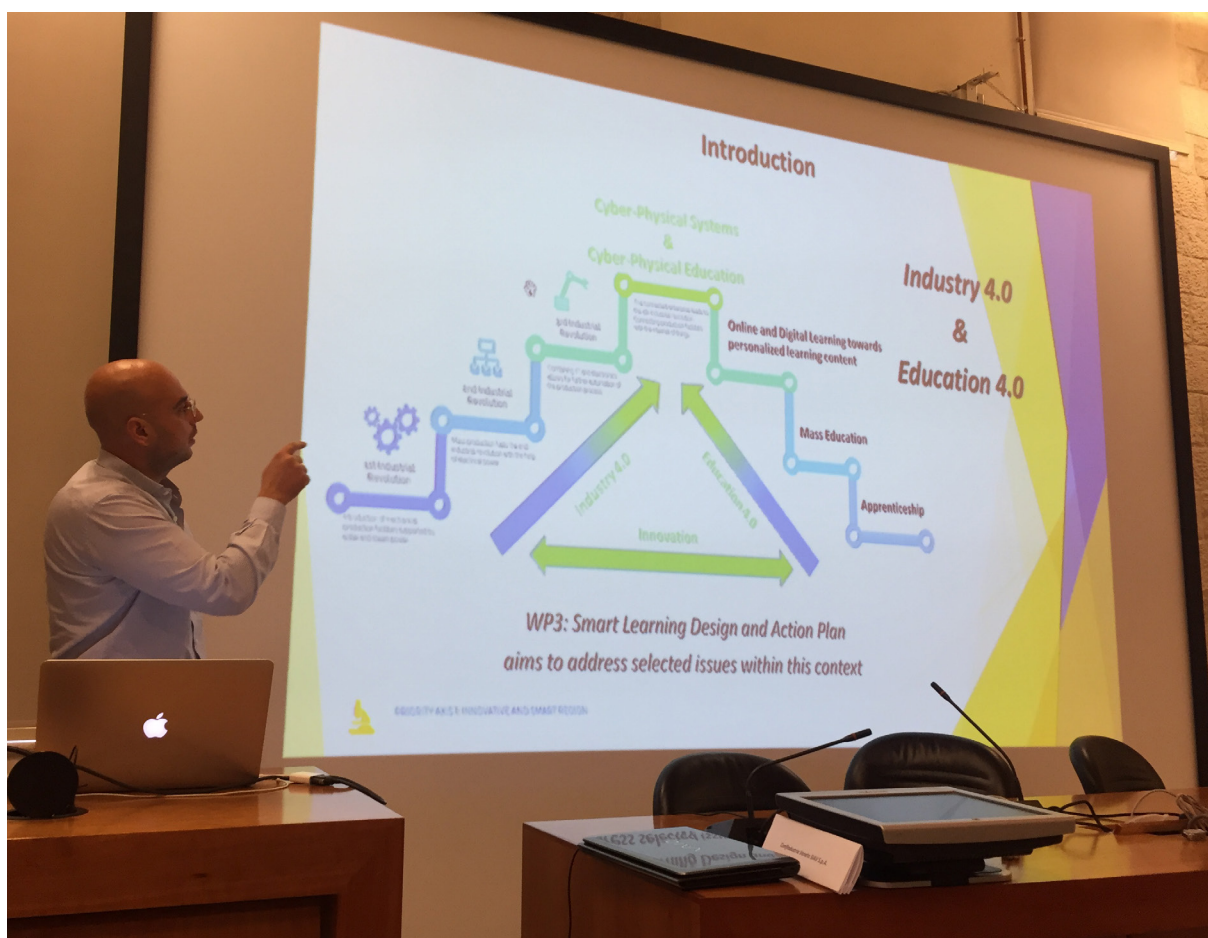
2.2

This second chapter of the Future 4.0 publication includes as well information about the learning model that project partners elaborated, tested, discussed with stakeholders and eventually validated.

The reference pattern is called Smart learning model. Smart learning is an organisational change approach that offers learners the opportunity to learn in specific areas at time and place that suits learners on-line.

The learners have the opportunity to stay more time at some parts of the curriculum and spend less time at other parts where practical examples on specific situations can be simulated through videos, games, on-line simulation tools etc. Both learners and educators have the opportunity to interact with each other through Information and communication technologies. In other words, Smart learning is a new way to design, develop and implement courses where a software system or platform is used for the learning design and implementation and the material content is secured and maintained in the highest quality through an approval process. In this approach, learning objectives should be SMART, i.e. Specific, Measurable, Attainable, Results-focussed and Time-focussed.

The Smart learning model is an intelligent and integrated learning space that is open to end users and is based on practical, specialized learning theory, and modern education methods that consist of devices, e - tools, e - learning, traditional as well as blended learning techniques, media, teaching resources, teachers' communities, and learners' communities.





A decorative graphic in the top right corner consisting of a cluster of triangles in various shades of orange, grey, and blue, arranged in a geometric pattern.

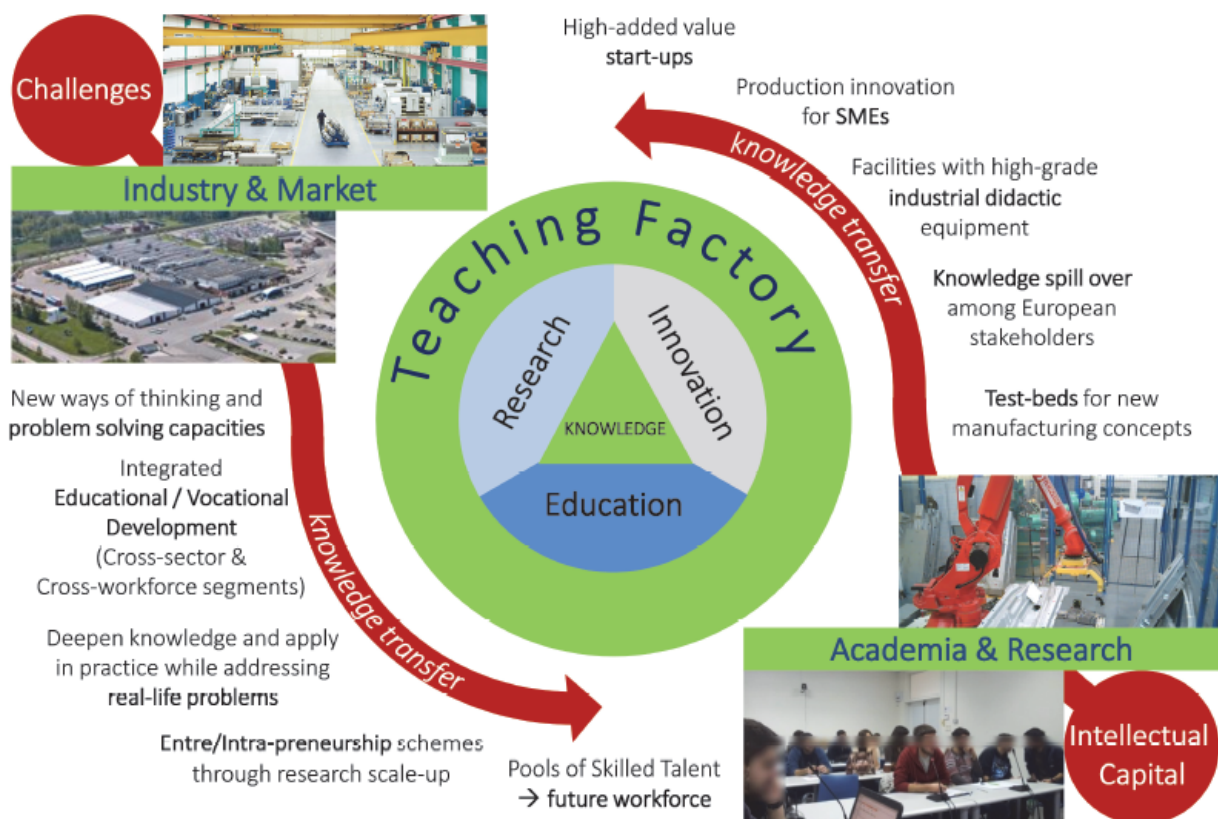
CHARACTERISTICS OF THE FUTURE 4.0 LEARNING MODEL

2.3

The rapid technological development has as result the introduction of new training and learning techniques. The learning and training actions that the Future 4.0 learning model consists of are the following: synchronous and asynchronous, on - site and distance content delivery; learning games and simulation tools techniques; the teaching factory paradigm (Teaching Factory is the concept where manufacturing practitioners “teach” students in Engineering Schools about manufacturing problems, manufacturing issues and manufacturing practices. The concept also involves the other direction, that from a classroom to a factory, where students and faculty “teach” manufacturing practitioners about advances made in manufacturing technology, new trends, results of research and development work).

An example of this approach taken from the Future 4.0 project is the “academia-to-industry” scheme that aims to transfer knowledge from academia to industry and is used for training and re-training operators and engineers on Industry 4.0 enabling technologies. Within the teaching factory approach, an industrial or didactic equipment is installed into academic classrooms and is used as test beds and demonstrators for new technological concepts that are validated by researchers. Afterwards this innovative technology is transmitted back to industry to meet the learning needs of employees.

An educational theme for knowledge-intensive manufacturing in Europe



The Teaching Factory Paradigm

If we go back to the learning model, partners identified four issues (or building blocks) that have to be dealt with to define it:

ATTITUDE:

the methodology that is created should first care for new 4.0 enabling technologies and attract the interest of engineers and operators to new technological advantages and eliminate any difficulty and concern that they have about any technological change or innovation.

KNOWLEDGE TRANSFER:

the smart learning model should address the transfer of knowledge about industry 4.0 enabling technologies and how to make them available to engineers, managers and workers. Knowledge transfer is the ability to share or disseminate your knowledge and provide inputs for the solution of a specific problem. Knowledge transfer is a new term in training and is always becoming critical because executives have to share or distribute their knowledge to the stakeholders that is continuously updated with new achievements of research and technological innovations.

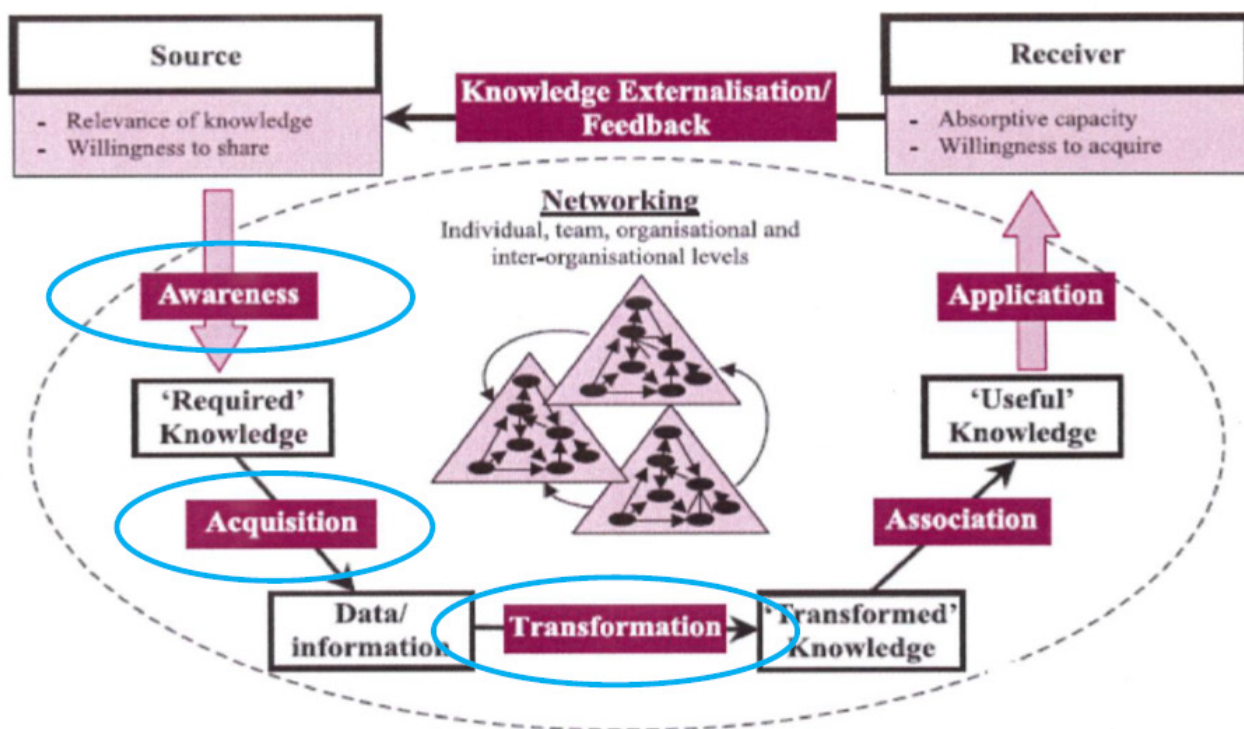
SKILLS DEVELOPMENT:

the model and the related methodology should focus on skills development for the implementation of this knowledge. In other words, skills development is the ability to apply knowledge and use the know-how to complete successfully the tasks. Thus, it is not enough to make new technology available to the workforce, there is a need for them to comprehend and learn how to use these technologies. It is apparent that the technical skills are developing only through practice under safe and close to reality conditions.

COMPETENCE DEVELOPMENT:

competence is the ability to apply knowledge skills and attitudes for achieving observable results. It can be also considered as the actual interface between the learning and innovation process. Specifically, competence is the ability to combine experience, engineering knowledge, personal attributes and appropriate resources. Let us now spend some more words about knowledge transfer as the local action plans, as we will see later, are mainly focussed on it. There is a tendency to consider technological transfer as limited to technological dimension in the strict sense, without considering instead the need to extend and integrate it within the wider logic of knowledge transfer. The acquisition of new external knowledge must be completed with its adaptation and integration of use within the new organisational and production context. It might be better therefore to speak about transformation, rather

than transfer. This transformation is driven by the learning process. More in detail, partners focussed on the “Knowledge transfer” block to start defining the model. They chose - as a methodological way - the organisation of five Local Action Plans to define the contents of a knowledge transfer process, which follows the taxonomy of Champica Liyanage. This author some years ago took as a point of reference the “triangle concept” to develop the so called Liyanage model which clearly explicate the whole knowledge transfer process. The model represents a sort of guide, for its clarity and completeness, to face the difficulties which lie mainly in the transformation association and application phases. KTA (Knowledge transformation and application) indicates the organisation’s final capability to effectively absorb the new external knowledge, unknown respect to the previous experience, developing in this way new routines to integrate the stock of pre-existing know-how and mutually adapting the new codes and cultural models to assimilate them.



A model for knowledge transfer (adapted from Liyanage et al, 2009)

The acquired knowledge requires some sort of a conversion of knowledge in order to make it useful for innovation; the receiver will be then able to produce new knowledge or improve knowledge skills or capabilities.

Liyanage's models can be articulated in the following steps:

- **Awareness**, that is the identification by the company of the new knowledge deemed most appropriate to use and that responds adequately to its innovation needs.

- **Acquisition**, that is the identification of the supplier and the acquisition of the knowledge. Receiver and source must ensure the ability and the willingness to manage complex processes.

- **Transformation**, that is the acquired knowledge requires to be processed, worked out so that it can become usable by the company. So an activity should be performed in order to adapt the new knowledge in order to integrate it into the heritage of already existing business knowledge. In some cases obsolete knowledge should be abandoned.



A decorative graphic in the top right corner consisting of a cluster of triangles in various shades of orange, grey, and blue, arranged in a geometric pattern.

THE FUTURE 4.0 LEARNING PLATFORM

2.4

As we have seen, in the Smart learning model a platform to design and deliver on-line training is an essential component. FUTURE 4.0 Learning Platform was designed to provide training to employees in the Shipyard and Nautical Logistic Supply Chain, and was conceived as a flexible solution that is versatile enough to satisfy the potential learners. The tools are provided to fulfill varying needs of multiple targets of audience. The FUTURE 4.0 online tool integrates collaboration and practice throughout the learning process encouraging the learners to ask, advice and share their ideas during the training.

FUTURE 4.0

Interreg 
ADRION **ADRIATIC-IONIAN**
European Regional Development Fund - Instrument for Pre-Accession II Fund

FUTURE 4.0

Knowledge Delivery Hub

Learners Log-in

You have been logged out from the system

Username

Password

Login

As for the learning content of the platform, this is an articulation of the six content blocks which partners identified in Industry 4.0, i.e. **additive manufacturing, big data and analytics, cyber security, advanced manufacturing, cloud computing and augmented reality.**

More in detail, as for additive manufacturing, the learning content is about the different classic additive manufacturing processes with their applications and the chain from the CAD (Computer Aided Design) software to the printed part.

As for Big data and analytics, the learning content regards Big data fundamentals and their applications in order to understand when to implement related solutions, considering positive aspects, risks and future trends.

Referring to cyber security, contents are about the collection of tools, policies, security concepts, security safeguards, guidelines, risk management approaches, actions, training, practices and technologies that can be used to safeguard the cyber environment with specific reference to the maritime industry.

As for advanced manufacturing, learning content encompasses industry 4.0 basic concepts, computer in manufacturing, numerical control, robotics, automation of shipbuilding processes.

Referring to Cloud computing, content is about exploring solutions and best practices of Cloud computing, in order to understand requirements and constraints of cloud applications and related future trends.

Finally, augmented reality learning content aims at understanding how the union of the physical environment with virtual information is and will be the way to interact in the business environment, where different working environments are susceptible to implement it, such as maintenance, storage, medical diagnosis, etc.

The courses of the 6 learning topics are scheduled to be performed online, mostly in an asynchronous and individual way, and will use the web to deliver the content. The FUTURE 4.0 Platform facilitates the integration of different and heterogeneous learning objects - such as videos, presentations, documents etc - into a common learning procedure. The teaching providers on one side are able to create new learning topics and insert material to the platform, while the users/trainees on

The FUTURE 4.0 Platform is available here:

Learners link:

<http://syrios.mech.upatras.gr/future40-elearning-platform-learners/>

Educators link:

<http://syrios.mech.upatras.gr/future40-elearning-platform/>

the other side are able to use the available material.

Regarding the learning procedure, in principle the learning content is divided into six topics, as we have just seen. For each topic, a pathway is defined containing the steps needed for achieving the specific topic. Each topic will be connected

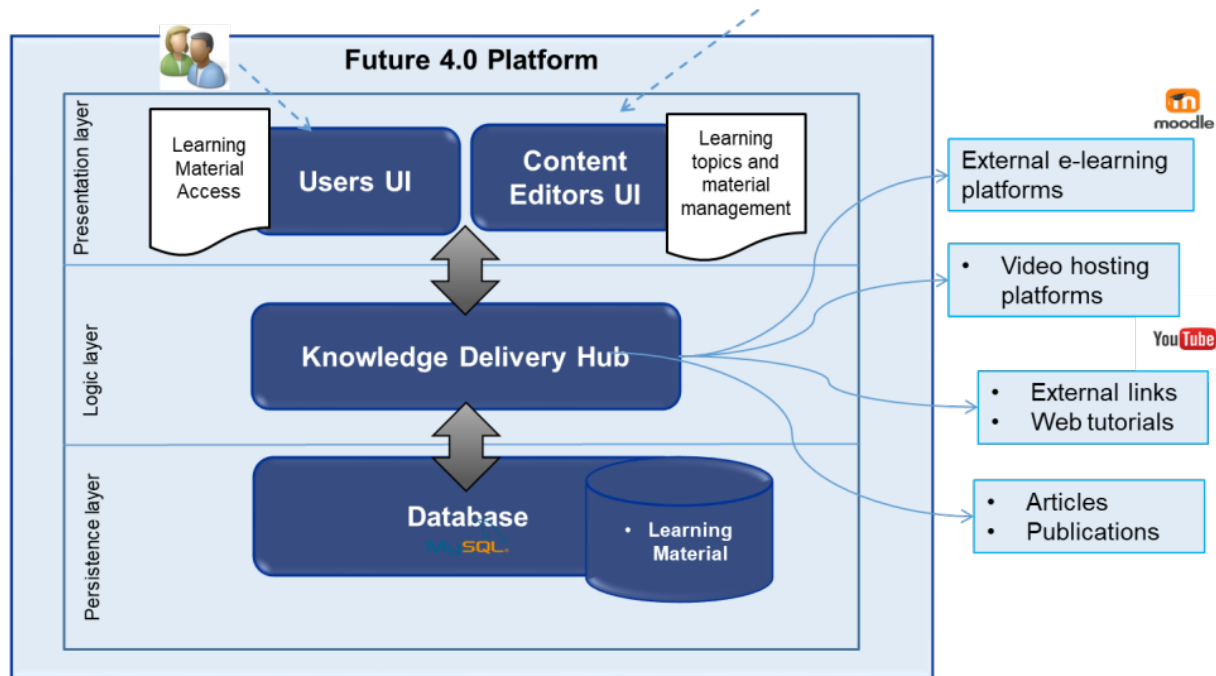


Figure 1: Future 4.0 platform architecture.

to some learning material that could have a number of different formats (file, link etc...). Furthermore, two separate front-ends provide the required functionalities both for educators and users. The educators have editing permissions in terms of creating, editing or deleting the material as well as the learners have access to the learning material that is presented in a user-friendly way.

The following figure shows the articulation of the platform.

Each e - module in the Future 4.0 Platform is classified into three main Smart Learning Model Levels:

1) Basic: the trainee after completing the basic level can have a general knowledge of each technology application and theory. This knowledge base will enable the employee to understand the specific learning topic.

2) Intermediate: the learners after completing the intermediate level of training will have deeper knowledge of the specific technology theory and application. So they will be prepared to apply the knowledge of the specific learning topic.

3) Advanced: the advanced level of training can pose an intimate and experiential knowledge of the specific learning topic. The learning is focused on building

expertise as well as experience in the chosen area of practice.

Besides online courses, another part of the Smart Learning Model aims to improve learners' individual performance through PC based simulation tools, design tools and play activities. This part contains rich multimedia elements.

In this stage learners after finishing with theory can navigate and interact, through tests, decision making scenarios, games sessions and simulation tools in Future 4.0 Platform.

The degree of complexity and interactivity is higher because it contains complex simulations and play activities that help them build actual skills and imitate hands-on experience that aim to prepare the learner into real life and work related situations. Also tests and quizzes can be a good choice for reinforcing feedback and letting learners know where they need to improve.

Who are the target groups of this learning model ?

During the target audience analysis, it is important to first think about learners and not only their age and their educational status. It is also preferable to consider their professional experience, desires and expectations as well as their preferences and their familiarity to PC based technology.

The Smart learning model addresses:

- the need to connect digital literacy, multifunctional and inter-disciplinary knowledge;
- the need for convergence and homogeneity of behaviors to implement company innovation strategy and achieve business objectives;
- the need to foster the integration among digital competencies, professional competencies and soft skills. The soft skills are “bridge skills”: they facilitate the integration between external and internal knowledge and between internal departments and organizational units.

Having said that, the learning model has as target groups the following:

- SMEs operating in the maritime sector;
- other enterprises in the maritime sector;
- local and regional Public authorities;
- higher education and research institutions;
- education and training centres and schools;
- business support organisations.

Interreg

ADRION

ADRIATIC-IONIAN

European Regional Development Fund - Instrument for Pre-Accession Assistance

FUTURE 4.0



TOSHIBA

Interreg
ADRION
ADRIATIC-IONIAN
European Regional Development Fund - Instrument for Pre-Accession Assistance
FUTURE 4.0



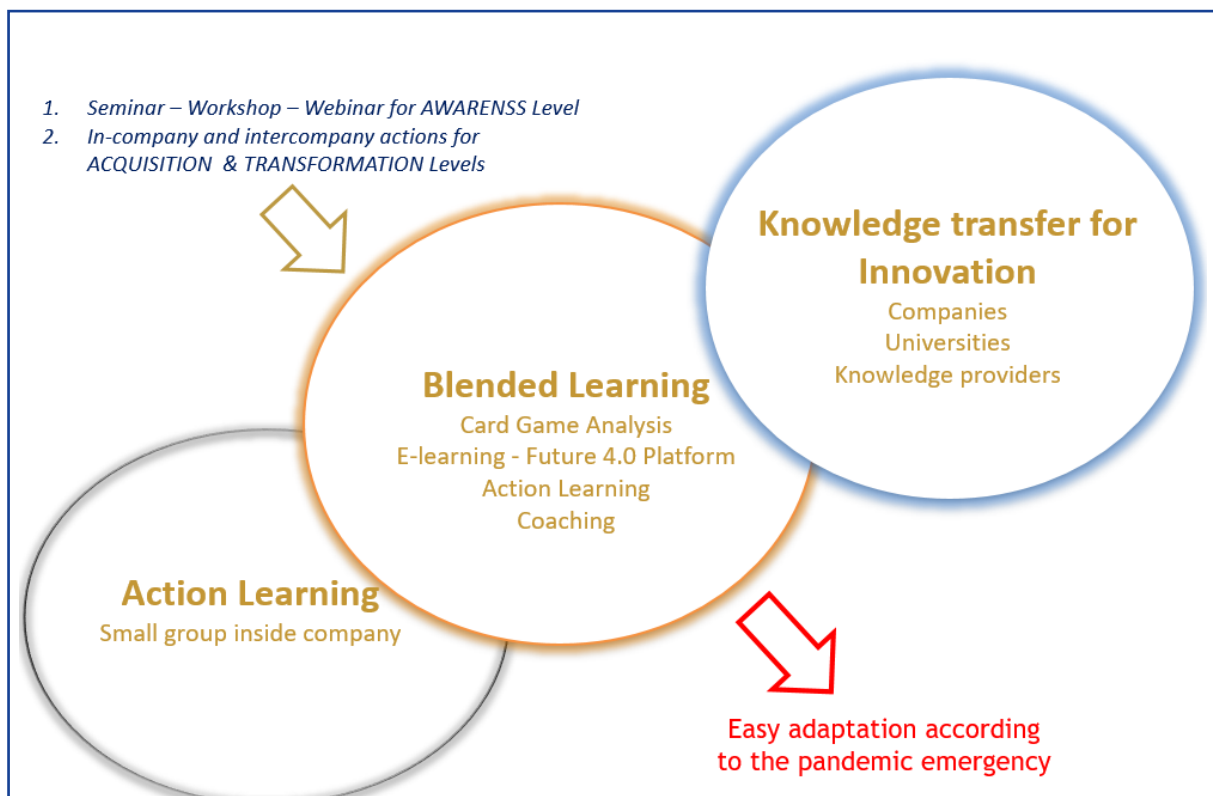
**THE LOCAL ACTION PLANS
AND THE REVISION OF THE
PROFESSIONAL PROFILES.
FROM THE LEARNING MODEL
TO THE VALIDATION OF THE
PROFESSIONAL PROFILES**

3.1

One of Europe's major weaknesses lies in its inferiority in terms of transforming the results of technological research and skills into innovations and competitive advantages. This assumption, taken from the EU Green Paper on innovation published in 1995, seems still true. With the aim of strengthening the realisation of the Smart Specialisation Strategies in the 5 covered economic areas, leading to a mutual policy learning on industrial strategies and with the objective of implementing tailored actions for raising competences in the form of upskilling and re-skilling of professional profiles, partners designed, implemented and realised 5 Local Action Plans (two in Italy and one in Croatia, Greece and Albania).

Moreover, in order to support the adoption of the governance model and of the Smart learning model as approaches for partners' daily working routines, the consortium organised the local action plans as a form of peer review to validate the industrial perspectives and related professional abilities. Therefore, the action plans represent a crucial step to stimulate the public and private industrial policies in designing and spreading new manufacturing business models (based on the technological megatrends and on regional smart specialisation strategies orientations) and to support the full application of smart manufacturing-related approaches within their own regional nautical supply chain.

Pilot actions had a common structure in the five different areas.



The methodological approach implemented in the FUTURE 4.0 project within the Local Pilot Actions

They were planned to encompass:

- Information seminars for Public administration, Universities/research centres and training institutions, companies;
- Actions to revise at least 4 professional profiles in each region according to the local/ regional/national Qualification system;
- Selection of piloting companies;
- Smart Learning activities including: a. Workshops about main technological mega-trends in Green Manufacturing and Logistics, impact on professional profiles and skills; b. Inter-company or in-company training; c. Recognition of acquired skills.
- This structure was modified as a consequence of the restrictions caused by the Corona 19 virus pandemic, as explained later on.

In total, 105 companies were planned to be involved in LAPs: 35 in Veneto, 30 in Apulia, 20 in Western Greece, 10 in Croatia and 10 in Albania. As a matter of fact, 132 companies were reached in the LAPs.

As for the contents, the Local Pilot Actions were based on the Analysis of emerging industrial needs and competences, implementing specific learning types, strategies and methods, corresponding to enterprises, including different methods and techniques to prepare employees to cope with challenges in Industry 4.0.

More in detail, in Veneto the LAP aimed at transferring the modules developed in the Future 4.0 platform for the manufacturing industry of the shipyard and nautical logistic supply chain, by applying an experimental methodology called knowledge transfer for innovation (see pages 37 - 38 for this concept.).

In Apulia the LAP was based on the conviction that the transmission of Industry 4.0 skills can foster a conscious transition to an approach that requires multiple changes at the same time: data must be enhanced to extract information; introducing smarter systems into the company to avoid production defaults; choose the most valid technological solutions to manage various processes, also focusing on the right customization rate. As for specific contents, the LAP dealt with I 4.0 technologies and methodologies, bringing out possible applications for the involved companies.

In Western Greece the LAP was about the actions for Blue growth in the region. These actions encompassed a focus on a basic knowledge of the 6 KETs of Industry 4.0, the possible application to local companies, the implementation of selected KETs to specific product or process innovation.

In Croatia, the LAP was based on the 6 KETs of Industry 4.0 with a specific fo-

cus on Big data analytics. In fact, Cloud systems that manage Big data that include important information are esteemed necessary to develop technical criteria and organizational security in order to avoid data protection malfunction that can result in huge and expensive harm. Big data analytics can provide benefits to enterprises and organizations in the maritime sector by solving many problems in government, telecommunication, insurance, education, energy, retail, transportation, manufacturing and healthcare.

Eventually, in Albania the pilot action plan aimed at raising awareness of public and private actors, research and technology transfer institutions, business organizations and enterprises, civil society organizations about the benefits that Industry 4.0 brings, providing personalized services to enterprises operating in the maritime transport sector to develop new skills in the three levels of technicians, engineers and managers. Besides the knowledge on the six KETs, the LAP encompassed a focus on the main technological megatrends in Green Manufacturing and Logistics and the impact on professional profiles and skills.

As stated, within the context of the LAPs the validation of the Smart learning model and the revision of the professional profiles were envisaged. The former activity saw the involvement of partners and of experts and academics in each region in the form of peer validation. LAPs and the interaction with companies brought out several best practices linked to each region and to the three levels considered in the Liyanage model: awareness, acquisition, transformation.

As for the revision of professional profiles, this was planned to be realised through interviews to companies and stakeholders. 12 interviews per region were scheduled and 60 were realized in total. As a result of the interviews, partner countries identified the following profiles. For Veneto: IT and innovation manager, Research and development manager, Administrative and finance manager/supplies manager and sales, logistic and commercial manager. For Apulia: IT manager, technical area manager, quality and security manager, human and resource manager. For Western Greece: Freelancer, Owner, Engineer and Business development manager. For Croatia: Financial manager, chief information officer, CEO / general director, and software sales manager.

Local action plans and the interviews to companies brought out several considerations on managers' and workers' skilling and reskilling. First of all, Industry 4.0 and digital innovation have led to a sharp redefinition of the set of competences needed to lead and to manage companies and organisations.

The redefinition concerns not only the new skills and competences that must be part of all professional profiles in the nautical sector, but also the relationship between know-

ledge and skills. Interviewees highlight the need to integrate their professional profiles with new digital competences. The integration of new digital skills changes according to responsibilities, activities and tasks.

For example, the digital competences are different for an IT manager, or a project manager, or a supplier manager. In the innovative SME, Industry 4.0 competences are not the exclusive monopoly of some super-specialised professional profile (for example, the data scientist), but become widespread within the company, the organisation and workers, from the entrepreneur or the CEO, to executives, middle management and blue collars.

Industry 4.0 competences are not enough to implement innovation projects. High performing workers show a strong connection between digital knowledge and soft skills. Moreover, they should have strong communication, team working, motivation skills to change the usual way to do, to overcome resistances and fears of the future. Since digital technologies enable the production of new data and information, one has to consider that in traditional organisations data were owned only by a few people. Now data and information can be spread in real time within the entire company community and sometimes even outside. For example, shipping companies which operate in logistics, circulate some data and information to truck drivers too.

So, there is a need to be able to read data and make decisions, on the basis of them and not only on past habits and experience.

Having said that, partners condensed these reflections in 4 professional profiles for the nautical and shipbuilding sector, whose main characteristics are as follows.

The IT Manager. IT professional profile is changing; from deep knowledge on traditional information technologies (such as Intranet, internal softwares,...), and specific softwares that enable the core process of the company, to tasks related to managing Cloud, to protect confidential information and data, to solve data breaks. The IT manager needs to “stay tuned” continuously with the fast evolution of technologies that connect more and more people, devices suppliers, customers, ... The perception of IT specialists indicates that they need to make an additional effort to reach a deeper level of expertise required by new technological contexts and to improve their communication and collaboration skills. Finally, IT managers must work in team with their colleagues in a more effective way.

The Technical Area - R & D Manager. For the Technical Area - R & D Manager it seems necessary to improve the level of knowledge on new technologies significantly and to improve the skills that are related to the acquisition and transformation of the new knowledge, such as managing change, managing people, communication and collaboration.

The Supply manager. As well, the professional profile of Supply manager who operates in the sector of naval business and shipbuilding is rapidly evolving. First, changes within the ecosystem advice to consider a larger number of suppliers, sometimes different from the usual ones. Besides that, the new technologies linked to Industry 4.0 and digital transformation propose a whole set of new skills to develop and perform. Last, in managing suppliers, the manager has to care for aspects linked to sustainability and environment respect.

The Human Resource Manager. In SMEs the role of the Human resource manager is often associated with other responsibilities, such as the head of administration and finance, the CEO. Human resource management is a key role in innovative companies, especially when they are designing and implementing change processes such as Industry 4.0 and digital transformation. However, the competences of this profile are in general limited to basic aspects of people management. Therefore, the profile should extend to the following areas: competence assessment tools, the ability to manage reskilling and upskilling plans, change management, communication with employees.

As already anticipated, the LAPs and the Smart learning activities were modified as a consequence of the Covid 19 pandemic: training on - site and the blended learning sessions were partially replaced by the reinforcement of digital or virtual learning. To be specific, this encompassed the use of webinars, web meetings, web conferencing, virtual training sessions and e-learning platforms.

As an example taken from the experience in Veneto, the information / awareness seminars were begun as a face-to-face activity at the end of 2019 and replaced by webinars when the territories were locked down. Their contents were: innovative design and technologies 4.0, industry 4.0 - robotics and augmented reality, digital technologies for the naval industry, shipbuilding and the related supply chain, logistic and digital technologies for boating.





**THE BEST PRACTICES
FROM THE LOCAL ACTION PLANS
AND THE VALIDATION PROCESS**

3.2

The conclusive stage of the project was realised in the form of an intense programme of dissemination in the 4 partner countries, which involved stakeholders, companies, experts, universities and training providers. Due to the Covid - 19 pandemic, the modalities for realising this campaign were partially modified, by making wide use of on - line and distance activities.

These events can be clustered in four groups, depending on their aim: dissemination, awareness, acquisition and transformation, using the three Liyanage categories plus dissemination.

In the following pages some of the most successful examples related to these levels are summed up.

For the **dissemination** level:

In Western Greece a on-site seminar was organised by the Chamber of Achaia and the University of Patras on the topic “Actions for Blue growth in the Region of Western Greece”. The purpose of the seminar was to attract regional companies in the field of Blue growth and support the initiative of the Chamber of Achaia to organize a Blue economy business network and improve Blue growth in Western Greece. This event was attended by companies belonging to the manufacturing sector and the shipbuilding industry. Participants included also public stakeholders at local and regional level, higher education organisations, training centres and business support bodies. The seminar aim was to disseminate the possibility of intervention with innovative technologies for knowledge transfer and training. Moreover, it aimed at fastening the sharing of research and innovation results for the development of a sustainable Blue economy in the region.



Dissemination activity in Western Greece

Key results include information spreading on Industry 4.0 concepts and technologies, the impact of digitalisation, the new professional profiles emerging from the 4th industrial revolution, the Future 4.0 platform.

For the **Awareness** level:

In Veneto, a seminar was organised by Confindustria Veneto SIAV and realised on the theme “Digital technologies 4.0 for the naval industry, shipbuilding and the related supply chain”. It aimed at promoting the transfer of 4.0 technologies for companies, mainly SMEs, active in the sector. In particular, attendees were from local shipyards, with consolidated experience and history, specialised in the naval construction and operating in the naval construction area.

Besides that, companies from the supply chain of the shipyards being specialised in the field of control of propulsion for boats, marine propulsion, naval technical accessories, components and custom - made and complete furnishing.

The six KET technologies were presented in detail, with an overview of potential applications of 4.0 technologies into companies. Enterprises’ needs and perceptions were analysed in terms of skills demand.

A focus was also made on Cloud and Cyber security. Success cases of companies already excellent in the field of advanced production systems and robotics were illustrated. The Future 4.0 platform and its functionalities were showed, as a supporting tool providing know-how and materials at companies’ disposal.

The companies understood the importance of the networking with other companies creating contents on 4.0 technologies and facing common problems concerning the implementation of the current technological 4.0 transformation, but also with the knowledge providers such as universities, experts, and research centres.



Awareness Seminar in Veneto Region

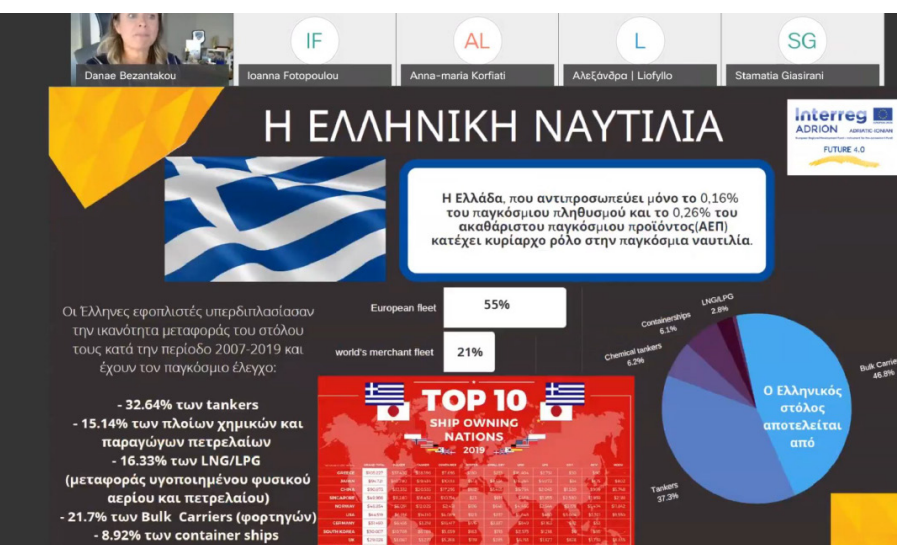
As well on the awareness level, in Croatia a webinar was organised by the Primorje-Gorski Kotar County and the University of Rijeka and held on the theme “Basic knowledge regarding Big data, Cloud Computing, Cyber Security, Augmented Reality, Additive Manufacturing Systems in Future 4.0 industries”.

Attendees were SMEs that are supporting organisations from sectors such as shipbuilding (and its supply chain), shipping nautical services, logistics, manufacturing, maritime transport, platforms and software development for defined sector needs and other Blue economy established and emerging sectors. Public institutions, educational institutions, Chambers of commerce were involved as well in order to provide information, discuss and develop new approaches in implementing business informatics, information and communication technology related to Industry 4.0 developments.

The companies of different industries were represented and showed great interest for the topics dealt with. Moreover, participants successfully adopted the knowledge and prepared plans to improve their business.

For the Acquisition level:

In Apulia the experience we consider was managed by the Polytechnic of Bari and was about an in-company experimental intervention on Cloud and Big data technologies towards an ICT platform for the nautical network. The place for the experimentation was Nautica Ranieri - a shipyard able to compete with other shipbuilding industries located in the rest of Europe - which is specialised in dry docking for sailing and motor boats. The experimental intervention was mainly focussed on the digitalisation of the process management and on the application of the Cloud, Big data and Augmented reality technologies. As a result, the experimentation brought



Acquisition activities in Western Greece



Acquisition activities in Apulia Region

to the definition of a platform where data and services such as maintenance, and refueling from multiple users (customer / suppliers) can converge in order to have a local network that allows the growth of boating in Apulia.

Also regarding the Acquisition level, in Western Greece an in-company experimental intervention was organised by the Chamber of Achaia and the University of Patras on the issue of Cyber security and the GDPR regulation. The experience involved three companies operating in the ship building sector and in the yacht renting compartment. The intervention, that was realized mainly on-line and with the use of Future 4.0 platform, was dedicated to stimulate companies to find the places that might be vulnerable in their daily operations and think of possible ways to strengthen them.

As a result, participating companies understood the importance of Industry 4.0 technologies to protect their data, their intellectual property and their future plans. Moreover, companies understood how they can use these technologies in order to optimize their procedures, take the first step towards scaling their businesses and prevent attacks or profit loss due to cyber security issues or GDPR non abidance.

Referring to the **Transformation** level:

An in-company experimental intervention was planned and implemented by Confindustria Veneto SIAV with the aim to support the digitalisation of the data procession of the waste collection service. This experience involved CONEPO SERVIZI - one of the most important private company and operator of environmental services and transport, specialised in the field of special and non special waste disposal activities in Venice historical centre and mainland. The intervention methodology was



Transformation activity in Veneto Region

a mix of face-to-face knowledge transfer, digital learning and use of the Future 4.0 platform. The outcome of the intervention led firstly to a flow chart presenting the application of 4.0 to the process and the development of a new flow. Secondly, a responsive web application that meets the identified company objectives was developed. The application has a twofold purpose: first, to support operational managers to plan the routes that the CONEPO vehicles must take in order to carry out the waste collection service. Second, to help field operatives who have the task of recording the types and quantities of waste released by each ship.

Again on the Transformation level, the Polytechnic of Bari organised an in-company experimental intervention with Marina Sport, a company operating in the nautical sector for the sale of medium - large boats, inflatable boats, outboard motors, accessories and nautical spare parts. This intervention was focussed on the digitalisation of the process management and on the application of the Cloud, Big data and augmented reality technology.

Among outstanding results, this intervention produced an App for the management of customers and employees, to be used to obtain information on the boats, upload pictures and monitor the progress of the work of employees.



Transformation activity in Apulia Region







POLICY RECOMMENDATIONS

According to FUTURE 4.0, the policy recommendations coming from the partnership at the end of the project should be in line with the first pillar of the European Strategy for the Adriatic - Ionian macroregion, which is about the Blue growth. More in detail, as specified by this pillar, the Adriatic and Ionian Region suffers a lack in “business resource efficient culture” and cooperation of business, research and the public sector. Blue Growth industrial sectors are short on clustering and fail to fully exploit the advantages of effective cooperation among research centres, public and private sectors and users.

It is essential to transfer R&D results of Key Enabling Technologies (IT, robotics, materials, automation) in new end-users components & applications for the advanced manufacturing industries. EUSAIR Action Plan argues that some key sectors, such as shipbuilding, the boating industry and logistics, risk losing competitive leverage while others, such as marine technologies or blue bio-technologies, have not yet developed their full potential.

To face this challenge, the project worked for three years to drive innovative maritime and marine growth and employment by enhancing innovation and business opportunities in blue economy sectors, with a focus on developing human capital, promoting entrepreneurship, fostering cooperation among research, knowledge providers and industry to develop innovative products and knowledge and technology transfer.

In the following pages, 18 recommendations are developed and proposed to ease the transfer of project results into industrial policy for the shipyard and maritime sector. Recommendations can be clustered in three groups: related to competence development, related to the support to Adriatic and Ionian Region companies for understanding digitalisation and Industry 4.0., and related to the relations between nautical and shipbuilding companies and their environments.



FUTURE 4.0 Partners during the Study Visit at the Port of Durres (AL)

About competence development:

- In order to support companies and workers to face successfully the changes in the nature of work induced by technological development and the digitalisation of production linked to Industry 4.0, there is a need to constantly update education and training. The continuous analysis of new roles, new jobs and new skills produced by Industry 4.0 transformations brings out the need to equip companies and the workforce with the right skills to be prepared for the production and the jobs of the future and for a constantly changing industrial environment.
- Companies should be aware that the interaction man - machine that is so frequent in Industry 4.0 working environments, made the necessary set of skills composed not only of technical competences but also of soft and relational skills. Moreover, it is fruitful to consider machine - to - machine relations and human - to - machine interaction. Therefore, it might be useful to foresee the investment on specialists of the training and skills development focussed on specific technologies and on the whole spectrum of relational skills. From a methodological point of view, partners found that the rapid technological development has as result the introduction of new training and learning approaches and methodology. To be specific, the training experimentations made during the Future 4.0 project encompassed several learning methods and actions: synchronous and asynchronous delivery, on - site and distance content delivery; learning games and simulation tools techniques. Partners investigated deeply the concept of knowledge transfer. In fact, there is a tendency to consider technological transfer as limited to technological dimension in the strict sense, without considering instead the need to extend and integrate it within the wider logic of knowledge transfer. The acquisition of new external knowledge must be completed with its adaptation and integration of use within the new organisational and production context.
- Partners experimented with a methodology for knowledge transfer in the shipbuilding sector companies, 132 of which were involved in the testing. Beside the use of the Future 4.0 Learning platform, enterprises were involved in seminars, in-company action learning interventions and webinars with the aim of enhancing their final capability to effectively absorb the new external knowledge, unknown respect to the previous experience, developing in this way new routines to integrate the stock of pre-existing know-how and mutually adapting the new codes and cultural models to assimilate them. The three steps of the methodology are called awareness, acquisition and transformation.
- After elaborating the Smart learning model, partners tested it with companies from the shipbuilding sector using seminars, in-company action learning and webinars. One of the results of the testing was the fine - tuning of 4 professional profiles whose competences have been analysed and designed for the maritime

industry. The 4 profiles are: the IT Manager, the Technical Area - R & D manager, the Supply Manager and the Human Resource Manager.

About the support to companies for understanding digitalisation and Industry 4.0:

- The change towards Industry 4.0 is not merely a matter of investments: it is a technological and cultural change that needs a strategy. The experience done with companies and stakeholders during the local action plans advises to start with small projects and reduced investments to explore the scalability of Industry 4.0 technologies.
- Another point regards the relevance of the awareness of the implications on company organisation. IT infrastructures are important, but it is not enough to have 4.0 operators and more digital skills. The mindset of managers and workers is equally critical and still lacking.
- It is important to frame investments within a specific strategy, avoiding isolated implementations of one new technology. This allows the definition of a technological roadmap, the formulation of a whole strategy for digitization and the identification of key factors to improve competitiveness.
- Companies should be aware of policies and existing support implementation measures and combine them to real business needs. Local synergies and market opportunities can be created on the basis of clustering companies and by promoting stakeholder partnerships among companies with different competences and size in a given field.
- Companies have to be supported to understand how the business model of the enterprise changes following the adoption of 4.0 technologies. In fact, new technologies strongly impact the business model, bringing multiple and multi-level benefits. Partners found that digital technology acquisition is more successful when integrated in a smart digital business model.
- The challenge of sharing knowledge is pivotal: it is fundamental to adopt a collaboration perspective with other companies, suppliers and customers to integrate digital technologies into the supply chain. It is also important to collaborate with universities (also at international level) for cooperation on research and development.
- Then, it is important to increase the knowledge of I 4.0 technologies and to develop specific skills to use them correctly and to overcome the resistance to change and the lack of experience.

About the relations between companies and their environments:

- Analysing territorial and economic megatrends for the shipbuilding and maritime sector, partners found that sustainable development is an emerging issue in the process of realising Industry 4.0. The issue is relevant against the background of cross - cutting issues and social challenges like climate change and energy transformation in the industrial context. Within this framework, the project Future 4.0 focussed on the energy-intensive shipbuilding industry and related services.
- As well, it is important to take advantage of connections with the local ecosystem, by making agreements with universities, research centres, knowledge providers, technology parks and agencies for innovation. Connections are also very useful with the Public administrations, for issues related to research, territorial development and employment and for contributing to the policy - making process.
- One interesting experience for enhancing the link between companies and the local ecosystem was designed and used in Rijeka. The university involved and selected 15 young researchers/PhDs in the field of 4.0 technologies, as mentors of some companies belonging to the naval sector and its related supply chain. Each researcher/mentor selected one of the 6 KETs technologies, according to company needs, and tried to support and drive its implementation into the company, thanks also to the adoption and testing of Future 4.0 platform.
- The role of the entrepreneur is central in the process of acquisition and development of new skills connected with Industry 4.0 and digital transformation in companies. The leadership of the owner - manager enables the innovative company to place learning at the centre of their business activities and relations. Moreover, it makes sure that employees develop skills by taking advantage of all learning opportunities that may arise.
- In Industry 4.0 ecosystems, socio-economic sustainability trends are anticipated to involve a shift towards lean, clean and green energy in order to reduce resource consumption, achieve sustainability in production processes and material as well as preserve scarce resources.

Interreg

ADRION

European Regional Development Fund - Instrument for Pre-Accession II Fund



ADRIATIC-IONIAN

FUTURE 4.0



This document represents the Deliverable C.3.3 - Final Publication of the Interreg ADRION Project 294 FUTURE 4.0 “ManuFactU-ring educaTion and training governance model for Industry 4.0 in the Adriatic-Ionian aREa”.

This document has been written by Veneto Region, Lead Partner of FUTURE 4.0 Project and coordinator of this publication. The author assumes no responsibility for errors or omissions, or for damages resulting from the use of this document.

This document has been produced with the financial assistance of the European Union. The content of the document is the sole responsibility of the author and can under no circumstances be regarded as reflecting the position of the European Union and/or ADRION programme authorities.
