Interreg
Atlantic Area
European Regional Development Fund

EUROPEAN UNION

IN 4.0

IN 4.0

ADAPTATION OF INDUSTRY 4.0 MODEL TO THE NAVAL SECTOR

Report on the redefinition of job positions in the shipbuilding and repair industry

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1.

Introduction

1 Introduction

1.1 The IN 4.0 Project

1.1.1 *IN 4.0 Project overall objective*

The IN4.0 Project aims at improving competitiveness of companies in the naval sector through their adaptation to the productive model represented by industry 4.0, guaranteeing the continuity of the sector in an increasingly demanding market, where innovation is a key factor in strategic positioning.

To this end, the following actions will be carried out:

- Validating the main barriers that prevent the shipbuilding sector and subsidiary companies from adapting their business model
- Determining of the degree of maturity of existing technologies in the market, which can be implemented in shipbuilding SMEs
- Redefining of work organisation systems
- Training workers to move towards the industry 4.0 model
- Redesigning innovative strategies to save costs in the implementation of technologies
- Detecting new marketing methods and implementing innovations designed in IN 4.0 in selected SMEs in the regions that participate in the project.

1.1.2 *IN 4.0 Project work plan*

The project will be implemented through 4 technical work packages:

- IN CONTEXT: it is the starting point to adapt to a new production model based on the existing state of the art, detecting innovation applicable to 4.0 technologies relevant to the naval sector.
- IN WORK AND IN TRAINING: Protocol for redefining the tasks of the workers and training the personnel of the sector.

- IN COMMERCIALIZATION AND COSTS: Reduction of costs in the implementation of technologies and new marketing methods.
- IN ADAPTATION: Advice for the transformation of intelligent naval companies.

1.1.3 *IN 4.0 Project partners*

PARTNER ORGANISATION	AA COUNTRY
1. Diputación Provincial de Pontevedra (DEPO)	Spain
2. Bretagne Pôle Naval (BPN)	France
3. Cork Institute of Technology (CIT)	Ireland
4. Fórum Oceano – Associação da Economia do Mar	Portugal
5. Asociación Cluster del Naval Gallego (ACLUNAGA)	Spain
6. University of Strathclyde	United Kingdom
7. Foro Marítimo Vasco (FMV)	Spain
8. Pôle de compétitivité EMC2 (EMC2)	France
9. Asociación de Industriales Metalúrgicos de Galicia (ASIME)	Spain
10. High Speed Sustainable Manufacturing Institute Ltd (HSSMI)	United Kingdom

The following partners participated, out of ten, participated in the elaboration of the current report by gathering information from relevant agents and companies in the shipbuilding and ship repair sector in their regions:

– Bretagne Pôle Naval (BPN)
– Cork Institute of Technology (CIT)
– Fórum Oceano – Associação da Economia do Mar
– Asociación Cluster del Naval Gallego (ACLUNAGA)
– Foro Marítimo Vasco (FMV)
– High Speed Sustainable Manufacturing Institute Ltd (HSSMI)

1.2 Objectives of the current report

The current paper, under the title **"Report on the redefinition of job positions in the shipbuilding and repair industry"** constitutes the first deliverable within work package IN WORK AND IN TRAINING of the European Project *IN4.0. Adaptation of Industry 4.0 Model to the Naval Sector (EAPA-383/2016)*, co-financed by the ERDF (75%) under the call for proposals 2014-2020 of the Interreg Atlantic Area Territorial Cooperation Programme.

This report was included in the IN 4.0 Project work plan as the starting point for understanding the work areas and job positions that would be most affected by the introduction of new technologies and industry 4.0 innovations. It was carried out by the partnering organisation "Asociación Cluster Naval Gallego" (hereinafter ACLUNAGA) and provides a review analysis of the current situation of job positions and skills, as well as of expectations in terms of adaptation, of the European shipbuilding and ship repair industry.

This task aims at improving technical knowledge in human resources management and for that reason, it concludes in a rank of priority job positions and in a "**Human Resources Protocol methodology for the shipbuilding and repair industry**" (described in section 5), which is expected to serve as a guide for shipbuilding and repair SMEs when reorganising their human resources structures for adaptation to the industry 4.0 model. Both, the rank of priority jobs and the human resources methodology will constitute the pillars for the development of the adapted training syllabus and contents to be developed at a later stage in the IN 4.0 Project (second deliverable of work package IN WORK AND IN TRAINING) .

The methodology for the development of the **"Report on the redefinition of job positions in the shipbuilding and repair industry"** is based in existing bibliography, as well as on the information compiled by the IN 4.0 Project partners in the five participating countries (Ireland, United Kingdom, France, Portugal and Spain). Such methodology is explained in depth in section 2.

2.

Methodology

2 Methodology

2.1 Metodology stages

The methodology chosen by ACLUNAGA for the drafting of the current report included three main stages:

1. **Review of existing bibliography**: analysis of existing literature about employment and labour market in the shipbuilding and repair industry in Europe
2. **Survey:** compilation of relevant information across the Atlantic Area through the distribution of a survey for project partners to consult key shipbuilding and repair industry agents or experts in the five participating countries (Ireland, United Kingdom, France, Portugal and Spain)
3. **Validation**: discussion and remarks regarding the compiled information by the IN 4.0 Project partners for validation and elaboration of the main conclusions

2.1.1 *Review of existing bibliography*

The study "Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry" was chosen as the starting point for the development of the current report. This study was elaborated by EMF (European Metalworkers' Federation) and CESA (Community of European Shipyards' Associations) in 2018 and was used **for the identification of the work areas and job positions most likely to be affected by the implementation of industry 4.0 processes**. Such areas and job positions were outlined in a preliminary report under the title "Analysis of the impact of Industry 4.0 on job positions in the shipbuilding sector", included in sections 3, which was used as the baseline for the survey on the impact of industry 4.0 in specific job positions.

2.1.2 *Survey*

After the identification of the work areas and job positions most likely to be affected by the implementation of industry 4.0 processes, information related to the impact of Industry 4.0 in the

shipbuilding and repair sector job positions across the Atlantic Area was collected through a survey form intended **to assess the situation of a series of proposed job positions, as well as of any other non-listed jobs identified by the respondents**.

The survey form was structured in the following blocks:

– Block 1: Collection of further background information per participating region
– Block 2: Assessment of the relevance of soft skills (high, medium, low)
– Block 3: Classification of job positions according to current trends (extinguishment, adaptation or job position creation) along the shipbuilding and repair value chain: sales and administration and production (engineering and manufacturing).
– Block 4: A section for respondents to include any relevant comments that could help understanding the previous assessment and classification of job positions

This form was distributed to all partner institutions of the IN 4.0 Project, in such a way that homogeneous comparison, based on reliable information provided by experts, could be established between all the countries participating in the study. Contributions collected per participating partner are attached in Annex 10.1.

When analysing the received feedback, concern emerged over the contributions made by some partners, so a second request for information was launched in order to clarify any uncertainties.

Partners were given approximately 10 days to submit their feedback so that the results of the report could be easily harmonised.

2.1.3 *Validation*

After the process of information through the survey had concluded, preliminary conclusions related to soft skills and job positions in the shipbuilding and ship repair value chain were extracted and presented to partners at the IN 4.0 Project Meeting held in Glasgow on the 12th December 2018.

During this meeting, partners agreed that **manufacturing was the priority area for the transformation of the shipbuilding and ship repair sector across the Atlantic Area**, so a new questionnaire including a series

of validation questions was launched. The purpose of this questionnaire was to add new contributions in line with the chosen approach and therefore refocus the report on the manufacturing area, without discarding conclusions already drawn in other areas of the shipbuilding and ship repair value chain.

The second request for information consisted on a series questions aimed at clarifying previous feedback per block:

- Do all partners agree with the achieved priorisation of soft skills? Are there any other soft skills that could be included?
- Are all "assistant" positions doomed to disappear? Do all partners agree?
- Are the sales and administration areas really affected by 4.0 technologies?
- Are there any other positions that need to be created in the engineering area?
- Are there any other endangered job positions in the production area?

Compiled contributions per partner during the validation phase are attached in Annex 7.2 and are already integrated in the resulting appreciations of the survey per country in section 4.

3.

Brief analysis of the current structure of workforce in the shipbuilding and ship repair industry based on existing bibliography

3 Review: Brief analysis of the current structure of workforce in the shipbuilding and ship repair industry based on existing bibliography

3.1 Introduction

The current review consists in a brief diagnosis of skills and job positions in the naval sector across the Atlantic Area. The objective of this analysis is identifying the exiting 4.0 technologies that will have the greatest impact on employment in the naval sector. The report **"Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry"**, published by CESA (Community of European Shipyards Associations) in 2018 is the main source of information for the analysis. However prior clarifications are needed in order to understand the current document:

- The resulting report collects data at country level (not at regional level), so the information provided in the study should be analysed qualitatively rather than quantitatively.
- It is important to remark that Ireland is not included in the above mentioned study, what is understood as clear indicator of the minimum weight of the shipbuilding industry in Ireland.
- Only direct jobs are considered in this study (outsourced job positions are not considered).

3.2 Main excerpts: background information

- Most of the workforce in the analysed countries is engaged in the construction of new ships, except for France, where the weight of the repair workforce is relatively greater.
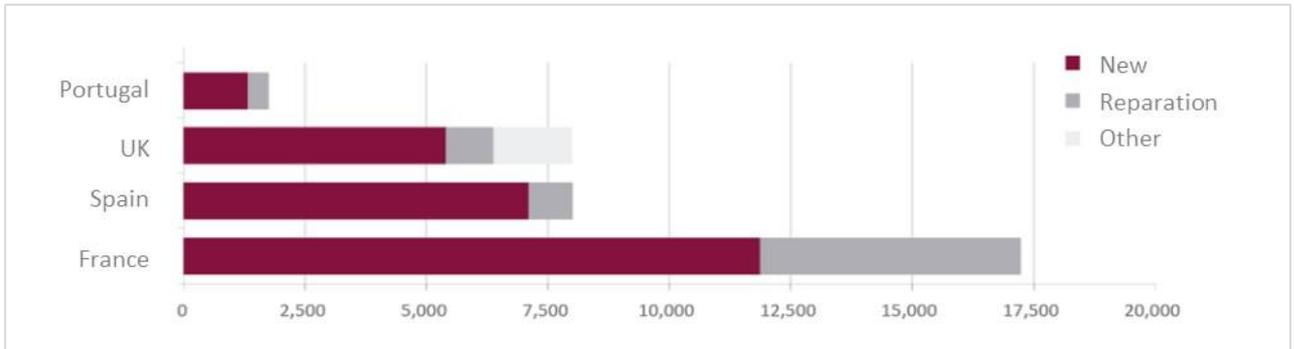
Illustration 1 Distribution of the workforce. Report "Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry"

- There is a clear lack of young technical workforce. Except for France, in the rest of countries more than 60% of the workforce is over 40 years old. Young workforce (<25 years old) rates below 15% across the Atlantic Area. On the other hand, since most of workers are over 40 years old, a high demand for skilled labour is expected in the next 15 years, when senior workers retire.
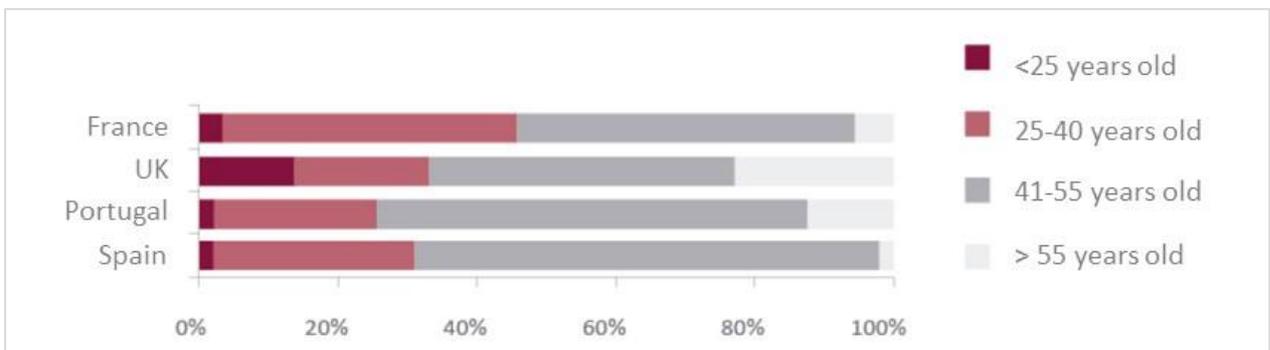
Illustration 2 Distribution of workforce by age. Report "Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry"

- The level of workers education and qualifications in the shipbuilding sector is generally high, but with important differences among countries. The case of Spain is particularly significant, where more than 35% of employees hold higher education qualifications. Nearly 30% of French employees also hold higher education qualification, while in the UK and Portugal less than 20% of employees are qualified to this level.
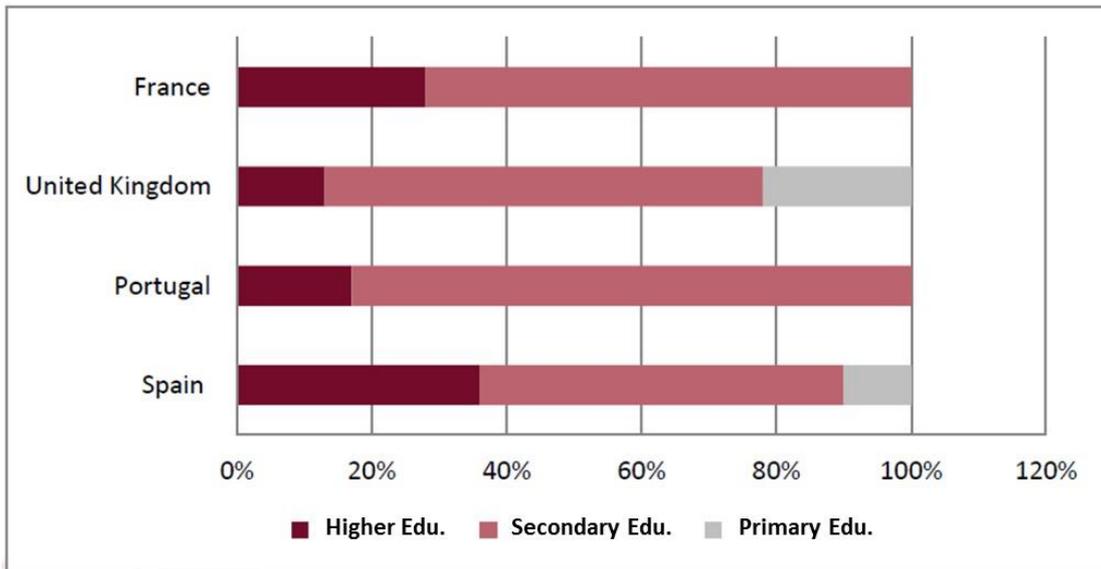
Illustration 3 Level of workers education and qualifications in the shipbuilding sector. Report "Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry"

- Technical jobs positions in the shipbuilding and ship repair sector can be classified according to their functions in the company, based on the CESA* study. In this study, the technical professions in the naval sector are divided into 3 main functional areas:
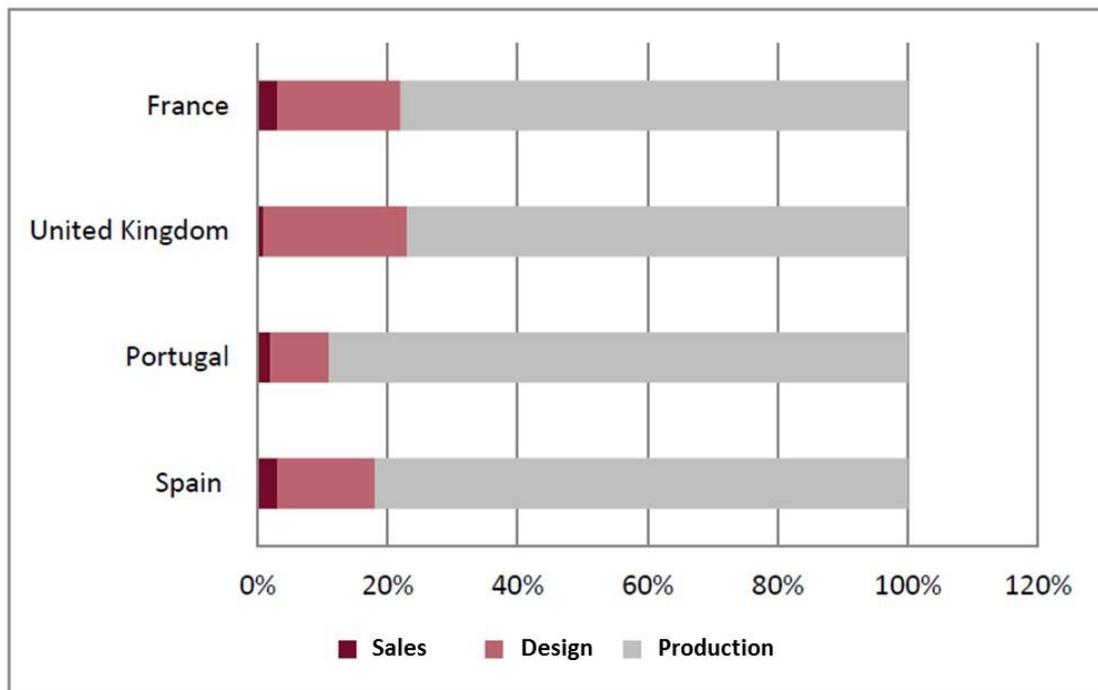
Illustration 4 Main functional areas in technical professions in the naval sector. Report "Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry"

o **Complete sales cycle** (including pre- and after sales): Pre-sales engineering, Commercial, Budgeting, Proposal engineering and Post-sales.

o **Design and Engineering**: Designers, Draughtsmen, Ship architects, Structural engineers, etc.

o **Building and production planning:** Building planning, Project management, Carpenters, Pipeworkers, Welders..., etc.

As shown in the above graph, only 2% of the shipbuilding workforce in the 4 countries is dedicated to the sales cycle (within the European average), 16% is dedicated to design and engineering (above the European average), and 82% of workforce is dedicated to planning and production (below the European average).

*The required qualifications and level of education per job position may not coincide in all countries, as an example, in Spain, Portugal and France workers holding only primary education certifications are not normally accepted in the shipbuilding industry.

As a conclusion, and based on the CESA study, job positions per functional area and educational level along the shipbuilding and ship repair value chain can be classified as follows:

	Sales/After sales	Design/Engineering	Production
Higher education	Sales Department Manager Technical Sales Manager Pre-Sales Engineer After Sales Manager Account Manager Customer Service Manager Budget Manager	Design Department Manager Engineering Department Manager Engineering Manager Shipbuilding architect Designer Structural Engineer Chief Engineer	Construction Planning Manager Production Department Manager Logistics Manager Project Manager Production co-ordinators Repair/Maintenance Manager Dock manager Occupational Risk Manager
Upper and intermediate Vocational education	Technical Sales assistants Budget assistants After sales assistants Accounting Assistants Customer Service Assistants	Construction technician Mechanical technician Electrical technician Planning Technician Draughtsman (CAD)	Production Assistants Planning Assistants Logistics Assistants Supervisors Repair and maintenance assistants Master craftsmen Dock assistants Carpenters Master builder
Basic Vocational Education		Naval Designer Mechanical designer Electrical Designer	Metal/steel operators Assembling Operator Welders Cutters Pipeworkers, plumbers Electricians Carpenters Boiler maker Maintenance technicians Service technicians Dock Assistant

Illustration 5 Job positions per functional area and educational level along the shipbuilding and ship repair value chain.
Source: Own elaboration

These three functional areas, as well as the job positions comprised in each of them, will be the basis for the structure of the questionnaire included in the survey, explained in section 4.

3.3 Impact of industry 4.0 on the current structure of the workforce in the shipbuilding sector

Now that workforce in the shipbuilding sector has been analysed and characterised, this the impact of the next step is the assessment of the expected impact of industry 4.0 technologies in the sector. At this point, it is worth recalling some of the main conclusions of the preceding diagnosis: 82% of employees are dedicated to production and planning tasks, compared to 12% dedicated to design and engineering tasks, and only 2% committed to the sales cycle.

The main consequence of implementing industry 4.0 processes, relies then in the fact that employment intensity is greater in the production and planning areas, what will result in the redundancy of a high number of repetitive and low-skilled positions, as most of new technologies are related to production.

The following graph illustrates the **impact of emerging technologies according to the functional area** in terms of job creation or destruction, which will be detailed at a later stage:
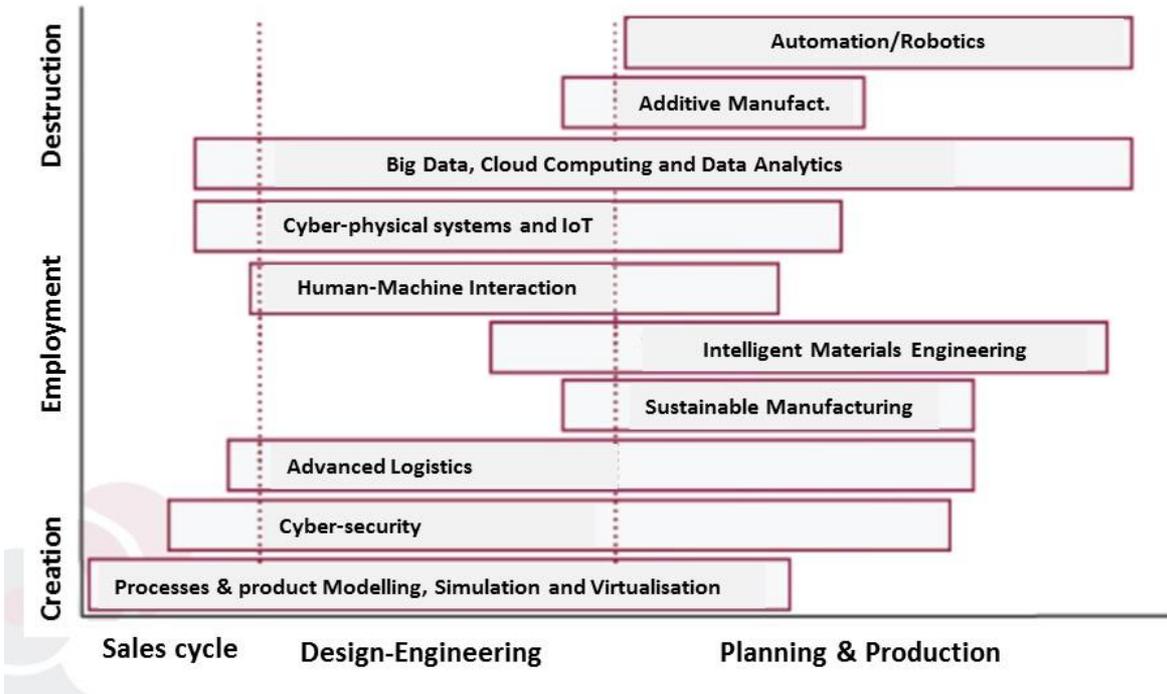
Illustration 6 Impact of emerging technologies according to the functional area in terms of job creation or destruction.
Source: Own elaboration

When these technologies are implemented, most job positions at all functional levels will be affected, some of them are expected to disappear and other are expected to undergo important changes, or even merging with other job positions. Therefore, the digital transformation will require a thorough assessment of the transformation and recycling capacity of each of these job positions.

3.4 Impact on jobs according to technology groups

At this stage of the study, the previous classification of emerging 4.0 technologies is reconsidered. This classification is the one proposed by ATIGA and IGAPE in March 2018 in the study "Industry 4.0 opportunities in Galicia". Based on this classification, technologies will be divided into two blocks which will allow the analysis of their impact on jobs in the shipbuilding sector:

MATERIALS AND INTELLIGENT MANUFACTURING

Materials and intelligent manufacturing

- Automation and advanced & collaborative robotics
- Human Machine Interaction
- Additive manufacturing
- Intelligent materials technology
- Sustainable manufacturing

ANALYTICS, MANAGEMENT AND MONITORING

Connectivity and Data analytics

- Cyberphysical systems and IoT
- Big Data Computing and Data Analytics
- Safety and Security

Production management

- Advanced logistics
- Modeling, and process simulation & virtualization
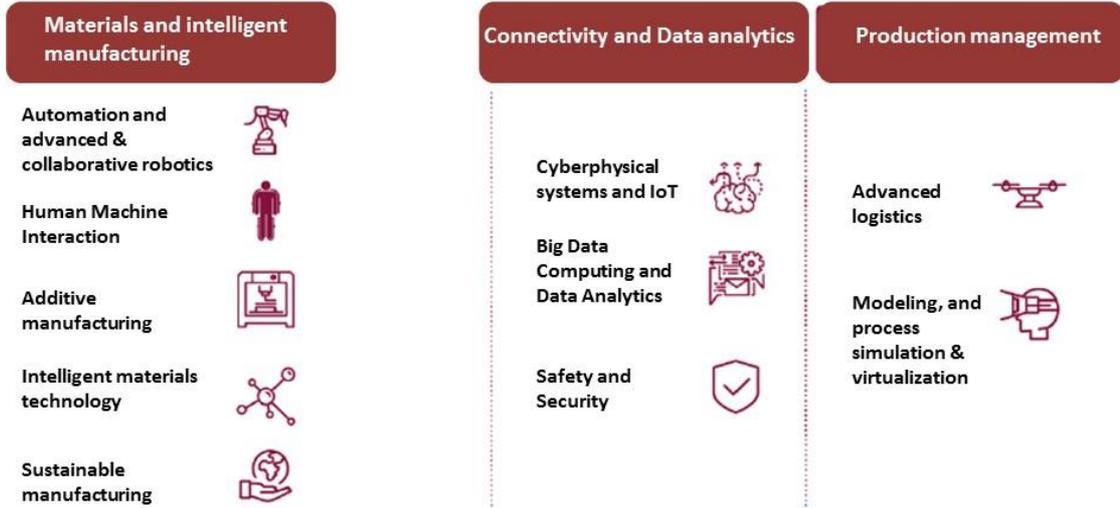
Illustration 7 Industry 4.0 opportunities in Galicia. Source: Own elaboration

3.4.1 *Block 1: Materials and Intelligent Manufacturing*

Block 1 refers to those technology groups encompassing all manufacturing processes (excluding monitoring and control elements). And some of the main considerations regarding the impact of these technologies 4.0 in manufacturing processes are that:

- Some job positions, such as welders, parts straighteners and assemblers, tubers or electricians, are expected to be replaced by robots and automated machinery

- Only low-skilled jobs requiring a certain skill or dexterity/creativity whose substitution by mechanical resources is not profitable will be maintained. This is the case of jobs requiring a high level of handicraft skills, such as certain carpentry works.

In addition, since the level of supervision of the work performed by machines or robots is insignificant compared to the performed by humans, all supervision and auxiliary production jobs are somehow doomed to disappear or to be minimized. Instead, training in Man-Machine collaborative environments is expected to become essential.

Managing positions in each functional area of the production and engineering processes, usually occupied by highly educated employees, are expected to undergo a complete transformation. New technologies will alleviate supervision workload; however, managers are expected to be skilled in technology processes such as:

- o Robot and machinery monitoring tools

- o Robotics and automation

- o Integrated information systems

- o Man-Machine Collaborative processes

- o New materials structures and behaviour

- o Additive manufacturing methods and processes

    o   New design and engineering tools

    o   Sustainable and energy efficient manufacturing techniques

Simplification is also expected in complex manufacturing processes, being nowadays highly dependent on human interaction due to the complexity of geometrics and the lack of appropriate materials. This is the reason why the production of an elevated number of boat pieces or parts involves nowadays handicraft techniques, or the application of materials that do comply with the required standards of hardness or elasticity, resulting in greater risk of abrasion or damage.

Changes are also expected in engineering and design processes, especially linked to the implementation of additive manufacturing techniques and to the introduction of new materials.

3.4.2 Block 2: Analytics, Management and Control *Technologies*

Block 2 includes technologies related to the analysis, management and monitoring of any process other than the manufacturing ones. They usually known as enterprise management technologies and support the:

- Sales cycle data analysis, from pre-sales and sales to after-sales

- Automated monitoring of the information generated by the sensors located at strategic points in the manufacturing and logistics chain, for maintenance purposes, materials management, supply management, etc.

- Customer data management, for the design of new marketing strategies, business development, etc.

- Image and augmented reality, for virtual sales catalogues, product presentations, and training purposes.

- Implementation of advanced algorithms and artificial intelligence for the optimisation of information analysis to support decision making processes and strategy design.

Most of these job positions are associated with the sales functional area (marketing strategy / sales and after-sales strategy / customer management), as well as with the engineering and design functional areas. Even though, most employees in these areas hold higher education qualifications and their main functions are expected to be maintained, digital transformation will force them to update their knowledge and skills. Some design and engineering positions are expected to become more generalist, while other will require a greater specialisation.

3.5 Soft skills

Keeping in mind that the concept "skill" refers to the ability or readiness of people to perform certain activities or tasks, skills are classified into:

- Hard skills: the skills and competences acquired through academic knowledge and professional experience; this is what is commonly known as intelligence, including memory skills, logics or languages.

- Soft skills: are those personal qualities related to emotional and social intelligence. They enhanced when dealing with others and are cultivated throughout life through interaction with others and are not learned through training courses. They are complemented by hard skills.

The following image reflects the difference between soft and hard skills in the brain:

Hard Skills

Focus on know-how

Are tangible and measurable

They are rational knowledge and skills

Soft Skills

Are related to emotional intelligence

Are based on behaviours
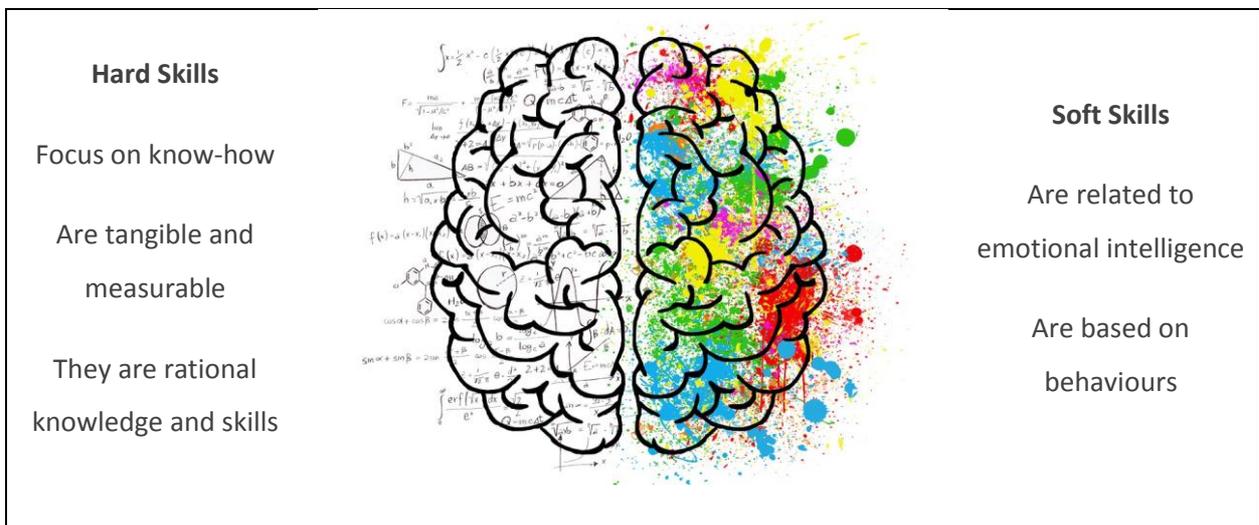
Illustration 8 Difference between soft and hard skills in the brain. Source: Own elaboration

Soft skills are the habits and behaviours that define professionals and that make the difference when managing a project, solving a conflict and / or relating to others.

The report "Learning in the Workplace 2018" maintains that "the increasing process of task automation requires flexible and critical thinking employees, capable of communicating and leading organisations. Machines currently lack such skills".

Communication and empathy are two of the most valued soft 'virtues' in job applicants. And most important, they are not only vital and strategic for business, but are also essential in the vast majority of areas and industry sectors.

Likewise, the technological explosion and the exponential digitization of processes in industries and sectors do not weaken the relevance of soft skills; they rather bring new communication challenges in all types of organizations.

The most popular soft skills in the field of information and communication technologies are presented below:

- **Ethics**. It is based on the norms, values and principles that regulate a person's good behaviour throughout his or her life and professional career.

- **Ease of communication**. Facility to present points of view, concerns, problems or ideas without difficulty of understanding for the others.

- **Active listening**. It refers to the ability to hear not only what the person is expressing directly, but also the feelings, ideas or thoughts underlying what is being said.

- **Empathy**. It is the ability to perceive, share and understand what another person may feel.

- **Sociability**. Ability thanks to which it is possible to relate to any person inside or outside the organization through interaction in various activities, apart from the necessary aptitude for the creation of contacts and constant communication with them.

- **Responsibility**. The virtue not only of making a series of decisions consciously, but also of assuming the consequences of those decisions and of answering for them before the appropriate person.

- **Creativity**. Ability to generate new ideas, concepts, original solutions that take advantage of existing resources to solve day-to-day problems.

- **Pressure tolerance**. This ability is based on the self-control of feelings to be able to perform work under stressful circumstances without these affecting the efficiency of it.

- **Positive attitude**. This skill consists of focusing on the strengths, virtues and resources available to encourage positive thinking to cope with any situation.

- **Adaptation to change**. This skill is based on flexibility in the face of the change; flexibility to approach what is known, but also flexibility and openness towards new changes and situations, willingness to adapt and to acquire new knowledge, as well as willingness to take advantage of new opportunities.

- **Spirit of service**. Enthusiasm for serving others.

- **Time optimization**. Since time is a scarce resource, resource optimization is a skill that allows people to manage this resource much more efficiently.

- **Ability to solve problems**. This skill refers to both effectiveness and agility to provide solutions to problems that are detected at a given time and in a given context.

- **Teamwork**. It is born as a need to have interpersonal relationships and complementarity to achieve challenges that would not be achieved individually. In a work group, skills are pooled and efforts are strengthened, therefore, work time reduces, efficiency increases and results are more accurate.

- **Personal security**. It is based on the confidence that a person has in his or her actions when performing a task or job.

- **Respect for opinions**. Ability to tolerate other people's different opinions and points of view.

- **Assertiveness**. This very important skill consists in having the courage to state an opinion, a feeling or a request in a clear, respectful and firm manner.

- **Leadership**. It is the art of commanding, motivating and leading people to work enthusiastically to achieve a common goal.

Soft skills are worked out through workshops, games, artistic participation or any type of activity involving group interaction. These workshops normally involve challenges related to cooperation skills, differences of opinion, leadership, etc., aimed at improving interpersonal bonds among the group members.

3.6 Classification of job positions according to workers' educational level

As previously mentioned, there are currently 103,000 (81%) workers, out of 127,500 workers in the EU-14 shipbuilding and ship repair industry, occupying technical positions related to sales, after-sales, design, engineering, work preparation and production.

And according to the report "Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry", **the average annual demand for technical profiles** at all educational levels is quantified per functional group as follows:

- Sales and after-sales: 3% of workforce demand
- Design and engineering: 17% of workforce demand
- Work preparation and production: 80% of workforce demand

The current distribution of the technical profiles per functional group is as follows:

- Sales and after-sales: 2% of the current workforce.
- Design and engineering: 12% of the current workforce.
- Work preparation and production: 86% of current workforce.

The average annual demand for technical profiles at all levels can also be divided per educational level:

- MSc/BSc[1] Level (University or College Degree): 25% of the shipbuilding need.
- Professional level: 74% of workforce demand
- Basic level: <1 % of workforce demand

The current distribution of technical profiles according to their qualifications is quantified as follows:

- MSc/BSc level: 19% of the current workforce.
- Professional level: 66% of the current workforce.

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[1] Master/Bachelor's degree

- Basic level: 15% of current workforce.

The shipbuilding and ship repair industry employs in the EU-14 more workers holding a master/bachelor's degree (19%) than the European average (15%). Such figures prove the high-tech profile of the EU shipbuilding industry.

3.7 Expectations in terms of job creation

It is a matter of fact that the emergence of automation and industry 4.0 processes in productive sectors is generating extended uncertainty and concern regarding the future prevalence of certain job positions. But it is also proven that labour markets are progressively adjusting to technological disruptions in terms of workforce demand.

The creation of new jobs will counterbalance the impact of automation, although additional investment may be needed to ensure that workers have the skills and support needed to adapt to technological challenges.

The impact of new technologies, and hence, job creation will vary depending on the following factors:

- **Wages**. High wages are the most extended reason for adopting automation.

- **Demand growth**. Economic growth is essential for job creation.

- **Demographics**. Demography affects both demand and supply of labour. Countries with a declining labour force need automation to reduce labour supply, while countries with a growing labour force have a challenge for job creation.

- **Combination of occupations**. The global potential for automation will depend on the capability to merge and combine occupations within each sector.

The fact that machines can perform routine, dangerous or filthy tasks is a great advantage, as it allows workers to make better use of their skills. However, in order to take full advantage of this technological advantage, companies must now focus on new skills and training.

The introduction of industry 4.0 will lead to the disappearance of some jobs, but also to the emergence and transformation of many others. Some of them are already defined and many others are yet to be defined. For that reason, a survey to gather conclusion in the real situation of job positions per country- whose outputs are analysed in the following section as a factor of anticipation to the challenge ahead- has been conducted according to the methodology explained in section 2.1.

3.8 SWOT analysis

The resulting diagnosis of the current structure of workforce in the shipbuilding and ship repair industry based on existing bibliography can be summarised in the following SWOT diagram:

Strengths

- Acceptable levels of skilled workforce (30-35% higher education in France and Spain, less than 20% in the UK and Portugal).
- Solid experience the construction of new ships across the Atlantic Area
- Capability to reach international markets

Weaknesses

- Lack of young technical workforce (under 40 years old), which will result in a shortage of technicians in about 15 years.
- Need to consolidate the ship repair sector as an important part of the maritime industry (the weight of the repair workforce is only relatively greater in France).
- Only 2% of the workforce across the Atlantic Area is dedicated to the sales cycle (12% to design and 82% to production).

Opportunities

- Technologies related to process and product modelling, such as real and augmented reality, are expected to have a positive impact on job creation throughout the shipbuilding and ship repair value chain (sales, design-engineering and planning-production).
- Cybersecurity and smart logistics are expected to have a positive impact on job creation in the design-engineering and production-planning links of the value chain.

Threats

- Risk of redundancy in unskilled and repetitive jobs, especially due to the emergence of additive manufacturing and robotics related technologies applied to the production cycle.
- The implementation of highly technological processes that replace humans can threaten communication within companies and work teams, which is based on soft skills.

Thus, according to this SWOT analysis, and as a starting point conclusion, some of the challenges ahead for EU shipbuilding and ship repair companies to adapt to the new scenario are:

- Designing qualifications and courses (not necessarily university degrees) specifically aimed at young people and at reinforcing technical profiles in the shipbuilding and ship repair sector
- Implementing actions towards engaging young people in the last years of compulsory education and attracting them to the above mentioned courses
- Training actions must be strongly practical, and technology based (additive manufacturing, robotics, AR, VR, smart logistics, cybersecurity, management tools, etc.)
- Companies should also dedicate efforts to the training and updating of current workers for the use of new technologies and adaptation to new management and production models
- Reinforcing sales departments by training workers for international sales positions, not only aimed at bringing new construction projects to the EU shipyards, but also ship refurbishing and repair projects from around the globe.
- The international market is still a challenge for the EU shipbuilding and ship repair industry, and companies should make the most of their expertise and capability to offer highly compliant projects
- Training actions must also imply a soft skills approach in order to maintain fluent and healthy communication within work teams and across all company departments

3.9 Prioritisation and analysis of the threats and weaknesses identified in the SWOT analysis

Once the SWOT analysis of the "Report on the redefinition of job positions in the shipbuilding and repair industry" had concluded, the partnership decided to include a prioritisation and analysis of the weaknesses and threats detected in the aforementioned SWOT analysis.

The resulting diagnosis of the current workforce structure in the shipbuilding and ship repair sector resulted in the following threats and weaknesses:

- **WEAKNESSES:**
    - **A)** Lack of young technical workforce (under 40 years old), which will result in a shortage of technicians in about 15 years.
    - **B)** Need to consolidate the ship repair sector as an important part of the maritime industry (the weight of the repair workforce is only relatively greater in France).
    - **C)** Only 2% of the workforce across the Atlantic Area is dedicated to the sales cycle (12% to design and 82% to production).
- **THREATS:**
    - **A)** Risk of redundancy in unskilled and repetitive jobs, especially due to the emergence of additive manufacturing and robotics related technologies applied to the production cycle.
    - **B)** The implementation of highly technological processes that replace humans can threaten communication within companies and work teams, which is based on soft skills.

2.- METHODOLOGY:

Given the experience and knowledge of the institutions that are part of the project in the field of shipbuilding and ship repair in each of the European regions, and in particular with regard to the application of new technologies and the typology of the workforce, it was decided that the project partners should ideally prioritise each of the weaknesses and threats based on the level of criticality. Thus, obtaining results that would be included in a pre-conclusion that would enhance and give more importance to the SWOT analysis.

For this purpose, and to achieve an agile and dynamic methodology, a questionnaire was used as a means to collect experts opinion on the level of criticality of the "weaknesses" and "threats" detected in the SWOT analysis of the report "Report on the redefinition of job positions in the shipbuilding and repair industry" (questionnaire included in Annex 7.3). Prioritization was based on the level of criticality of such "weaknesses" and "threats": a *very low level of criticality was valued with a 1, and a very high level of criticality with a 5.*

3.- WEAKNESSES ANALYSIS

WEAKNESS "A": **"(Lack of young technical workforce (under 40 years old), which will result in a shortage of technicians in about 15 years.)"**


The first weakness of the SWOT analysis of the questionnaire that was circulated revealed the following prioritization: The ratings collected ranged from 4 to 5, it is to say, between a high and a very high level of criticality. It was therefore perceived by most participants as a weakness to be taken into account.

Among the most remarkable arguments that motivate the assessment:

This weakness is clearly perceived, so much so that in some regions participating in the project, apprenticeship programmes are being developed and implemented to involve a younger workforce. Even valuing that the lack of employees in this sector will be plausible well before the age of 15, placing it as a lack that will already be noticeable within the next 3 to 5 years.

Efforts must not stop and, on the contrary, must be stepped up, especially with regard to the current management style of most companies in the sector with a much more effective approach. Access to new technologies must be one of the pillars to make the sector more attractive and to be able to attract qualified workers who want to develop their professional career in the field of shipbuilding and ship repair.

WEAKNESS "B": "(Need to consolidate the ship repair sector as an important part of the maritime industry (the weight of the repair workforce is only relatively greater in France)".
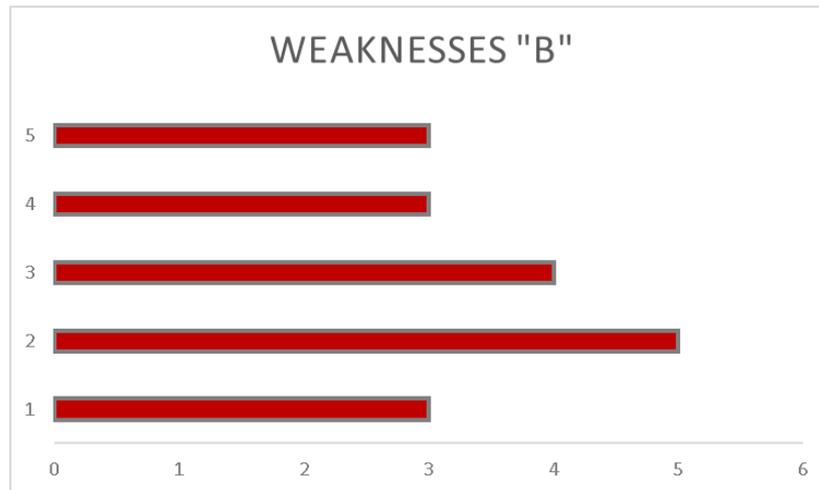
3 was the predominant response, although there were also partners who punctuated weakness B with a 4 and a 5. Therefore, the critical level of this detected weakness is recognised, and it is assessed with high and very high levels of criticality.

Among the arguments that stand out most in the motivation of the answers is that it is undoubtedly an activity that must be recognized and given more importance and support, which clashes with the support for new construction. The increase in investment should be in both construction and repair. There are regions involved in the project in which the ship repair activity is of fundamental importance in the economic and labour field, which reinforces this idea of giving it importance and support. Moreover, if we take into account the importance that the so-called predictive maintenance will have in the immediate future, which implies new marketing methods.

Therefore, diversification, expansion and adoption of new techniques supporting ship repair activities should be of major importance for the regions involved in the IN 4.0 project. The need to apply innovative technologies that enable the evolution of the professions, especially in relation to predictive maintenance.

WEAKNESSES "C": "Only 2% of the workforce across the Atlantic Area is dedicated to the sales cycle (12% to design and 82% to production)".
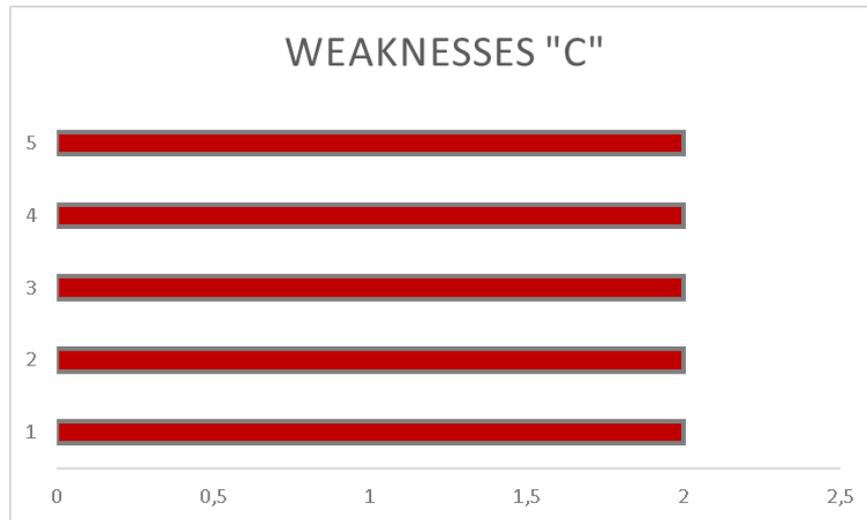
As shown in the graph, all experts coincided in responding 2, meaning a low level of criticality.

The sales cycle is perceived as important, but not less important than training and improvement of current production processes. Therefore, it is deduced that of course the sales cycle must be reinforced and updated, but at the same level as many other issues; that should have a greater importance in order to adapt the sector to the new circumstances that will bring the irruption and implementation of new technologies.

The sales cycle of companies will be affected in some way with the new changes that will be introduced in the sector, so adequate training in new sales techniques will be necessary.

4.- THREAT ANALYSIS

THREATS "A": "Risk of redundancy in unskilled and repetitive jobs, especially due to the emergence of additive manufacturing and robotics related technologies applied to the production cycle".
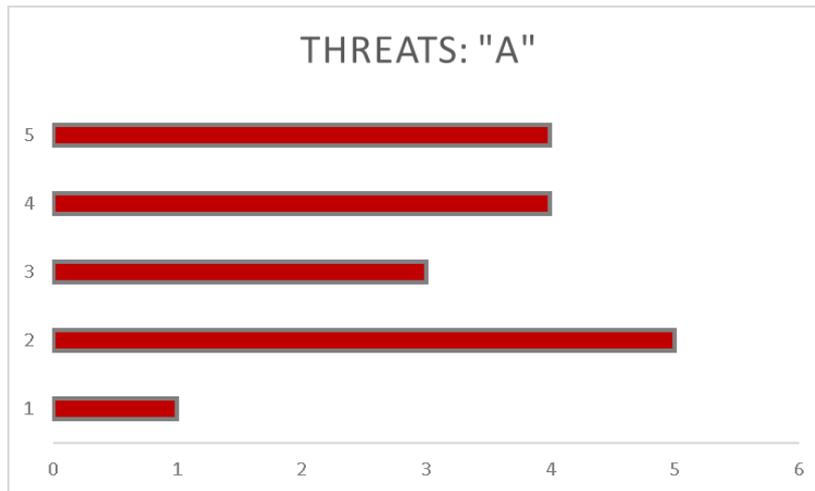
In this case and taking into account the profile of each of the experts, the levels of criticality were perceived in very different ways. Four of the five organisations rated this threat as important or very important. Assuming that some of this work, which does not require a great deal of specialisation, will be affected in some way by the impact of the development and use of 4.0 technologies. We are talking about welders, machining operators, more than one production profile; but also, the position of draughtsman in small studies could suffer this impact in disciplines such as engineering.

However, the vision of the technology centres included in this section is curious and of great importance, since from another approach, it is valued as an opportunity. Despite the uncertainty related to the acquisition of 4.0. technologies the risk of redundancy in unskilled and repetitive jobs is not perceived, it is considered low. This is because new technologies are perceived as generative of new opportunities. By applying them correctly and with proper training, new knowledge will be generated within the company, which will have a positive impact on the definition of new jobs.

THREATS "B": "The implementation of highly technological processes that replace humans can threaten communication within companies and work teams, which is based on soft skills".
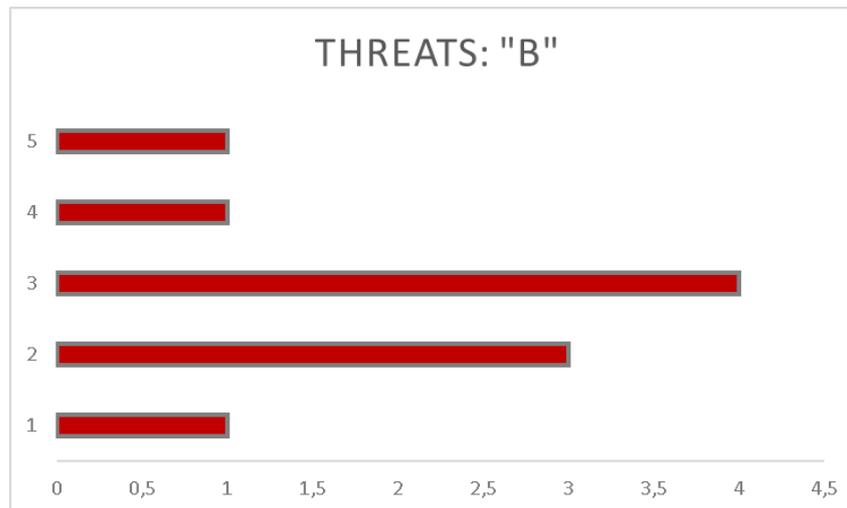
This threat was perceived as very low by some of the participants and as high by others. The reasons are that while for those who consider it low, communication should always be a key priority and should not be affected by the redefinition of technological processes, more so considering that it is people and business culture that drive this change; for organizations that perceive this aspect as important, they point out that the change will not be the same for large organizations as for small companies. Since the risk of deterioration in communication between different sections of the company will not apply at the same level in a company of 20 employees as in a large business group.

4. CONCLUSIONS TO THE PRIORITASATION OF THREATS AND WEAKNESSES

As a conclusion to this "threats and weaknesses" analysis, shipbuilding and ship repair sector policies and actions should be structured around the following appreciations:

In order to minimise **WEAKNESS "A"** (Lack of young technical workforce (under 40 years old), which will result in a shortage of technicians in about 15 years.), considered by experts as very critical:

Access to new technologies should be one of the pillars to make the sector more attractive and to be able to attract qualified workers who want to develop their professional career in the field of shipbuilding and

ship repair, reinforcing the need to design qualifications and courses (not necessarily university degrees) to attract young people to the sector.

In order to minimise **WEAKNESS "B** (Need to consolidate the ship repair sector as an important part of the maritime industry-the weight of the repair workforce is only relatively greater in France-), considered by experts as not especially critical, but important:**

Diversification, expansion and adoption of new techniques supporting ship repair activities should be of major importance for the regions involved in the IN 4.0 project, reinforcing the need to dedicate efforts to the training and updating of current workers for the use of new technologies and adaptation to new management and production models, without forgetting the significance of predictive maintenance models as a key resource optimisation mechanism for companies.

In order to minimise **WEAKNESS "C"** (Only 2% of the workforce across the Atlantic Area is dedicated to the sales cycle (12% to design and 82% to production)", considered by experts as not especially critical:**

The sales cycle of companies will be affected in some way with the new changes that will be introduced in the sector, so adequate training in new sales techniques will be necessary, aimed at bringing new construction projects to the EU shipyards, but also ship refurbishing and repair projects from around the globe.

In order to minimise **THREAT "A"** (Risk of redundancy in unskilled and repetitive jobs, especially due to the emergence of additive manufacturing and robotics related technologies applied to the production cycle), considered by experts as critical:**

According to this analysis, and despite uncertainty related to the loss of unskilled jobs, new technologies are perceived quite often perceived as generative of new opportunities. By applying them correctly and with proper training, new knowledge will be generated within the company, which will have a positive impact on the definition of new jobs.

In order to minimize **THREAT "B"** (The implementation of highly technological processes that replace humans can threaten communication within companies and work teams, which is based on soft skills), considered by experts as critical**

Training actions must also imply a soft skills approach in order to maintain fluent and healthy communication within work teams and across all company departments, however according to the

current analysis, deterioration in communication between different sections of the company will not affect at the same level in a company of 20 employees as in a large business group.

4.

Analysis of the impact of the industry 4.0 in the competences and positions of the naval sector

4 Survey: Analysis of the impact of the industry 4.0 in the competences and positions of shipbuilding and ship repair sector

4.1 Introduction

Such as previously explained, the methodology implemented by ACLUNAGA for the analysis of current skills and job profiles in the shipbuilding and ship repair sector, consisted in the distribution of a survey form to the partners participating in the IN 4.0 Project. The survey was aimed at the collection of relevant information in the regions participating in the project: Ireland, United Kingdom, France, Spain (Galicia and the Basque Country) and Portugal.

The information requested through the survey form was structured in the following blocks:

Block 1	1. Brief analysis of skills and employment opportunities	Open questions intended at extracting comparable information per participating country in the IN 4.0 Project
	2. Industry 4.0: Impact on the current structure of the shipbuilding workforce	
	3. Impact on employment per technology group	
Block 2	4. Soft skills	Three choice questions related to the relevance of soft skills: • High • Medium • Low
Block 3	5. Classification of job positions according to the expected impact of the implementation of industry 4.0	Three choice questions related to expectations per job positions: • To be created as new • To be adapted • To be extinguished
Block 4	6. Complementary remarks	Open questions for further contributions or clarification on the above answers

Table showcasing the structure and stages of the survey "Analysis of the impact of the industry 4.0 in the competences and positions of shipbuilding and ship repair sector" carried out in the five participating countries

It is important to remark that, for the time being, and due to the lack of extensive background literature and previous research on the evolution of the shipbuilding and ship repair industry in terms of technological transformation, it has not been possible to obtain even qualitative or descriptive information related to all the questions included in Block 1 and in the 5 countries. However, consulted experts in the five countries have answered the questions included in Blocks 2, 3 and 4.

New contributions per country collected during the validation phase are included in the analysis below.

4.2 Block 1 of questions

4.2.1 *Brief analysis of skills and employment opportunities in the sector*

Showcasing the information gathered in the five project regions begins in this section with a brief comparison between the demand for skilled workers and the current type of job profiles in the Atlantic Area. These contributions collected by the IN 4.0 Project partners disclose a number of relevant facts about the current situation of employment structure in the European shipbuilding and ship repair industry:

- Jobs related to the construction of new ships generally account for the largest share of employment in the shipbuilding and ship repair sector in the five participating countries.

    o However, the number of employees engaged in ship repair is higher in France than in other Atlantic Area countries. Ship repair and refurbishing is gaining significance in France, demanding a wide range of skills, including engineering qualifications.

- More than 60% of employees are over 40, while young employees (under 25) account for less than 15% in the Atlantic Area. Thus, with exception of France, there is a shortage of young skilled and qualified workers.

    o It is important to remark that there is a significant age gap in France, ranging from 8 to 10 years, mainly due to asbestos outbreaks.

- o Most of the working population is between 41 and 55 in the United Kingdom, so the general perception is that the maritime industry is a '*sunset'* industry.

- Employees' level of education in the shipbuilding and ship repair industry is generally high, but differs significantly from country to country:

  - o 30% of workers hold higher education certifications in **Spain**

  - o According to a recent study conducted by BPN in **France**, which includes a sample of 350 employees, 51% of them claim to hold higher education qualifications (Bac + Bac + 5)

  - o There is a shortage of highly skilled workers in the shipbuilding and ship repair sector in the **United Kingdom**, raking below the European average for employment requiring higher educational qualifications.

- Technical professional profiles in the shipbuilding and ship repair sector are grouped into three main functional areas or departments: Sales, Design and Engineering, and Planning and Production.

  - o Workforce is quickly evolving in **France**, especially regarding the acquisition of design and mechatronics skills. On the other hand, French shipyards are already working in line with the recruitment plan launched in the Atlantic Area regarding the "*Outfitting Area*".

- Despite historical experience and knowledge, the main challenge for the **United Kingdom** shipbuilding and ship repair industry is to remain competitive. Other weaknesses include the fragmentation of the supply chain; the scarce number of large shipyards; and the low number of large equipment manufacturers.

- Shipbuilding and ship repair industry is on the rise in **Ireland**. According to "A Study of the Current and Future Skills Requirements of the Marine/Maritime Economy to 2020" the turnover generated by manufacturing, construction and shipbuilding engineering in 2014 was 121 million euros. The total gross value added (GVA) generated was 65 million euros. Turnover between 2012 and 2014 decreased by 39%; however, there was a 98% increase in GVA, which is consistent with the trend in the shipbuilding industry in general.

Therefore, the general perception is that the growth weight of shipbuilding and ship repair industry is greater in France, Spain and Ireland, where the demand for skilled and qualified workers is increasing, while in the United Kingdom there is an urgent need to increase competitiveness.

4.2.2 *Impact of industry 4.0 on the current structure of workforce*

This section showcases the appreciations on the impact of industry 4.0 on the shipbuilding sector collected in three of the five participating countries through the "complementary remarks field" included in the survey form:

- **Spain:**
    - o 82% of the workforce is dedicated to planning and manufacturing tasks in Spain. This factor implies the first consequence associated to the introduction of 4.0 technologies, which will cause the redundancy of low-skilled workers in charge of highly repetitive tasks, mainly in the manufacturing field.
    - o Nowadays, ship production is nearly an " industry of prototypes ", so the renewal of design processes through the incorporation of high-tech skilled workers is a key factor in maintaining and developing this niche.
- **United Kingdom:**
    - o In the UK, the implementation of the industry 4.0 model within the maritime sector will have a significant impact on workforce. Three main changes are expected: the creation of new jobs, the reskilling of the current workforce and redundancy of current roles. In the absence of in-house skills, companies in the shipbuilding sector will be forced to outsource a number of processes implying 4.0 technologies and skills.
- **Ireland:**
    - o In Ireland, the shipbuilding, construction and engineering sector is small; however, it is well positioned for industry 4.0 according to the RB Industry 4.0 Readiness Index. The shipbuilding industry is a relatively small employment sector, although initiatives highlighted by the Working Group on the Development of Shipbuilding in the Port of Cork

and a centre for international yacht racing teams would create higher levels of employment in the long term.

o Enabling education and training to support the development of the marine industry and the provision of efficient public services in Ireland is also considered a key factor in Ireland.

4.2.3 *Impact on employment according to technology groups*

Since the employment situation by functional areas is slightly different in the four countries in which qualitative information has been gathered, the inputs collected in Spain and France will be analysed jointly on one side, while the inputs collected in the United Kingdom and Ireland will be analysed on the other.

France and Spain:

- Materials and intelligent manufacturing.

The appreciations provided by Spain and France indicate that emphasis should be placed in the adaptation of manufacturing processes, focusing on the impact of technology on tasks that can be replaced by robots and/or machines. However, in the opinion of consulted experts, some job positions implying very repetitive tasks may survive, as they require some kind of skill which cannot be replaced by mechanical means in the short-medium term.

According to the experts, it is also necessary to check the maintenance of the supervision works, since the level of supervision of tasks performed by machines is minimal compared to that performed by human beings.

On the other hand, technological transformation in manufacturing is expected to result in an increased need for training in two main skills: man-machine collaboration skills and management skills.

- Analysis, management and monitoring

Based on the information compiled in Spain and France, experts agree that the growing introduction of analysis, management and monitoring tools is a key factor for competitiveness, for which company managers at all levels must imminently prepare for the use of technologies related to:

- Sales cycle data analysis
- Manufacturing cycle data analysis (information related to manufacturing is automatically collected and monitored through sensors fixed in different locations of the production facilities).
- Customer data analysis.
- Image and augmented reality
- Advanced algorithms and artificial intelligence

On the other hand, France makes the difference when it comes to the gender equality, as major efforts are being made to attract **female experts** in customer data management, image and augmented reality, as well as in advanced algorithms and artificial intelligence.

United Kingdom and Ireland:

In the United Kingdom, traditional skills will still be needed in the future; however, experts recognise that industry 4.0 practices can help improve the efficiency of routine activities across the industry.

As for managers and supervisors, they will be soon required to be skilled in the use of new technologies, and most especially in the following ones:

- Collaborative Robots to assist with welding.
- Additive Manufacturing.
- Virtual and Augmented Reality.
- Predictive Maintenance.
- Digital Twins.

In general, the existing workforce will be soon required to be skilled in the use of advanced software (3D modelling and advanced algorithms for predictive maintenance.

In **Ireland**, consulted experts consider that the implementation of new technologies such as collaborative robotics, augmented reality, automated visual inspection systems and additive manufacturing is already an urgent issue. Manufacturers need to change the way they produce to remain competitive, as the era of smart manufacturing will change and improve what is produced.

In this new era of manufacturing, the Internet of Things and cloud connections will become a key factor for the sector. Machines will be more autonomous and will interact and communicate with each other in real time. Advanced technologies will manage Big Data and will facilitate this enhanced integration, not just between machines, but between every segment of a manufacturing enterprise from designers and engineers to technicians/operators and office staff.

"The Future of Jobs Survey 2018" suggests that the drivers of change are the following four specific technological achievements:

- Ubiquitous high-speed mobile internet
- Artificial intelligence
- Widespread adoption of big data analytics
- Cloud technologies are set to dominate the 2018-2022 period.

According to the investment intentions declared by the companies surveyed in the Future of Jobs Survey 2018, included in the World Economic Forum report, by 2022, 85% of respondents are likely or very likely to have increased the number of big data analysis users. Similarly, it is likely or very likely that a large number of companies have scaled up the implementation of technologies such as the Internet of Things, cloud computing, and web/app enabled markets. Machine learning, augmented reality and virtual reality are also expected to receive considerable business investment.

4.3 Block 2 of questions

4.3.1 *Soft or transversal skills*

4.3.1.1 *Main skills*

The following chart summarises the contributions made by experts in the shipbuilding and ship repair sector regarding the relevance of main soft skills. This information was collected by the IN 4.0 project partners through the survey form distributed by ACLUNAGA:

Skill	Level of importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Organizational flexibility						
Willingness to accept change						
Empathy						
Creative and critical thinking						
Problem resolution						
					High	Medium

Illustration 9 Source: Own elaboration based on survey results

All partners coincide in considering "Willingness to accept change" as of high importance and "Empathy" as of medium importance.

There is almost unanimity regarding the other skills, with only one or two territories valuing them as of medium importance.

Thus, this is the rank of soft skills resulting from the survey, according to the level of importance:
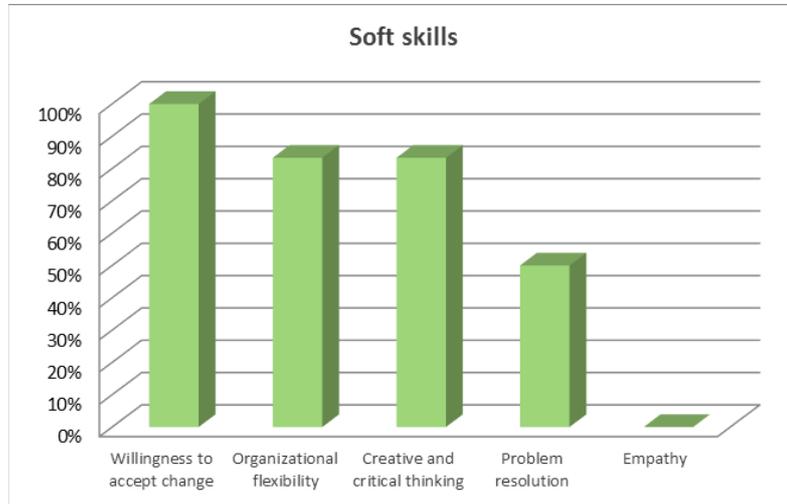
Illustration 10 Source: Own elaboration based on survey results

4.3.1.2 Other skills identified by the IN 4.0 Project partners

The following chart summarises the list of skills pointed out by project partners as of certain relevance in their regions. These soft skills were not originally included in the survey form distributed by ACLUNAGA, and were mainly identified by partners in the Basque Country, France Galicia, Ireland and Portugal:

Skill	Level of importance					
	Basque Country	**France**	**Uk**	**Galicia**	**Ireland**	**Portugal**
Link between design studies and production	Unknown	Medium	Unknown	Medium	Medium	Medium
Complex problem solving	High	High	Unknown	High	High	High
Active and continuously learning	High	High	Unknown	High	High	High
Systems and content skills	Medium	Unknown	Unknown	High	High	Medium
Service orientation	Medium	Medium	Unknown	High	High	High
Digital literacy skills	High	Unknown	Unknown	High	High	High
Monitoring Self and Others	High	High	Unknown	Medium	High	High
Mathematical reasoning	High	Medium	Unknown	Medium	Medium	High
Training others	High	High	Unknown	High	High	High
Resource Management	Medium	Unknown	Unknown	High	Medium	High
Transdisciplinary thinking	High	High	Unknown	High	High	High
Virtual collaboration	High	Medium	Unknown	High	High	High
Global vision	High	High	Unknown	High	High	High
	Unknown	**High**	**Medium**			

Illustration 11 Source: Own elaboration based on survey results

Partners were asked to assess the relevance of the new skills added to the questionnaire. The white cells are skills whose relevance could not be assessed by partners and experts on the basis of current knowledge about the sector.

Portuguese experts considered that the following skills are worth considering for future training actions:

- **Initiative** - It is the willingness to act, create opportunities and improve results without the need for an external requirement that pushes them to do so, to act proactively and to think not only about what needs to be done in the future.

- **Analytical Thinking** - It is the ability to understand a situation, disaggregating it into small parts or identifying its implications step by step. It includes the ability to systematically organize the parts of a problem or situation, make comparisons between different elements or aspects and establish rational priorities. it also includes the understanding of temporal sequences and the cause-effect relationships of actions.

- **Intellectual Curiosity** - It is the keenness and constant curiosity to know and learn more about things, facts or people. It involves looking for information, new concepts, new ways of doing and always going beyond routine questions or what is required by the position. It implies always going one step ahead. It may involve questioning the current ways of doing or simply the desire to move forward learning and deepening, always in order to get extra value to the tasks of the position.

- **Cognitive Flexibility** - It is the ability to modify personal behaviour to achieve certain objectives when difficulties arise, new data or changes in the environment. Versatility is associated with behaviour to adapt to different contexts, situations, means and personnel in a fast and adequate way. Flexibility is more associated with cognitive versatility, the ability to change convictions and ways of interpreting reality, it is also closely linked to the capacity for critical review.

As a conclusion on the most relevant soft skills across the Atlantic Area, they are ranked as follows:

Illustration 12 Source: Own elaboration based on survey results

4.4 Block 3 of questions

4.4.1 *Classification of jobs according to the expected impact after the implementation of the industry 4.0 model*

4.4.1.1 Sales and administration

The following chart summarises the evaluation of sales and management positions as assessed by experts form the participating regions:

Position	Level of importance					
	Basque Country	France	UK	Galicia	Ireland	Portugal
Accounting Assistant	To be redundant	To be redundant	To be redundant	To be adapted	To be redundant	To be adapted
Customer Service Assistant	To be adapted	To be adapted	To be redundant	To be adapted	To be adapted	To be adapted
Sales Assistant	To be adapted	To be adapted	To be redundant	To be adapted	To be adapted	To be adapted
Budget Assistant	To be redundant	To be adapted	To be redundant	To be adapted	To be redundant	To be adapted
Sales Manager	To be adapted	To be adapted	To be adapted	To be adapted	To be adapted	To be adapted
Technical Sales Manager	To be adapted	To be adapted	To be adapted	To be adapted	To be adapted	To be adapted
Pre-sales Manager	To be adapted	To be created	To be redundant	To be adapted	To be adapted	To be adapted
Post-sales Manager	To be adapted	To be created	To be adapted	To be adapted	To be adapted	To be adapted
Account Manager	To be adapted	To be redundant	To be adapted	To be adapted	To be redundant	To be adapted
Customer Service Manager	To be adapted	To be adapted	To be adapted	To be adapted	To be adapted	To be adapted
Budget Manager	To be adapted	To be adapted	To be redundant	To be adapted	To be redundant	To be adapted
Data analyst	To be adapted	To be created	To be created	To be adapted	To be adapted	To be created
Virtual reality creator	To be created	To be created	To be created	To be adapted	To be adapted	To be created
Legal expert on database	To be adapted	To be created	To be created	To be adapted	To be adapted	To be created
Alliance Manager	To be created	To be adapted	To be redundant	To be adapted	To be adapted	To be created
Production flow management	Unknown	To be created	Unknown	To be adapted	Unknown	To be adapted
Data Scientist	Unknown	Unknown	Unknown	Unknown	To be created	To be created

Unknown	To be created	To be adapted	To be redundant

Illustration 13 Source: Own elaboration based on survey results

Major controversy around the sales and administration areas focused on the particularity of contributions by British representatives, who believe that assistance positions will tend to disappear. The discussion also included the proposal of other sales and administration positions that had not been included in this block of valuations.

Overall valuations per country include the above issues introduced for discussion during the validation phase, are summarised as follows:

– **Spain:**

For experts in the Basque Country, assistant positions will require a re-skilling to deliver a higher level of assistance to managers. Assistants will be expected to acquire the necessary skills to provide more accurate information from a wider range of sources and to be capable of translating that information into more precise conclusions and reports.

Sales and administration positions are highly affected by the introduction of 4.0 technologies, as they will allow an integral management approach that no longer requires isolated tools. Many tasks in these areas can either be automated or highly simplified through the implementation of new technologies, but the final decision will remain on the human side. However, new technologies are considered a key factor for accuracy in data analysis. So, positions such as Alliance Manager, Data Analyst and Database Legal Expert are expected to be adapted in Spain.

- **France:**

French experts detected a need for the creation of pre-sales and after-sales managing positions, which is the first job position identified in the United Kingdom as unnecessary due to the small number of commercial shipyards. Data Analyst, virtual reality creators, database legal experts, production flow managers and alliance managers will be required, according to French appreciations

French experts maintain their position and, unlike in the United Kingdom, consider that the large number of small French shipyards must remain competitive, and it implies maintaining the jobs that support the shipyard's managers, as they will bring technological knowledge to a large extent.

And, coinciding with the Irish opinion, the position of Account Manager is expected to be redundant in France.

- **Portugal:**

Portuguese experts believe that the industry revolution ahead will not lead to the disappearance of assistant positions in Portugal. However, these assistants will require profound reskilling.

In Portugal, 4.0 technologies are also expected to affect both sales and administration areas. Positions such as Data analyst, Data Scientist, Virtual reality creator, Database legal expert and Alliance Manager should be created in Portugal, whereas other positions could be adapted.

Such as in Spain and France, alliance managers are particularly valued in Portugal due to the fact that traditionally companies managed innovation in a closed way (projects can only start inside the company and end up in their own market), but the open innovation model is now gaining importance (where projects can originate both inside and outside the company) and can be incorporated both at the

beginning and in intermediate stages of the innovation process, and can reach the market through the same company or through other companies (patent licensing, technology transfer, etc.), as the company develops cooperation with external organizations or professionals. So counting on internal capabilities to find the right partners will be a key factor for the survival of SMEs.

On the other hand, Portuguese experts point out that greater attention should be paid to supply chain positions and processes, since technological evolution will dramatically affect delivery lead times.

－ **Ireland:**

As a conclusion to this question, only experts in the United Kingdom consider that assistant positions in the sales and administration areas will be redundant, while they will be adapted to the new technology paradigm in the other territories.

On the other hand, from the Irish perspective, sales and management positions are key jobs within any organisation, and their occupiers will be forced to understand IN4.0 technologies, as in the future, technologies will be part of the product and service development process.

Data Analyst and Database Legal Expert positions are also expected to be adapted in Ireland, while Budget and Account Managing positions are gradually disappearing.

－ **United Kingdom**

While experts in Ireland, France, Spain and Portugal consider that most of current assistant positions will remain after significant adaptation, consulted experts in the United Kingdom, point out that most of SMEs cannot afford having "assistant" positions, and large companies tend to substitute assistant positions with technologies that support managers. Such British shipyards rank low in competitiveness compared to other EU countries, mainly due to high wages and lack of adequate productive infrastructures.

In the United Kingdom, sales positions are considered to be less affected by the introduction of new technologies, depending on the overall performance of the company. However, administration roles are susceptible to be affected due to streamline of processes, administration tasks could potentially be done more efficiently. However, this change is unlikely to happen immediately as it depends of the degree of implementation of Industry 4.0 tools and technologies.

On the other hand, Alliance managing, and Budget managing positions are gradually disappearing in the United Kingdom too.

4.4.1.2 Engineering

The following chart summarises the evaluation of engineering positions according to experts participating in the survey:

Position	Level of importance					
	Basque Country	France	UK	Galicia	Ireland	Portugal
Structure Building technician						
Sales technician						
Planning technician						
Draftsperson (CAD)						
Design Manager						
Engineering Manager						
Shipbuilding architect						
Designer						
Robotics expert						
3D Simulation expert						
Artificial Intelligence expert						
Shipbuilding Information Modelling Expert						
	Unknown		To be created	To be adapted	To be redundant	

Illustration 14 Source: Own elaboration based on survey results

Although there is almost total unanimity in analysing the suitability and relevance of engineering roles, especially regarding the creation of the Robotics Expert, 3D Simulation Expert and Artificial Intelligence Expert posts; as well as regarding the expected updating of existing jobs (Drafter, Design Director, Chief Engineer, Ship Architects and Designers), some differing opinions were initially collected through the survey:

    – **Spain:**

Basque experts remark that the position of Planning Technician does not exist in Spain, so it should be created in the future. However, Structural Construction Technician is gradually disappearing in the Basque Country, while Galician experts consider that Sales Technicians will soon be redundant.

According to the Basque Country, the position of New materials expert should also be classified as an engineering role, rather than a production one.

– **France:**

Surveyed experts in **France** consider the positions of Structure technician and Sales technician are bound to disappear, while there is coincidence with Basque experts in considering that the job of Planning technicians is not well covered in France now, so it should be created in the future.

French experts confirm the relevance of planning technicians, in fact, the role of urban planning technician already exists in France as a consequence of the impact of technology, but it should be adapted to the shipbuilding and ship repair sector.

– **United Kingdom:**

Once more, British experts consider that the role of a sales technician will no longer be necessary in the United Kingdom due to the low commercial profile of existing shipyards.

Based on new feedback from SMEs, British experts think that all Engineering Roles included in the survey, except for Planning assistants, are essential.

As for the position of Robotics Expert, 3D Simulation Expert and Artificial Intelligence Expert, it is unlikely that these roles are created in-house but as 4.0 technologies are gradually being implemented, SMEs may consider creating these positions.

Other new positions may need to be created within the company to asses and support the SME on the digital journey.

– **Portugal:**

Portuguese experts believe that all roles related to Reliability Engineering Departments should be given certain relevance in the future. Particularly, Reliability Managers, who oversee the integrity of equipment and ensure best practices and compliance with design and repair specifications while maximising reliability.

4.4.1.3 Production

The following chart summarizes the evaluation of engineering positions as assessed by experts:

Position	Level of importance					
	Basque Country	France	UK	Galicia	Ireland	Portugal
Production assistant						
Maintenance assistant						
Planning assistant						
Foreman						
Welder						
Electrician						
Pipe-fitter						
Carpenter						
Service technician						
Chief Engineer						
Project Manager						
Structure Engineer						
Logistics Manager						
Occupational risks Manager						
Maintenance and repair Manager						
New Materials expert						
Cybersecurity expert						
Additive manufacturing expert						
Smart Logistics expert						
				To be created	To be adapted	To be redundant

Illustration 15 Source: Own elaboration based on survey results

Foro Marítimo Vasco proposed a list of 17 new profiles, but these new jobs to be created did not have the validation or consensus of the other project partners. Therefore, this list can be consulted in the annexes section (pages 76-77).

Even though conclusions in this area are quite homogeneous, there are also certain particularities were identified and discussed during the validation phase, with the following outputs:

– **Spain:**

Basque experts consider that the role of Production Assistants and Foremen is currently weak but will be needed in the future, while Galician experts consider that they must be adapted to the new scenario.

Basque and French experts consider that the role Production Assistant will be needed in the future, while is it considered unnecessary in the United Kingdom. Galicia and Ireland, do it for adaptation.

Within the same country, Basques and Galicians are again in disagreement regarding the roles of project managers, logistics managers and maintenance and repair managers. In the opinion of Basque experts, they are weak positions in the Basque Country now, and their responsibilities will be introduced in the immediate future of shipbuilding and ship repair industry; whereas the same position already exist in Galicia and some changes and adaptation will be needed as 4.0 technologies are implemented. The fact that project managers, logistics managers and maintenance and repair managers are somehow consolidated in Galicia is a clear sign of the local shipbuilding and ship repair leadership in Spain.

– **United Kingdom:**

British experts consider that all profiles of Production assistant, Foreman, Tuber and Carpenter, Project Manager, Logistics Manager, Maintenance and Repair Managers, Structural Engineer and Labour Risk Managers must adapt to the use of new technologies. Even if the amount of work remains consistent, the number of required positions may be reduced as the Industry 4.0 tools will facilitate greater efficiencies.

In terms of adaptation and redundancy, intelligent Logistics Experts will be needed but their competencies will probably fall into the new job specifications of the logistics manager. Maintenance and Planning Assistants, New materials experts are also expected to be unnecessary in the UK, while they are **expected to emerge in the rest of territories**.

– **France:**

The only role that is expected to disappear in France, only coinciding with the feedback provided by the Basque Country, is the position of Foreman.

For French experts, the current functions of a supervisor could be considered, but in the Breton shipyards the tendency is to use the multiple competences of intermediate managers with transversal functions (engineering/production/management) to the disadvantage of supervisors. For this reason, the creation of project managing, logistics managing and a maintenance managing roles is required.

– **Ireland:**

Irish experts are unique in considering that less skilled roles such as pipe-fitter, carpenters, structure engineers and occupational risks managers are bound to disappear.

– **Portugal:**

Most of analysed positions in the production cycle already exist in Portugal, and they are all expected to undergo adaptation as 4.0 technologies are being implemented, except for Cybersecurity expert, New materials expert, Additive manufacturing expert and smart logistics expert, which are being created as the sector modernises.

Portuguese consider that the other endangered jobs in the production area are Preventive and Predictive Maintenance.

4.5 Prioritasiton of job positions in the shipbuliding and ship repair insdustry according to the survey outputs

As a conclusion of the inputs provided by experts and partners from the five participating countries, shipbuilding and ship repair companies across the Atlantic Area are well aware of the upcoming organisational transformation, to the extent that have identified an extensive list of jobs whose demand will be a direct consequence of the incorporation of 4.0 technologies, either as positions of new creation, or positions to be adapted through training.

The following classification is based on the degree of consensus, with at least 50% of answers coinciding in the same trend:

– Bound to disappear
– To be adapted
– To be created

	Job positions bound to disappear	Job positions to undergo important adaptation	Job positions to be created
Sales	Accounting assistant Budget assistant Account manager Budger manager	Custormer service assistant Sales assistant Sales manager Technical sales manager Post-sales manager Customer service manager Production flow manager	Data analyst Virtual reallity creator Database legal expert
Ingineering	Structure building technician Sales support engineer	Drafts person (CAD) Design manager Engineering manager Shipbuilding architect Designer Planning technician	Robotics expert 3D simulation expert Artificial Intelligence expert
Manufacturing	Foreman	Production assistant Maintenance assistant Planning assistant Welder Electrician Pipe-fitter Carpenter Service technician Chief engineer Project manager Struture engineer Logistics manager Occupational Risks manager Maintenance and repair manager	New materials expert Cyber security expert Additive manufacturing expert Smart logistics expert

Illustration 16 Source: Own elaboration based on survey results

The positions of Alliance manager, Data scientist and Pre-sales manager were left out of the above classification due to the uneven consensus regarding the future of such professions per country

So, according to the survey implemented for the current report, the top 10 priority job positions to be created are:

1. Data analyst

2. Virtual reality creator

3. Database legal expert

4. Robotics expert

5. 3D simulation expert

6. Artificial Intelligence expert

7. New materials expert

8. Cyber security expert

9. Additive manufacturing expert

10. Smart logistics expert

However, it is important to remark that on the experience of the IN 4.0 Project partners, **manufacturing is the immediate priority in terms of innovation and workers training and adaptation to the industry 4.0 model**, which comprises the following 4 top positions:

> **TOP 4 FOUR TECHNOLOGIES TO BE CREATED IN THE ATLANTICA AREA MANUFACTURING AREA OF THE SHIPBUILDING AND SHIP REPAIR SECTOR**
>
> 1. **New materials expert**
> 2. **Cyber security expert**
> 3. **Additive manufacturing expert**
> 4. **Smart logistics expert**

5.

Human Resources Protocol Methodology

5 Human Resources Protocol methodology

Considering previous conclusions, and in view of future demands, the challenge for shipbuilding and ship repair companies across the Atlantic Area is to become more competitive compared to other companies that have already modified their organisational structure and work profiles.

Each company in the shipbuilding and ship repair sector should go through a self-assessment process in order to identify weaknesses in the current organisational situation and hence, to transform them into opportunities. The most useful methodology for companies to undergo organisational improvement is the development of a customised human resources protocol linked to a management plan. It is important to remark that the current proposal of human resources protocol has a sector approach rather than a company approach, and it is intended as a guide for companies to understand the challenge of organisational transformation.

Every company in the shipbuilding and ship repair sector should undergo a self-assessment process in order to identify weaknesses in their organisational structure and therefore transform them into opportunities. The most useful methodology for organisational improvement is the development of a customised human resources protocol linked to a management plan, for that reason the current report concludes with the proposal of a human resources protocol methodology. This methodology is intended as a guide for shipbuilding and ship repair companies to understand the challenge of organisational transformation and how to deal with it.

The following sections focuses on the description of the three main stages that companies must undertake to achieve such an organisational transformation.

5.1 Phase 1: Analysis of the organizational situation. Organizational Performance and Improvement Report

The first step consists in the analysis of the business model, including a detailed analysis of all the existing job positions in the company. All sorts of information and documents related to these job positions must be gathered, evaluated and structured in order to achieve the following results:

- in-depth knowledge of the current organizational structure

- design of the real organisational diagram (not the functional one)

- assessment of the current dimensioning of human resources structures and whether they are optimal

The next steps, resulting from the above analysis are the preparation of a diagnosis of the current organizational structure of the company, as well as the preparation of a series of proposals for improvement, both aimed at ensuring balance between the current business model, the expected organizational structure and the required professional profiles. Subsequently, companies should start by:

- Identifying current job positions that will no longer be profitable or optimal in the new organisational structure designed for the adaptation to the industry 4.0 model and developing mechanisms for their harmonisation.

- Articulating mechanisms for the transformation of the existing positions that will no longer be profitable into new ones aligned with the future needs of the company, seeking the greatest optimization of the workforce.

- Identifying the new profiles that should be incorporated to the new organisational structure adapted to the industry 4.0 model.

5.2 Phase 2: Job positions description

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Once the new organizational structure is designed, a new Job Positions Manual should be developed. This manual should include an in-depth analysis and description of the jobs listed in Phase 1, identifying the deficiencies that need to be rectified.

The handbook should also list the new professional profiles that, as discussed in section 4.5, are necessary for the positioning of shipbuilding and ship repair SMEs in the 4.0 industry paradigm, as well as for the design of new growth strategies.

The process of describing and analysing each job position should be approached through:

- Simplification of job positions categories, as it will allow greater versatility of human resources
- Analysis of the job positions in collaboration with the employees who are occupying them. Employees should have the opportunity to add comments and observations to such analysis
- Each job position will be characterized in a card, listing the mission, functions and responsibilities. Job cards will be consolidated into a manual
- This manual must be digitally supported in order to facilitate further modifications
- The manual must regulate the functions assigned to each job position, indicating details such as equipment involved, any special technical complexity, dedication, full list of responsibilities, as well as any other requirements that may contribute to a greater precision in the specifications of each job position

The mandatory minimum fields that each job card should include are:

- Job title
- Job code
- Number of homogeneous positions
- Service, unit or department that employee must report to
- Type of contract
- Functional dependency
- Particular performance conditions: training, specific requirements, other requirements...
- Description of main functions and responsibilities

- Proposal of specific objectives for the position

- Observations

A simplified example is provided:

JOB DESCRIPTION SHEET
Job title: **Robotics engineer**
Job code: (internal classification according to each company's organigramme and structure)
Number of existing homogeneous positions in the company: (according to each company's circumstances)
Service/unit/department (position in the company's organigramme): (according to each company's organigramme)
Reports to: (person/team/ department according to each company's organigramme)
Coordinates: (person/team/department according to each company's organigramme)
Type of contract: (permanent, eventual, fix-term)
JOB REQUIREMENTS
Required qualifications: Automation and Industrial Robotics engineering (BCs)
Overall skills: - Must be capable of managing and implementing projects for the assembly and maintenance of automatic measurement, regulation and facility control.   - Must supervise the assembly, maintenance and start-up of manufacturing processes.   - Must supervise Quality control and Environmental procedures, as well as guarantee compliance with occupational health regulations in the factory premises.
Professional environment: Public and private companies related to industrial automatic systems, in the areas of design, assembly and maintenance of industrial automation systems.
Most relevant task and responsibilities:

- Chief of assembly of industrial automation systems
- Chief of industrial automated systems maintenance
- Verifier of appliances, panels and electrical equipment
- Chief of the electromechanical workshop
- Industrial automated systems maintenance technician
- Technician specialised in the implementation of industrial automated systems.
- Designer of control systems for industrial automation systems.
- Designer of measurement and regulation systems for industrial automation systems.
- Designer of communication networks for industrial automation systems.
- Programmer controller of industrial robots.
- Technician specialised in the design of electrical control systems.
- Designer of circuits and integrated systems in industrial automation.

JOB OBJECTIVES
Companies must describe the specific objectives per job position according to the particular circumstance of the organization and functional area (lead a team, achieving a certain goal, etc.)

OBSERVATIONS
Any comment that may help understanding all the characteristic of the job position

5.3 Phase 3: Human resources management plan

The final objective of Phase 3 is to provide shipbuilding and ship repair companies with a Human Resources Management Plan that serves as an effective instrument for optimising human resources. The objectives of the plan are:

- Achieving efficient management by adapting human resources to real and future needs

- Implementing the correct actions for the adaptation of human resources to real needs

- Optimising the allocation of human resources, which will result in better quality of service delivery

- Seeking optimal balance between job creation, renewal of the workforce and labour stability

- Incorporating measures for professional and personal motivation, for the stimulation of activity and service quality.

In order to achieve these objectives, the Human Resources Management Plan must include a series of organisational measures such as the analysis of training needs, development of a training plan and mentoring.

5.3.1 Identification of training needs

The first step consists in analysing the training actions are currently being carried out in the company in order to prepare workers for internal and external challenges, both in the short and medium term. At this stage, any barriers or difficulties for the implementation of new training actions must also be identified and considered.

After collecting information on the training and qualifications situation of workers, a survey on training needs should be designed. This survey should be tailored specifically to the company's needs and should be answered by each member of staff. But before emailing or distributing it, a meeting with respondents is recommended, so they are explained the survey methodology. Respondents will be given a certain period of time to submit it. Seven days is a reasonable deadline.

5.3.2 *Training plan*

When training needs and barriers had been identified through the survey, it is time to design training actions that allow workers to acquire new skills and efficient working methods.

In this context of transformation and adaptation of shipbuilding and ship repair workers, the objective of training actions should focus on providing occupants of certain positions with the necessary skills to perform other jobs and tasks different from the ones they occupy, in line with the profiles identified in section 4.5.

Training actions per job position should be worked out through the following phases:

- **Identification of training needs according to skill requirements per job position**

In view of the survey results, it is essential to clearly identify the differences between how each job is currently being carried out and how it should be carried out in order to achieve greater efficiency.

- **New Skills Specifications List**

New skills specifications should list and describe the capabilities, attitudes and minimum qualifications required to employees per job position.

- **Training objectives**:

When defining the training objectives, the methodology must consider the following aspects:

- Setting up training objectives, clearly aligned with the company's objectives in terms of growth and adaptation to the industry 4.0 model.

- Assessing to what point the identified training needs are essential, or in other words, assessing whether workers would be able to achieve the company's objectives if they are not correctly trained to acquire new skills

- Listing the new skills, in observable and measurable terms, classifying them according to homogeneity criteria and expected qualifications.

5.3.3 *Mentoring plan*

After workers who occupy both nonessential positions and positions that need to be upgraded have been trained to perform new tasks adapted to the 4.0 industry model, knowledge must be consolidated at their new workstations. This practical training will be carried out through a mentoring programme, pursuing clear objectives and within a precise timeframe.

Mentors will be appointed from amongst the most experienced coworkers to guide, advise and support the trainees.

Mentors must be willing to facilitate the professional development of their colleagues and will follow customised mentoring plans per type of job according to their expertise, as the performance of each job implies specific technologies and administration procedures.

There is flexibility in terms of schedule, however 6 months from the moment trainees are effective in their new job positions should be sufficient to achieve the training programme objectives.

Mentoring Programme main steps:

- The mentoring programme should start with an interview between mentors and trainees, where information regarding personal data, previous training, mentoring expectations (duration, objectives, etc.) is exchanged.

- The mentoring program will include a daily one-hour follow-up session. Subsequently, these sessions will be reduced according to achievements, until they reach a weekly session in the last month of the program.

- In the last week of the program a final evaluation interview will be held between the human resources coach, the mentor and the trainee. This interview is aimed at determining the main achievements, as well as identifying any weak aspects for the improvement of future mentoring programmes.

The mentoring program may include additional support by phone or email, if the tutor and trainee are not physically located in the same premises.

Recognition and incentives for mentors are also an important aspect to be considered by the company. Typically, experienced professionals in the company who get involved in the training of their co-workers do so voluntarily and out of personal commitment, for which official recognition should be granted, such as the valuation of these actions in view of professional promotion processes.

5.4 Phase 4: Closing analysis of the new structure

Following the steps outlined in these human resources protocol methodology, the company must perform a final process of self-assessment to determine whether the protocol has been successfully implemented or whether any other corrective action is required.

The current business scenario means that in the structure of each company what should prevail is flexibility and agility to identify opportunities in time and that the organization knows how to adapt to it.

The current business scenario in the shipbuilding and ship repair sector demands flexibility and agile identification of new opportunities. More and more new professional profiles with the capacity to affect companies' growth strategies are appearing, and for this reason shipbuilding and ship repair companies must be prepared.

Therefore, this final self-assessment must conclude whether the protocol has been satisfactorily implemented and has been sufficient to achieve a business structure adapted to the new technological needs of the shipbuilding and ship repair sector or, on the contrary, whether further corrective actions are necessary.

At this stage of conclusions, the company must make decisions based on the information resulting from the self-assessment process and must carry out actions aimed at improving its structure.

The self-assessment process must include:

- Analysis of the document "Human Resources Management Plan".
- Analysis of the strengths and weaknesses identified in the outcomes of the employees' self-assessment.

- Describing the possible causes of the weaknesses, i.e., establishing the reasons that cause or influence them.

- Prioritisation of the weaknesses to include them in the management plan, according to the business characteristics and context.

- List of corrective actions that could improve the current situation of the company from the HR point of view (solutions).

- Feasibility analysis per action in terms of timing, cost, technical resources, etc.

- Analysis of the strengths that must be secured and/or maintained

- Design of the improvement plan for the adaptation to the new scenario of industry 4.0, envisioning the actions to be carried out in the short and medium term.

6.

Conclusions

6 Conclusions

Such as abstracted from the analysis of the current structure of workforce in the shipbuilding and ship repair industry across the Atlantic Area based on existing bibliography (section 3), the implementation of 4.0 technologies showcases a **scenario of opportunities in terms of job creation, especially in the design and production links of the value chain**. The creation and adaptation of jobs to the new technological scenario seems to be possible thanks to the great number of qualified and skilled workers, with extensive experience in the construction of new ships.

However, **some risks are also foreseen in terms of job destruction** as 4.0 technologies are expected to destroy positions implying repetitive jobs occupied by unskilled workers, especially in the production cycle. On the other hand, workforce is rather aging, and a shortage of technical profiles is expected in about 15 years, without forgetting that new technologies may endanger communication within companies due to the loss of soft skills that are inherent to humans.

As a preliminary conclusion, the sector should prepare to undergo important changes towards adaptation to the new scenario by:

- Designing qualifications and courses (not necessarily university degrees) specifically aimed at young people and at reinforcing technical profiles in the shipbuilding and ship repair sector
- Implementing actions towards engaging young people in the last years of compulsory education and attracting them to the above mentioned courses
- Reinforcing sales departments by training workers for international sales positions, not only aimed at bringing new construction projects to the EU shipyards, but also ship refurbishing and repair projects
- Training actions must be strongly practical, and technology based, and must also imply training to improve and identify soft skills

Such as previously explained, the methodology implemented by ACLUNAGA for the analysis of current skills and job profiles in the shipbuilding and ship repair sector, consisted in the distribution of a survey (section 4) to collect information in the five regions participating in the IN 4.0 Project: Ireland, United Kingdom, France, Spain (Galicia and the Basque Country) and Portugal.

The objective of this survey was obtaining complementary information to the main conclusions obtained through the analysis of existing bibliography regarding the current structure of workforce in the shipbuilding and ship repair industry across the Atlantic Area. In this end, the most relevant contributions are listed below.

When it comes to analysing current labour opportunities, the general perception is that **the growth weight of shipbuilding and ship repair industry is greater in France, Spain and Ireland**, where the demand for skilled and qualified workers is increasing, while in the United Kingdom there is an urgent need to increase competitiveness:

- Jobs related to the construction of new ships generally account for the largest share of employment in the shipbuilding and ship repair sector in the five participating countries (but for France, where the number of employees engaged in ship repair activities is slightly higher)
- More than 60% of employees are over 40, while young employees (under 25) account for less than 15% in the Atlantic Area. Thus, with exception of France, there is a shortage of young skilled and qualified workers
- Employees' level of education in the shipbuilding and ship repair industry is generally high, but differs significantly from country to country (30% of workers hold higher education certifications in Spain; 51% in France and shortage is identified in the United Kingdom)
- Workforce is quickly evolving in France, especially regarding the acquisition of design and mechatronics skills
- The shipbuilding and ship repair industry struggles to remain competitive in the UK, partly due to the fragmentation of the supply chain and the small number of existing shipyards, although the surviving companies are leading-edge shipyards at international level, which are even influencing national education policies aimed at attracting young students to the shipbuilding and repair industry. Whereas the sector is on the rise in Ireland.

As for **the impact of 4.0 technologies in the current structure of workforce**, the survey shows even results across the Atlantic Area, as responders coincide in considering that the scenario will be highly affected by job destruction, especially with the redundancy of low-skilled workers mainly in the manufacturing link of the value chain, to the point that shipyards in the UK might be forced to outsource a certain number of processes implying 4.0 Technologies and skills. Despite being small, the Irish shipbuilding and engineering sector seem to be well positioned for industry 4.0 and open to fostering public policies that enable education and training actions for the development of the marine industry.

Spanish, British and French experts consider that **technologies related to new materials and intelligent manufacturing** will have a significant impact on tasks that can be replaced by robots and/or machines. However, some jobs involving very repetitive tasks may survive, as they require skills that cannot be replaced by mechanical means in the short and medium term and some supervision-related jobs will also be maintained, as supervision cannot be replaced by technology in many cases. On the other hand, technological transformation in manufacturing is expected to result in an increased need for training in two main skills: **man-machine collaboration and management.**

Based on the information compiled in Spain, France, experts agree that the growing introduction of **analysis, management and monitoring tools** is a key factor for competitiveness. On the other hand,

France makes the difference when it comes to the gender equality, as major efforts are being made to attract **female experts** in customer data management, image and augmented reality, as well as in advanced algorithms and artificial intelligence.

In general, the compiled list of change drivers according to experts form the five territories, include the following technological achievements:

- Collaborative Robots to assist with welding

- Additive Manufacturing

- Virtual and Augmented Reality

- Predictive Maintenance

- Digital Twins

- Advanced algorithms for predictive maintenance

- Internet of Things and cloud connections

- Ubiquitous high-speed mobile internet

- Artificial intelligence

- Widespread adoption of big data analytics

Soft skills were also analysed at this stage, and according to consulted experts across the Atlantic Area, the technological revolution ahead will only be possible if workers are well equipped with willingness to accept change, together with other soft skills such as organizational flexibility and creative and critical **thinking.** These findings support the previously described expectations regarding the relevance of soft skills for certain positions implying analysis, management and monitoring, as they cannot be replaced by the machine factor.

The graph below showcases the level of importance of soft skills as valued by survey respondents:
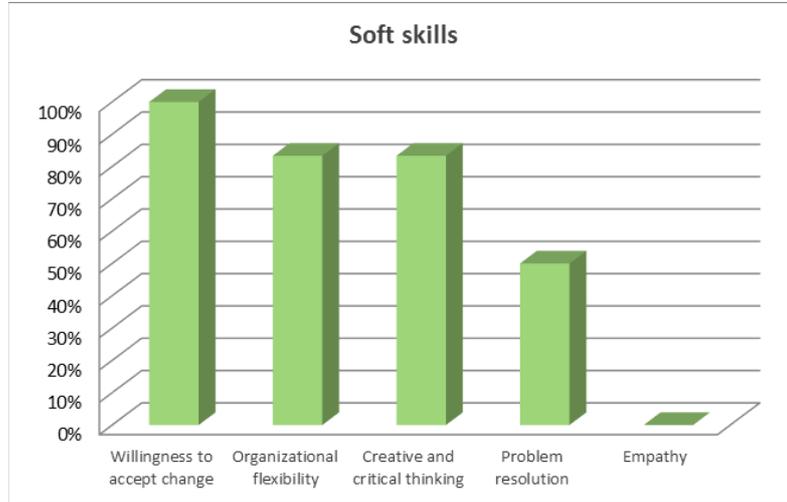
Experts across the Atlantic Area have also considered that training actions aimed at adaptation to the new industry model, should include the following soft skills:
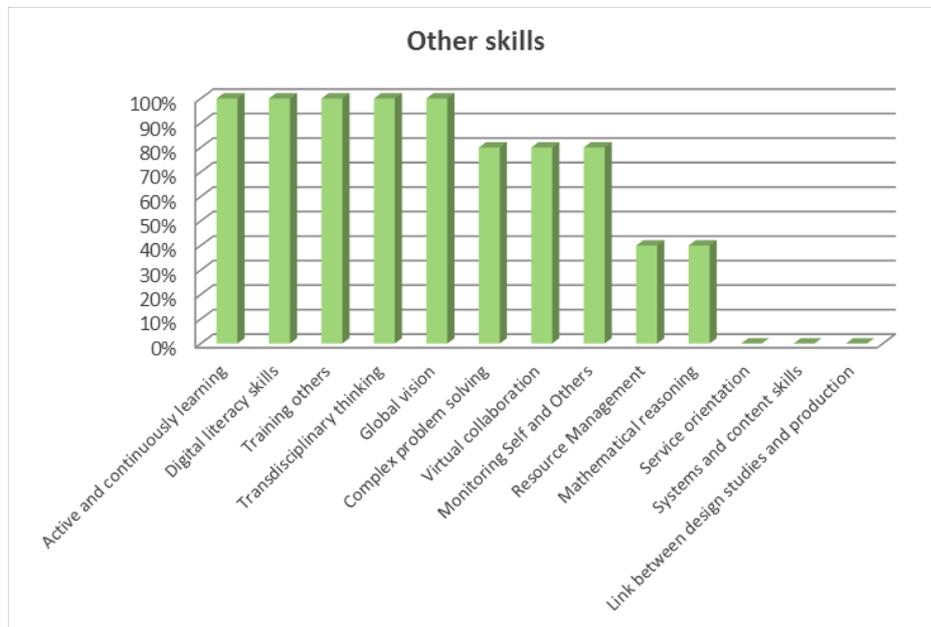
The analysis of **job trends according to the expected impact after the implementation of the industry 4.0 model** (in terms of adaptation, creation or redundancy of jobs) can be summarised as follows:

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- **Sales and administration positions**

Experts from the five participating countries agree on placing special emphasis on assistant positions in the sales and administration cycle. In the view of the experts consulted in the UK, assistant positions are doomed to disappear from British shipyards, as they are forced to optimise their resources due to their small size, thus managers will be required to acquire technological skills that will enable them to cover a wider range of tasks. However, Spanish, French, Irish and Portuguese experts consider that assistant positions are expected to be filled by younger workers in the near future. These workers are likely to have a more technological profile and will therefore bring knowledge to companies, through the use of integrated management tools and the introduction of a more open approach to innovation based on alliances with other companies and stakeholders. Alliance managers are envisioned as a key position for the modernization of the sector.

- **Engineering positions**

There is almost total unanimity in the analysis of the suitability and relevance of engineering functions, especially with regard to the creation of positions such as Robotics Expert, 3D Simulation Expert and Artificial Intelligence Expert, as well as with regard to the expected adaptation of existing positions (draughtsman, design director, chief engineer, naval architects and designers.

However, it is important to underline that, once again, experts believe that due to the small size of British shipyards, many of these engineering positions will have to be outsourced rather than created within the company. Engineering assistant positions are also expected to disappear.

On the other hand, and throughout the Atlantic Area, it may be necessary to create other new positions to support SMEs in the digital journey, and functions related to Reliability Engineering Departments will have some relevance in the future.

- **Production**

Conclusions regarding job positions in the production cycle are quite homogeneous in the five analysed territories, where most of jobs are expected to undergo relevant adaptation to the new technological scenario. However, there are also certain disagreements, especially regarding the positions of **foreman, planning assistant, pipe-fitter, carpenter, structure engineer, occupational risks manager, new materials expert and smart logistics expert** that are expected to be redundant in some territories.

On the other hand, some positions in the production cycle, such as **production assistant, project manager, logistics manager, maintenance and repair manager, new materials expert, cybersecurity expert, additive manufacturing expert and smart logistics expert** are considered weak or not currently

existent in some territories, but are expected to become necessary to make the sector more competitive. Thus, they represent and opportunity for job creation and for adaptation to the industry 4.0 model.

As a conclusion of the analysis carried out in the five project territories (Ireland, United Kingdom, France, Spain and Portugal), the **top 10 priority job positions to be created** in order to adapt the shipbuilding and ship repair sector to the industry 4.0 model are:

1. Data analyst
2. Virtual reality creator
3. Database legal expert
4. Robotics expert
5. 3D simulation expert
6. Artificial Intelligence expert
7. New materials expert
8. Cyber security expert
9. Additive manufacturing expert
10. Smart logistics expert

However, it is important to remark that on the experience of the IN 4.0 Project partners, **manufacturing is the immediate priority in terms of innovation and workers' training and adaptation to the industry 4.0 model**, which comprises the following 4 top positions:

1. **New materials expert**
2. **Cyber security expert**
3. **Additive manufacturing expert**
4. **Smart logistics expert**

Considering previous the conclusions, and in view of future demands, the challenge for shipbuilding and ship repair firms across the Atlantic Area is to become more competitive compared to other companies that have already modified their organisational structure and work profiles.

The most useful methodology for companies to undergo organisational improvement is the development of a **customised human resources protocol linked to a management plan**. The current report includes a human resources protocol model (section 5), based on a sector approach rather than a company approach, and it is intended as a guide for companies to understand the challenge of organisational transformation, so it needs to be adapted and developed according to the size and needs of each

individual firm. The objective of this human resources protocol and management plan is to identify weaknesses in the company's organisational structure and therefore transform them into opportunities.

The three proposed main stages for companies to undertake to achieve such an organisational transformation are:

- **Phase 1**: analysis of the organisational situation in terms of current performance and opportunities for improvement. This analysis must be carried out according each company's particular business model.
- **Phase 2**: analysis of job positions (description, requirements-skills, tasks and responsibilities-objectives, etc.). Job positions, qualifications and skills will be analysed and classified according to each company's particular needs and priorities (engineering, production, maintenance, etc.)
- **Phase 3**: **human resources management plan, which should be scheduled according to each company's needs, size and capability to speed up organisational changes**[2]:
    - o Identification of training needs
    - o Design of the training plan
    - o Design of the mentoring plan
- **Phase 4**: review and closing analysis of the new structure

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[2] The next step in the IN 4.0 Project is the implementation of a pilot project based on the design and implementation of specific (and very practical) training actions aimed at upgrading the technological skills of selected SME's workers and young trainees across the five participating territories. Thus, clearer conclusions regarding the training and monitoring plans will be added to the overall results of the project.
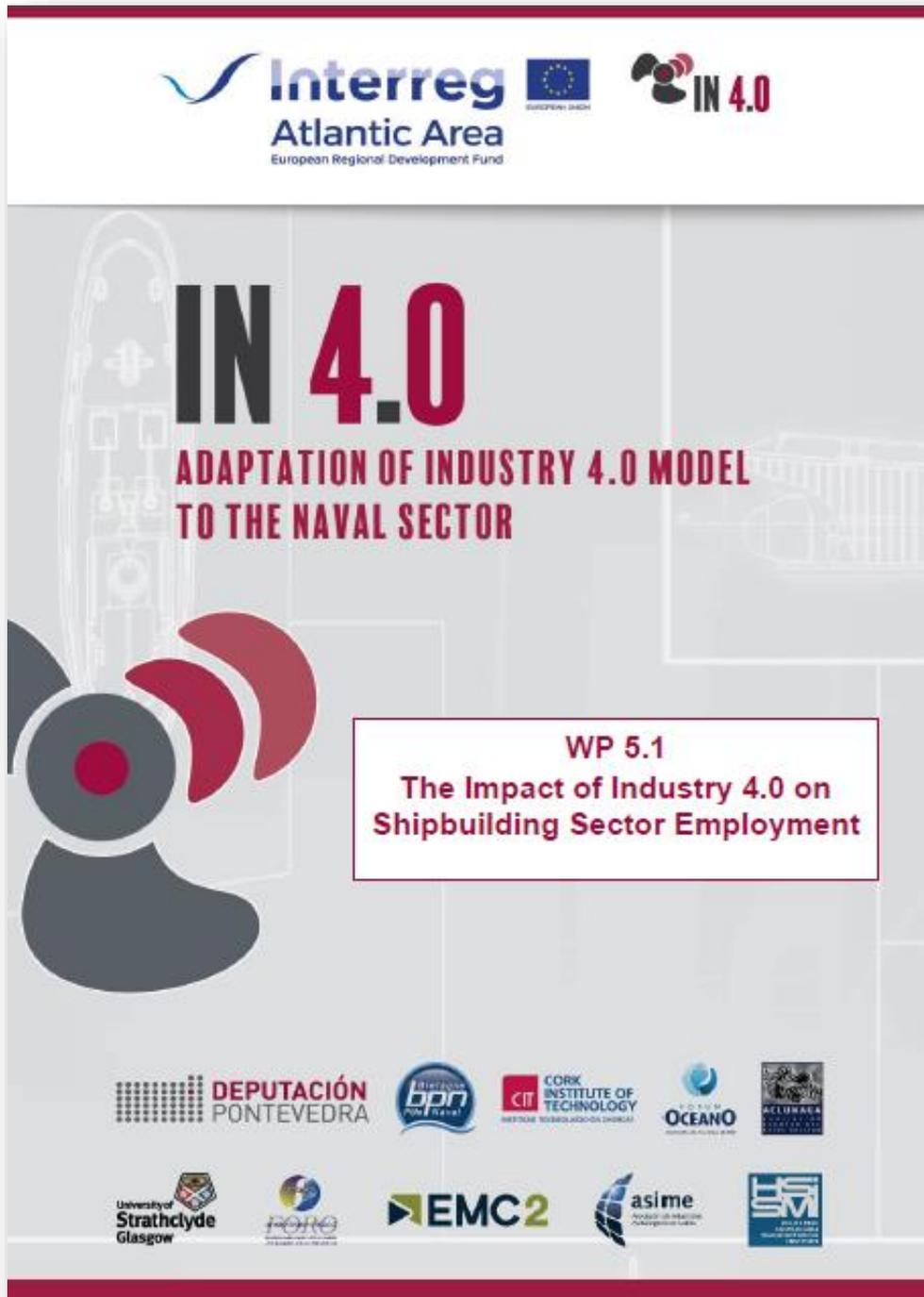
7.

Annexes

7 Annexes

7.1 Questionnaires on "The Impact of Industry 4.0 on Shipbuilding Sector Employment" per partner

7.1.1 *Basque Country*

WP 5.1 The Impact of Industry 4.0 on Shipbuilding Sector Employment

WP 5.1 Objective: "Analysing the naval sector in the region of Basque Country in order to elaborate a diagnosis of the skills and job profiles, which will be later validated by the rest of project partners. The final objective is drawing up a final document which will include all contributions.

- *Objective of this template:* collecting all the information regarding to Impact of Industry 4.0 in the jobs in the shipbuilding sector in your regions of the Atlantic Area.

- *Reminder:* please provide a **first version by the end of September**; do not hesitate to contact me for any question.

- *Guidelines for completion of the template:*

  - This template has to be filled in with information from your country (thanks to existing literature and national studies), please identify the scope of the data you will provide (regional or national). If you do not have access to the information required please come back to me and explain the reason.

  - For inspiring purpose, you will find some answers from Basque Country data and also comparison with other countries in the form; please do not consider this information as completely exhaustive and replace my answers by yours.

  - Do not hesitate to add other elements and information that may not appear in this template. This template was created from the information I collected regarding the Basque Country situation, it may not be completely adequate to your country situation.

For any question or remark, do not hesitate to contact me at: apurens@aclunaga.es

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Literature review

This section contains information about the sources than have been consulted during preparation of this research report.

In the case of the Basque Country study, references that have been used are:

- Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry, report published by Community of European Shipyards Associations (CESA).

- ATIGA data (http://www.atiga.es/industria-4-0/)

- IGAPE data (http://www.igape.es/es/ser-mas-competitivo/galiciaindustria4-0/estudos-e-informes)

- The Future of Jobs (World Economic Forum)

- Skills Framework for Marine and Offshore. Skillsfuture

- La Digitalización y la Industria 4.0. Impacto laboral e industrial. CCOO Industria.

Please fill in the table indicating your sources as per the provided template.

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1. Brief analysis of skills and employment opportunities in this sector

In this section, we will carry out an analysis of skills requirements and type of job profiles in the naval sector of Atlantic Area.

Based on the study made in Basque Country, some of the main conclusions are:

- Countries in Atlantic Area are characterized by a large share of workforce engaged in the construction of new vessels, except in the case of France, where the workforce dedicated to repair works is somewhat higher than in the other countries.

- These countries have a shortage of young technical workers; with the exception of France, in other countries more than 60% of the workers are older than 40 and young workforce (<25 years) in all countries in Atlantic Area is below 15%. Moreover, because most workers are over 40 years, in the next 15 years there will be a high demand for skilled workers.

- The level of education in the naval sector is generally high, but differs significantly between countries, being particularly high in Spain and France, where around 30% of workers have a tertiary education.

- Technical profiles in the naval sector can be classified according to their function at the company, based on CESA study. In this way, there are 3 main functional areas or departments:

    - **Wholesales life cycle (including pre and post sales service):** Pre-sales engineering, commercial activity, budgeting and after-sales service.
    - **Design and Engineering:** Designers, draftspersons, naval architects, structural engineers, etc.
    - **Planning and production:** Work-Planning, Project Management, carpentry, pipe-fitters, welders, etc.

    Based on this research, only 2% of workers are engaged in sales departments, 16% in design and engineering and 82% in planning and production. This indicator is an interesting basis for analysis of industry 4.0 impacts on shipbuilding.

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2. Industry 4.0 impact on the current shipbuilding workforce structure

Once the current workforce in shipbuilding has been analysed, the purpose of this section is to assess the impact of industry 4.0 on it.

Based on previous diagnose, it's important to take into account that 82% of workforce is engaged in planning and production work. This factor determines the first consequence associated with the impact, since most of the technologies involved produce results in a reduction of profiles that require repetitive work and low-skilled workers, who mostly are in production areas.

3. Impact on jobs according to technological groups

To analyse the impacts on jobs in the sector, it will be divided into two blocks: "Materials and intelligent manufacturing" and "Analytical, management and control".

Block 1: Materials and Smart Manufacturing
This block includes technology related to manufacturing processes. In this section it's important to asses the impact on jobs that can be supplanted by robots and automated machinery, such as welders, workers who make straightening and assembly of parts, pipe-fitters and electricians. Only low-skilled jobs that require some skill or skill / creativity that make no profitable mechanical work will remain. We're talking about jobs with a high level of craftsmanship, such as some carpentry work.

In addition, all work supervision and production aid is destined to disappear or be minimized, since the level of supervision of work performed by machines or robots is minimal compared to executed by humans. Training will be essential in man-machine collaborative environments.

Concerning to higher education employees, manager positions in production and engineering areas will be totally transformed by the technological change introduced.

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This is because main work of managers was to supervise teams of workers, as they must now about:

- Knowledge of different tools of management and control of machinery and robots
- Knowledge of robotics and automation
- Integration of different levels of information systems
- Collaborative work elements Man-Machine
- Structures and properties of new materials
- Methods and additive manufacturing processes
- New design tools and engineering
- Sustainable manufacturing techniques and energy efficiency
- Planning and control in all the supply chain
- Innovation and collaboration
- Managing the complexity

Block 2: Analytical Technologies, Management and Control

This block includes technologies related to analysis, management and control, instead of manufacturing and production. This means:

- All activity related to data analysis of the whole sales life cycle (pre-sales, sales and after-sales)
- All information management related to the sensors installed in the company, about manufacturing process and logistics, maintenance, materials management, supplier management equipment, etc.
- Customer data management, for marketing, business development and definition of new strategies.
- Image and augmented reality, virtual catalogue for sales, product presentations and training.

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- Advanced algorithms and artificial intelligence to optimize the processing of all information received, make predictions and act accordingly.

Most of these jobs are related to sales area (marketing/ strategy commercial-sales-sales / customer management) and engineering and design areas too. In these departments, most of the employees have higher education and, although most of these profiles will remain, they need a transformation as a result of the digital transformation.

4. "Soft" or transversal skills

Apart from technical knowledge (also known as "hard"), "soft" skills are very important in a company. These are skills and transversal competences that are essential for a job to adapt quickly in a digital environment characterized by continuous a change in the field of digital tools, production systems and internal and external relationships.
In this section our purpose is to classify transversal skills related to naval companies, according to its level of importance.

Some examples are:

Skills	Level of importance
Organizational flexibility	Medium
Willingness to accept change	High
Empathy	Medium
Creative and critical thinking	High
Problem sensivity and resolution	High
Complex problem solving	High
Active and continuously learning	High
Systems and content skills	Medium
Service orientation	Medium
Digital literacy skills	High

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Monitoring Self and Others	*High*
Mathematical reasoning	*High*
Training others	*High*
Resource Management	*Medium*
Transdisciplinary thinking	*High*
Virtual collaboration	*High*
Global vision	*High*

5. New jobs profiles creation

In this section we will explain the **change in job profiles** caused by the implementation of industry 4.0. Although it is true that it will bring the disappearance of some jobs, also it will bring the appearance of many others, some already defined and many others to be defined. Among those already defined, some examples are:

- Robotics engineer (design and build robots to and software)
- Specialist in artificial intelligence.
- Creator of virtual reality and augmented
- Scientist or data analyst.
- Responsible for planning digital image of the company and social networks
- Responsible for engineering and design for additive manufacturing.
- Responsible for environmental impact and efficiency.
- Legal experts in data management
- Industrial data scientist
- Robot coordinator
- IT/IoT solution architect
- Industrial UI (user interface)/UE(User experience) designer
- Salesmen with 3D-tools expertise and process simulations
- Cybersecurity Manager
- Machine Learning engineers

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- 3D technical teachers for production and maintenance
- Fast and short lines industrial designers
- Digital document manager
- Product Lifecycle Manager
- Digital Supply Chain configurator
- Advanced warehouse managers
- Proactive maintenance
- Cobots (collaborative robots) designers

Another very important part in the future companies is related to innovation. Today no company is able to manage completely its R&D internally. It is based on external collaborations system where knowledge is shared by specialists. It is the Open Innovation model, where they work in globalized innovation networks. Innovation staff, apart from a deep technical knowledge in their areas of excellence and specialization, should also serve as a link to the different areas of knowledge that are necessary in the company.

6. Jobs classification according to the industry 4.0 implementation

As it was mentioned earlier, in this sector we can classify job profiles into three different areas according to their function at the company.

Sales and administration

Positions	Level of importance
Accounting Assistant	Extinguish
Customer Service Assistant	Adapt
Sales Assistant	Adapt
Budget Assistant	Extinguish
Sales Manager	Adapt

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Technical Sales Manager	*Adapt*
Pre-sales Manager	*Adapt*
Post-sales Manager	*Adapt*
Account Manager	*Adapt*
Customer Service Manager	*Adapt*
Budget Manager	*Adapt*
Data analyst	*Adapt*
Virtual reality creator	*Create*
Legal expert on database	*Adapt*

Engineering area

Positions	Level of importance
Structure Building technician	*Adapt*
Sales technician	*Adapt*
Planning technician	*Adapt*
Draftsperson (CAD)	*Adapt*
Design Manager	*Adapt*
Engineering Manager	*Adapt*
Naval architect	*Adapt*
Design Engineer	*Adapt*
Robotics expert	*Create*
3D Simulation expert	*Create*
Artificial Intelligence expert	*Create*
Assistant Designer Engineer	*Extinguish*

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Production

Positions	Level of importance
Production assistant	Adapt
Maintenance assistant	Adapt
Planning assistant	Adapt
Foreman/Supervisor	Adapt
Welder	Adapt
Electrician	Adapt
Pipe-fitter	Adapt
Carpenter	Adapt
Service technician	Adapt
Chief Engineer	Adapt
Project Manager	Adapt
Project Engineer	Adapt
Structure Engineer	Adapt
Logistics Manager	Adapt
Labor risks Manager	Adapt
Maintenance and repair Manager	Adapt
New Materials expert	Create
Cybersecurity expert	Create
Additive manufacturing expert	Create
Smart Logistics expert	Create
Rapid prototyping technician	Create
Trade Specialist	Adapt
Production Engineer	Adapt

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Production Section Manager	Adapt
Procurement Executive	Adapt
Procurement Specialist	Adapt
Quality Control Engineer	Adapt
Quality Control Manager	Adapt
Quality Control Assistant	Adapt
Workplace Safety and Health Coordinator	Adapt
Workplace Safety and Health Manager	Adapt
Operations Manager	Adapt
General Manager	Adapt
Chief Operating Officer	Adapt
Warehouse Manager	Adapt
Warehouse Assistant	Adapt

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Free comments

Basque and Spanish naval industry are in general characterized by a low/medium size and a low volume of construction and their competitivity has been affected by Asiatic ones with low labour costs and a serial production. The competitive advantage for the region is to specialize in high technological niches with fast production and offering high service/quality. In this scenario, there are some needs to cover and naval sector must adapt to industry 4.0 to get their goals, and of course, the workforce must change to these new needs.

The transformation of the society is changing the economy, the industry and the nature of the jobs and labour skills. Companies must to know this new reality and prepare for it and academic community must adapt to develop the new roles appearing in industry.

7.1.2 *France*

WP 5.1 The Impact of Industry 4.0 on Shipbuilding Sector Employment

> **WP 5.1 Objective:** "Analysing the naval sector in the region of Galicia in order to elaborate a diagnosis of the skills and job profiles, which will be later validated by the rest of project partners. The final objective is drawing up a final document which will include all contributions.

- *Objective of this template: collecting all the information regarding to Impact of Industry 4.0 in the jobs in the shipbuilding sector in your regions of the Atlantic Area.*

- *Reminder: please provide a first version by the end of September; do not hesitate to contact me for any question.*

- *Guidelines for completion of the template:*
  - *This template has to be filled in with information from your country (thanks to existing literature and national studies), please identify the scope of the data you will provide (regional or national). If you do not have access to the information required please come back to me and explain the reason.*
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- ATIGA data (http://www.atiga.es/industria-4-0/)

- IGAPE data (http://www.igape.es/es/ser-mas-competitivo/galiciaindustria4-0/estudos-e-informes)

FRENCH

- European Erasmus IBCVET Program (http://www.ibcvet.eu/)

PRO & MER 2018 balance sheet (March)

GICAN : navire des métiers (CORICAN) https://corican.demedicis.fr/

Work of the BPN and CMF Employment Training Committee (French maritime cluster) www.cluster-maritime.fr

news about trades and skills: launching craft trades

EURONAVAL : https://www.euronaval.fr/85/metiers

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IN **4.0** ADAPTATION OF INDUSTRY 4.0 MODEL
TO THE NAVAL SECTOR

Interreg
Atlantic Area
European Regional Development Fund
IN 4.0

1. Brief analysis of skills and employment opportunities in this sector

In this section, we will carry out an analysis of skills requirements and type of job profiles in the naval sector of Atlantic Area.

Based on the study made in Galicia, some of the main conclusions are:

- Countries in Atlantic Area are characterized by a large share of workforce engaged in the construction of new vessels, except in the case of France, where the workforce dedicated to repair works is somewhat higher than in the other countries.

Ship repair is an important activity for the French shipbuilding industry, it requires diversified skills and in particular for refitting ships. Many engineering companies are also working on the conversion of large units, particularly for Offshore Oil & Gas.

- These countries have a shortage of young technical workers; with the exception of France, in other countries more than 60% of the workers are older than 40 and young workforce (<25 years) in all countries in Atlantic Area is below 15%. Moreover, because most workers are over 40 years, in the next 15 years there will be a high demand for skilled workers.

    - Regarding the average age especially for technicians it is important to moderate this notion for France. We have a significant gap between generations (estimate about 8 to 10 years) due to departures for asbestos cause. The new generation has been formed and recruited with a gap. In addition, the high demand of skill workers has to be face with a lack of interest ofthe worker for this type of job.

- The level of education in the naval sector is generally high, but differs significantly between countries, being particularly high in Spain and France, where around 30% of workers have a tertiary education.

    - Following a recent study (2018 March) conducted by BPN on a representative sample of more than 350 people, the level of education reaches the level of higher education (Bac + Bac + 5) at 51%

- Technical profiles in the naval sector can be classified according to their function at the company, based on CESA study. In this way, there are 3 main functional areas or departments:

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- **Wholesales life cycle (including pre and post sales service):** Pre-sales engineering, commercial activity, budgeting and after-sales service.
- **Design and Engineering:** Designers, draftspersons, naval architects, structural engineers, etc.
- **Planning and production:** Work-Planning, Project Management, carpentry, pipe-fitters, welders, etc.

Based on this research, only 2% of workers are engaged in sales departments, 16% in design and engineering and 82% in planning and production. This indicator is an interesting basis for analysis of industry 4.0 impacts on shipbuilding.

For France it is important to note an evolution of the jobs especially for the design (draftsman designer, design) also the jobs of mechatronics are more and seeked by companies of all sizes.

Currently a major recruitment plan has been launched on the Atlantic area (Great West) for "Outfitting Area"

2. Industry 4.0 impact on the current shipbuilding workforce structure

Once the current workforce in shipbuilding has been analysed, the purpose of this section is to assess the impact of industry 4.0 on it.

Based on previous diagnose, it's important to take into account that 82% of workforce is engaged in planning and production work. This factor determines the first consequence associated with the impact, since most of the technologies involved produce results in a reduction of profiles that require repetitive work and low-skilled workers, who mostly are in production areas.

It is important to remember that ship production is almost "prototype Industry", so a renewal of design means using high-tech skills is therefore a key factor in maintaining and developing this niche.

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3. Impact on jobs according to technological groups

In the case of the study made in Galicia, to analyse the impacts on jobs in the sector, it will be divided into two blocks: "Materials and intelligent manufacturing" and "Analytical, management and control".

Block 1: Materials and Smart Manufacturing

This block includes technology related to manufacturing processes. In this section it's important to asses the impact on jobs that can be supplanted by robots and automated machinery, such as welders, workers who make straightening and assembly of parts, pipe-fitters and electricians. Only low-skilled jobs that require some skill or skill / creativity that make no profitable mechanical work will remain. We're talking about jobs with a high level of craftsmanship, such as some carpentry work.

In addition, all work supervision and production aid is destined to disappear or be minimized, since the level of supervision of work performed by machines or robots is minimal compared to executed by humans. Training will be essential in man-machine collaborative environments.

Concerning to higher education employees, manager positions in production and engineering areas will be totally transformed by the technological change introduced.

This is because main work of managers was to supervise teams of workers, as they must now about:

- Knowledge of different tools of management and control of machinery and robots
- Knowledge of robotics and automation
- Integration of different levels of information systems
- Collaborative work elements Man-Machine
- Structures and properties of new materials
- Methods and additive manufacturing processes
- New design tools and engineering
- Sustainable manufacturing techniques and energy efficiency

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Block 2: Analytical Technologies, Management and Control

This block includes technologies related to analysis, management and control, instead of manufacturing and production. This means:

- All activity related to data analysis of the whole sales life cycle (pre-sales, sales and after-sales)

- All information management related to the sensors installed in the company, about manufacturing process and logistics, maintenance, materials management, supplier management equipment, etc.

- Customer data management, for marketing, business development and definition of new strategies.

- Image and augmented reality, virtual catalogue for sales, product presentations and training.

- Advanced algorithms and artificial intelligence to optimize the processing of all information received, make predictions and act accordingly.

  - • Gestion des données client, marketing, développement commercial et définition de nouvelles stratégies.
  - • Image et réalité augmentée, catalogue virtuel de ventes, présentations de produits et de formation.
  - • Avancée des algorithmes et l'intelligence artificielle afin d'optimiser le traitement de toutes les informations reçues, de faire des prédictions et d'agir en conséquence.

Regarding the last 3 typologies of skills / job identified, it should be noted that there is an important reinforcement of companies able to provide these types of advanced skills to women, especially for the treatment of augmented virtual reality, as well as for BIM or big data but also in monitoring facilities and equipment.

Most of these jobs are related to sales area (marketing/ strategy commercial-sales-sales / customer management) and engineering and design areas too. In these departments, most of the employees have higher education and, although most of these profiles will remain, they

4. "Soft" or transversal skills

Apart from technical knowledge (also known as "hard"), "soft" skills are very important in a company. These are skills 8 and transversal competences that are

essential for a job to adapt quickly in a digital environment characterized by continuous a change in the field of digital tools, production systems and internal and external relationships.
In this section our purpose is to classify transversal skills related to naval companies, according to its level of importance.

Some examples are:

Skills	Level of importance
Organizational flexibility	High
Willingness to accept change	High
Empathy	Medium
Creative and critical thinking	High
Problem resolution	Medium
link between design studies and production	Medium

5. New jobs profiles creation

In this section we will explain the change in job profiles caused by the implementation of industry 4.0. Although it is true that it will bring the disappearance of some jobs, also it will bring the appearance of many others, some already defined and many others to be defined. Among those already defined, some examples are:

- Robotics engineer (design and build robots to and software)
- Specialist in artificial intelligence.
- Creator of virtual reality and augmented
- Scientist or data analyst.
- Responsible for planning digital image of the company and social networks
- Responsible for engineering and design for additive manufacturing.

- Responsible for environmental impact and efficiency.
- Legal experts in data management

Another very important part in the future 9 companies is related to innovation. Today

no company is able to manage completely its R&D internally. It is based on external collaborations system where knowledge is shared by specialists. It is the Open Innovation model, where they work in globalized innovation networks. Innovation staff, apart from a deep technical knowledge in their areas of excellence and specialization, should also serve as a link to the different areas of knowledge that are necessary in the company.

6. Jobs classification according to the industry 4.0 implementation

As it was mentioned earlier, in this sector we can classify job profiles into three different areas according to their function at the company.

Sales and administration

Positions	Level of importance
Accounting Assistant	To extinguish
Customer Service Assistant	To adapt
Sales Assistant	To adapt
Budget Assistant	To adapt
Sales Manager	To adapt
Technical Sales Manager	To adapt
Pre-sales Manager	Create as new
Post-sales Manager	Create as new
Account Manager	To extinguish
Customer Service Manager	To adapt
Budget Manager	To adapt
Data analyst	Create as new

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Virtual reality creator	*Create as new*
Legal expert on database	*Create as new*
Alliance Manager	*Create as new*
production flow management	*Create as new*

Data analyst is already a function but a complex one. A training in computer engineering is recommended as well as a master's degree in marketing or statistics with an IT focus. In addition, he must be trained in big data. Therefore, a data analyst needs to be trained in line with our specific shipbuilding expectations regarding the IN 4.0 model.)

Engineering area

Positions	Level of importance
Structure Building technician	*To extinguish*
Sales technician	*To extinguish*
Planning technician	*Create as new*
Draftsperson (CAD)	*To adapt*
Design Manager	*To adapt*
Engineering Manager	*To adapt*
Naval architect	*To adapt*
Designer	*To adapt*
Robotics expert	*Create as new*
3D Simulation expert	*Create as new*
Artificial Intelligence expert	*Create as new*

This type of function is also available but not very widespread, especially in SMEs. This function is mainly found in very large engineering or construction sites like "Chantiers de l'atlantique" (liner) or "Naval Group" (defense)

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Production

Positions	Level of importance
Production assistant	Create as new
Maintenance assistant	To adapt
Planning assistant	To adapt
Foreman	To extinguish
Welder	To adapt
Electrician	To adapt
Pipe-fitter	To adapt
Carpenter	To adapt
Service technician	To adapt
Chief Engineer	To adapt
Project Manager	Create as new
Structure Engineer	To adapt
Logistics Manager	Create as new
Labor risks Manager	To adapt
Maintenance and repair Manager	Create as new
New Materials expert	Create as new
Cybersecurity expert	Create as new
Additive manufacturing expert	Create as new
Smart Logistics expert	Create as new
Click to add new positions	Select a level of importance

Project Manager

This function, ideed, already exists but it requires technical skills as well as management skills. The "marketing" aspect is not integrated to date. It would therefore be necessary to plan a complete overhaul of the Project Manager function taking into account this essential dimension to the management of projects in IN.4.0 version.
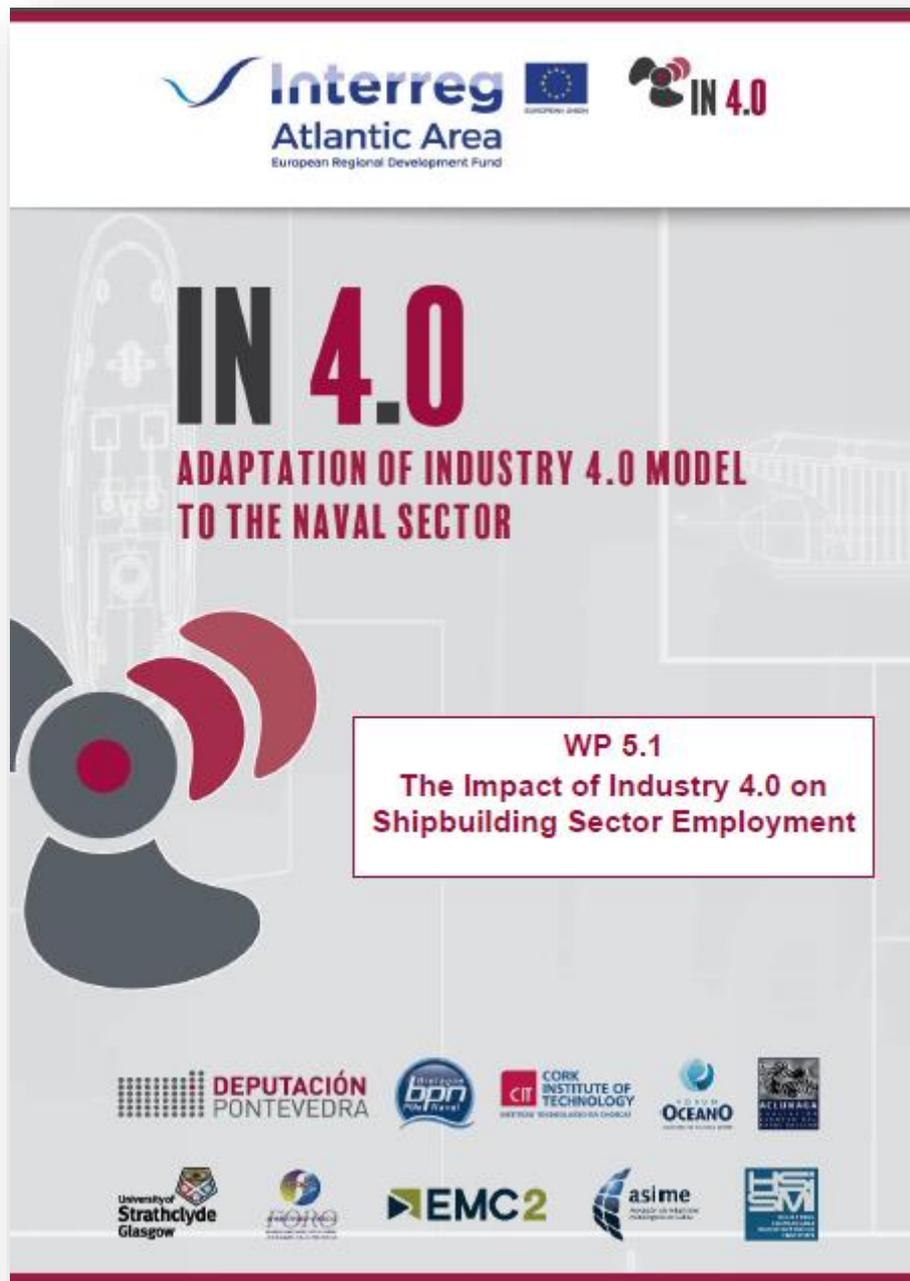
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Free comments

Many adaptations to the functions must be integrated, complementary training modules to be put in place to make the different jobs evolve. Common skills modules are needed to homogenize levels.

For example for the Engineering part design: naval architect trades and level III designer (group leader) a common module to deal with HSE, quality with in addition to elements for cyber security.

SME are not able to deal with all aspects of design in a sophisticated way, it is therefore necessary to provide related skills to address the various points outlined above.

7.1.3 *Ireland*

WP 5.1 The Impact of Industry 4.0 on Shipbuilding Sector Employment

> **WP 5.1 Objective:** "Analysing the naval sector in the region of Galicia in order to elaborate a diagnosis of the skills and job profiles, which will be later validated by the rest of project partners. The final objective is drawing up a final document which will include all contributions.

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For any question or remark, do not hesitate to contact me at: aourens@aclunaga.es

2

Literature review

This section contains information about the sources than have been consulted during preparation of this research report.

- The Future of Jobs Report 2018, World Economic Forum - 17th September 2018.
- FEPORT and PEMA Start Industry 4.0 Committee, Published in Port Technology, June 15th 2018.
- Ports for Tomorrow: Smart Links in Supply Chains, Published in Port Technology, Edition 78 - Linking the Supply Chain, June 2nd 2018.
- New centre to put Irish manufacturing light years ahead, Published by Irish Times, Author Barry McCall, May 18th 2017.
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- THINK ACT INDUSTRY 4.0, The new industrial revolution - How Europe will succeed, Roland Berger, Strategy Consultants, March 2014.
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1. Brief analysis of skills and employment opportunities in this sector

In this section, we will carry out an analysis of skills requirements and type of job profiles in the Marine Manufacturing, Construction and Engineering sector in Ireland.

The information for Ireland is taken from both 'A Study of the Current and Future Skills Requirements of the Marine/Maritime Economy to 2020' and Ireland's Ocean Economy 2017 from Ireland.

Table 1: Marine Manufacturing, Construction and Engineering turnover, GVA, employment, 2012, 2014 and 2016

Marine Manufacturing	2012	2014	2016
Turnover €000's	€199,083	€121,000	€132,231
GVA €000's	€32,829	€64,959	€70,989
Employment FTEs	875	906	1,023

Source: CSO – Census of Industrial Production; Building and Construction Inquiry; REV 2: NACE Four-Digit Codes: 30.11, 30.12, 33.15, 42.91; Industrial Turnover Index; CSO – National Household Survey; SEMRU Company Survey; Figures for 2015 and 2016 are estimates.

The turnover generated by marine manufacturing, construction and engineering in 2014 was €121 million. Total GVA generated was €65 million. Turnover decreased between 2012 and 2014 by 39%, with a 98% increase in GVA in the same period, which is consistent with trends in general marine manufacturing. Employment in the sector was 906 FTEs in 2014, which shows an increase of 4% with respect to the previous reporting period.

Estimates in Table 1 suggest that the turnover generated by the sector in 2016 was €132 million, representing an increase in activity of 9% between 2014 and 2016. Similarly, estimated GVA increased by 9% to €71 million in the same period, while employment increased by 13% to 1,023 FTEs.

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2. Industry 4.0 impact on the current shipbuilding workforce structure

A brief diagnosis of the capabilities and jobs positions in the marine manufacturing sector in Ireland will be carried out in order to analyse and identify which of the exiting 4.0 technologies will have the greatest impact on employment in the naval sector.

Companies involved in marine manufacturing are found throughout Ireland, both along the coast and inland. However, there are clusters of particular marine product manufacturing to be found in certain areas, particularly in Co. Donegal (marine industrial engineering) and counties Galway and Cork (boat building).

In Ireland's Ocean Economy firms were asked about their employment growth by occupation over the last three years and their anticipated growth for the next six years. Examples of job roles by occupation within the Maritime Transport, Shipbuilding and Services Sector are outlined below:

Occupation Level:	Job roles
Operative Grades	General Operatives, Stevedores, Tug Operators, Crane operators, Deckhands, Boat Crew, Riggers
Administration HR staff,	General Administrators, Receptionists
Skilled Trades	Harbour Masters, Berthing Masters, Bunker Brokers, Pilots, Radio Operators
Associate Professional & Technical	Marine Insurance Agents, Marine Underwriters, Cargo Claims Personnel, Ships Agents, Freight Forwarders, Commodity Traders, Charterers, Ship Brokers, Ship Chandlers and Equipment Suppliers.
Professionals	Master Mariners and other Deck Officers, Engineering Officers, Naval Architects, Marine Surveyors, Hull Surveyors, Cargo Surveyors, Maritime Analysts, Shipping Accountants & Lawyers, Hydrographic Surveyors, Marine Planners
Management	Directors, Project Managers, Fleet Managers

Enterprise 2025 (EP 2025) is the Irish government's enterprise policy framework and strategy which sets the ambition to have 2.18 million people at work by the end of 2020, and to achieve an unemployment rate of 6%. Applying the multiplier (1.142) for the 2020 target to the Marine Manufacturing, Construction and Engineering employment figures for 2014 the target for 2020 is 1,035 jobs. Whilst the industry sector for Marine Manufacturing,

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Construction and Engineering is small, Ireland is said to be particularly well set for Industry 4.0.

The RB Industry 4.0 Readiness Index' (Roland Berger, 2014) is represented on the vertical axis. It is calculated as follows: the following elements are bundled - production process sophistication, degree of automation, workforce readiness and innovation intensity into a category called "industrial excellence". Then high value added, industry openness, innovation network and Internet sophistication are combined into a category labelled 'value network.' Each category was measured using a 5-point scale, with '5' indicating that a country is excellently prepared for the Industry 4.0 landscape. The combination of these two categories determines a country's position in the RB 4.0 Readiness Index. The horizontal axis represents the traditional industry measure – the manufacturing share.
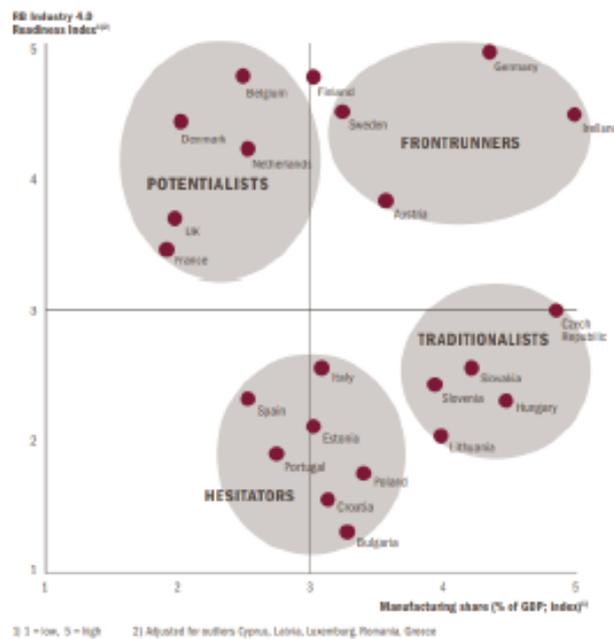
1) 1 = low, 5 = high   2) Adjusted for outliers Cyprus, Latvia, Luxemburg, Romania, Greece

Once the current workforce in shipbuilding has been analysed, a decline in employment for operative grades with an increase in employment for professionals could be explained by the mix of sub sectors in Maritime Transport, Shipbuilding and Services sector. Shipping companies, like those being attracted for the Irish Shipping Services Cluster, employ highly qualified professionals and the Irish Marine Development Office have been working to attract companies here ahead of the ISSC.

High-tech marine companies have potential for fast growth trajectories and Maritime Transport, Shipbuilding and Services is one of the emerging markets identified for focus in Harnessing Our Ocean Wealth. Marine manufacturing is currently a relatively small area of employment, though initiatives highlighted by the Development Task Force on ship building in Cork Harbour and a centre for international yacht racing teams would create much higher levels of employment in the longer term.

The importance of marine training is highlighted in Harnessing Our Ocean Wealth (HOOW). Enabling Education and Training in the marine economy is identified as a key action (Actions 27 and 28) to support the development of the marine industry and the provision of efficient public services in Ireland. The marketing and promotion of Ireland as a marine training and education destination of excellence is another goal. Further recommendations from the Marine Development Task Force to achieve HOOW vision and targets emphasize the need to 'marinise' occupations and qualifications that may not be specific to the marine sector, but for which 'marinising' would bring further opportunities for the marine sector.

Irish based organisations and firms provide a broad range of marine industry - specific training e.g. fishing, seafood, merchant (seafarer) and ocean energy. This training is provided by both public and private organisations. The National Maritime College of Ireland would be one of the largest private providers of marine training although a large number of small and medium sized enterprises (SMEs) provide marine training courses across Ireland. Public organisations providing marine training would include Bord Iascaigh Mhara (BIM) and the Strategic Marine Alliance for Research and Training (SMART).

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3. Impact on jobs according to technological groups

The World Economic Forum (WEF) has released The Future of Jobs report revealing the top 10 skills you'll need by 2020. The world of work is changing and adapting at speed to catch up with the rapid and continuous advances being made in technology. We are transitioning into an era that has been dubbed 'The Fourth Industrial Revolution' (Industry 4.0). The Technological Age is squeezing out manual labour and it is predicted that by 2020 over five million jobs will be replaced by automated machines.

Manufacturers must adopt a more agile approach to product demands and embrace new technologies like: collaborative robotics; augmented reality; automated visual inspection systems and additive manufacturing. In an article in Engineers Journal 'Industry 4.0: the future of manufacturing in the digital age' the author speaks about how the era of smart manufacturing will change and enhance what is produced and so manufacturers need to change how they produce it to stay competitive. In this new era of manufacturing, everything will be Internet of Things-enabled and connected in the cloud. Machines will be more autonomous and will interact and communicate with each other in real time. Advanced technologies will manage Big Data and will facilitate this enhanced integration, not just between machines, but between every segment of a manufacturing enterprise from designers to engineers to shop floor technicians/operators and office staff.

Product lifecycle management (PLM) and manufacturing enterprise systems (MES) will become mission-critical technologies for Industry 4.0. These systems will manage every aspect of: the design process; design validation; quality planning; manufacturing scheduling; manufacturing; quality execution; compliance management; manufacturing intelligence; after-market lifecycle.

Enterprise resource planning (ERP) and MES are the tools used to manage the transactional and manufacturing process in today's automated world. In this new environment, ERP and MES systems will be accessing smart data from the PLM system, enabling the manufacturer to design and build better products faster, and with a higher level of quality than ever before. 'Mature systems' lie at the heart of Industry 4.0. This maturity will be characterised by robust integration, digital control, data capture and data management.

The Future of Jobs Survey 2018 suggests 9 the drivers of change: Four specific technological advances ubiquitous high- speed mobile internet; artificial intelligence;

widespread adoption of big data analytics; and cloud technology are set to dominate the 2018-2022 period as drivers positively affecting business growth. They are flanked by a range of socio-economic trends driving business opportunities in tandem with the spread of new technologies, such as national economic growth trajectories; expansion of education and the middle classes, in particular in developing economies; and the move towards a greener global economy through advances in new energy technologies.

Table 2: Trends set to impact business growth positively/negatively up to 2022, top ten

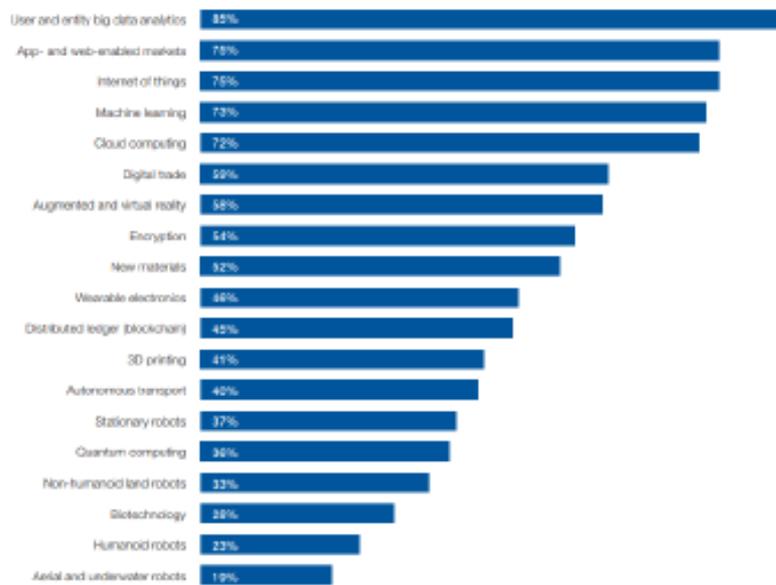| Trends set to positively impact business growth up to 2022	Trends set to negatively impact business growth up to 2022
Increasing adoption of new technology	Increasing protectionism
Increasing availability of big data	Increase of cyber threats
Advances in mobile internet	Shifts in government policy
Advances in artificial intelligence	Effects of climate change
Advances in cloud technology	Increasingly ageing societies
Shifts in national economic growth	Shifts in legislation on talent migration
Expansion of affluence in developing economies	Shifts in national economic growth
Expansion of education	Shifts of mindset among the new generation
Advances in new energy supplies and technologies	Shifts in global macroeconomic growth
Expansion of the middle classes	Advances in artificial intelligence

Source: Future of Jobs Survey 2018, World Economic Forum.

While individual companies may not have the option to disconnect their corporate strategy from the fundamental trajectory of these wider trends, such as the unfolding Fourth Industrial Revolution, they do, however, have the possibility of formulating a proactive response. Two investment decisions, in particular, will be crucial to shaping the future of jobs: the question of whether to prioritise automation or augmentation and the question of whether or not to invest in workforce reskilling.

By 2022, according to the stated investment intentions of companies surveyed in the Future of Jobs Survey 2018, World Economic Forum report, 85% of respondents are likely or very likely to have expanded their adoption of user and entity big data analytics (Figure 1). Similarly, large proportions of companies are likely or very likely to have expanded their adoption of technologies such as the internet of things and app- and web-enabled markets, and to make extensive use of cloud computing. Machine learning and augmented and virtual reality are poised to likewise receive considerable business investment.

Figure 1: Technologies by proportion of companies likely to adopt them by 2022 (projected)

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Technology	%
User and entity big data analytics	85%
App- and web-enabled markets	75%
Internet of things	75%
Machine learning	73%
Cloud computing	72%
Digital trade	59%
Augmented and virtual reality	58%
Encryption	54%
New materials	52%
Wearable electronics	46%
Distributed ledger (blockchain)	45%
3D printing	41%
Autonomous transport	40%
Stationary robots	37%
Quantum computing	36%
Non-humanoid land robots	33%
Biotechnology	28%
Humanoid robots	23%
Aerial and underwater robots	19%

Source: Future of Jobs Survey 2018, World Economic Forum.

4. "Soft" or transversal skills

Apart from technical knowledge (also known as "hard"), "soft" skills are very important in a company. These are skills and transversal competences that are essential for a job to adapt quickly in a digital environment characterized by continuous a change in the field of digital tools, production systems and internal and external relationships.

Some forecasts project that advances in automation will result in the wholesale replacement of the human workforce. Encompassing the near- or medium-term timeframes, our analysis suggests another perspective: that work currently performed by humans is being augmented by machine and algorithmic labour.

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Figure 2 outlines how presently enterprise, machines and algorithms most often complement human skills in information and data processing. They also support the performance of complex and technical tasks, as well as supplementing more physical and manual work activities. However, some work tasks have thus far remained overwhelmingly human: Communicating and interacting; coordinating, developing, managing and advising; as well as reasoning and decision making. Notably, in terms of total working hours, in the aggregate no work task was yet estimated to be predominantly performed by a machine or an algorithm. By 2022, this picture is projected to change somewhat, this is reflected in Figure 2.

Figure 2: Ratio of human-machine working hours, 2018 vs. 2022 (projected)
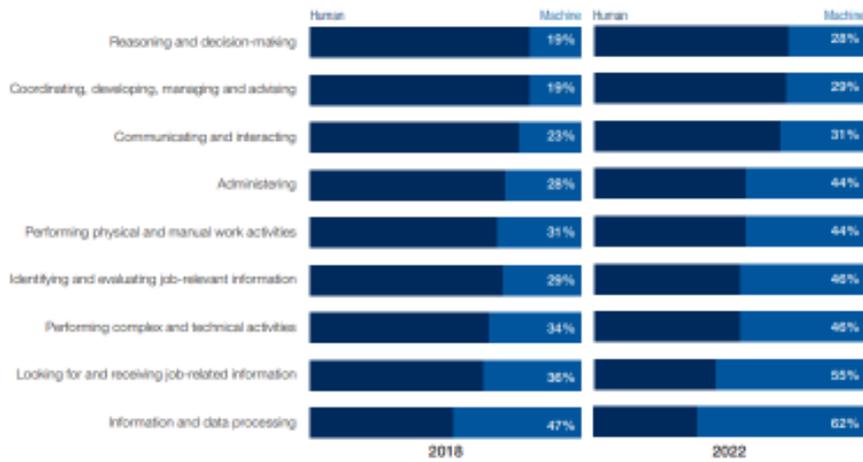
Source: Future of Jobs Survey 2018, World Economic Forum.

Skills	Level of importance
Organizational flexibility	*High*
Willingness to accept change	*High*
Empathy	*Medium*

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Creative and critical thinking	High
Problem resolution	High
Click to add new skills	*Select a level of importance*

5. New jobs profiles creation

Table 3 outlines the range of roles that are set to experience increasing demand in the period up to 2022 are established roles such as Data Analysts and Scientists, Software and Applications Developers, and Ecommerce and Social Media Specialists that are significantly based on and enhanced by the use of technology. Also expected to grow are roles that leverage distinctively 'human' skills such as Customer Service Workers, Sales and Marketing Professionals, Training and Development, People and Culture, and Organisational Development Specialists as well as Innovation Managers. Moreover, our analysis finds extensive evidence of accelerating demand for a variety of wholly new specialist roles related to understanding and leveraging the latest emerging technologies: AI and Machine Learning Specialists, Big Data Specialists, Process Automation Experts, Information Security Analysts, User Experience and Human-Machine Interaction Designers, Robotics Engineers and Blockchain Specialists

Table 3: Examples of stable, new and redundant roles, all industries

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Stable Roles	New Roles	Redundant Roles
Managing Directors and Chief Executives	Data Analysts and Scientists*	Data Entry Clerks
General and Operations Managers*	AI and Machine Learning Specialists	Accounting, Bookkeeping and Payroll Clerks
Software and Applications Developers and Analysts*	General and Operations Managers*	Administrative and Executive Secretaries
Data Analysts and Scientists*	Big Data Specialists	Assembly and Factory Workers
Sales and Marketing Professionals*	Digital Transformation Specialists	Client Information and Customer Service Workers*
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Sales and Marketing Professionals*	Business Services and Administration Managers
Human Resources Specialists	New Technology Specialists	Accountants and Auditors
Financial and Investment Advisers	Organizational Development Specialists*	Material-Recording and Stock-Keeping Clerks
Database and Network Professionals	Software and Applications Developers and Analysts*	General and Operations Managers*
Supply Chain and Logistics Specialists	Information Technology Services	Postal Service Clerks
Risk Management Specialists	Process Automation Specialists	Financial Analysts
Information Security Analysts*	Innovation Professionals	Cashiers and Ticket Clerks
Management and Organization Analysts	Information Security Analysts*	Mechanics and Machinery Repairers
Electrotechnology Engineers	Ecommerce and Social Media Specialists	Telemarketers
Organizational Development Specialists*	User Experience and Human-Machine Interaction Designers	Electronics and Telecommunications Installers and Repairers
Chemical Processing Plant Operators	Training and Development Specialists	Bank Tellers and Related Clerks
University and Higher Education Teachers	Robotics Specialists and Engineers	Car, Van and Motorcycle Drivers
Compliance Officers	People and Culture Specialists	Sales and Purchasing Agents and Brokers
Energy and Petroleum Engineers	Client Information and Customer Service Workers*	Door-To-Door Sales Workers, News and Street Vendors, and Related Workers
Robotics Specialists and Engineers	Service and Solutions Designers	Statistical, Finance and Insurance Clerks
Petroleum and Natural Gas Refining Plant Operators	Digital Marketing and Strategy Specialists	Lawyers

Source: Future of Jobs Survey 2018, World Economic Forum.

Note: Roles marked with * appear across multiple columns. This reflects the fact that they might be seeing stable or declining demand across one industry but be in demand in another.

6. Jobs classification according to the IN 4.0 implementation

In Ireland we do not have data on the progress of IN 4.0 so the data in Table 3 above can act as a guideline, with the proviso that it is relevant across all sectors.

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Sales and administration

Positions	Level of importance
Accounting Assistant	To extinguish
Customer Service Assistant	To adapt
Sales Assistant	To adapt
Budget Assistant	To extinguish
Sales Manager	To adapt
Technical Sales Manager	To adapt
Pre-sales Manager	To adapt
Post-sales Manager	To adapt
Account Manager	To extinguish
Customer Service Manager	To adapt
Budget Manager	To extinguish
Data analyst	To adapt
Virtual reality creator	Create as new
Legal expert on database	To adapt
Alliance Manager	To adapt
Data Scientist	Create as new

Engineering area

Positions	Level of importance
Structure Building technician	To adapt
Sales technician	To adapt

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Planning technician	To adapt
Draftsperson (CAD)	To adapt
Design Manager	To adapt
Engineering Manager	To adapt
Naval architect	To adapt
Designer	To adapt
Robotics expert	Create as new
3D Simulation expert	Create as new
Artificial Intelligence expert	Create as new
Shipbuilding Information Modelling Expert	Create as new

Production

Positions	Level of importance
Production assistant	To adapt
Maintenance assistant	To adapt
Planning assistant	To adapt
Foreman	To adapt
Welder	To adapt
Electrician	To adapt
Pipe-fitter	To extinguish
Carpenter	To extinguish
Service technician	To adapt
Chief Engineer	To adapt
Project Manager	To adapt

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Structure Engineer	*To extinguish*
Logistics Manager	*To adapt*
Labor risks Manager	*To extinguish*
Maintenance and repair Manager	*To adapt*
New Materials expert	*Create as new*
Cybersecurity expert	*Create as new*
Additive manufacturing expert	*Create as new*
Smart Logistics expert	*To adapt*
Click to add new positions	*Select a level of importance*

Free comments

The new labour market taking shape in the wake of the Fourth Industrial Revolution holds both challenges and opportunities. As companies begin to formulate business transformation and workforce strategies over the course of the 2018-2022 period, they have a genuine window of opportunity to leverage new technologies, including automation, to enhance economic value creation through new activities, improve job quality in traditional and newly emerging occupations, and augment their employees' skills to reach their full potential to perform new high value added work tasks, some of which will have never before been performed by human workers.

The World Economic Forum's Future of Jobs Survey 2018 suggests that within governments, firstly, there is an urgent need to address the impact of new technologies on labour markets through upgraded education policies aimed at rapidly raising education and skills levels of individuals of all ages, particularly with regard to both STEM (science, technology, engineering and mathematics) and non-cognitive soft skills, enabling people to leverage their uniquely human capabilities. Relevant intervention points include school curricula, teacher training and a reinvention of vocational training for the age of the Fourth Industrial Revolution, broadening its appeal beyond traditional low and medium skilled occupations.

Secondly, improvements in education and skills provision must be balanced with efforts on the demand side. Governments 17 can help stimulate job creation through additional public investment as well as by leveraging private investments through

IN 4.0
ADAPTATION OF INDUSTRY 4.0 MODEL TO THE NAVAL SECTOR

Interreg
Atlantic Area
European Regional Development Fund
IN 4.0

blended finance or government guarantees. The exact nature of desirable investments will vary from country to country. Furthermore, there is scope and a clear unmet need in creating the hard and soft infrastructure to power the Fourth Industrial Revolution - from digital communication networks to renewable and smart energy grids to smart schools and hospitals to improved childcare facilities.

For industries, firstly, it will pay to realise that – as competition for scarce skilled talent equipped to seize the opportunities of the Fourth Industrial Revolution intensifies and becomes more costly over the coming years there is an opportunity to support the upskilling of their current workforce toward new (and technologically reorganised) higher-skilled roles to ensure that their workforce achieves its full potential. Findings from the Future of Jobs Survey 2018 indicate that, to date, many companies intend to limit their skills training provision over the 2018-2022 period to employees performing today's in-demand job roles, rather than thinking more long-term and creatively.
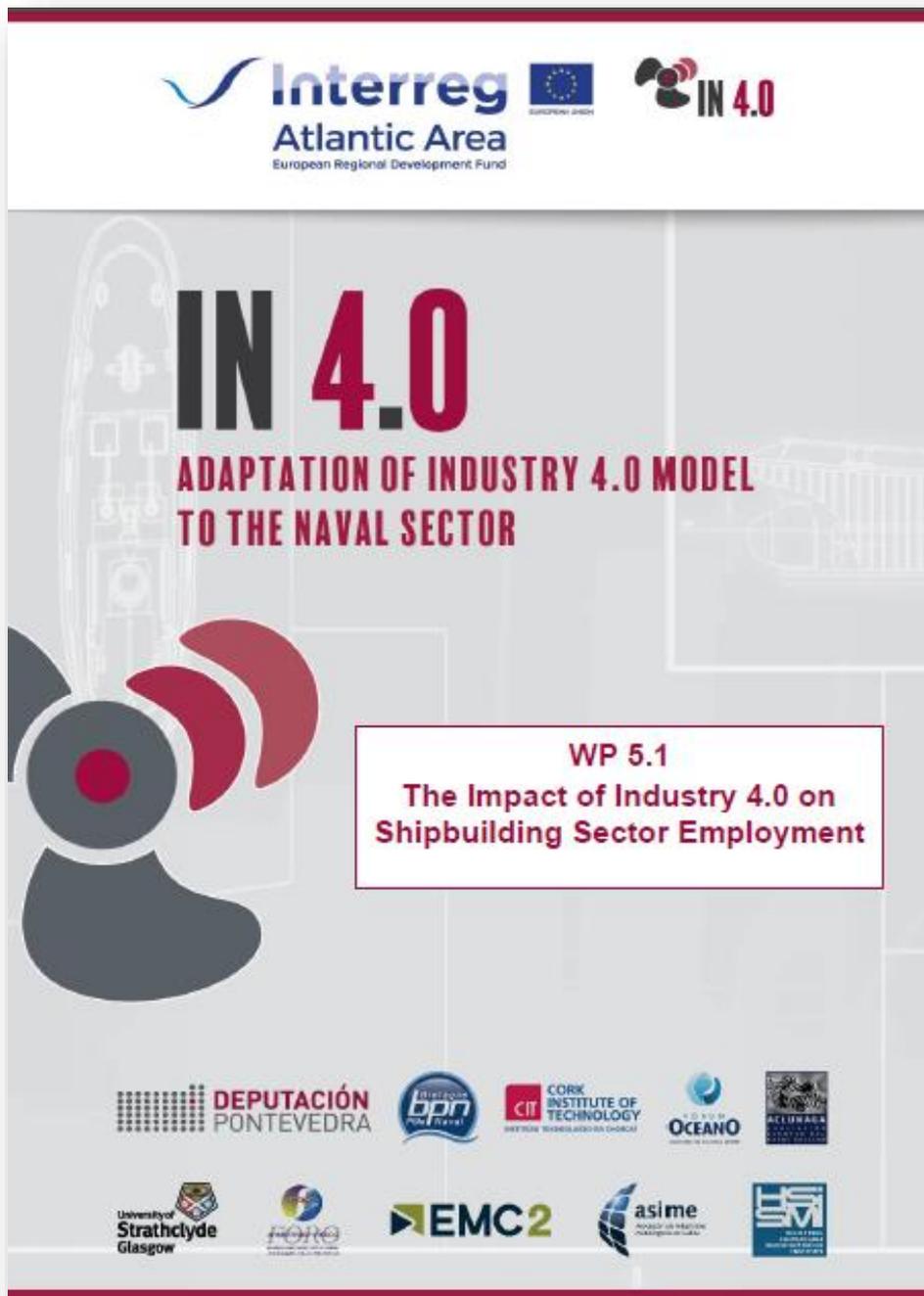
Clearly, a more inclusive and proactive approach will be needed to both increase the availability of future skills and address impending skills scarcity, and to enable a wider range of workers to share in the gains from new technologies and work more effectively with them through skills augmentation. Secondly, the need to ensure a sufficient pool of appropriately skilled talent creates an opportunity for businesses to truly reposition themselves as learning organisations and to receive support for their reskilling and upskilling efforts from a wide range of stakeholders.

It is clear that many individuals will need to be supported through periods of job transition and phases of retraining and upskilling by governments and employers. Lifelong learning is becoming a rich area of experimentation, with several governments and industries looking for the right formula to encourage individuals to voluntarily undergo periodic skills upgrading. Similarly, while a fully-fledged universal basic income may remain politically and economically unfeasible or undesirable over the 2018-2022 period, some variants or aspects of the idea such as providing a 'universal lifelong learning fund' for individuals to draw on as needed might receive increasing attention over the coming years.

Solutions are likely to vary by country and to depend on local political, economic and social circumstances. Ultimately, the core objective for governments, industries and workers alike should be to ensure that tomorrow's jobs are fairly remunerated, entail treatment with respect and decency and provide realistic scope for personal growth, development and fulfilment.

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7.1.4 *Galician*

WP 5.1 The Impact of Industry 4.0 on Shipbuilding Sector Employment

> **WP 5.1 Objective:** "Analysing the naval sector in the region of Galicia in order to elaborate a diagnosis of the skills and job profiles, which will be later validated by the rest of project partners. The final objective is drawing up a final document which will include all contributions.

- _Objective of this template: collecting all the information regarding to Impact of Industry 4.0 in the jobs in the shipbuilding sector in your regions of the Atlantic Area._

- _Reminder: please provide a **first version by the end of September**; do not hesitate to contact me for any question._

- _Guidelines for completion of the template:_
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2

Literature review

This section contains information about the sources than have been consulted during preparation of this research report.

In the case of the Galician study, references that have been used are:

- Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry, report published by Community of European Shipyards Associations (CESA).

- ATIGA data (http://www.atiga.es/industria-4-0/)

- IGAPE data (http://www.igape.es/es/ser-mas-competitivo/galiciaindustria4-0/estudos-e-informes)

Please fill in the table indicating your sources as per the provided template.

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1. Brief analysis of skills and employment opportunities in this sector

In this section, we will carry out an analysis of skills requirements and type of job profiles in the naval sector of Atlantic Area.

Based on the study made in Galicia, some of the main conclusions are:

- Countries in Atlantic Area are characterized by a large share of workforce engaged in the construction of new vessels, except in the case of France, where the workforce dedicated to repair works is somewhat higher than in the other countries.

- These countries have a shortage of young technical workers; with the exception of France, in other countries more than 60% of the workers are older than 40 and young workforce (<25 years) in all countries in Atlantic Area is below 15%. Moreover, because most workers are over 40 years, in the next 15 years there will be a high demand for skilled workers.

- The level of education in the naval sector is generally high, but differs significantly between countries, being particularly high in Spain and France, where around 30% of workers have a tertiary education.

- Technical profiles in the naval sector can be classified according to their function at the company, based on CESA study. In this way, there are 3 main functional areas or departments:

  - **Wholesales life cycle (including pre and post sales service):** Pre-sales engineering, commercial activity, budgeting and after-sales service.
  - **Design and Engineering:** Designers, draftspersons, naval architects, structural engineers, etc.
  - **Planning and production:** Work-Planning, Project Management, carpentry, pipe-fitters, welders, etc.

  Based on this research, only 2% of workers are engaged in sales departments, 16% in design and engineering and 82% in planning and production. This indicator is an interesting basis for analysis of industry 4.0 impacts on shipbuilding.

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2. Industry 4.0 impact on the current shipbuilding workforce structure

Once the current workforce in shipbuilding has been analysed, the purpose of this section is to assess the impact of industry 4.0 on it.

Based on previous diagnose, it's important to take into account that 82% of workforce is engaged in planning and production work. This factor determines the first consequence associated with the impact, since most of the technologies involved produce results in a reduction of profiles that require repetitive work and low-skilled workers, who mostly are in production areas.

3. Impact on jobs according to technological groups

In the case of the study made in Galicia, to analyse the impacts on jobs in the sector, it will be divided into two blocks: "Materials and intelligent manufacturing" and "Analytical, management and control".

Block 1: Materials and Smart Manufacturing
This block includes technology related to manufacturing processes. In this section it's important to asses the impact on jobs that can be supplanted by robots and automated machinery, such as welders, workers who make straightening and assembly of parts, pipe-fitters and electricians. Only low-skilled jobs that require some skill or skill / creativity that make no profitable mechanical work will remain. We're talking about jobs with a high level of craftsmanship, such as some carpentry work.

In addition, all work supervision and production aid is destined to disappear or be minimized, since the level of supervision of work performed by machines or robots is minimal compared to executed by humans. Training will be essential in man-machine collaborative environments.

Concerning to higher education employees, manager positions in production and engineering areas will be totally transformed by the technological change introduced.

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This is because main work of managers was to supervise teams of workers, as they must now about:

- Knowledge of different tools of management and control of machinery and robots
- Knowledge of robotics and automation
- Integration of different levels of information systems
- Collaborative work elements Man-Machine
- Structures and properties of new materials
- Methods and additive manufacturing processes
- New design tools and engineering
- Sustainable manufacturing techniques and energy efficiency

Block 2: Analytical Technologies, Management and Control

This block includes technologies related to analysis, management and control, instead of manufacturing and production. This means:

- All activity related to data analysis of the whole sales life cycle (pre-sales, sales and after-sales)
- All information management related to the sensors installed in the company, about manufacturing process and logistics, maintenance, materials management, supplier management equipment, etc.
- Customer data management, for marketing, business development and definition of new strategies.
- Image and augmented reality, virtual catalogue for sales, product presentations and training.
- Advanced algorithms and artificial intelligence to optimize the processing of all information received, make predictions and act accordingly.

Most of these jobs are related to sales area (marketing/ strategy commercial-sales-sales / customer management) and engineering and design areas too. In these departments, most of the employees have higher education and, although most of these profiles will remain, they need a transformation as a result of the digital transformation.

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4. "Soft" or transversal skills

Apart from technical knowledge (also known as "hard"), "soft" skills are very important in a company. These are skills and transversal competences that are essential for a job to adapt quickly in a digital environment characterized by continuous a change in the field of digital tools, production systems and internal and external relationships.

In this section our purpose is to classify transversal skills related to naval companies, according to its level of importance.

Some examples are:

Skills	Level of importance
Organizational flexibility	High
Willingness to accept change	High
Empathy	Medium
Creative and critical thinking	Medium
Problem resolution	Medium
Link between design studies and production	Medium
Complex problem solving	High
Active and continuously learning	High
Systems and content skills	Medium
Service orientation	Medium
Digital literacy skills	High
Monitoring Self and Others	Medium
Mathematical reasoning	Medium
Training others	High
Resource Management	High
Transdisciplinary thinking	High

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Virtual collaboration	*High*
Global vision	*High*

5. New jobs profiles creation

In this section we will explain the **change in job profiles** caused by the implementation of industry 4.0. Although it is true that it will bring the disappearance of some jobs, also it will bring the appearance of many others, some already defined and many others to be defined. Among those already defined, some examples are:

- Robotics engineer (design and build robots to and software)
- Specialist in artificial intelligence.
- Creator of virtual reality and augmented
- Scientist or data analyst.
- Responsible for planning digital image of the company and social networks
- Responsible for engineering and design for additive manufacturing.

- Responsible for environmental impact and efficiency.
- Legal experts in data management

Another very important part in the future companies is related to **innovation**. Today no company is able to manage completely its R&D internally. It is based on external collaborations system where knowledge is shared by specialists. It is the Open Innovation model, where they work in globalized innovation networks. Innovation staff, apart from a deep technical knowledge in their areas of excellence and specialization, should also serve as a link to the different areas of knowledge that are necessary in the company.

6. Jobs classification according to the industry 4.0 implementation

As it was mentioned earlier, in this sector we can classify job profiles into three different areas according to their function at the company.

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Sales and administration

Positions	Level of importance
Accounting Assistant	To adapt
Customer Service Assistant	To adapt
Sales Assistant	To adapt
Budget Assistant	To adapt
Sales Manager	To adapt
Technical Sales Manager	To adapt
Pre-sales Manager	To adapt
Post-sales Manager	To adapt
Account Manager	To adapt
Customer Service Manager	To adapt
Budget Manager	To adapt
Data analyst	Create as new
Virtual reality creator	Create as new
Legal expert on database	Create as new
Alliance Manager	To adapt
Production flow management	To adapt

Engineering area

Positions	Level of importance
Structure Building technician	To adapt
Sales technician	To adapt
Planning technician	To adapt

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Draftsperson (CAD)	To adapt
Design Manager	To adapt
Engineering Manager	To adapt
Naval architect	To adapt
Designer	To adapt
Robotics expert	Create as new
3D Simulation expert	Create as new
Artificial Intelligence expert	Create as new
Shipbuilding Information Modelling Expert	Create as new

Production

Positions	Level of importance
Production assistant	To adapt
Maintenance assistant	To adapt
Planning assistant	To adapt
Foreman	To adapt
Welder	To adapt
Electrician	To adapt
Pipe-fitter	To adapt
Carpenter	To adapt
Service technician	To adapt
Chief Engineer	To adapt
Project Manager	To adapt
Structure Engineer	To adapt
Logistics Manager	To adapt

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Labor risks Manager	To adapt
Maintenance and repair Manager	To adapt
New Materials expert	Create as new
Cybersecurity expert	Create as new
Additive manufacturing expert	Create as new
Smart Logistics expert	Create as new
Click to add new positions	*Select a level of importance*

Free comments

Feel free to add any comments necessary to understand the topic under analysis.

7.1.5 *United Kingdom*

WP 5.1 The Impact of Industry 4.0 on Shipbuilding Sector Employment

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2

Literature review

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In the case of the UK study, references that have been used are:

- Demographic Change & Skills Requirements in the European Shipbuilding & Ship Repair Industry, report published by Community of European Shipyards Associations (CESA)

- The economic contribution of the UK Marine industry (A report for Maritime UK, September 2017

- English Apprenticeships: Our 2020 Vision, HM Government

- The digital workforce succession in manufacturing, ManpowerGroup

- Technology, jobs, and the future of work, McKinsey Global Institute, May 2017 (*https://www.mckinsey.com/featured-insights/employment-and-growth/technology-jobs-and-the-future-of-work*)

- Harnessing Revolution, Creating the future workforce, Accenture strategy (*https://www.accenture.com/gb-en/_acnmedia/A2F06B52B774493BBBA35EA27BCDFCE7.pdf#zoom=50*)

- DMDII, Jobs Taxonomy (https://www.uilabs.org/innovationplatforms/manufacturing/taxonomy/

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1. Brief analysis of skills and employment opportunities in this sector

In this section some of the main conclusions with regards to the skills and employment opportunities within UK shipbuilding sector are highlighted based on the literature reviewed.

Besides its strong geographical advantage, the UK is renowned for its broad knowledge and high expertise in the marine sector. However, the country is currently facing numerous issues on thread to stay competitive on the international stage. These include a significant skill gap between old and young generation, a fragmented industry and supply chain, and a high wage economy compared to Far East economies which produce at a larger scale and cheaper.

The shipbuilding and marine engineering activities made the largest direct contribution through employment within the maritime industry, 26300 jobs or 26% of employment in 2015. Most of the workforce as in the other countries in Atlantic Area is engaged in the construction of new ships.

Despite the important contribution of the UK shipbuilding industry to the UK economy there are also some competitive weaknesses which may be highlighted:

- The fragmentation of the UK marine industry and their supply chain, there is a low number of major ship yards and there is limited major manufacturers of main equipment.

- The lack of high-skilled workforce within the shipbuilding sector. UK stands below the average employment with tertiary education which is represented by Romania at European level.

- UK shipbuilding industry is ageing skills base and there is a public perception of marine as a "sunset" industry. The young workforce in UK (<25 years old), even if it is slightly better than other European countries such as France or Spain is still below 15%. Most of the workforce is between 41-55 years old.

There are multiple reasons behind this situation. Apart from the fact that UK is a high wage economy another barrier which make difficult to attract overseas marine talent is the UK visa controls. That's why there is a need for UK to catch up on this topic attracting young talent and training the marine workforce

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2. Industry 4.0 impact on the current shipbuilding workforce structure

The implementation of Industry 4.0 within the marine industry is set to have a significant impact on the associated workforce. This will lead to three main changes: the creation of new jobs, reskilling the current workforce and redundancy of current roles. Without internal capabilities, companies within the shipbuilding industry will need to source externally to implement cutting edge Industry 4.0 technologies and skills.

3. Impact on jobs according to technological groups

It is important to acknowledge that traditional skills will still be required for the foreseeable future. However, the implementation of Industry 4.0 practices can improve the efficiency of the day-to-day activities throughout the industry. In addition, supervisors and managers will need to adapt to Industry 4.0 by becoming more aware and knowledgeable of the new technologies that they will be working with. Within the shipbuilding industry, the following Industry 4.0 technologies are the most likely to be utilised in the near future and subsequently, managers and supervisors must be aware of them and how they impact the workforce:

- Collaborative Robots to assist with welding
- Additive Manufacturing
- Virtual and Augmented Reality
- Predictive Maintenance
- Digital Twins

The use of advanced software solutions will require the development of existing workforce skills and the consideration of future employee requirements to successfully utilise the platforms. It is likely that most of the role profiles within this block will remain but are likely to require further development. The software solutions that are likely to be required within the marine industry will be closely related to the key technologies listed above. Therefore, 3D modelling software, and advanced algorithms for predictive maintenance are examples of what is going to be important for the transition towards Industry 4.0.

4. "Soft" or transversal skills

Apart from technical knowledge (also known as "hard"), "soft" skills are very important in a company. These are skills and transversal competences that are essential for a job to adapt quickly in a digital environment characterized by continuous a change in the field of digital tools, production systems and internal and external relationships.

In this section our purpose is to classify transversal skills related to naval companies, according to its level of importance.

Some examples are:

Skills	Level of importance
Organizational flexibility	High
Willingness to accept change	High
Empathy	Medium
Creative and critical thinking	High
Problem resolution	High
Click to add new skills	*Select a level of importance*

5. New jobs profiles creation

Industry 4.0 will introduce new skills and technologies and subsequently, new job profiles will be required to meet these needs. These new profiles will be channelled from various sources including:

- Technology focussed apprenticeships
- Increased promotion of STEM subjects at government level
- Industry defined degrees
- Promotion of relevant technologies at a lower education level
- Graduate schemes and internal development schemes

Companies will have to be proactive in identifying and promoting these roles to secure suitable employees in order to be successful in implementing Industry 4.0.

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6. Jobs classification according to the industry 4.0 implementation

As it was mentioned earlier, in this sector we can classify job profiles into three different areas according to their function at the company.

Sales and administration

Positions	Level of importance
Accounting Assistant	To extinguish
Customer Service Assistant	To extinguish
Sales Assistant	To extinguish
Budget Assistant	To extinguish
Sales Manager	To adapt
Technical Sales Manager	To adapt
Pre-sales Manager	To extinguish
Post-sales Manager	To adapt
Account Manager	To adapt
Customer Service Manager	To adapt
Budget Manager	To extinguish
Data analyst	Create as new
Virtual reality creator	Create as new
Legal expert on database	Create as new
Alliance Manager	To extinguish
Click to add new positions	*Select a level of importance*

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Engineering area

Positions	Level of importance
Structure Building technician	To adapt
Sales technician	To extinguish
Planning technician	To adapt
Draftsperson (CAD)	To adapt
Design Manager	To adapt
Engineering Manager	To adapt
Naval architect	To adapt
Designer	To adapt
Robotics expert	Create as new
3D Simulation expert	Create as new
Artificial Intelligence expert	Create as new
Click to add new positions	*Select a level of importance*

Production

Positions	Level of importance
Production assistant	To extinguish
Maintenance assistant	To extinguish
Planning assistant	To extinguish
Foreman	To adapt
Welder	To adapt
Electrician	To adapt
Pipe-fitter	To adapt

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Carpenter	*To adapt*
Service technician	*To adapt*
Chief Engineer	*To adapt*
Project Manager	*To adapt*
Structure Engineer	*To adapt*
Logistics Manager	*To adapt*
Labor risks Manager	*To adapt*
Maintenance and repair Manager	*To adapt*
New Materials expert	*Create as new*
Cybersecurity expert	*Create as new*
Additive manufacturing expert	*Create as new*
Smart Logistics expert	*To extinguish*
Click to add new positions	*Select a level of importance*

Free comments

Feel free to add any comments necessary to understand the topic under analysis.

Some of the new created job positions may be subject to the size and needs of the business in question. (e: An SME may not be able to afford a legal expert on databases). Also, some other jobs could be combine into one role, for example material expert and additive manufacturing expert.

Some of the job positions would be required however it will make more sense to adapt a current
role than to create a brand new one. For example, a smart logistics expert would be needed but its competencies will probably fall into the new job specifications of the logistics manager.

A fourth option should be added to the table as "Non-applicable" because some roles may not exist, therefore they will not be extinguished and there may be no need for them to be created.

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7.2 Compilation of partners contributions used in the validation phase

Analysis of the impact of the industry 4.0 in the competences and job positions of the naval sector

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1. INTRODUCTION

Aclunaga, in collaboration with the partners of the IN 4.0 project, analysed the Adaptation of the Naval Sector in the 4.0 industry. For this, a template was used with the aim of homogenising the data and making them comparable in all the regions of the Atlantic axis participating in the project.

The aim of this document is to present and validate the results obtained, both in terms of soft skills and jobs.

Thus, the document is structured in three differentiated blocks:

- Level of importance of the skills or "soft skills".

- Impact that the incorporation of industry 4.0 will have on the jobs of the identified work areas in the naval sector.

- Main conclusions obtained.

2. BACKGROUND INFORMATION

During the data analysis phase, different doubts arose regarding the contributions made by some of the partners, so a "request" for information was sent to those partners to clarify the data.

Once the clarifications had been received from the partners, ACLUNAGA prepared a presentation with the main conclusions of the study, with the objective set at the meeting on 12 December in Glasgow.

During this meeting of partners it was established as a priority to work in the production area. It was also agreed to send all partners the questions listed in point 6 of this document, so that partners could reflect on them and answer them in writing.

2. BACKGROUND INFORMATION

Starting from previous studies that identified the work areas and jobs that would be affected by the introduction of innovations from industry 4.0, ACLUNAGA carried out a first draft of the study "Impact of Industry 4.0 on jobs in the shipbuilding sector".

Once this first draft of the study was prepared, a stencil was drafted with the objective of collecting all the information related to the Impact of Industry 4.0 on the jobs in the shipbuilding sector in the Atlantic Area regions.

This stencil was completed by the project partners. In addition, they had the capacity to make all the contributions they deemed appropriate in order to improve the study.

Once the answers and contributions from all the partners had been received, ACLUNAGA proceeded to analyse the information

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3. "SOFT" SKILLS 3.1 MAIN SKILLS

Skill	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Organizational flexibility	Medium	High	High	High	High	High
Willingness to accept change	High	High	High	High	High	High
Empathy	Medium	Medium	Medium	Medium	Medium	Medium
Creative and critical thinking	High	High	High	High	High	High
Problem resolution	High	Medium	High	Medium	High	Medium

High   Medium

The survey shows the unanimity of the majority of partners in considering "Willingness to accept change" as of high importance and "Empathy" as of medium importance.

The rest of the skills almost reach unanimity, with only one or two territories valuing them as medium important

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3. "SOFT" SKILLS 3.2 OTHER SKILLS IDENTIFIED BY THE PARTNERS

Skill	Level of Importance					
	Basque Country	France	Uk	Galician	Ireland	Portugal
Link between design studies and production		Medium		Medium		Medium
Complex problem solving	High	High		High	High	Medium
Active and continuously learning	High	High		High	High	Medium
Systems and content skills	High	Medium		Medium	Medium	Medium
Service orientation	High	Medium		High	High	High
Digital literacy skills	High			High	High	High
Monitoring Self and Others	High	High		Medium	High	High

High   Medium

These skills have been identified and added to the skills chart by partners in the Basque Country, France and Galicia. It is advisable that all partners try to value them all in their territory.

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3. "SOFT" SKILLS — 3.2 OTHER SKILLS IDENTIFIED BY THE PARTNERS

Skill	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Mathematical reasoning	High	Medium		Medium	High	Medium
Training others	High	High		High	High	High
Resource Management	Medium	High		High	Medium	High
Transdisciplinary thinking	High	High		High	High	High
Virtual collaboration	High	Medium		High	High	High
Global vision	High	High		High	High	High

Legend: High / Medium

These skills have been identified by the Basque and Galician partners. It is advisable that all partners try to measure them in their territory.

4. JOB POSITIONS — 4.1 SALES AND ADMINISTRATION

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Accounting Assistant						
Customer Service Assistant						
Sales Assistant						
Budget Assistant						
Sales Manager						
Technical Sales Manager						
Pre-sales Manager						
Post-sales Manager						

Legend: Create as new / To adapt / To extinguish

According to the UK survey, most of SMEs cannot afford having "assistant" positions, while large companies tend to substitute assistant positions with technologies that support managers. The remaining territories recommend assistant positions for adaptation, in most cases.

Another remarkable conclusion is that France detected a need for the creation of pre-sales and after-sales manager positions, which is the first job position that the United Kingdom identifies as unnecessary due to the small number of commercial shipyards. Such shipyards rank low in competitiveness compared with other EU countries, mainly due to high wages and lack of adequate productive infrastructures.

4. JOB POSITIONS   4.1 SALES AND ADMINISTRATION

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Account Manager						
Customer Service Manager						
Budget Manager						
Data analyst						
Virtual reality creator						
Legal expert on database						
Alliance Manager						
Production flow management						

Create as new	To adapt	To extinguish

Other positions include Data Analyst and Database Legal Expert, which must be adapted in the Basque Country and Ireland, while in other territories, they must be created from scratch.

France and Ireland propose to terminate the position of Account Manager and the United Kingdom and Ireland the position of Budget Manager.

UK proposes the position of Alliance Manager for extinction, while the Basque Country and France propose to create it from scratch and Ireland to adapt it.

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4. JOB POSITIONS   4.1 SALES AND ADMINISTRATION

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Data Scientist						

Create as new	To adapt	To extinguish

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4. JOB POSITIONS — 4.2 ENGINEERING AREA

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Structure Building technician						
Sales technician						
Planning technician						
Draftsperson (CAD)						
Design Manager						
Engineering Manager						
Naval architect						
Designer						

Create as new | To adapt | To extinguish

There is almost total unanimity when analysing the suitability/relevance of the proposed positions.

These positions require an adaptation to the requirements of Industry 4.0.

The qualification given by France and the Basque Country to the position of Planning Technician stands out, as they indicate that it has to be created, while in the rest of the territories they propose it for adaptation

The same applies to the posts of Structural Construction Technician and Sales Technician. In the first, Basque Country and France recommend that it should be extinguished while the other territories propose it for adaptation. In the second, Basque Country, France and United Kingdom propose its extinction, while Galicia and Ireland propose to adapt it.

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4. JOB POSITIONS — 4.2 ENGINEERING AREA

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Robotics expert						
3D Simulation expert						
Artificial Intelligence expert						
Shipbuilding Information Modelling Expert						

Create as new | To adapt | To extinguish

These positions (Robotics Expert, 3D Simulation Expert and Artificial Intelligence Expert) must be created from scratch.

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4. JOB POSITIONS — 4.3 PRODUCTION

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Production assistant	Create as new	Create as new	To adapt	To adapt	To adapt	To adapt
Maintenance assistant	To adapt	To adapt	To adapt	To adapt	To adapt	To adapt
Planning assistant	To adapt	To adapt	To extinguish	To adapt	To adapt	To adapt
Foreman	To extinguish	To extinguish	To extinguish	To adapt	To adapt	To adapt
Welder	To adapt	To adapt	To adapt	To adapt	To adapt	To adapt
Electrician	To adapt	To adapt	To adapt	To adapt	To adapt	To adapt
Pipe-fitter	To adapt	To adapt	To adapt	To adapt	To extinguish	To adapt
Carpenter	To adapt	To adapt	To adapt	To adapt	To extinguish	To adapt

Legend: Create as new | To adapt | To extinguish

Conclusions in this area are quite homogeneous, although there are also certain particularities.

The Basque Country and France propose to create the position of Production Assistant from scratch, while the United Kingdom proposes it for extinction. Galicia and Ireland do it for adaptation.

The United Kingdom also proposes to extinguish the positions of Maintenance and Planning Assistant, while the rest of the territories suggest their adaptation.

Basque Country and France propose to eliminate the position of Foreman while the other territories propose to adapt it.

According to Ireland, the positions of Tuber and Carpenter should be extinguished, while for the other territories consider it for adaptation.

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4. JOB POSITIONS — 4.3 PRODUCTION

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Service technician	To adapt	To adapt	To adapt	To adapt	To adapt	To adapt
Chief Engineer	To adapt	To adapt	To adapt	To adapt	To adapt	To adapt
Project Manager	Create as new	Create as new	To adapt	To adapt	To adapt	To adapt
Structure Engineer	To adapt	To adapt	To adapt	To adapt	To extinguish	To adapt
Logistics Manager	Create as new	Create as new	To adapt	To adapt	To adapt	To adapt
Labor risks Manager	To adapt	To adapt	To adapt	To adapt	To extinguish	To adapt
Maintenance and repair Manager	Create as new	Create as new	To adapt	To adapt	To adapt	To adapt
New Materials expert	Create as new	Create as new	To adapt	To adapt	To adapt	To adapt

Legend: Create as new | To adapt | To extinguish

For the Basque Country and France, the positions of Project Manager, Logistics Manager and Maintenance and Repair Manager must be created from scratch, while for the rest of the territories they must be adapted.

The position of Structural Engineer and Labor Risk Manager should be abolished Ireland, while for the other territories it should be adapted.

4. JOB POSITIONS   4.3 PRODUCTION

Position	Level of Importance					
	Basque Country	France	UK	Galician	Ireland	Portugal
Cybersecurity expert						
Additive manufacturing expert						
Smart Logistics expert						

Create as new	To adapt	To extinguish

United Kingdom proposes to extinguish the position of Intelligent Logistics Expert, while Ireland considers it for adaptation and the rest of the countries consider that it should be created from scratch.

---

5. CREATING NEW JOB PROFILES

Taking into account the foregoing and the assessments of the partners at the time of qualifying the jobs in the areas contemplated (sales and administration, engineering and production) according to the need in the sector (adapt, extinguish or create new) the following prioritization of jobs is established:

- Robotics engineer.
- Artificial intelligence specialist.
- Virtual reality creator.
- 3D simulation expert.
- New materials expert.
- Cybersecurity expert.
- Additive manufacturing expert.
- Data analyst.
- Legal data management specialist.
- Smart logistic expert.

6. MAIN CONCLUSIONS — Job vacancies. Sales and administration

Are "assistant" positions doomed to disappear? Do all partners agree?

Portugal, believe that the changes promoted by the 4.0 industry revolution will not lead to the disappearance of the "assistant" positions.
These technological developments have to be mirrored by some change in these roles that will promote some reskilling but we consider that their extinction is not considered in the Portuguese reality.

From consideration from an Irish perspective and the links CIT have with Industry from the various head of function in the institute it seems that this is the case.

---

6. MAIN CONCLUSIONS — Job vacancies. Sales and administration

Other positions include Data Analyst and Database Legal Expert, which according to the Basque Country and Ireland must be adapted, while according to the survey in other territories, they must be created from scratch.

France and Ireland propose to terminate the position of Account Manager and the United Kingdom, while Ireland identifies the position of Budget Manager as to disappear.

UK proposes to extinguish the position of Alliance Manager, while the Basque Country and France propose to create it from scratch. According to Ireland it must be adapted.

Is this area really affected by 4.0 technologies?

For Basque Country yes, in the sense that Information Technologies can offer proper tools to manage all these topics in an integrated way instead of managing them with different tools isolated between them. A lot of these tasks can be automated or highly lighted, but the final decision will always remain in the human side. The Information Technologies can help with the data preparing.
For Ireland, Sales and administration are key roles within an organisation, and in such cases must have an awareness of IN4.0 technologies. As in the future they will be part of the process which develops the products and service.

6. MAIN CONCLUSIONS — Job vacancies. Sales and administration

Is this area really affected by 4.0 technologies?

For France, the function nof creating partnerships (in the sense of a company grouping) seems important because it will allow small companies to access IN4.0 by taking into account managerial and production evolutions, etc....essential for the implementation of innovation.

UK affirms that for sales jobs will be a limited impact based on overall company performance. Administration roles will be affected due to streamline of processes, admin tasks could potentially be done more efficiently.

In Portugal 4.0 technologies will really affect the sales and administrative area. For that reason we thought that positions like Data analyst; Data Scientist; Virtual reality creator; Legal expert on database; Alliance Manager must be created from de scratch. The other positions can be adapted to the Naval Sector. We believe that we should give greater attention to the positions related to the supply chain due to the major changes that technological development will bring both to the associated processes and to the lead time of the operation.

---

6. MAIN CONCLUSIONS — Job vacancies. Engineering Area

The conclusions in this area are quite homogeneous, although there are also certain particularities

The first engineering positions must undergo adaptation to the requirements of Industry 4.0; while the latter (Robotics Expert, 3D Simulation Expert and Artificial Intelligence Expert) must be created from scratch.

It is outstandig that France and the Basque Country identify the position of "Planning Technician" as to be created, while the rest of the territories consider it should be adapted.

The same conslusion applies to the positions of "Structural Construction Technician" and "Sales Technician". The Basque Country and France recommend the first for extinction while the other territories propose it for adaptation. In the second case, the Basque Country, France and United Kingdom propose the position of Sales Technician as to be extinguished, while Galicia and Ireland consider that it needs to be adapted.

Are we forgetting any positions that need to be created in the engineering area?

For Basque Country new materials expert should be also considered in Engineering department, rather than for Production.

France confirms the interest of the function of urban planning technician, in fact the fields of study Maritime works have already evolved towards IN4.0, so the basic competencies there but needs to be created or adapted for the naval sector.

6. MAIN CONCLUSIONS — Job vacancies. Engineering Area

Are we forgetting any positions that need to be created in the engineering area?

Based on new conversations with SMEs, UK recomend that these positions would be adapted rather than to be extinguished. Of the Production Roles mentioned with the exception of Planning assistant are essential. A Planning assistant would be irrelevant when the main function of the role is to fit all the work into the Yard in Question, once that is done, what does the assistant do? All the trades mentioned such as welder, electrician, pipe fitter and carpenter are necessary as these are elements which will always be required onboard a vessel, regardless of size. There is a risk for the administration positions to disappear as the new digital tools will automate the process and reduce the workload. This change is unlikely to happen immediately as it depends of the degree of implementation of Industry 4.0 tools and technologies.
Robotics Expert, 3D Simulation Expert and Artificial Intelligence Expert: In the current state is unlikely that these roles would be created in-house but as 4.0 technologies are gradually being implementing the SME may consider to create this position. Industry 4.0 steering committee: new job's function may need to be created within the company to asses and support the SME on the digital journey. There is not a need for a sales technician as its responsibilities falls into a sales person category.

6. MAIN CONCLUSIONS — Job vacancies. Engineering Area

Are we forgetting any positions that need to be created in the engineering area?

Portugal believes that will be important to considered all position related with the Reliability Department. Pex: Reliability Manager -To lead condition monitoring and integrity of equipments and to ensure adherence to the design specifications while maximising their availability and reliability. To also ensure the monitoring and measurement good engineering and code compliant practices in repair and modifications within the plant. Plan inspection requirements and frequency for all equipments based on the criticality of process.

Ireland do not believe that there are any further positions which have to be created outside the aforementioned.

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6. MAIN CONCLUSIONS — Job vacancies. Production

The conclusions in this area are fairly homogeneous, although there are also certain particularities.

The Basque Country and France propose to create the position of Production Assistant from scratch, while the United Kingdom proposes to extinguish it and Galicia and Ireland to adapt it.

The Basque Country and France propose to eliminate the post of Foreman while the other territories propose to adapt it.

For Ireland, the positions of Tuber and Carpenter must be extinguished while for the other territories they must be adapted.

According to the Basque Country and France, the positions of Project Manager, Logistics Manager and Maintenance and Repair Manager must be created from scratch, while for the rest of the territories they must be adapted.

According to Ireland, the positions of Structural Engineer and Labour Risk Manager should be abolished, while for the other territories they should be adapted.

United Kingdom proposes to extinguish the position of Intelligent Logistics Expert, while Ireland considers it for adaptation and the rest of the countries consider that it should be created from scratch.

Are there any other endangered job positions in the production area?

For Basque Country not for now. For France with a view to training skills"to train employees and operators", the current functions of a supervisor could be taken into account, but in Breton shipping companies the tendency is to use the multi-skills of middle managers with transverse functions (engineering/ production/ management) to the detriment of supervisors, which is why the creation of a Project Manager, Logistics Manager and Maintenance Manager is required.

IN 4.0 ADAPTATION OF INDUSTRY 4.0 MODEL TO THE NAVAL SECTOR

### 6. MAIN CONCLUSIONS — Job vacancies. Production

Are there any other endangered job positions in the production area?

UK considers that all profiles of Production assistant, Foreman, Tuber and Carpenter, Project Manager, Logistics Manager, Maintenance and Repair Manager, Structural Engineer and Labour Risk Manager must adapt to the use of new technologies. Even if the amount of work remains consistent the number of required positions may be reduced as the Industry 4.0 tools will facilitate greater efficiencies. Intelligent Logistics Expert: a smart logistics expert would be needed but its competencies will probably fall into the new job specifications of the logistics manager.

Portugal includes Preventive & Predictive Maintenance

7.3 Questionnaire to prioritise weaknesses & threats identified in the SWOT ANALYSIS
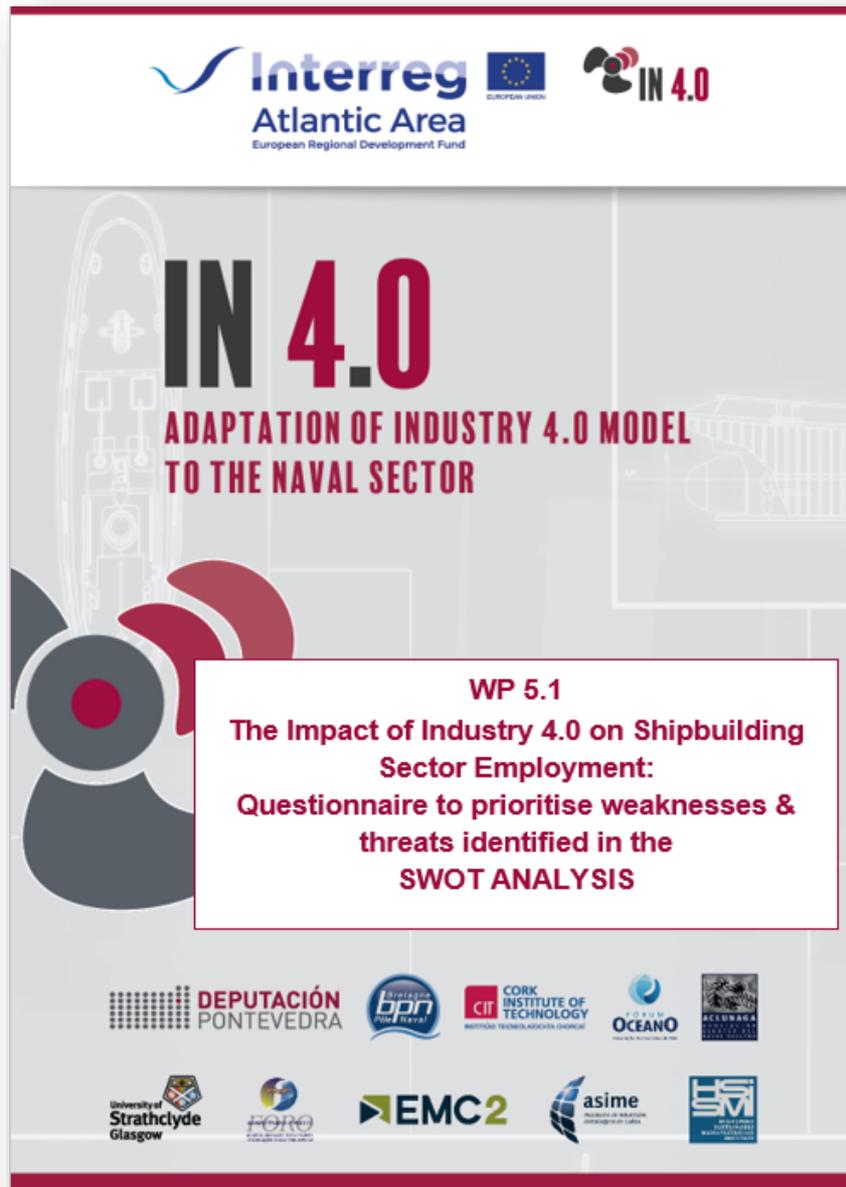
The following questionnaire attempts to collect a prioritization, based on their level of criticality, of the "weaknesses" and "threats" detected in the SWOT analysis of the report **"Report on the redefinition of job positions in the shipbuilding and repair industry"** (generated in Work Package No. 5, Activity 5.1).

This information will be included in a "pre-conclusion" to enhance the SWOT analysis included in the document.

Please, for this purpose and according to the experience of your organization:

Prioritize from **1 to 5**, with 1 being a very low criticality level and 5 being a very high criticality level, the following weaknesses and threats:

WEAKNESSES:

- **a)** Lack of young technical workforce (under 40 years old), which will result in a shortage of technicians in about 15 years. **(1 to 5)**

- **b)** Need to consolidate the ship repair sector as an important part of the maritime industry (the weight of the repair workforce is only relatively greater in France). **(1 to 5)**

- **c)** Only 2% of the workforce across the Atlantic Area is dedicated to the sales cycle (12% to design and 82% to production). **(1 to 5)**

THREATS:

- **a)** Risk of redundancy in unskilled and repetitive jobs, especially due to the emergence of additive manufacturing and robotics related technologies applied to the production cycle. **(1 to 5)**

- **b)** The implementation of highly technological processes that replace humans can threaten communication within companies and work teams, which is based on soft skills. **(1 to 5)**

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