Interreg ADRION ADRIATIC-IONIAN

EUROPEAN UNION

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

FUTURE 4.0

TECHNOLOGICAL MAP OF THE SHIPYARD & NAUTICAL LOGISTIC SUPPLY CHAIN

WP2 T1

Project number and acronym	294 – FUTURE 4.0
Lead partner	Veneto Region
Prepared by	PP3, Polytechnic university of Bari Maria Pia Fanti, Valentino Sangiorgio, Beatrice Di Pierro
Address	Via Amendola, 127/B, Bari, Italy
Email	mariapia.fanti@poliba.it valentino.sangiorgio@poliba.it beatrice.dipierro@poliba.it
Date, Venue	Bari, 30/03/2019
Delivery Date	April 2019

Regione del Veneto – Veneto Region (IT)

Confindustria Veneto SIAV S.p.A. – Confindustria Veneto SIAV S.p.A. (IT)

Polytechnic University of Bari (IT)

Chamber of Achaia – Since 1836 – Chamber of Achaia (GR)

LMS Laboratory for Manufacturing Systems & Automation – University of Patras (GR)

Primorje-Gorski Kotar County (HR)

University of Rijeka Faculty of Economics – University of Rijeka Faculty of economics (HR)

CCIT – Chamber of Commerce and Industry, Tirana (AL)

Universiteti Mesdhetar – "Mesdheu" Center (AL)

Confindustria Bari e Barletta-Andria-Trani – Confindustria Bari and Barletta-Andria-Trani

Regione Puglia – Apulia Region - Department of Economic Development, Education, Training and Employment

DOCUMENT CONTROL SHEET

Work package Number	T1
Work package Title	SMART INDUSTRIAL CHANGE, TECHNOLOGIES AND FUTURE JOBS
Activity Number	-
Activity Title	-
Deliverable Number	-
Deliverable Title	Final Document “Technological map of the Shipyard & Nautical logistic supply chain”
Dissemination level	Public
Main author	PP3, Polytechnic university of Bari
Contributors	Future 4.0 Partners
Quality Assurance	LP, PSC

TABLE OF CONTENT

Project summary 3
Work package 2: objectives, structure and general approach 4
Structure 4
General approach 8
Methodology 1: Analitic Hierarchy Process 8
Methodology 2: Card Game Analysis 13
Methodology 3: Road Map 17
Main results 21
The results of Card Game analysis: Enabling technologies of industry 4.0 21
The study of the Professional Skills required in the technologies 4.0 31
Road Map of the education for technologies 4.0 39
Focus Group and achieved target 45
Albania 45
Croatia 46
Greece 47
Puglia 47
Veneto 48

Project summary

The challenges brought about by the fourth industrial revolution are at the very heart of the project FUTURE 4.0. The further developmental stage in the organization and management of the entire value chain process involved in manufacturing industry is radically changing even the concept of enterprise. EUSAIR area societies and economies are affected as well by this paradigm shift, which has effects on production, intercompany relations, human capital development. To face this, and having as specific focus Blue Economy, the shipyard & nautical logistic supply chain, the project intends to design a shared strategy to innovate companies approach to training through a Smart Learning Model enhancing shipyard competitiveness in Italy (Veneto & Apulia), Croatia, Greece and Albania. The project structure foresees the definition of a Technological Map of the Shipyard & Nautical Logistic supply chain thorough inclusive road mapping and foresight activity on technology and related competences. Results will be the lay for the designing of a knowledge, competence and skills training/learning hub (FUTURE4.0 platform) involving Universities and training orgs., companies and PAs. The platform will be part of the above-mentioned Smart Learning Model and Strategy, implemented and validated through local pilot actions, encompasses effective industrial education and training for innovation, enhancing the University-Industry cooperation. The partnership is multi actor and includes public and private bodies, universities, business supp. orgs., HE institutions active in Industry 4.0 which will cooperate together applying a Triple Helix approach. Accordingly, the project will impact on current situation stimulating a common and participatory rethinking of regional governance systems for training and innovation support towards Industry 4.0, specific for the shipyard & nautical logistic supply chain. Mutually cooperating 4 universities, PAs, business actors (Large Companies, SMEs, KIBs, Business Supp. orgs.) and R&I players will define a sectorial technological roadmap and foresight as basis for the subsequent development of a share Training Model, tested and validated through its application at each local context. FUTURE 4.0 will see the involvement of 105 companies (primary target group and beneficiaries along with PAs) of the Blue Economy in a knowledge and technology transfer tailored process, along with the production of tools and methods to facilitate a smart industrial change. Results are addressed at Adriatic-Ionian companies, human capital developers, public administrations and knowledge providers. Involved regions share the same challenges, as they face the same transformations and their productive systems should be more integrated. That is why the project should be realized transnationally. What is original is the combination of model design, learning actions, local action plans, profiles upskilling, within a topic - Industry 4.0 - which is brand new.

For further informations visit https://future4.adrioninterreg.eu/.

Work package 2: objectives, structure and general approach

Lead by POLIBA, according to the consortium agreement WP2 (Figure 1) analyses the state of art of the Smart Industrial Changes, the Technologies and Future Jobs in the Adriatic-Ionian Countries. Each activity is organised as follows: i)On-desk analysis and reporting (qualitative and quantitative analysis); ii)Focus groups (with a participatory structure), involving companies, policy makers, labour market actors and education and training institutions.
Activities:

- analyse the radical changes and transformation, define the research priorities in manufacturing and production processes with the purpose of identifying the main technological trends and their impact on the competitiveness, growth and labour market of each region involved in the project.;
- consider the complexity of the systems interacting at regional, interregional and transnational level by identifying the manufacturing and logistic subsectors which contribute to the development and growth of the Blue economy in sustainable way;
- perform a Technological Road Map in order to define the technological trends in each region and subsector;analyze existing skills and identify emerging professionalism with the goal of defining key competencies for the success of SMEs, through contributions from the business community, professional and academic areas.

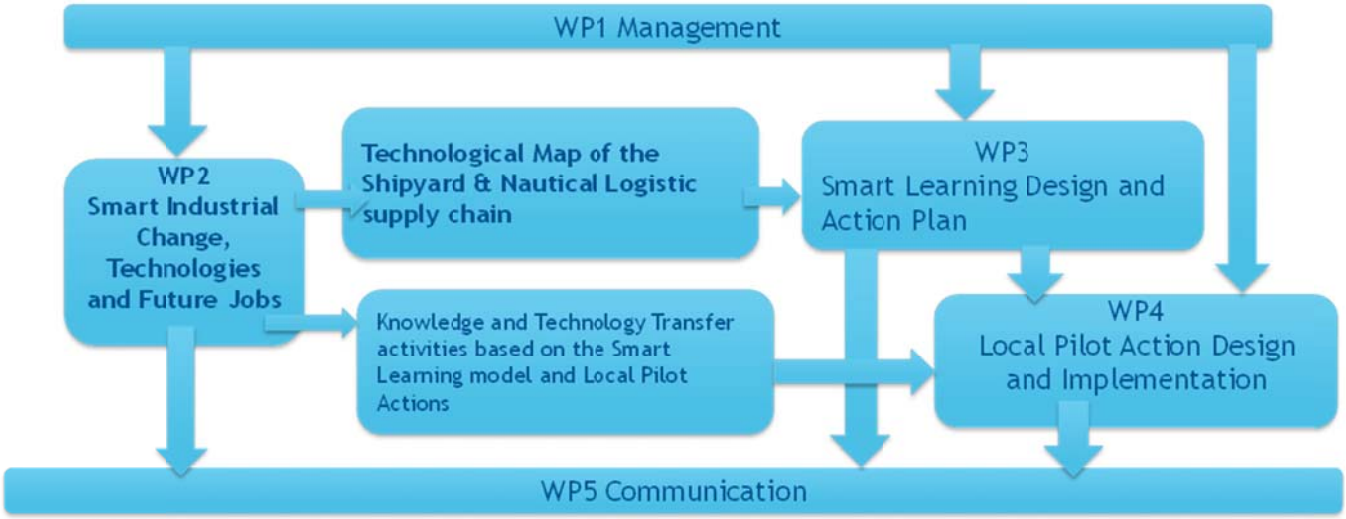


Figure 1 - Future 4.0 WP

Structure

WP2T1 has been divided in activities as follows:

Activity T1.1, Technological Map of the Shipyard & Nautical Logistic supply chain: Acquisition of technological state of the art map for the Shipyard & Nautical Logistic supply chain at regional level to identify trends/mechanisms to forecast tech. developments. The output (shared framework), allows to plan and coordinate professional profiles updating/re-skilling and technological innovation. The investigation foresees the close collaboration of companies, research inst. And PAs. Each partner will audit 5 SMEs.

Activity T1.2, Mapping and data collection: A Technological Road Map has been performed to involve participants in the definition of the technological trends in each region and subsector defined. Particular attention has been paid to the RIS3 of each economic area, in order to investigate the potential development of common industrial strategies and the possibilities offered by a blueprint process, so to tackle the weakness in innovation governance and policy coordination at transnational level amidst countries with interrelated growth trajectories.
Activity T1.3, **Data Analysis and assessment (RIS3 - Regional development strategies):** According to the outcomes of the previous two activities, this activity defines and develops an action plan for implementation and assessment of the identified best practices in the participating regions.
Activity T1.4, Participatory FOCUS GROUPS: The objective of this activity is determining the target groups of the project and the members of the target group. The road map has been shared with the members of the group and specific research and innovation topics has been formed, with a view to their becoming the inspiration for possible future projects. They represent groups of ideas to support research priorities taking a bottom-up approach.

In particular, the activities have been developed according to the following sequence:
Deliverable T1.1.1, *Current status and potential in the ADRION area*
This preliminary study is about the state of art of the Smart Industrial Changes, the Technologies and Future Jobs in the Adriatic-Ionian Countries. This first part of on-desk analysis and reporting aims at the acquisition of technological state of art map for the Shipyard & Nautical Logistic supply chain at regional level to identify trends and mechanisms to forecast tech. A general analysis of the economic situations of the ADRION regions has been presented, which paves the basis for the analysis of the economy of each region from different perspectives and criteria: productivity, professional skills and improvement of sustainability.
Each of these criteria is examined according to further sub-criteria: Demographic change ad labor market, New emerging markets, Scarcity of resources, Climate change, Acceleration of technological progress, Financial environment.
This in-depth analysis on the as-is situation of the various regions is a starting point to compare the data of different regions from the point of view of various parameters, and constitutes a basis for numerical analysis.

Deliverable T1.1.2, *Consensus on a set of needs and related technologies required to satisfy shipyard and logistics industry KSC updating*
In the framework of the study of the state of art of the current status (socio, economic and technological megatrends) that influences the manufacturing sectors, this phase deals with the identification and definition of shared (at EUSAIR area level) functional trends/mechanism to forecast tech. developments.

The new European industrial revolution marked by the advancement of technologies applicable to the industry, demands high R&D intensity, rapid innovation cycles and more skilled jobs.
Smart manufacturing, understood as that set of digital innovations that has come to mature in recent years mainly in advanced services, now seeks new application space within operational processes (manufacturing and logistics) of industrial companies.

Industry 4.0 technologies which are Advanced Manufacturing Solutions, Augmented Reality, Cloud, Additive Manufacturing, Big Data and Analytics and Cyber-security have been

analyzed and studied in the regional context. Others' partner data have been collected and processed by POLIBA.

The partners have analyzed the technologies in relation with their territory. Industry 4.0 technologies have been studied on the bases of the following criteria: Professional skills required; Short-term economic benefit; Long-term economic benefit; Initial costs; Operating costs; and Improvement of sustainability.

Deliverable T1.2.1, *Technological Roadmap and Foresight*
The process of mapping and data collection in the definition of the Technological Road Map and Foresight has been studied in this phase (covering each region and each subsector defined). It results in a framework to plan and coordinate professional profiles updating/re-skilling and technological innovation. In the section Technical approach it is reported the detailed description of the adopted technological approach.

Deliverable T1.2.2, *Identification of 4 Professional Profiles in each region which will be impacted by the industrial change (Company Interviews)*

It is known that Industry 4.0 will revolutionize the tasks that must be performed within companies. These new technologies entail the need for new, cutting-edge professional figures, but not only: the social problems linked to the loss of importance of traditional professions are not to be ignored. Therefore, the word "avant-garde" is accompanied by the word "reconversion": it is important that the pre-existing personnel in the companies do not lose their jobs and that their usefulness is restored, reconverting them to tasks, in fact, at the forefront.

In the framework of the Mapping data and collection analysis, in this deliverable, after a brief introduction on industry 4.0 and its effects on work, company interviews done by each Future 4.0 Partner and a description of the followed methodology are reported.

These interviews have been functional also for the identification of 4 main professional profiles most affected by Industry 4.0 affirmation.

Deliverable T1.3.1, *Report on profession profiles needs' analysis*
The adoption of new technologies is a fundamental resource for a company, in order to be competitive. However, companies have to face with numerous organizational problems, as a highly flexible internal structure is needed, where the machines and workers find themselves carrying out increasingly difficult to predict jobs, which complicate both the programming of the machines is the management of the workers, as well as requiring more and more skills.
Then, the state of the art of the gap between demand and supply in the world of work and the difficulties related to personnel management have been analyzed, in particular the difficulties in finding skilled labor, in terms of skill gaps between demand and offer. In a second part they have been reported the answers concerning the Professional Profiles, obtained during the interviews that each partner has carried out in his own country.

Deliverable T1.3.2, *RIS3 assessement*
"Industry 4.0" means the various new technologies that are currently changing the manufacturing and process industries in their form and in their operation, making the processes leaner and more efficient. By narrowing the focus on the shipbuilding industry, it is necessary to study the main factors of success towards the implementation and adoption

of the 4.0 technologies in the shipbuilding sector.

With this aim, it is appropriate to examine which are the main challenges to adopt Industry 4.0 technologies in the Shipyard Industry and what kind of recommendations should be given to a shipbuilding company to increase the chances of a successful implementation of Industry 4.0 technologies.

Different approaches have been studied and on the basis of the literature the approach has been adapted to the industries of the ADRION area.

In the results of various studies it appeared that, even if there are many benefits from implementing Industry 4.0 technologies in the Shipbuilding Industry, there are still many challenges that need to be solved before it is possible to completely adopt these technologies. A general perspective for a shipbuilding company has been given wishing to begin the transformation process towards digitized technologies and the best practices resulting from the various methodologies examined have been indicated for each of the partners.

Deliverable T1.4.1, *Focus Groups Summaries*

During the WPT1, the theoretical and practical study of the Industry 4.0 situation in the Adriatic-Ionian area has been carried out.

Through the research, interesting results were collected, especially during the interviews carried out within the company, where it has been possible to see more closely the real technological and economic situation of the respective territory.

Following the analysis conducted within the WPT1, this last phase wants to go to validate the obtained results, turning once again to the companies of the various involved territories, trying to create reference targets to carry out the research and make that Industry 4.0 takes root in the territory.

The partners have turned to companies in different ways, that is through meetings or by involving them electronically, pursuing the common objective of validating the results obtained and capturing future objectives in the Industry 4.0 field.

General approach

The pursued procedure includes four synergistically techniques for data acquisition and analysis: i) Desk Studies to collect data in the existing literature, 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 analyze the perception of companies.

The steps of the data acquisition process of the WP2 are the following:

- A Desk Study to analyse the state of art of the Smart & Green features of the Industry connected to the Blue Economy and the national and regional industrial development and transformation related to the global macroeconomic and technological megatrends.
- An Analytic Hierarchy Processes based on the results of the Desk Study to understand how economic and technological megatrends influences the manufacturing sectors in the last 20 years in the investigated regions.
- A second Desk Study about the enabling technologies of industry 4.0. Analyse the definition of trends/mechanisms to forecast tech developments and identify a set of needs and related technologies required to satisfy shipyard and logistics industry KSC updating. (results in T1.1.2)
- An Analytic Hierarchy Processes based on the results of the second Desk Study to analyse the potential of enabling technologies of industry 4.0.
- A Card Game to analyse the perception of companies regarding the enabling technologies of industry 4.0.

In particular, the **technical approach** consists of 3 main methodology:

- Methodology 1: Analitic Hierarchy Process
- Methodology 2: Card Game Analysis
- Methodology 3: Road Map

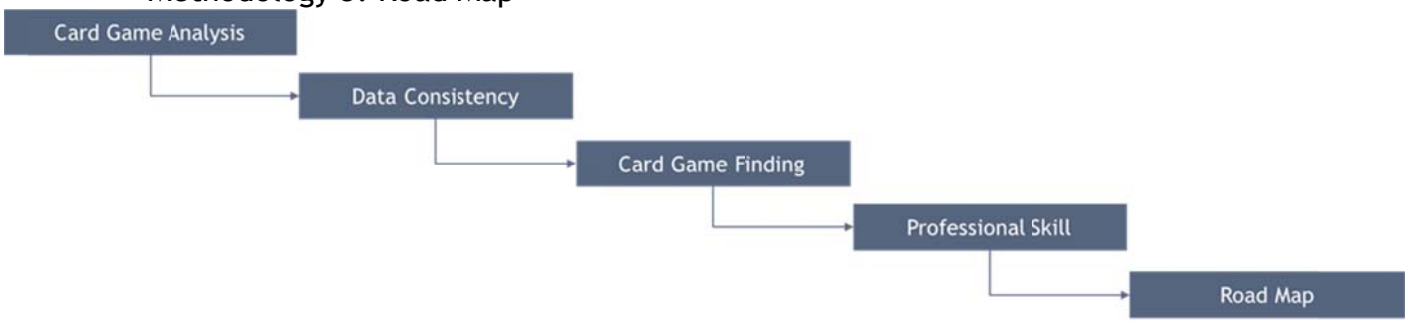


Figure 2 - Technical approach

Methodology 1: Analitic Hierarchy Process

The Analytic Hierarchy Processes has been applied to the two Desk Study to derive quantitative data, in addition the Card Game procedure (Methodology 2) used to analyze the perception of the interviewed companies.
The Analytic Hierarchy Process (AHP) provides the objective mathematics to analyze a problem from a qualitative and quantitative point of view (Saaty and Vargas 2001). The AHP is based on the decomposition of the problem in independent criteria: such operation allows

transforming a multidimensional scaling problem to a one-dimensional scaling problem. Therefore, every criterion is analysed individually in order to identify the related priority vectors, i.e., the weights assigned to each alternative or criterion (Saaty and Vargas 2001).

Table 1

Fundamental scale of Saaty

a_{ij}	Verbal scale
$a_{ij} = 1$	Equal importance
$a_{ij} = 3$	Moderate importance of one over another
$a_{ij} = 5$	Strong importance
$a_{ij} = 7$	Very strong importance
$a_{ij} = 9$	Extreme importance
1.5 - 4 - 6 - 8	Intermediate value
1/9,1/8,….,1/2	The reciprocal expresses an opposite judgement

Figure 3 - Fundamental scale of Saaty

The AHP uses the principal eigenvalue method for deriving ratio scale priority vectors from positive reciprocal matrices. In particular, such matrices, named comparison matrices or judgement matrices, are established through pairs of comparisons (Barzilai et al. 1987; Saaty and Hu 1998).

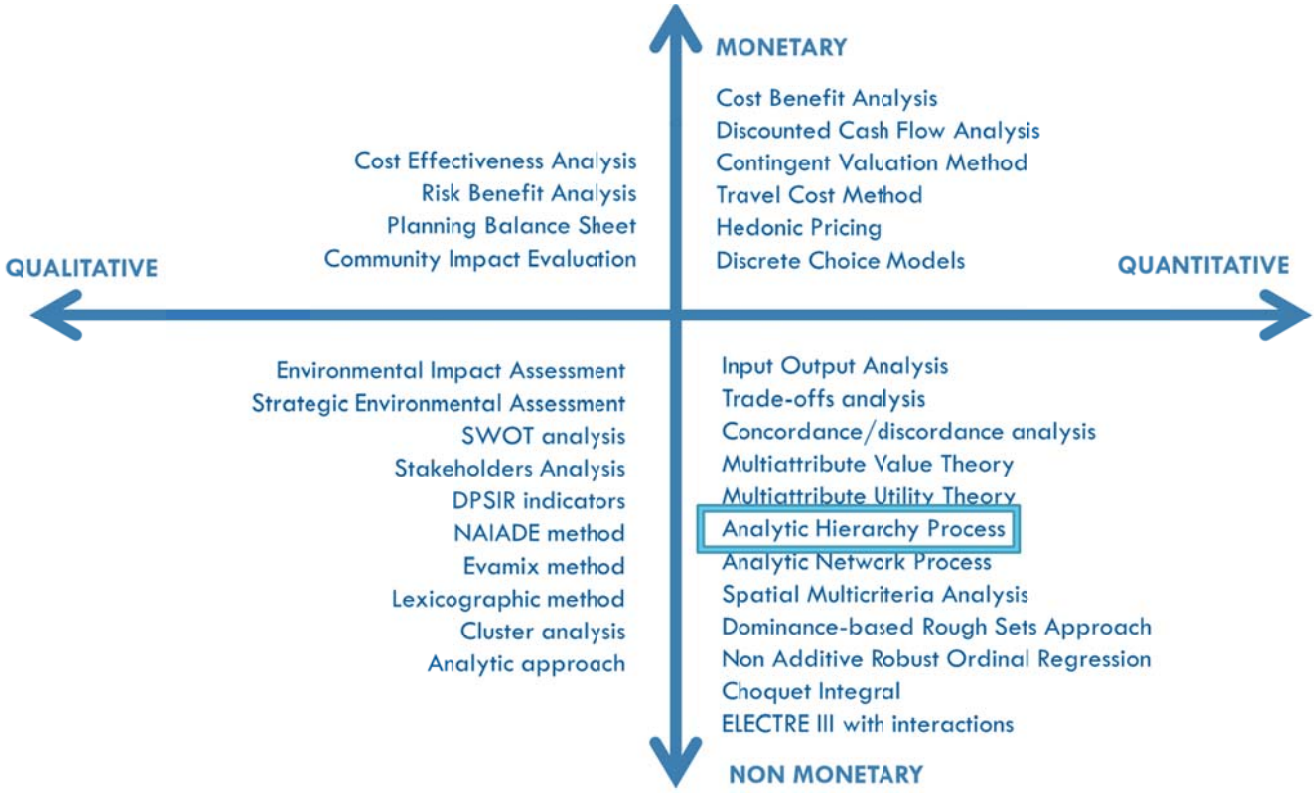


Figure 4 - Evaluation methods

- ***The Analytic Hierarchy Processes applied to the desk study: macroeconomic and technological megatrends***

The AHP Methodology is applied in the desk study to obtain quantitative data and considerations from the study carried out by each partner on the "current status and potential in the Adrion area".

The first step in AHP, as applied to understand how economic and technological megatrends influences the manufacturing sectors, consists of the Structure of the Problem.
The defined criteria considered in the analysis are: Professional skills, Productivity and Improvement of 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 (globalisation, exports'growth, growth of developing countries); 3) scarcity of resources (energy, water, raw materials, others); 4) climate change (eg. CO2 increase, global warning); 5) acceleration of technological progress (exponential growth of technologies, cost reductions,pervasiveness); 6) and financial environment.
Fig. 5 shows the considered problem structured in a hierarchical flowchart.

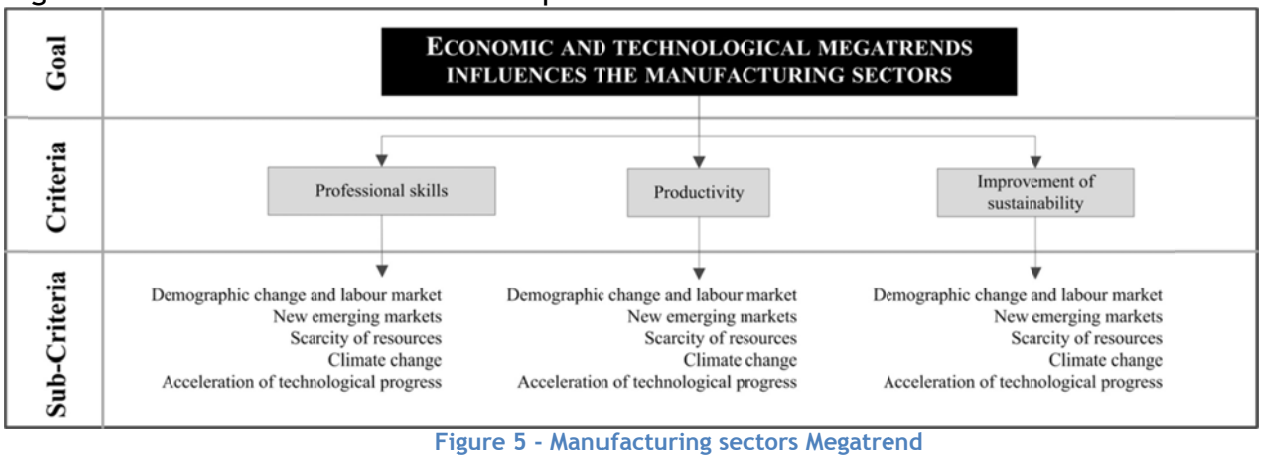


Figure 5 - Manufacturing sectors Megatrend

In the second step of AHP every partner exploiting the results of the desk study has achieved tables (Figure 6 shows the table filled for the analysis of Veneto region) useful for making pairs comparisons and generating the judgments matrix of the AHP.

For the sake of brevity only the table regarding the Professional skills is showed.

How these parameters affect the **Professional skills** of the companies?	Demographic change and labor market	New emerging markets	Scarcity of resources	Climate change	Acceleration of technological progress	Financial environment
Demographic change and labor market	1	3	7	7	1	5
New emerging markets	0.33	1	5	5	0.33	3
Scarcity of resources	0.14	0.20	1	1	0.14	0.33
Climate change	0.14	0.20	1.00	1	0.14	0.33
Acceleration of technological progress	1.00	3.00	7.00	7.00	1	5
Financial environment	0.20	0.33	3.00	3.00	0.20	1
	2.82	7.73	24	24	2.82	14.7

Figure 6 - Judgment Matrix; alternatives analyzed for the Professional Skill criterion

Alternatives	Weights (%)	*CR*	Consistency requirement	Ranking
Demographic change and labor market	33.694	0.039933	satisfied	1º Demographic change and labor market
New emerging markets	16.450			1º Acceleration of technological progress
Scarcity of resources	3.888			2º New emerging markets
Climate change	3.888			3º Financial environment
Acceleration of technological progress	33.694			4º Scarcity of resources
Financial environment	8.386			4º Climate change

Figure 7 - Local weights: alternatives analyzed for the Professional Skill criterion

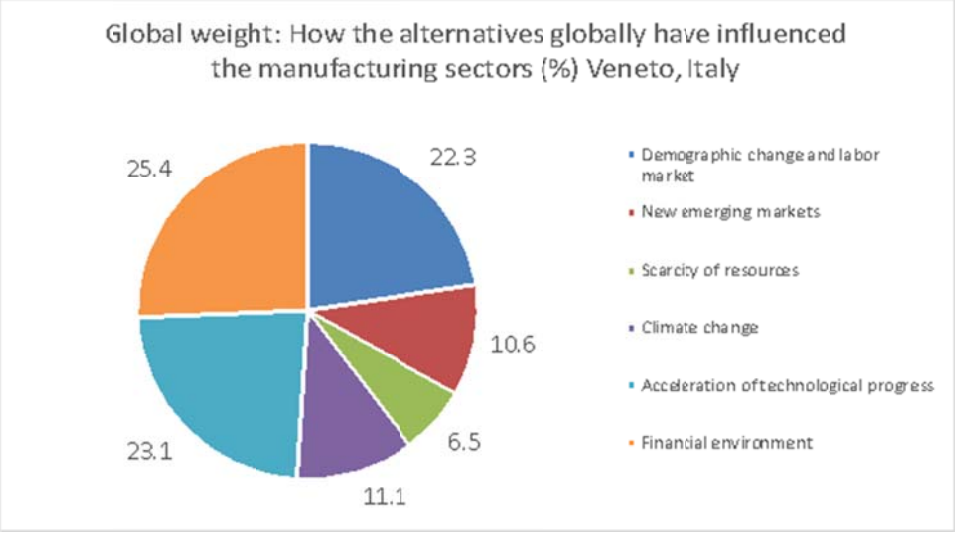


Figure 8 - Parameter influencing globally the manufacturing sector in Veneto region

Overall the most important parameter that have influenced the macroeconomic and technological megatrends are:

1) *financial environment*

2) *the demographic change and labour market*
3) *the acceleration of technological progress.*

Such a condition is shared and approved by the analyses performed for each involved region.

- ***The Analytic Hierarchy Processes applied to the second desk study: Enabling technologies of industry 4.0***

The AHP Methodology is applied in the desk study to obtain quantitative data and considerations from the study carried out by each partner on the "Enabling technologies of industry 4.0"

The first step in AHP, consists of the Structure of the Problem. The goal is understand the potentiality of the Enabling technologies of industry 4.0 by considering advantages and disadvantages of the six main enabling technologies (the alternative 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 is performed on the base of six criteria. In particular the enabling technologies are analised on the base of the following six aspect: 1)Professional skills; 2)Short-term economic benefit; 3)Long-term economic benefit; 4)Initial costs; 5)Operating costs; 6)Improvement of sustainability.

In the second step of AHP every partner exploiting the results of the desk study has achieved by tables useful for making pairs comparisons and generating the judgments matrix of the AHP.

To provide an example Starting from the Professional Skill criterion, the Judgment Matrix is obtained comparing the alternatives in pairs. In particular, every numerical value in the cell represent which enabling technology require less Professional skills change (Figure 9).

Professional skills	Advanced Manufact.Solutions	Augmented Reality	Cloud Computing	Additive Manufacturing	Big Data and Analytics	Cyber-security
Advanced Manufact.Solutions	1	1	0.33	0.33	0.33	0.33
Augmented Reality	1.00	1	0.33	0.33	0.33	0.33
Cloud Computing	3.00	3.00	1	1	1	1
Additive Manufacturing	3.00	3.00	1.00	1	1	1
Big Data and Analytics	3.00	3.00	1.00	1.00	1	1
Cyber-security	3.00	3.00	1.00	1.00	1.00	1

Figure 9 - Judgment Matrix; enabling technologies analyzed for the Professional Skill criterion

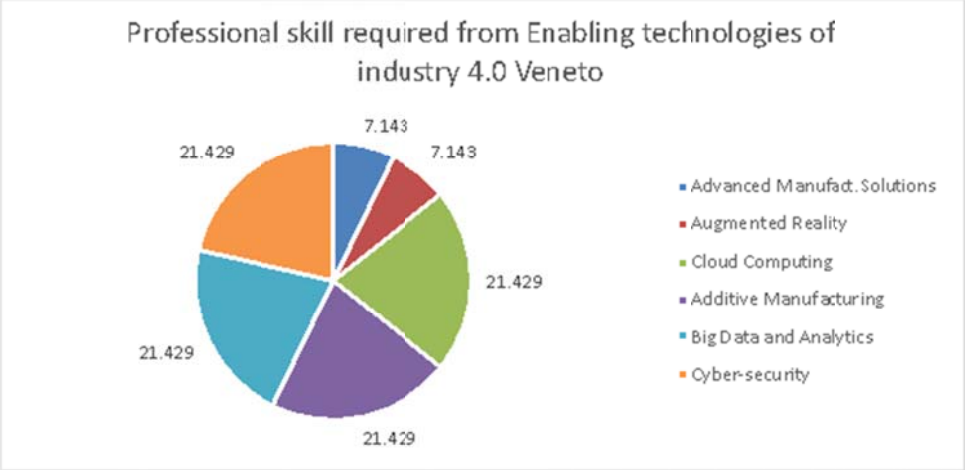
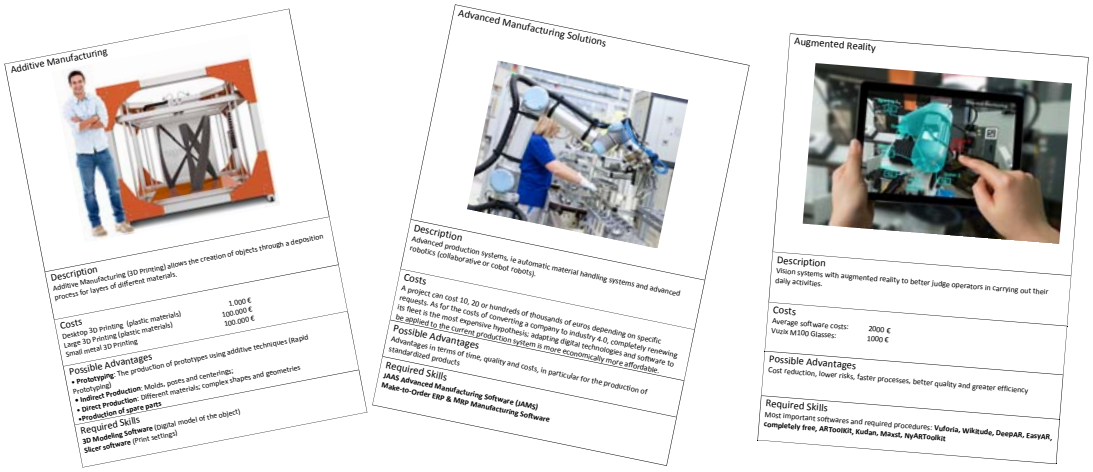


Figure 10 - Veneto Region Professional skills

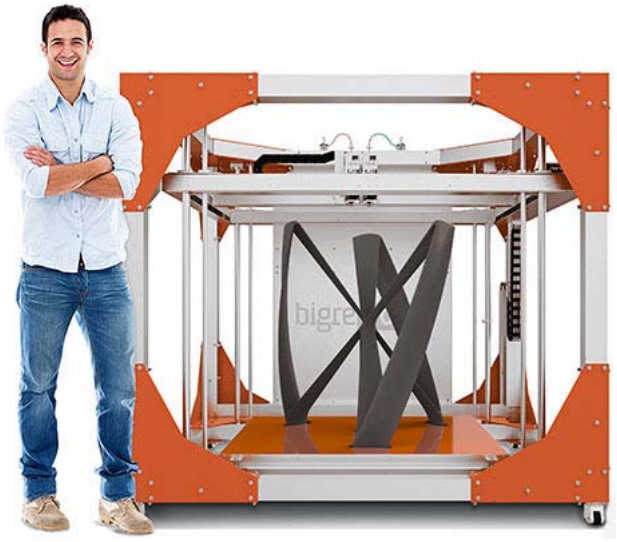
Methodology 2: Card Game Analysis

The technique used to collect information consists of the following three steps:

Firstly, it is necessary give to the person being tested (the user) a set of cards: the name of each criterion is written on each card together with some other (complementary) information, if necessary. Therefore, we have n cards, n being the number of criteria of a family. These cards should exhibit no number what-so-ever in order not to induce the answers. The user also receive a set of white cards with the same size. The number of the latter will depend on the user's needs.



Additive Manufacturing



Description

Additive Manufacturing (3D Printing) allows the creation of objects through a deposition process for layers of different materials.

Costs

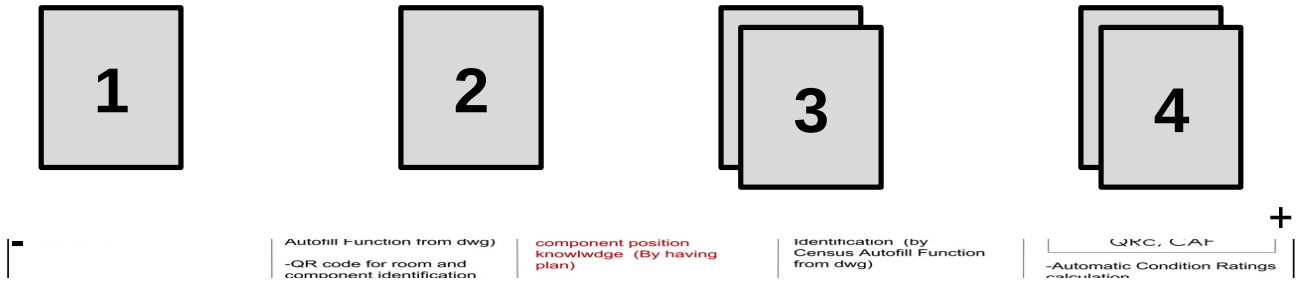
Desktop 3D Printing (plastic materials)	1.000 €
Large 3D Printing (plastic materials)	100.000 €
Small metal 3D Printing	100.000 €

Possible Advantages

• **Prototyping**: The production of prototypes using additive techniques (Rapid Prototyping)
• **Indirect Production**: Molds, poses and centerings;
• **Direct Production**: Different materials; complex shapes and geometries
•**Production of spare parts**

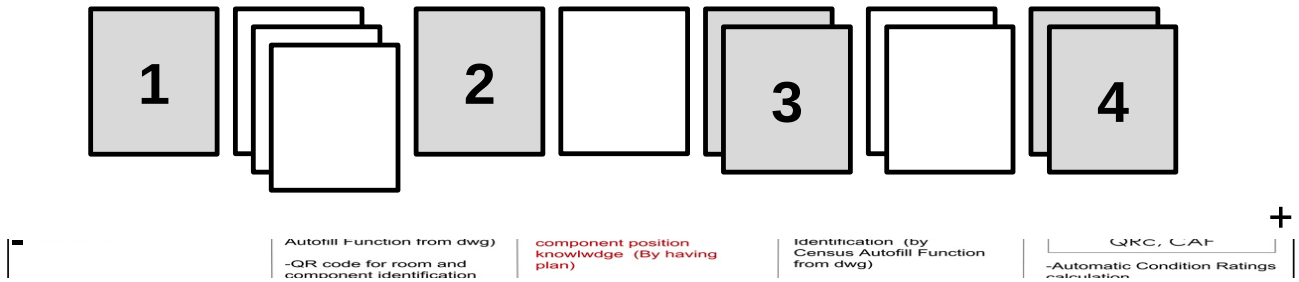
Required Skills
3D Modeling Software (Digital model of the object) **Slicer software** (Print settings)

Secondly, the user have to rank these cards (of criteria) from the least important to the most important. So, the user rank in ascending order according to the importance he wants to ascribe to the criteria: the first criterion in the ranking is the least important and the last criterion in the ranking is the most important. According to the user's point of view, if some criteria have the same importance (i.e., the same weight), he should build a subset of cards holding them together with a clip or a rubber band. Other ways of ranking the cards may be used (e.g., purely displaying them .at on a table) being it a simple matter of preference of the user. Consequently, it is possible to obtain a complete pre-order on the whole of the n criteria. Let n be the number of ranks of this pre-order (most of these ranks being reduced to one card only, i.e., to one criterion). The first rank is named Rank 1, the second one Rank 2, and so on.



Thirdly the user has to think about the fact that the importance of two successive criteria (or two successive subsets of ex aequo criteria) in the ranking can be more or less close. The determination of the weights must take into account this smaller or bigger difference in the importance of successive criteria. So, the user introduce white cards between two successive cards (or subsets of ex aequo cards). The greater the difference

- One white card means a difference of two times u.
- Two white cards mean a difference of three times u, etc.



Finally, taking advantage of the rankings obtained with a series of standardizations, it is possible to obtain the weight of each criterion (card) for the decision problem considered.

Figure 11 – Real Example of card ranking

The card game provides the company perception related to the desirability of technologies 4.0. In addition, a resulting Tab is achieved for every company to summarize the main aspects of the company and to display the Pie chart of the technologies 4.0 desirability. In particular the aspect indicates the region of the company, the type of production/activity and the dimension evaluated on the base of the number of the Employers or on the base of an evaluation based on the result of the interview when the number of employers was not provided.

The classification on the base of the employers is listed as follows:

Small, less than 150 employers;
Medium, 150<employers<500
Large, 500<employers<1000
Very large, more than 1000 employers

In the lower part of the resulting Tab. 1 and 2 it is possible to display the local weight obtained during the card game analysis. Such weight describes the desirability of technologies 4.0 by considering every single criterion. Such a values are normalized to 1.

Table 1 - Results

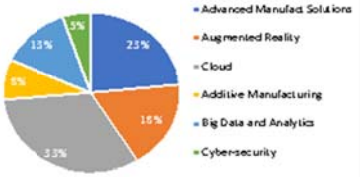
Logo	Name of the Company					
Logo of the company	Region Employers >800 Type of production Advanced Manufact.Solutions AugmentedReality Cloud Additive Manufacturing Big Data and Analytics Cyber-security				Results of the Card Game anaisis. Company perception: desirability of technologies 4.0	
Criteria/Subcriteria	Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
Professional skills	Local Weights normalized to 1:					
Short-term economic benefit						
Long-term economic benefit						
Initial costs						
Operating costs						
Improvement of sustainability						
Criteria	Professional skills	Short-term economic benefit	Long-term economic benefit	Initial costs	Operating costs	Improvement of sustainability
Weight	Local Weight of criteria normalized to 1					

Desirability of Advanced Manufact Solutions considering the requirement of Professional Skills (low level of Professional Skills make technology more desirable)

Desirability of Augmented Reality considering the provided Long-term economic benefit (high level of Long-term economic benefit make technology more desirable)

Example:

Table 2 - Examples of results

Logo	Giuliano					
	Region Employers >800 Type of production Advanced Manufact.Solutions AugmentedReality Cloud Additive Manufacturing Big Data and Analytics Cyber-security	*Puglia Italy* *Large company* *Industrial (Food)* *Yes* *No* *Yes* *No* *Yes* *Yes*			Giuliano perception: desirability of technologies 4.0 	
Criteria/Subcriteria	Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
Professional skills	0.10	0.14	0.29	0.05	0.24	0.19
Short-term economic benefit	0.28	0.08	0.24	0.04	0.20	0.16
Long-term economic benefit	0.16	0.08	0.24	0.04	0.20	0.28
Initial costs	0.04	0.26	0.13	0.30	0.09	0.17
Operating costs	0.04	0.26	0.13	0.30	0.09	0.17
Improvement of sustainability	0.38	0.13	0.13	0.13	0.13	0.13
Criteria	Professional skills	Short-term economic benefit	Long-term economic benefit	Initial costs	Operating costs	Improvement of sustainability
Weight	0.24	0.19	0.29	0.10	0.14	0.05

Then, a **coherence analysis** has been performed; the consistency of the card game is analyzed considering the compatibility between the implemented technologies and the perception of the desirability expressed with the card game. Such a consistency is classified as “Good” “medium” and “low” for every company.

Methodology 3: Road Map

Firstly, a set of data are pointed out from the results of the desk study and the company interviews and stored in suitable tabs. In particular, in such a tables, the professional skill and competences required per technology are defined. In addition, for every region it is specified if there are public or private trainers that provides skill and competences in the territory.

Table 3 shows an extract of the considered tables.

Table 3 - Technologies table

Technology	Professional skill per technology	Professional Training	Professional profiles needed
Cloud	Microsoft Azure ☒	High school ☐ Technical College ☒ University☐ Doctorate☐ Training in company ☐	IT consulting
	Amazon ☒	High school ☒ Technical College ☐ University☐ Doctorate☐ Training in company ☐	IT consulting
	Google ☒	High school ☒ Technical College ☐ University☐ Doctorate☐ Training in company ☐	IT consulting
	VMWare ☒	High school ☐ Technical College ☐ University☐ Doctorate☐ Training in company ☒	IT consulting

From this first analysis it is possible to define the lack of professional skill and competences in every region.
In particular the ranking is obtained by considering the following proprieties of the single professional skill:

1 ° Not provided in the region
2 ° Training in company
3 ° Doctorate
4 ° University
5 ° Technical College
6 ° High school

Secondly a weighting of the technologies that requires more professional skills is obtained from the AHP applied to the second desk study. Also in this case, a ranking is obtained for every region. Such a ranking is used to provide the second level of classification. Priority is given to the technology that requires more professional skills.

Figure 12 shows an example of the weights used to obtained the ranking of Puglia Region.

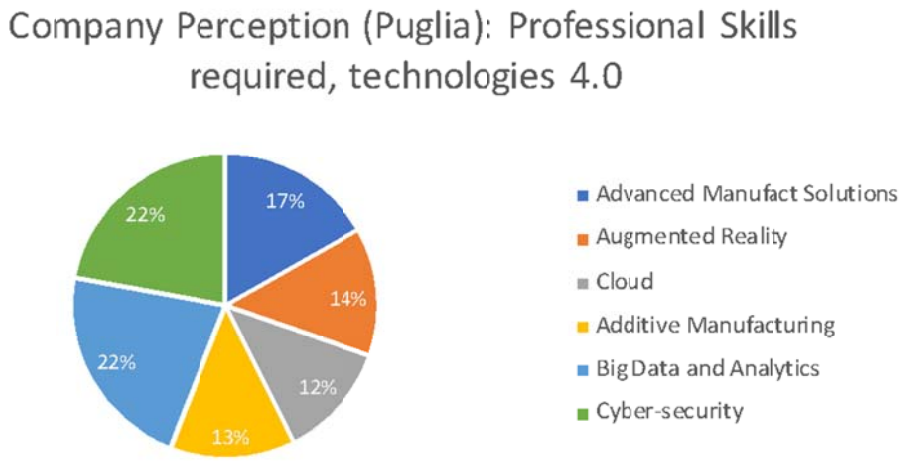


Figure 12 - Puglia Region Professional skills

By exploiting synergistically, the result of the first two steps it is possible to define the priorities of the education for technologies 4.0. In particular, the first selection is done on the base of the professional skill and competences for which there are no trainers on the territory. Among such professional skill and competences, the ranking is performed on the base of the technologies that requires more professional skills.

This analysis provides a global roadmap in the Adrion area by provide the priorities of the professional skill and competences to be offered by the trainers in every region.

Finally, the Road Map of learning Content of every region is specified, as the following example for Puglia Region (Table 4).

Table 4 - Example of Road Map of Learning content: Puglia Region

Road Map of learning Content: Puglia			
Hyerarchy	**Professional skill**	**Professional Training**	**Technology**
1º	**Wikitude**	Not provided in the region	AugmentedReality
2º	**Security information management**	Training in company	Cyber sec.
2º	**SIEM**	Training in company	Cyber sec.
3º	**Make-to-Order ERP & MRP Manufacturing Software**	Training in company	Advanced Manufact.Solutions
3º	**Manufacturing Software (JAMS)**	Training in company	Advanced Manufact.Solutions
3º	**JAAS Advanced**	Training in company	Advanced Manufact.Solutions
4º	**Database NoSQL**	Doctorate	Big Data and Analytics
4º	**Hadoop**	Doctorate	Big Data and Analytics
5º	**ARToolKit**	Doctorate	AugmentedReality
5º	**NyARToolkit**	Doctorate	AugmentedReality
5º	**Vuforia**	Doctorate	AugmentedReality
5º	**Maxst**	Doctorate	AugmentedReality
5º	**DeepAR**	Doctorate	AugmentedReality
6º	**Amazon**	Doctorate	Cloud
7º	**Apache Spark**	University	Big Data and Analytics
7º	**Database In-memory**	University	Big Data and Analytics
8º	**EasyAR**	University	AugmentedReality
8º	**Kudan**	University	AugmentedReality

9º	**Microsoft Azure**	University	Cloud
9º	**Google**	University	Cloud
9º	**VMWare**	University	Cloud
10º	**Anti-malware**	High school	Cyber sec.
10º	**Anti-spyware**	High school	Cyber sec.
10º	**Anti-keyloggers**	High school	Cyber sec.
10º	**Antivirus software**	High school	Cyber sec.
11º	**3d modelling**	High school	Additive Manufacturing
11º	**Slicer software**	High school	Additive Manufacturing

Main results

The results of Card Game analysis: Enabling technologies of industry 4.0

In this section all the results carried out with the card games are analysed. The analysis is performed by considering the following parameters: Company size, Type of production, Geographic location and economic context. The goal is to identify the causes that influences the company's perception.

Coherence analysis: Relationship between used technologies and perception

The consistency of the card game is analyzed considering the compatibility between the implemented technologies and the perception of the desirability expressed with the card game. Such a consistency is classified as "Good" "medium" and "low" for every company. To provide an example, the Sammyacht enterprise perform a Card Game with a good consistency because the most desirable technologies are the same ones that have already been implemented. Figure 13 shows that the most desirable technologies are cloud, Big data and Cyber security. The same technologies indicated as already used by the company in the left part of the image.

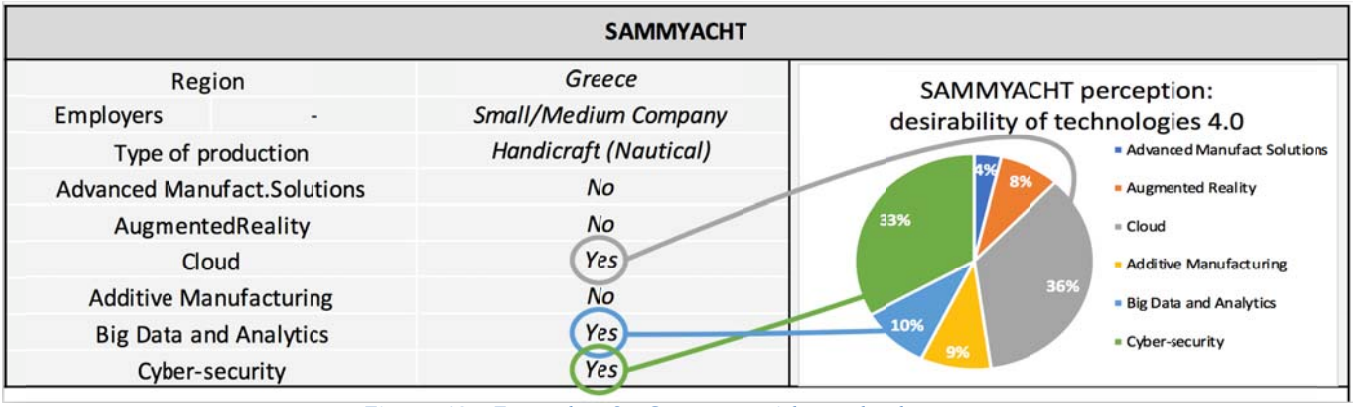


Figure 13 - Example of a Company with good coherence

In the following all the companies are classified on the base of the "good compatibility between the perception of the most useful technologies and those actually used".

The classification of the companies consistency is performed on the base of the following criteria:

Good coherence: if the used technologies are also in the first three places in the ranking of desirability.
Medium coherence: if the used technologies have a good score but the ranking is not perfectly consistent.
Low coherence: if the used technologies have an incoherent score and ranking.
Low coherence and bad knowledge of technologies: inconsistent score and ranking, in addition a bad knowledge of technologies is emerged from the interviews.

Puglia

Bosh Bari:	Good coherence
Divella Bari:	Low coherence
Energy & Movement:	Medium coherence
Giuliano:	Medium coherence
Explosion Marine:	

Veneto

Viraver Technology:	Good coherence
Marelli Motori:	Good coherence
Cantieri Vizianello Srl:	Medium coherence
Italia Yachts srl:	Low coherence and bad knowledge of technologies,
Wiforce Italia S.R.L.	Medium coherence

Croatia

Brodogradilište Viktor Lenac d.:	Good coherence
Interadria SC d.o.o.:	Medium coherence
IHC Engineering Croatia d.o.o.:	Good coherence
SCAM marine d.o.o. :	Good coherence
JLM Perković d.o.o. :	Medium coherence

Albania

Mediterranean Shipping:	Low coherence
Shega Trans:	Medium coherence
Finikas:	Medium coherence
Pelikan Ltd:	Low coherence
Denor Yachting & Decortion	Low coherence and bad knowledge of technologies,
Hudson	Low coherence

Greece

Karel Boats Company:	Medium coherence
SAMMYACHT:	Good coherence
Seatrips-Yachting & Maritime Training:	Good coherence
Dynacomp:	Good coherence
ROTA:	Good coherence

Overall the companies card game provides good and very good coherence. Such data are reliable and can be used to obtain further consideration in the next sections.

The perception analyzed considering the company size

The first comparison of the data is carried out considering the size of the companies. The main considerations obtained from this analysis are listed below:

Very Large and Large companies

The parameters in common for all the large and very large companies are the need of Big Data and Cloud technologies. Such a result is predictable and coherent since large companies

have to manage a large amount of data. In addition, the large companies have a medium coherence in the Card Game results. This indicates a medium knowledge of the technologies.

Bosh					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.025	0.031	0.028	0.037	0.030	0.016
Divella					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.035	0.044	0.018	0.042	0.032	0.004
Giuliano					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.008	0.010	0.062	0.024	0.052	0.023
Mareli Moroti					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.020	0.033	0.031	0.016	0.036	0.030
IHC Engineering Croatia d.o.o.					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.002	0.016	0.052	0.020	0.041	0.061
Brodogradilište Viktor Lenac d.					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.040	0.037	0.021	0.007	0.022	0.035
Mediterranean Shipping Company MSC					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.007	0.044	0.060	0.024	0.027	0.013
ROTA					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.013	0.028	0.042	0.006	0.036	0.051
Weights Large and Very Large companies					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.01877	0.03055	0.03926	0.02204	0.03439	0.02931

Figure 14 - Very Large and Large companies parameters

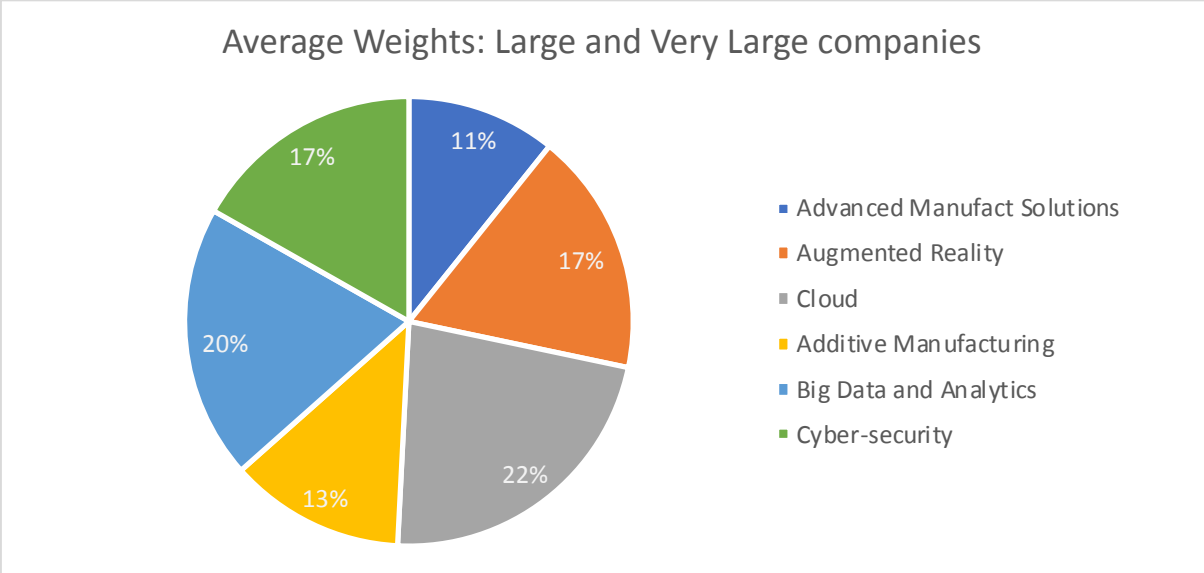


Figure 15 - Perception result considering the large and very large company

Medium Companies

The parameters in common for the medium companies are the need of Cloud and Cyber security technologies. In addition, the medium companies have a medium or good coherence in the Card Game results.

Brodogradilište Viktor Lenac d.					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.051	0.007	0.048	0.019	0.014	0.035
Interadria SC d.o.o.					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.040	0.006	0.062	0.021	0.014	0.035
Shega Trans					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.006	0.032	0.064	0.031	0.017	0.026
SAMMYACHT					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.007	0.015	0.065	0.017	0.017	0.060
Dynacomp					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.008	0.030	0.062	0.016	0.021	0.036
Weights Medium companies					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.02227	0.01797	0.06021	0.02093	0.01673	0.03836

Figure 16 - Medium companies parameters

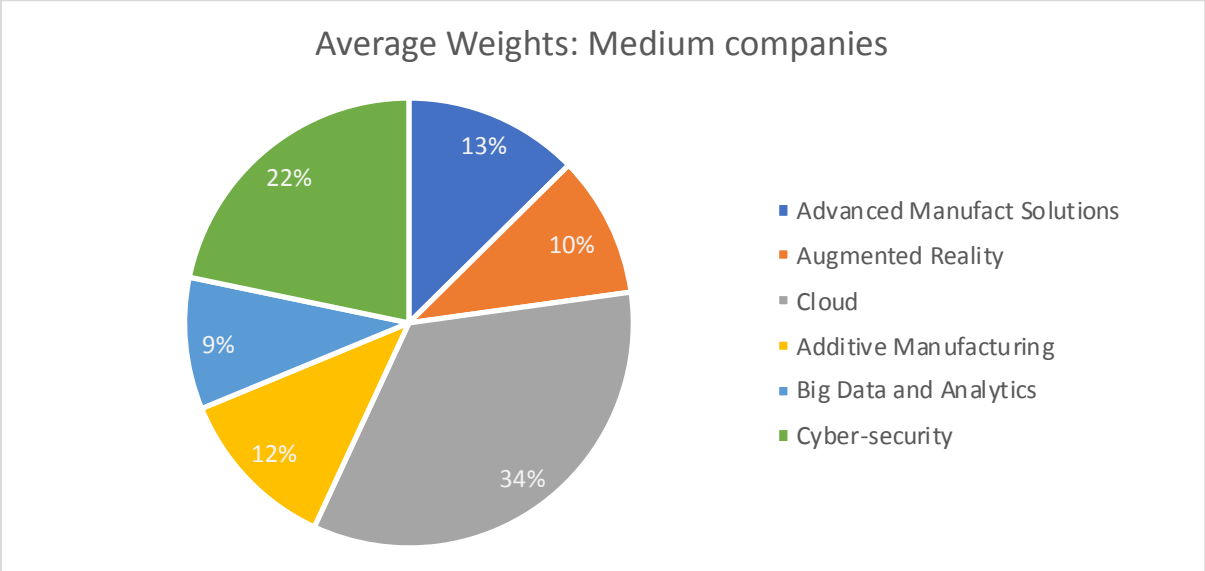


Figure 17 - Perception result considering medium companies

Small Companies

Small companies have a very different perception. The parameter that unites them all is the desirability of Big Data, single parameter of the analysis with a small standard deviation. In addition Small Companies have a medium coherence in the Card Game results. This indicates a medium knowledge of the technologies.

Energy & Movement					
Advanced Manufact Solutions	**Augmented Reality**	**Cloud**	**Additive Manufacturing**	**Big Data and Analytics**	**Cyber-security**
0.010	0.011	0.052	0.029	0.044	0.021
Explosion Marine					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.008	0.057	0.023	0.042	0.024	0.016
Viraver Technology					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.038	0.021	0.030	0.030	0.024	0.024
Cantieri Vizianello Srl					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.028	0.025	0.042	0.025	0.023	0.024
Italia Yachts srl					
loo inconsistent answers					
SCAM marine d.o.o.					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.016	0.036	0.057	0.007	0.022	0.036
JLM Perković d.o.o.					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.040	0.013	0.054	0.010	0.025	0.021
Finikas					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.004	0.034	0.024	0.040	0.041	0.023
Pelikan Ltd					
Advanced Manufact Solutions	**Augmented Reality**	**Cloud**	**Additive Manufacturing**	**Big Data and Analytics**	**Cyber-security**
0.014	0.045	0.007	0.054	0.023	0.014
Karel Boats Company					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.013	0.032	0.032	0.006	0.036	0.052
Seatrips-Yachting & Maritime Training Company					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.005	0.030	0.033	0.013	0.048	0.049

Weights Medium companies					
Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
0.01753	0.03042	0.03541	0.02560	0.03091	0.02784

Figure 18 - Small companies parameters

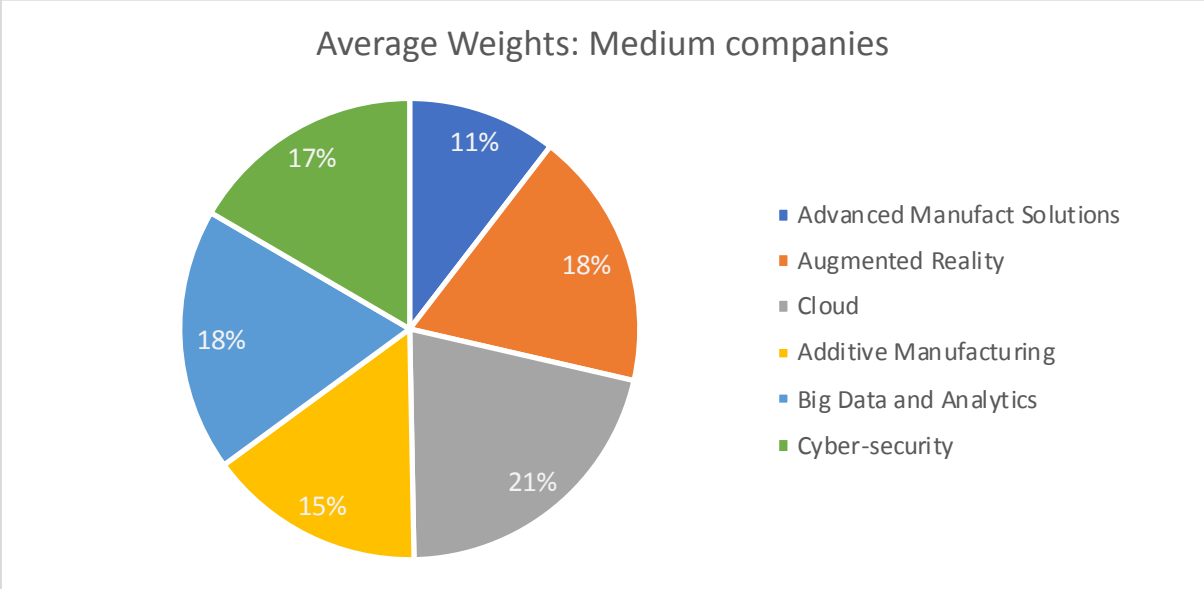


Figure 19 - Perception result considering small companies

The perception analyzed considering the type of production

Useful information are obtained by analyzing the companies considering their type of activity and production.

Handicraft (Nautical)

Overall the companies based on the Handcraft production of nautical typology have a similar desirability on all the technologies. Instead, it is worth noting that only the Large companies prioritize the technologies of Cloud and Cyber security. Small and medium nautical companies uses traditional and artisanal production processes. They do not perceive the potential of Advanced Manufacturing technology.

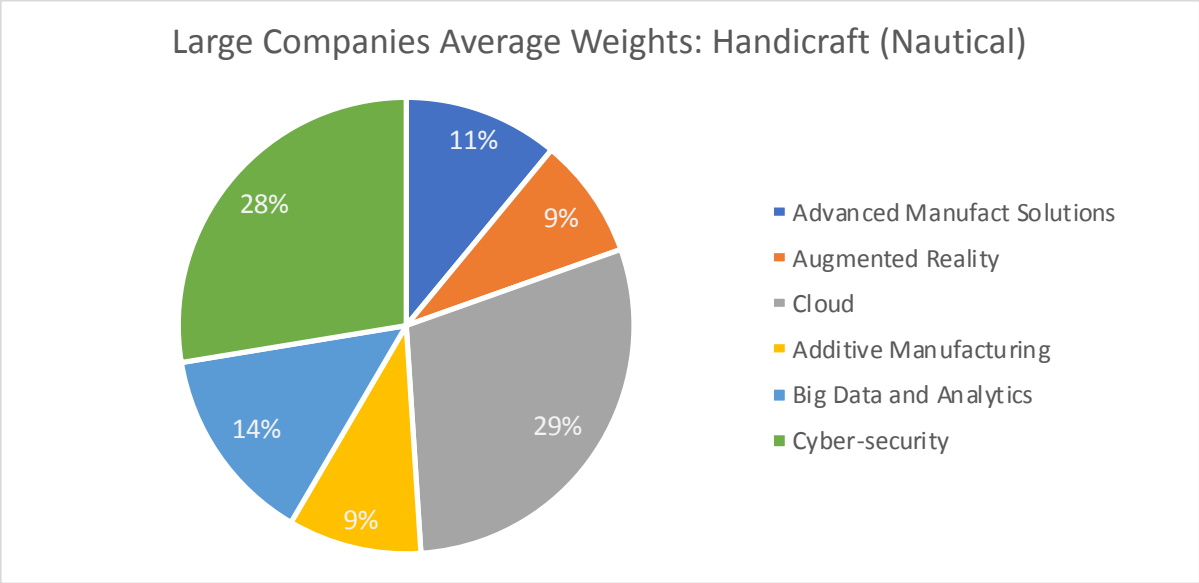


Figure 20 - Perception result considering Nautical companies

Shipping and transport

The second set of companies regards the companies working on Shipping and transport.

The most significant technology is considered the Cloud necessary to store all relevant information of a transport company.
As was easily foreseeable, Advanced Manufacturing Solution is an undesirable technology for shipping and transport companies.

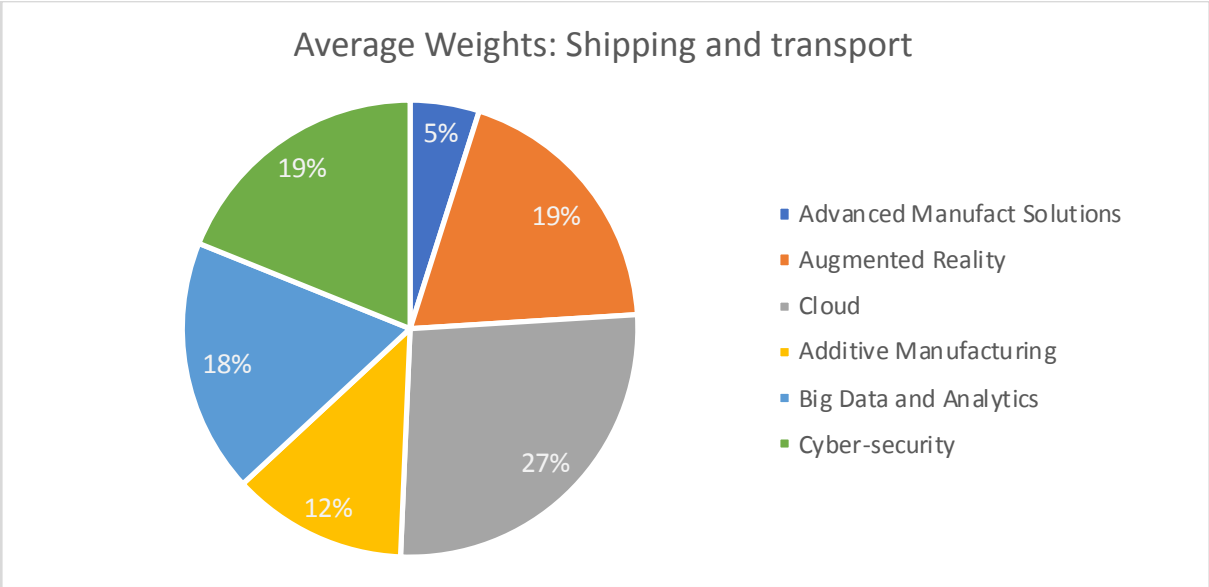


Figure 21 - Perception result considering Shipping and transport companies

The perception analyzed considering the Regional Context

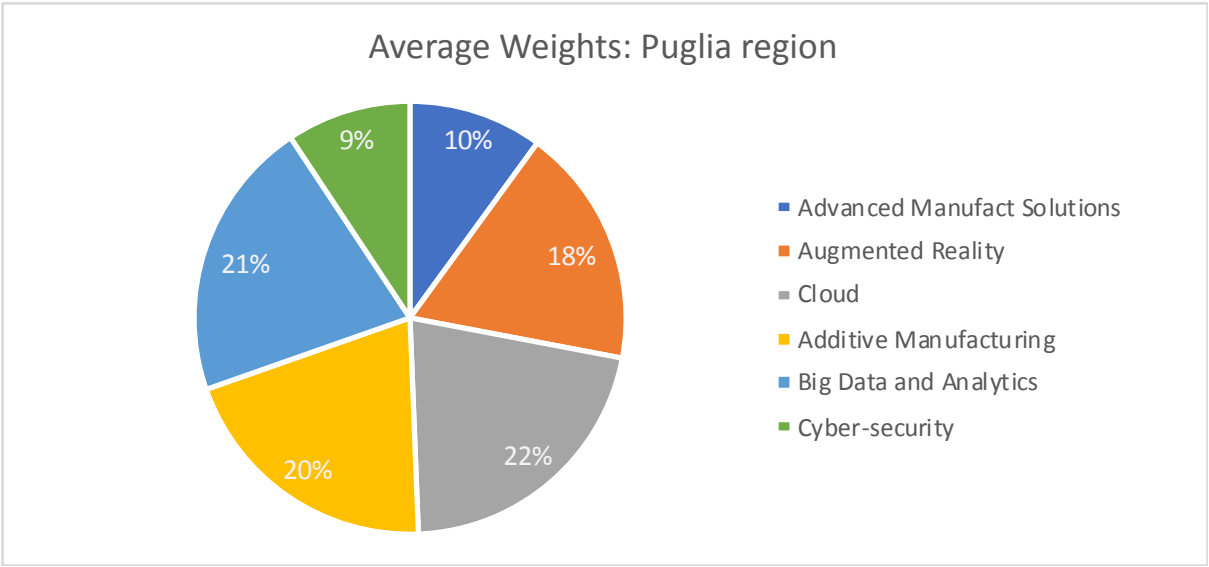


Figure 22 - Puglia Region: the perception analyzed considering the Regional Context

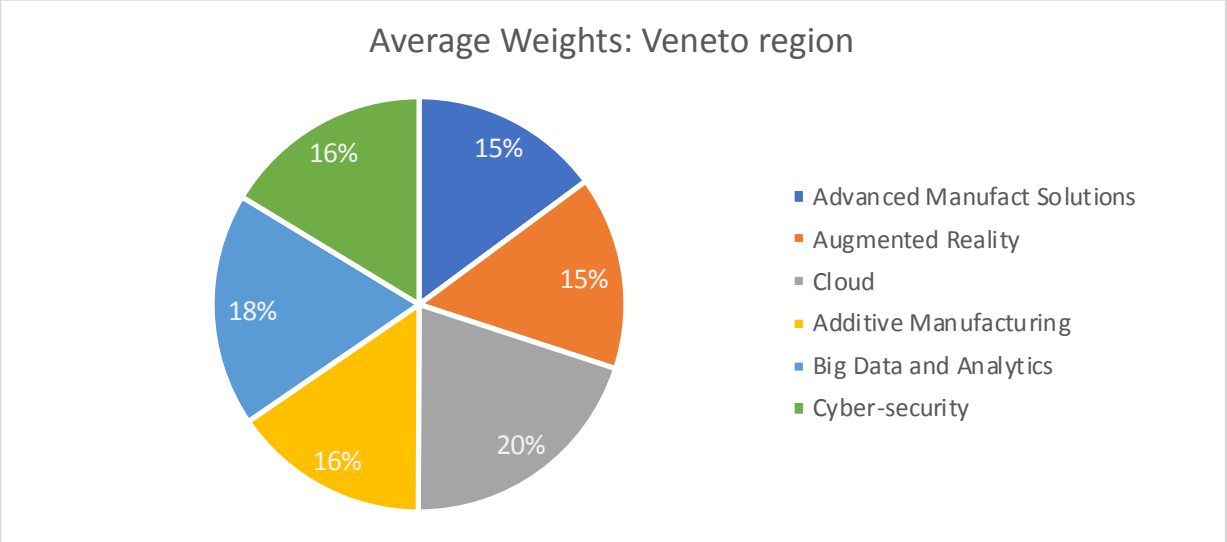


Figure 23 - Veneto Region: the perception analyzed considering the Regional Context

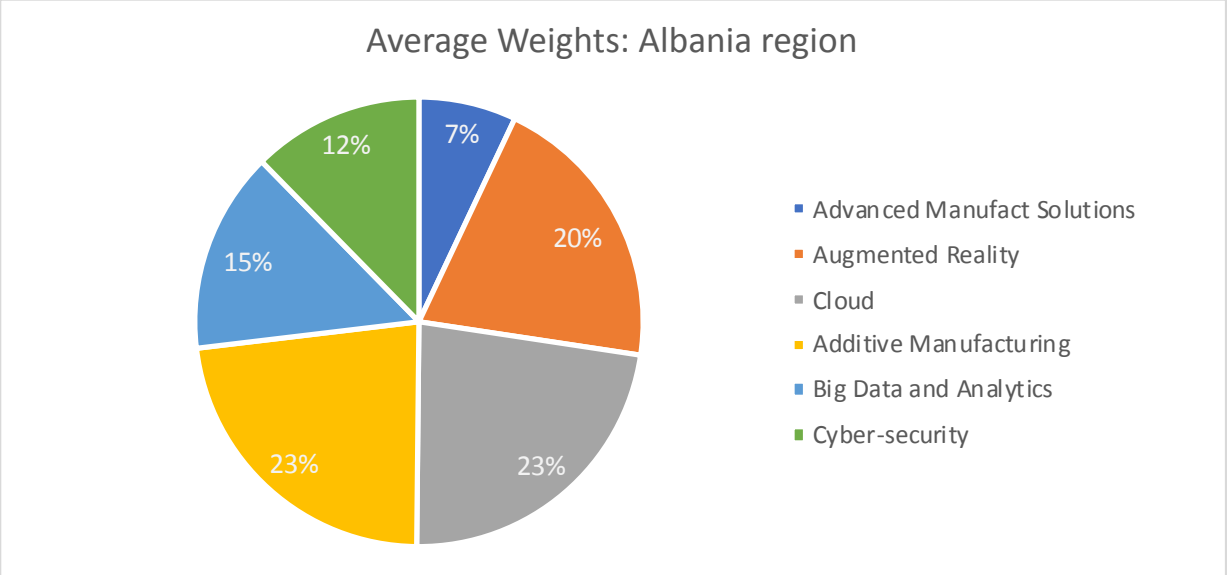


Figure 24 - Albania: the perception analyzed considering the Regional Context

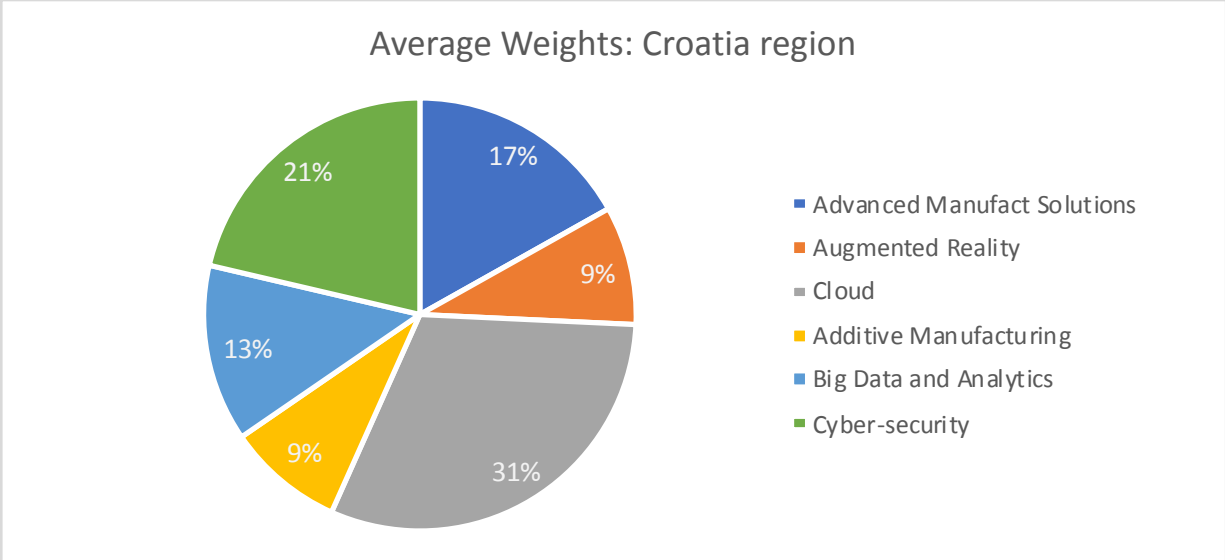


Figure 25 - Croatia: the perception analyzed considering the Regional Context

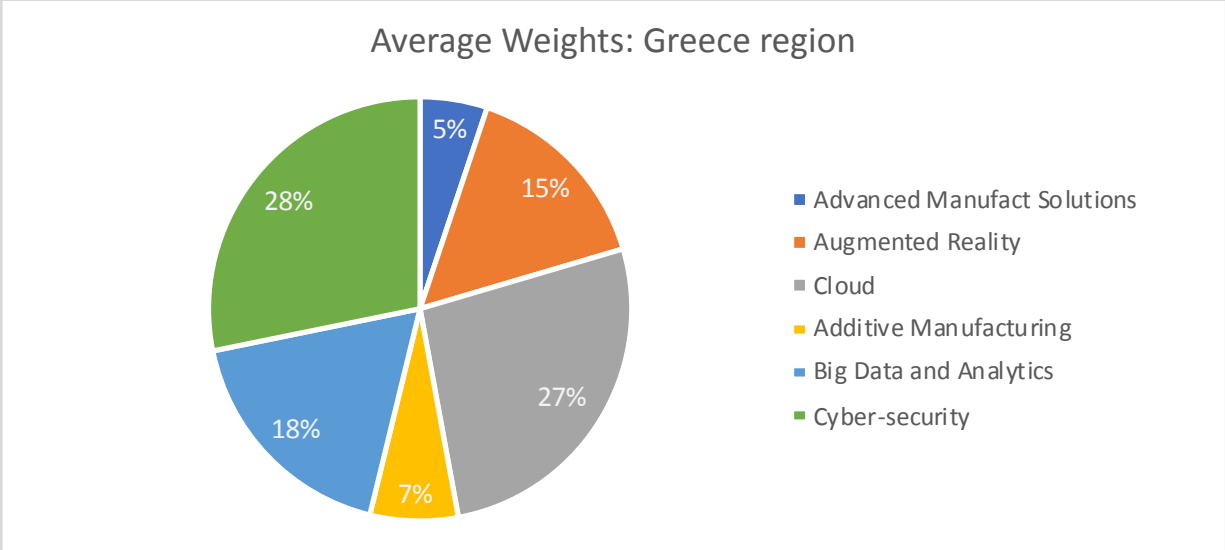
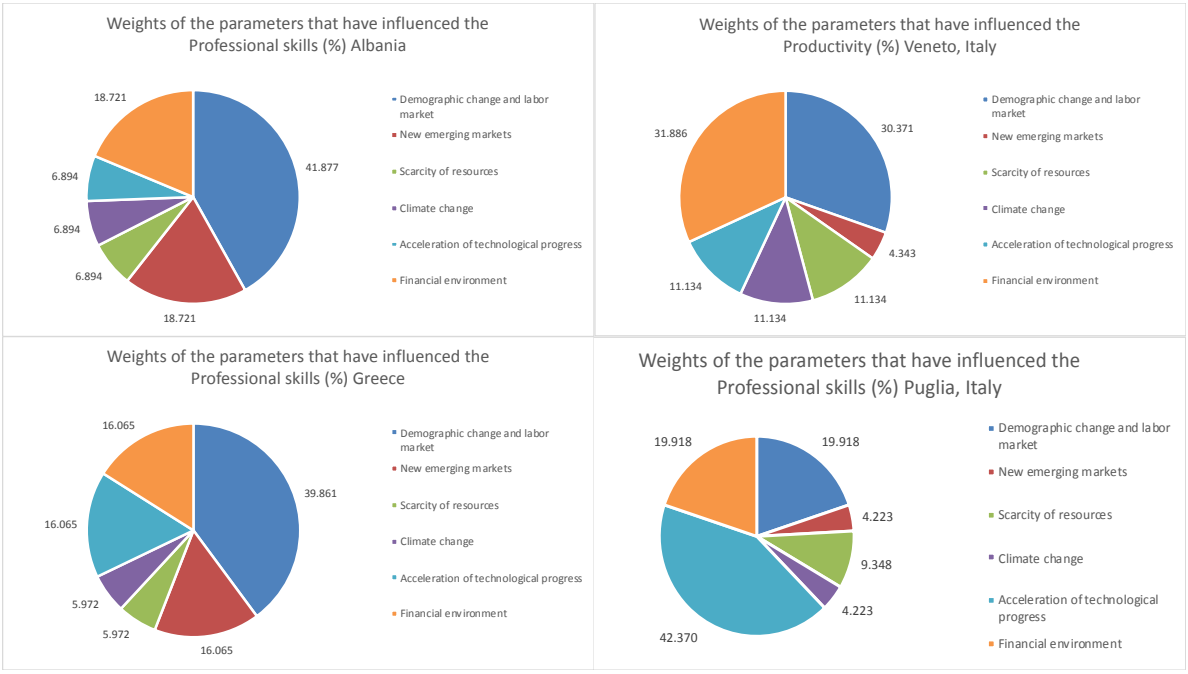


Figure 26 - Greece : the perception analyzed considering the Regional Context

The only really constant parameter in all the regions regards the Cloud technology that is considered indispensable.

The study of the Professional Skills required in the technologies 4.0

Macroeconomic and technological megatrends: The parameter influenced the Professional Skills



The most important parameter influenced the Professional Skills in the last decades in the Adriatic Ionian area is the Labour market. Only in Puglia the Acceleration of technological progress had a greater influence. Moreover, for all the regions the rank-by-second parameter is the Financial environment.
In the following paragraphs the professional skills related to the implementation of 4.0 technologies will be analysed in detail.

The study of the enabling technologies: The Company perception

The study of the enabling technologies by considering the Company perception is a fundamental analysis to the WP2. In fact, the final road map of the education, discussed in the next section, is developed by consider the result of this analysis. For every region and for every card game provided by the company the perception of the Professional skills required by the enabling technologies is extracted to be individually analyzed. The result quantify how in each region it is considered difficult to have the skills for each enabling technology. In particular the following Pie chart shows the complexity of the Professional Skills required for every enabling technology by expressing the results in percentage (if the values is high, the required skills are greater).

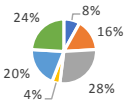
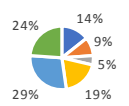
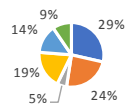
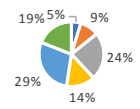
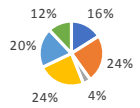
		Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security	
Croatia	**JLM Perković d.o.o.**							
	Card ranking	2	4	7	1	5	6	
	Normalized weight	0.080	0.160	0.280	0.040	0.200	0.240	
	SCAM marine d.o.o.							
	Card ranking	3	2	1	4	6	5	
	Normalized weight	0.143	0.095	0.048	0.190	0.286	0.238	
	IHC Engineering Croatia d.o.o.							
	Card ranking	6	5	1	4	3	2	
	Normalized weight	0.286	0.238	0.048	0.190	0.143	0.095	
	Interadria SC d.o.o.							
	Card ranking	1	2	5	3	6	4	
	Normalized weight	0.048	0.095	0.238	0.143	0.286	0.190	
	Brodogradilište Viktor Lenac d.							
	Card ranking	4	6	1	6	5	3	
	Normalized weight	0.160	0.240	0.040	0.240	0.200	0.120	

Figure 27 - Company perceptions: Croatia

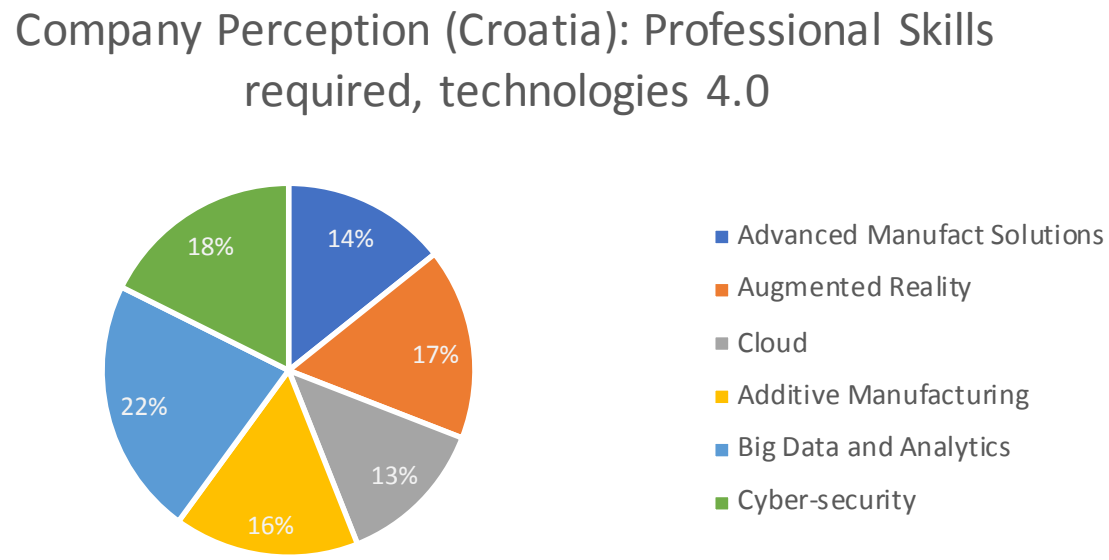


Figure 28 - Croatia: Professional skills required

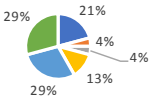
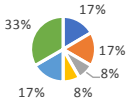
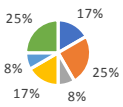
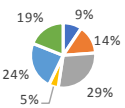
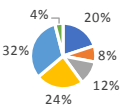
		Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security	
Puglia	**Bosh**							
	Card ranking	5	1	1	3	7	7	
	Normalized weight	0.208	0.042	0.042	0.125	0.292	0.292	
	Divella							
	Card ranking	2	2	1	1	2	4	
	Normalized weight	0.167	0.167	0.083	0.083	0.167	0.333	
	Energy & Movement							
	Card ranking	2	3	1	2	1	3	
	Normalized weight	0.167	0.250	0.083	0.167	0.083	0.250	
	Giuliano							
	Card ranking	2	3	6	1	5	4	
	Normalized weight	0.095	0.143	0.286	0.048	0.238	0.190	
	Explosion Marine							
	Card ranking	5	2	3	6	8	1	
	Normalized weight	0.200	0.080	0.120	0.240	0.320	0.040	

Figure 29 - Croatia: Professional skills required by companies

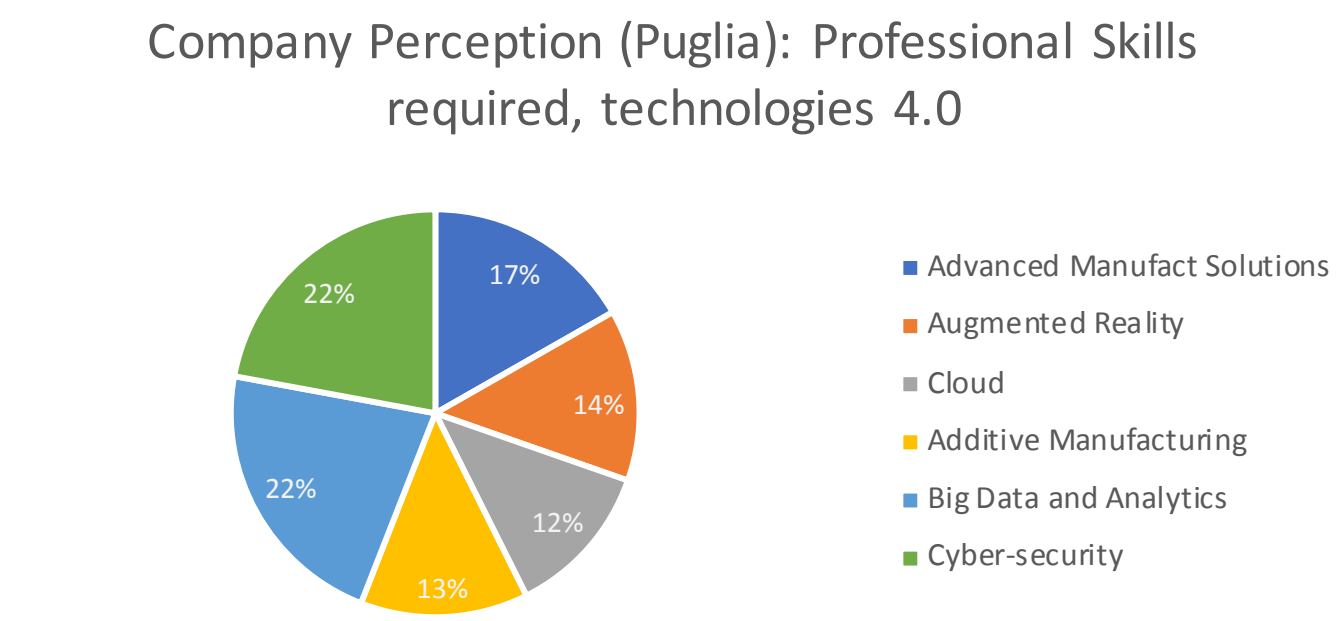


Figure 30 - Puglia Region: Professional skills required

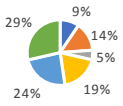
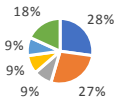
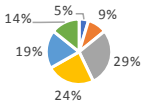
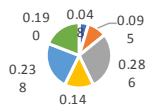
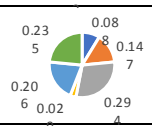
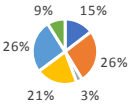
		Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security	
Albania	**Mediterranean Shipping Company MSC**							
	Card ranking	2	3	1	4	5	6	
	Normalized weight	0.095	0.143	0.048	0.190	0.238	0.286	
	Shega Trans							
	Card ranking	3	3	1	1	1	2	
	Normalized weight	0.273	0.273	0.091	0.091	0.091	0.182	
	Finikas							
	Card ranking	1	2	6	5	4	3	
	Normalized weight	0.048	0.095	0.286	0.238	0.190	0.143	
	Pelikan Ltd							
	Card ranking	1	2	6	3	5	4	
	Normalized weight	0.048	0.095	0.286	0.143	0.238	0.190	
	Denor Yachting & Decortion							
	Card ranking	3	5	10	1	7	8	
	Normalized weight	0.088	0.147	0.294	0.029	0.206	0.235	
	Hudson							
	Card ranking	5	9	1	7	9	3	
	Normalized weight	0.147	0.265	0.029	0.206	0.265	0.088	

Figure 31 - Puglia Region: Professional skills required by companies

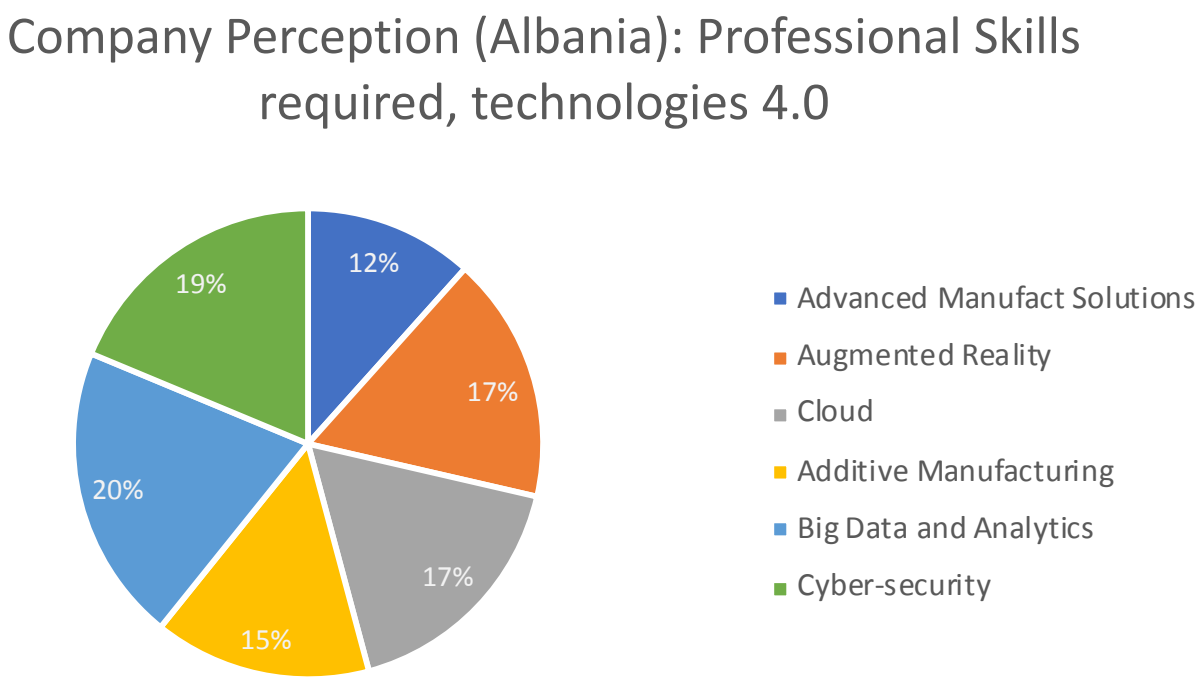


Figure 32 - Albania: Professional skills required

		Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security	
Greece	**Karel Boats Company**							
	Card ranking	6	1	7	4	1	2	
	Normalized weight	0.286	0.048	0.333	0.190	0.048	0.095	
	SAMMYACHT							
	Card ranking	3	7	1	2	6	4	
	Normalized weight	0.130	0.304	0.043	0.087	0.261	0.174	
	Seatrips-Yachting & Maritime Training Company							
	Card ranking	7	4	1	6	7	3	
	Normalized weight	0.250	0.143	0.036	0.214	0.250	0.107	
	Dynacomp Company							
	Card ranking	5	3	2	1	6	4	
	Normalized weight	0.238	0.143	0.095	0.048	0.286	0.190	
	ROTA							
	Card ranking	6	7	1	4	1	2	
	Normalized weight	0.286	0.333	0.048	0.190	0.048	0.095	

Figure 33 - Albania: Professional skills required by companies

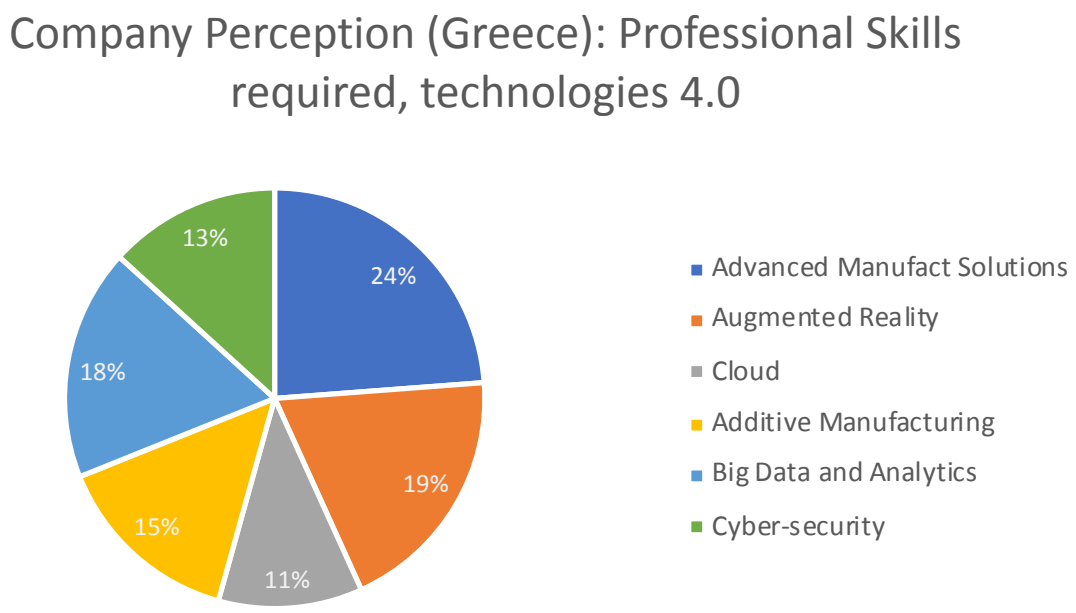


Figure 34 - Greece: Professional skills required

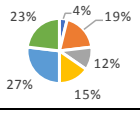
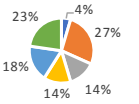
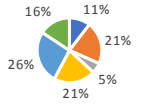
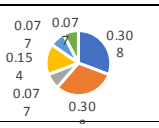
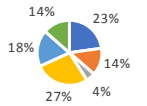
		Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security	
Veneto	**Viraver Technology**							
	Card ranking	1	5	3	4	7	6	
	Normalized weight	0.038	0.192	0.115	0.154	0.269	0.231	
	Mareli Moroti							
	Card ranking	1	6	3	3	4	5	
	Normalized weight	0.045	0.273	0.136	0.136	0.182	0.227	
	Cantieri Vizianello Srl							
	Card ranking	2	4	1	4	5	3	
	Normalized weight	0.105	0.211	0.053	0.211	0.263	0.158	
	Italia Yachts srl							
	Card ranking	4	4	1	2	1	1	
	Normalized weight	0.308	0.308	0.077	0.154	0.077	0.077	
	WIFORCE ITALIA S.R.L.							
	Card ranking	5	3	1	6	4	3	
	Normalized weight	0.227	0.136	0.045	0.273	0.182	0.136	

Figure 35 - Veneto Region: Professional skills required by companies

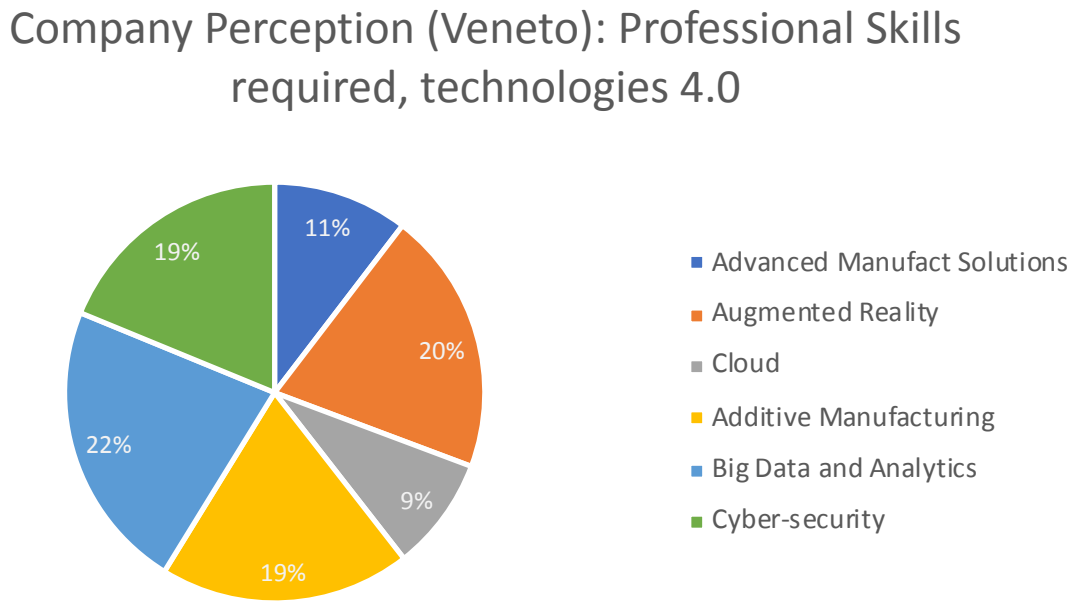


Figure 36 - Veneto Region: Professional skills required

Average Adrion						
Technologies 4.0	Advanced Manufact Solutions	Augmented Reality	Cloud	Additive Manufacturing	Big Data and Analytics	Cyber-security
Average weight	0.160	0.178	0.126	0.155	0.204	0.177

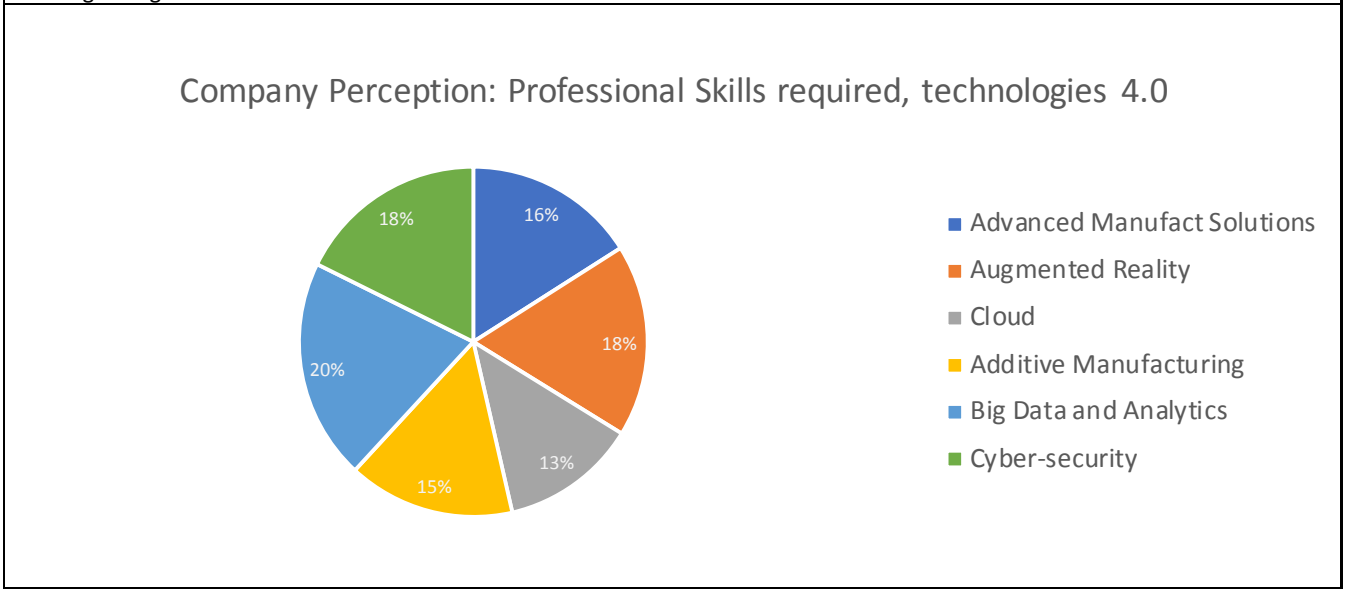


Figure 37 - Average Company Perception: Professional skills required

Road Map of the education for technologies 4.0

In this section the methodology to obtain the Road Map of learning Content of every region is defined and discussed in the following steps.

Firstly, a set of data are pointed out from the results of the desk study and the company interviews and stored in suitable tabs. In particular, in such a tables, the professional skill and competences required per technology are defined. In addition, for every region it is specified if there are public or private trainers that provides skill and competences in the territory.

Table 5 shows an extract of the considered tables of Greece.

Table 5 - Example of technologies table

Technology	Professional skill per technology	Professional Training	Professional profiles needed
	Microsoft Azure ☒	High school ☐ Technical College ☒ University☐ Doctorate☐ Training in company ☐	IT consulting
	Amazon ☒	High school ☒ Technical College ☐ University☐	IT consulting

Cloud		Doctorate☐ Training in company ☐	
	Google ☒	High school ☒ Technical College ☐ University☐ Doctorate☐ Training in company ☐	IT consulting
	VMWare ☒	High school ☐ Technical College ☐ University☐ Doctorate☐ Training in company ☒	IT consulting

From this first analysis it is possible to define the lack of professional skill and competences in every region.
In particular the ranking is obtained by considering the following proprieties of the single professional skill:

1 ° Not provided in the region
2 ° Training in company
3 ° Doctorate
4 ° University
5 ° Technical College
6 ° High school

Secondly a weighting of the technologies that requires more professional skills is obtained from the AHP applied to the second desk study. Also in this case, a ranking is obtained for every region. Such a ranking is used to provide the second level of classification. Priority is given to the technology that requires more professional skills.

Figure 38 shows the weights used to obtained the ranking of Greece.

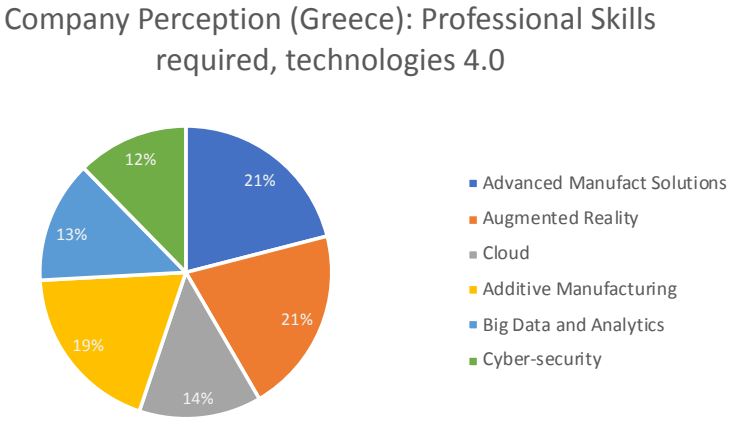


Figure 38 - Professional skills ranking, Greece

By exploiting synergistically, the result of the first two steps it is possible to define the priorities of the education for technologies 4.0. In particular, the first selection is done on

the base of the professional skill and competences for which there are no trainers on the territory. Among such professional skill and competences, the ranking is performed on the base of the technologies that requires more professional skills.

This analysis provides a global roadmap in the Adrion area by provide the priorities of the professional skill and competences to be offered by the trainers in every region.

In the following section the Road Map of learning Content of every region is specified.

Puglia

Table 6 - Road Map of learning Content: Puglia

Road Map of learning Content: Puglia			
Hyerarchy	**Professional skill**	**Professional Training**	**Technology**
1º	**Wikitude**	Not provided in the region	AugmentedReality
2º	**Security information management**	Training in company	Cyber sec.
2º	**SIEM**	Training in company	Cyber sec.
3º	**Make-to-Order ERP & MRP Manufacturing Software**	Training in company	Advanced Manufact.Solutions
3º	**Manufacturing Software (JAMS)**	Training in company	Advanced Manufact.Solutions
3º	**JAAS Advanced**	Training in company	Advanced Manufact.Solutions
4º	**Database NoSQL**	Doctorate	Big Data and Analytics
4º	**Hadoop**	Doctorate	Big Data and Analytics
5º	**ARToolKit**	Doctorate	AugmentedReality
5º	**NyARToolkit**	Doctorate	AugmentedReality
5º	**Vuforia**	Doctorate	AugmentedReality
5º	**Maxst**	Doctorate	AugmentedReality
5º	**DeepAR**	Doctorate	AugmentedReality
6º	**Amazon**	Doctorate	Cloud
7º	**Apache Spark**	University	Big Data and Analytics
7º	**Database In-memory**	University	Big Data and Analytics
8º	**EasyAR**	University	AugmentedReality
8º	**Kudan**	University	AugmentedReality
9º	**Microsoft Azure**	University	Cloud
9º	**Google**	University	Cloud
9º	**VMWare**	University	Cloud
10º	**Anti-malware**	High school	Cyber sec.
10º	**Anti-spyware**	High school	Cyber sec.
10º	**Anti-keyloggers**	High school	Cyber sec.
10º	**Antivirus software**	High school	Cyber sec.
11º	**3d modelling**	High school	Additive Manufacturing
11º	**Slicer software**	High school	Additive Manufacturing

Veneto

Table 7 - Road Map of learning Content: Veneto

Road Map of learning Content: Veneto			
Hyerarchy	**Professional skill**	**Professional Training**	**Technology**
1º	**Hadoop**	Not provided in the region	Big Data and Analytics
1º	**Apache Spark**	Not provided in the region	Big Data and Analytics
1º	**Database NoSQL**	Not provided in the region	Big Data and Analytics

1º	**Database In-memory**	Not provided in the region	Big Data and Analytics
2º	**EasyAR**	Not provided in the region	AugmentedReality
2º	**ARToolKit**	Not provided in the region	AugmentedReality
2º	**Kudan**	Not provided in the region	AugmentedReality
2º	**NyARToolkit**	Not provided in the region	AugmentedReality
2º	**Wikitude**	Not provided in the region	AugmentedReality
2º	**Vuforia**	Not provided in the region	AugmentedReality
2º	**Maxst**	Not provided in the region	AugmentedReality
3º	**Slicer software**	Not provided in the region	Additive Manufacturing
4º	**SIEM**	Not provided in the region	Cyber sec.
5º	**Manufacturing Software (JAMS)**	Not provided in the region	Advanced Manufact.Solutions
5º	**JAAS Advanced**	Not provided in the region	Advanced Manufact.Solutions
6º	**Microsoft Azure**	Not provided in the region	Cloud
6º	**Amazon**	Not provided in the region	Cloud
6º	**Google**	Not provided in the region	Cloud
6º	**VMWare**	Not provided in the region	Cloud
7º	**3d modelling**	High school	Additive Manufacturing
8º	**Anti-malware**	High school	Cyber sec.
8º	**Anti-spyware**	High school	Cyber sec.
8º	**Anti-keyloggers**	High school	Cyber sec.
8º	**Antivirus software**	High school	Cyber sec.
9º	**Make-to-Order ERP & MRP Manufacturing Software**	Technical College	Advanced Manufact.Solutions
10º	**Security information management**	University	Cyber sec.

Croatia

Table 8 - Road Map of learning Content: Croatia

Road Map of learning Content: Croatia

Hyerarchy	Professional skill	Professional Training	Technology
1º	**Hadoop**	Not provided in the region	Big Data and Analytics
1º	**Database NoSQL**	Not provided in the region	Big Data and Analytics
1º	**Apache Spark**	Not provided in the region	Big Data and Analytics
1º	**Database In-memory**	Not provided in the region	Big Data and Analytics
2º	**Wikitude**	Not provided in the region	AugmentedReality
2º	**DeepAR**	Not provided in the region	AugmentedReality
2º	**Vuforia**	Not provided in the region	AugmentedReality
2º	**Maxst**	Not provided in the region	AugmentedReality
2º	**EasyAR**	Not provided in the region	AugmentedReality
2º	**ARToolKit**	Not provided in the region	AugmentedReality
2º	**Kudan**	Not provided in the region	AugmentedReality
2º	**NyARToolkit**	Not provided in the region	AugmentedReality
3º	**Slicer software**	Not provided in the region	Additive Manufacturing
4º	**Make-to-Order ERP & MRP Manufacturing Software**	Not provided in the region	Advanced Manufact.Solutions
4º	**Manufacturing Software (JAMS)**	Not provided in the region	Advanced Manufact.Solutions
4º	**JAAS Advanced**	Not provided in the region	Advanced Manufact.Solutions
5º	**Microsoft Azure**	Not provided in the region	Cloud
5º	**Amazon**	Not provided in the region	Cloud
5º	**VMWare**	Not provided in the region	Cloud
5º	**Google**	Training in company	Cloud

6º	**3d modelling**	University	Additive Manufacturing
7º	**Anti-malware**	High school	Cyber sec.
7º	**Anti-spyware**	High school	Cyber sec.
7º	**Anti-keyloggers**	High school	Cyber sec.
7º	**Antivirus software**	High school	Cyber sec.
7º	**Security information management**	High school	Cyber sec.
7º	**SIEM**	High school	Cyber sec.

Greece

Table 9 - Road Map of learning Content: Greece

Road Map of learning Content: Greece			
Hyerarchy	**Professional skill**	**Professional Training**	**Technology**
1º	**VMWare**	Training in company	Cloud
2º	**Anti-malware**	Training in company	Cyber sec.
2º	**Anti-spyware**	Training in company	Cyber sec.
2º	**Anti-keyloggers**	Training in company	Cyber sec.
2º	**Antivirus software**	Training in company	Cyber sec.
3º	**Make-to-Order ERP & MRP Manufacturing Software**	University	Advanced Manufact.Solutions
3º	**Manufacturing Software (JAMS)**	University	Advanced Manufact.Solutions
3º	**JAAS Advanced**	University	Advanced Manufact.Solutions
4º	**Wikitude**	University	AugmentedReality
5º	**3d modelling**	University	Additive Manufacturing
5º	**Slicer software**	University	Additive Manufacturing
6º	**Vuforia**	Technical College	AugmentedReality
6º	**EasyAR**	Technical College	AugmentedReality
	DeepAR	University	AugmentedReality
6º	**ARToolKit**	Technical College	AugmentedReality
6º	**Kudan**	Technical College	AugmentedReality
6º	**Maxst**	Technical College	AugmentedReality
6º	**NyARToolkit**	Technical College	AugmentedReality
7º	**Microsoft Azure**	Technical College	Cloud
8º	**Hadoop**	Technical College	Big Data
8º	**Apache Spark**	Technical College	Big Data
9º	**Security information management**	Technical College	Cyber sec.
9º	**SIEM**	Technical College	Cyber sec.
10º	**Amazon**	High school	Cloud
10º	**Google**	High school	Cloud
11º	**Database In-memory**	High school	Big Data and Analytics

Albania

Table 10 - Road Map of learning Content: Albania

Road Map of learning Content: Albania

Hyerarchy	Professional skill	Professional Training	Technology
1º	**Hadoop**	University	Big Data and Analytics
1º	**Database NoSQL**	University	Big Data and Analytics
1º	**Apache Spark**	University	Big Data and Analytics
2º	**Database In-memory**	University	Big Data and Analytics
3º	**Anti-malware**	University	Cyber sec.
3º	**Anti-spyware**	University	Cyber sec.
3º	**Anti-keyloggers**	University	Cyber sec.
3º	**Antivirus software**	University	Cyber sec.
3º	**Security information management**	University	Cyber sec.
3º	**SIEM**	University	Cyber sec.
4º	**Microsoft Azure**	University	Cloud
4º	**Amazon**	University	Cloud
4º	**Google**	University	Cloud
4º	**VMWare**	University	Cloud
5º	**EasyAR**	University	AugmentedReality
5º	**ARToolKit**	University	AugmentedReality
5º	**DeepAR**	University	AugmentedReality
5º	**Kudan**	University	AugmentedReality
5º	**NyARToolkit**	University	AugmentedReality
6º	**3d modelling**	University	Additive Manufacturing
6º	**Slicer software**	University	Additive Manufacturing
7º	**Make-to-Order ERP & MRP Manufacturing Software**	University	Advanced Manufact.Solutions
7º	**Manufacturing Software (JAMS)**	University	Advanced Manufact.Solutions
7º	**JAAS Advanced**	University	Advanced Manufact.Solutions
8º	**Wikitude**	Technical College	AugmentedReality
8º	**Vuforia**	Technical College	AugmentedReality
8º	**Maxst**	Technical College	AugmentedReality

Focus Group and achieved target

The last part of WP2T1 concerns with the validation of the results obtained from the research and the technical methodology carried out, turning once again the results to the companies of the various involved territories.

The partners have turned to companies in different ways: through meetings or by involving them electronically, pursuing the common objective of validating the results obtained and capturing future objectives in the Industry 4.0 field.

During the first phases of the research (Activity 1.2), **29 companies** have been reached during the companies interview phase, and in addition to these, more than other ten companies in the focus group phase, as showed in the following paragraph.
As for the *main results* and feedback from the companies, for privacy issues, please refer to the deliverable 1.4.1.

Albania

Achieved target: involved companies

Mesdheu Center

1. **Mediterranean Shipping Company MSC**
2. **Shega Trans sh.a**
1. **Finikas Company**
2. **Pelikan Ltd**

Chamber of Commerce and Industry

3. **LIBURN MARINA & MERCURY MOTORS ALBANIA**
4. **Pasha Liman Base- Shipyard**
5. **Kaldaja SH.a**
6. **Hudson sh.a**
7. **Denor Yachting & Decortion**

Focus Group Companies:

1^ Focus group:
The forum was a good platform to share our FUTURE 4.0 project, as gathered more than 50 people, representatives from businesses, policy making, education institutions, civil society etc

2^ Focus group:
26 was the total number of participants, companies operating in the field of nautical sector, representatives from the business sector and business support organizations and people from academia and research institutions, people with a very strong professional background as naval engineers, as well as other representatives from the main Albanian Ports operating in the northern and south part of Albania.

Croatia

Achieved target: involved companies

1. **JLM Perković d.o.o.**
2. **SCAM marine d.o.o.**
3. **IHC Engineering Croatia d.o.o.**
4. **Interadria SC d.o.o.**
5. **Brodogradilište Viktor Lenac d.d.**

Focus Group Companies:

1. **JLM - Perković d.o.o.**
2. **SCAM Marine d.o.o.**
3. **IHC Engineering Croatia d.o.o.**
4. **Brodogradilište Viktor Lenac d.d.**
5. **Interadria SC d.o.o.**

Focus Group Stakeholders:

1. **Primorje-Gorski Kotar County**
2. **Faculty of Tourism and Hospitality Management**

3. City of Rijeka
4. Business Club PartneRi
5. Students' Council of Faculty of Engineering.

Greece

Achieved target: involved companies

1. Karel Boats Company
2. SAMMYACHT - For Smart Marinas and Yachters Company
3. Seatrips-Yachting & Maritime Training Company
4. Dynacomp Company
5. ROTA Shipping Company

Puglia

Achieved target: involved companies

1. Bosch Bari
2. Francesco Divella S.p.A
3. Giuliano Puglia Fruit
4. AS Labruna
5. Explosion Marine Srl

Focus Group Companies:

1. AS Labruna Srl
2. Climb 3D Srls
3. Automation in Logistics and Service Systems s.r.l.
4. Bosch Tecnologie Diesel S.p.a. (Bari plant)
5. Organizzazione di Produttori Giulano Srl

Veneto

Achieved target: involved companies

1. **Cantieri Vizianello Srl**
2. **Italia Yachts srl**
3. **Marelli Motori**
4. **Viraver Technology Srl**
5. **Wiforce Italia S.R.L**

Focus group Companies:

1. **Cantiere Navale Vittoria S.P.A**
2. **Wiforce Italia S.R.L**
3. **Venezia Terminal Passeggeri S.P.A.**
4. **Conepo Servizi S.C.A.R.L.**
5. **Atroos S.R.L.**
6. **Vf Elettronica S.A.S**
7. **Marina Del Cavallino S.R.L.**
8. **Marine Tech Ccyd S.R.L**

Focus Group Stakeholders:

1. **VENETO LAVORO (Regional body for labor policies)**
2. **VENETO INNOVAZIONE (Regional body for promotion and development of R&I)**
3. **UNIONCAMERE VENETO (Regional Union of Chambers of Commerce)**
4. **GALILEO VISIONARY DISTRICT (Science and Technology Park)**
5. **FGP CONSULENZE (Business consulting)**
6. **CUOA (Business school)**
7. **UNIVERSITÀ DI PADOVA (University)**
8. **UNIVERSITÀ IUAV VENEZIA (University)**
9. **POLITECNICO DI BARI (University)**
10. **UNIVERSITÀ CA FOSCARI VENEZIA (University)**
11. **UNIVERSITÀ DI TRENTO (University)**
12. **IFOA (Training and consulting body)**

This document has been produced with the financial assistance of the European Union. The content of the document is the sole responsibility of PP3, Polytechnic University of Bari and Future 4.0 Partners and can under no circumstances be regarded as reflecting the position of the European Union and/or ADRION programme authorities