Skills Alliance for Industrial Symbiosis: A Cross-sectoral Blueprint for a Sustainable Process Industry (SPIRE-SAIS)

Company Skills Requirements and Foresight

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Content

1. Introduction

The industry world is seeking solutions for an efficient use of resources and the reduction of CO_2 emission levels while maintaining their competitiveness and economic development. Thus, sustainability concerns are gradually being incorporated both into the agendas of policymakers and the strategies of companies. These strategies are mainly focused on developing circular economy & industrial symbiosis and improving energy efficiency, sustainability and optimal use of resources as well as safety and employee well-being.

Subsequently, in recent years, the general interest in Industrial Symbiosis (IS) and Energy Efficiency (EE) has considerably increased by acknowledging their potential in terms of its environmental, economic, and social aspects [1]. In order to foster Europe's development towards CO_2 neutrality and a circular economy in industry, more and more research and innovation (R&I) activities are carried out while the funding and investments for IS and energy efficiency are growingly strengthened by the European Commission [2].

For the performance of industrial companies, the interaction between the industry and the environment is crucial [3,4,5]. Environmental consequences have intensified the pressure on industrial enterprises because manufacturing sectors have a considerable impact on every component of sustainable development (social, environmental, economic and institutional) [6].

Furthermore, upcoming consumer societies and the exceptional growth of industrial activity have led to increasing environmental emissions, solid waste generation and landfills [7-10]. However, the demands for exponential economic and demographic growth cannot be realised since resources are limited [6,7,11].

In these circumstances, the threat of environmental contamination is becoming more severe, in addition to the worldwide scarcity of resources [4,12]. The European Commission (EUCOM) has reaffirmed its goal of being at the forefront of the battle against climate change and achieving a greenhouse-neutral continent by 2050 as a key step toward resolving environmental issues [5,7,13]. To fulfil the commitments made in the Paris Agreement, EU members have made an exemplary shift from an adaptive reduction to a proactive promotion of a climate-neutral economy [9]. In addition, the industrial sectors, especially energy intensive industries, are expected to follow the climate neutrality roadmaps that are defined by the EU Industrial Strategy (2020) [14]. These roadmaps are linked with zero-carbon technologies, with the Industrial Ecosystems – a concept introduced by the Strategy, that encompass all players operating in a value chain -, besides the expected introduction of norms, quotas and standards for zero-carbon materials (especially chemicals, steel and cement). Moreover, the EU Industrial Strategy (2020) states that one of the main drivers for the industrial decarbonisation will be leading a shift from linear production to a circular economy [14].

The manufacturing industry is also working towards the implementation of solutions that are innovative in the field of renewable energy sources and the transformation of the activities of companies to ensure that they operate with respect to energy efficiency [15,16]. The increasing use of renewable energy sources and energy-efficient technologies is one of the climate transition and sustainable development trends observed in the industrial sector, especially in energy intensive industries [17].

As a result, in addition to its daily operations, the industry is dealing with the pressures of environmental regulations, the obstacles of resource price volatility and resource supply threats [7]. The development and deployment of digital technologies in manufacturing is a critical factor in overcoming obstacles and speeding up the transition to a more sustainable and energy-efficient European industry [16,18].

Therefore, if the aim of Industry 4.0 is comprehended accurately and the latest technological

developments are implemented correctly, these technological innovations can be used as an effective solution for the achievement of circularity, and material and energy efficiency. In other words, the digital transformation of the industries not only enables increased productivity, but also provides immense opportunities for the realisation of sustainable and resource-saving manufacturing.

Improvement in the collection and use of data makes it possible to optimise business operations, maximise energy efficiency and use fewer resources more efficiently. Digital technologies are therefore pivotal in bringing about a change towards a more circular manufacturing sector [19].

Digitalisation is making the consumption of resources easier to measure which means that processes with excess energy and resource consumption can be identified and optimised.

As a result, the new era of digitalisation (Industry 4.0) and the adaption of sustainability and energy efficiency in European industry caused the use of the term "twin transition". The European Union is counting the so called “twin transition” since it will be the key for implementing a circular development strategy and decarbonising the economy, turning Europe to boost its innovation capacity, competitiveness and the industrial chain value [20-22].

As a proof of the aims of the EU about this subject, *The European Green Deal* is provided as a roadmap by the EU for making the EU’s economy sustainable by boosting the efficient use of resources by moving to a clean, circular economy and stop climate change, revert biodiversity loss and cut pollution. It outlines investments needed and financing tools available and explains how to ensure a just and inclusive transition. It aims to decouple economic growth from resource use by 2050 and transform ‘linear’ take-make-discard industrial value chains into virtuous models that design waste and pollution out of the process, keeping products and materials in use for longer and helping to regenerate ecosystems [23]. It underlines how Industry 4.0 developments, advances in robotics and other smart technologies are going to speed up the circular economy (CE) transition and get the European Green Deal done in many areas – from waste recovery to social innovation [20]. In addition, initiatives - such as the Sustainable Products Initiative - aim to make all products placed in the EU market more durable, reusable, repairable, recyclable and energy efficient and are expected to target industrial sectors in general.

As a result, technological developments urging with digitalization as well as growing energy costs and newly developed strict policies about circular economy and sustainability will transform occupations. Thus, they will result in the demand for new skills in the workforce and are likely to accelerate skill shifts compared with the historical trend.

Therefore, Industry 4.0, sustainability, (raw) material scarcity and energy costs appear to be the main drivers leading the evolution of skills needed in the SPIRE industries [24].

A competent, multi-skilled workforce that can handle the implementation of new business models compatible with IS & EE and technological developments is the major key condition to create a competitive and sustainable (circular) manufacturing industry in Europe. This highly qualified workforce can only be achieved on time through foreseeing and addressing the future skills requirements and updating the existing qualifications or creating new ones, to provide the knowledge and skills to the current labour force through upskilling /reskilling activities.

There are countless benefits of digitalisation for the realisation of sustainable production. Therefore, to respond to new skills demands and achieve a workforce proficient in IS (IS) and Energy Efficiency (EE), a holistic approach should be adopted for the workforce reskilling and upskilling. This approach should consider not only the IS & EE requirements but also the technological developments and transformations in the industry and their effect on the skills demands of the future workforce. In this work, the same all-embracing approach was developed to define the future skills requirements. The work provides ideas and hints from varied perspectives to deal with the current skills requirements and as well as to meet the future skills requirements urging with implementation of IS & EE and digitalization. Our work also

offers concrete examples to support the organisational change processes related to the adoption of EE and IS in daily work and digitalisation. These examples demonstrate how the relevant company departments (such as Human Resources (HR) Department etc.), curricula developers, qualification providers and other stakeholders can use the generated job profiles with their professional definitions during the assessment, career development and curriculum design. Additionally, this work provides a brief guidance on how to connect the profiles to other frameworks, e.g. ESCO the European Classification of skills, competences and occupations. Finally, it establishes conclusions for their integration into the European Blueprint through analysing the overall results and assessing their impact on the SPIRE sectors organisations and their staff.

Our work is aimed be an academic and industrial guideline to prepare convenient, and well-developed VET training programs to deliver the needed skills.

Therefore, considering the future technological developments for implementation of IS and EE solutions within process industry and skills development concepts stated in other recent and respectable sources and portfolio review of the projects on industrial symbiosis by European Commission, examining studies published by several book chapters and scientific articles, this document identifies and specifies the new skills and training needs within the SPIRE sectors, taking a framework of increasing environmental constraints and energy costs into account. In other words, this work focuses mainly on the near future changes in the professional skills requirements of the SPIRE sectors. The identified skills are to be incorporated into VET and tertiary education training curricula.

In this work, we fulfil a significant objective of the project through identifying and specifying new skills and training needs within the SPIRE sectors, considering a framework of Industrial Symbiosis, Energy Efficiency and growing digitalization.

After clarifying the industrial changes through the entire value chain resulting from sustainability, efficient resource use and digitalisation needs as well as defining the tasks of the professional profiles, it is possible to interpret the data on the expected evolution of skills needs. And once this expected evolution is defined, the skills mismatch between the workforce and industry demands can be clarified. Only then, the skills gaps can be reduced by delivering well-developed continuous trainings. In terms of capacity building, both IS and EE, including their potential and benefits, should be included in the education of engineers and business students to ensure the availability of a sufficient skill base [2].

2. Industry skills requirements

Setting up the definitions for "Industrial Symbiosis" and "Energy Efficiency"

Establishing the most accurate and present-day definitions of "Industrial Symbiosis" and "Energy Efficiency" concepts is a key condition to identify the correct and harmonized job profiles in different target sectors. Therefore, before the selection of the job profiles, the SPIRE-SAIS partners searched for the conventional definitions of these concepts.

"Industrial symbiosis" refers to the use by one company or sector of underutilised resources broadly defined (including waste, by-products, residues, energy, water, logistics, capacity, expertise, equipment and materials) from another, with the result of keeping resources in productive use for longer [25]. Industrial symbiosis (IS) is a systematic approach to a more sustainable and integrated industrial system, and identifies business opportunities that leverage underutilised resources (such as materials, energy, water, capacity, expertise, assets etc. The main objective of IS, is represented by the increase of production by saving energy and resources through the cooperation among companies that use by-products or waste from other companies [26]. By using this approach an interconnected network which strives to mimic the functioning of ecological systems is created, within which energy and materials cycle continually with no waste products produced. Industrial symbiosis is an important option for establishing a circular economy [2]. Keeping resources in productive use longer through industrial symbiosis is critical to Europe's circular economy transition [27].

Together with Industrial symbiosis, Energy Efficiency is another goal for Energy Intensive Industries (EII) towards higher environmental sustainability. 'Energy efficiency' means the ratio of output of performance, service, goods or energy, to input of energy [28]. In an industrial context, "Energy efficiency" simply means using less energy to perform the same tasks required to provide products and services [29]. It refers to more efficient, conservative use of energy across all sectors– that is, eliminating energy waste [29]. Energy efficiency brings a variety of benefits: decreasing greenhouse gas emissions, reducing natural resources consumption such as coal, oil, biomass, etc., minimizing demand for energy imports, and lowering costs on an economy-wide level. Growing awareness of climate change, legal and policy developments and rising energy prices all lead to increasing social and economic pressure to reduce energy consumption in as many domains as possible [19].

It is possible for EU countries to achieve a sustainable and energy-efficient economy and employment growth at the same time [30]. The first condition for attaining them both is the development of new skills required by a low carbon economy, which are compatible with the climate and energy polices and measures. In this chapter, the identification process of these skills is carried out.

2.1 Green Skills

"Green Skills" refer to skills based on the preservation of sustainable development in terms of technical knowledge, values and attitudes needed in the workforce to develop and support the social, economic and environmental elements established in business, industry and society [31]. CEDEFOP [32] defines green skills as the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society. The identification, assessment and creation of green skills is essential in transitioning to a low-carbon economy and being able to capitalise on all the social, environmental and economic benefits that this brings [33].

Green skills category is a wide-ranging skills classification and at the same time, it **involves the skills related to "Industrial Symbiosis" and "Energy Efficiency".**

Some examples for green skills can be enlisted as environmental awareness for production processes, application of lean manufacturing principles to reduce energy consumption and improve production quality, regulatory awareness, knowledge of environmental issues, life-cycle analysis, knowledge of energy consumption optimisation, costs and consequences of use, management of health and safety and security.

These skills are considered key to maintain the competitive edge of the European manufacturing industry [24]. This can be explained by the efforts that the industries in EU are making to meet the EU's 2050 environmental targets. Because of the increased focus on energy efficiency, sustainability and environmental awareness, green skills are projected to become highly important over the next five years among European companies which are active in a broad range of sectors.

2.1.1 Skills needed for Industrial Symbiosis

In established Industrial Symbiosis cases and in industrial symbiosis projects, the creation of new jobs is evident or clearly foreseeable. For established cases, the drivers for the implementation are growth of the businesses involved, improvement of the sustainability of the operations and new business development. All these drivers create new jobs. Beyond that, the operation of the symbiosis will also create a certain need for new jobs, though this only applies to larger symbioses [2].

During the phase when new technologies for future implementation in an industrial symbiosis are developed, the research, innovation and development activities themselves create additional activities and employment. This is also often true for mature technologies at high technology readiness levels (TRLs) (i.e. 9), because, as previously mentioned, their Systems Readiness Level (SRL) might be significantly lower and therefore significant work is needed to adapt them to the symbiosis scenario in which they are to be deployed [2].

Implementation of IS would almost certainly mean new jobs for a neutral, independent and trusted party. This provides a good example of a potential new job linked to the specific requirements and skills (technical, regulatory, business related, etc.) necessary for IS. Furthermore, considering the importance of the local and regional context in establishing such cooperation, it is likely that, along with industrial symbiosis, many of these entities would develop in different European countries and regions [2]. Beyond the new business models and the opportunity for job creation, increasing the competitiveness of the companies is another key benefit which industrial symbiosis can deliver, thereby allowing jobs to be retained in Europe, which is of critical importance [2].

Most of the stakeholders involved in IS implementation rely on a multi-disciplinary and complementary team: social & collaboration, international cooperation, commercial, economics & circular economy, energy, technical expertise etc. [34]. It means multi-disciplinary and complementary thinking, cooperation and collaboration skills, commercial skills, knowledge related to economics and sustainability will gain importance due to the IS implementation. Since the IS context is evolving fast, working autonomously will be a crucial skill. IS facilitators will be expected to have field experience and recognize local opportunities, necessary technologies, and have an understanding of the business culture. They need to own basic knowledge and concepts: IS core concepts, basic understanding of EE and IS, theoretical frameworks and methodologies [34].

It is important to underline the fact that the networking skills including fostering cooperation (between stakeholders and between facilitators), as well as the skills related to the use of collective intelligence facilitation tools, encouraging collective decisions are not only based on the IS facilitator's technical knowledge, but also based on every stakeholder's input.

Since IS initiatives need quality side streams to be exploited, Eco-design and Life Cycle Thinking are cited to be key skills for future IS facilitators [34].

The most crucial skills are interpersonal skills - the ability to network, collaborate, think systemically and develop an entrepreneurship mindset - and other transversal skills, such as effective communication skills to be able to present themselves properly, to convince enterprises of the merit of IS and to engage stakeholders in the approach. These skills also help overcome social barriers during the IS implementation [34].

Beyond interpersonal skills, legislation knowledge is essential; this is also fundamental to answer the most cited obstacles: legal barriers. This can be linked with the required knowledge in waste management, waste prevention, Eco-design, re-use and recycling.

Especially waste management legislation is a very complex matter, depending on EU, national and regional levels. An Industrial Symbiosis curriculum developed with an international perspective must consider the EU level but can't anyway ignore elements of both regional and national legislation [34]. Thus, the workers will need to have the capacity to look for the specific legal information needed [24].

With political support, financial incentives are viewed as the most important lever for IS implementation, while economic barriers are perceived as the third more important barrier. Consequently, the workforce at the management level needs to have a high score achieved for financial management skills and business model skills [34].

In addition, the potential and the benefits of IS should be included in the education of engineers and business students as well as the work-place trainings programmes. Since Industrial Symbiosis is a new approach, it would make progress much easier if already educated students were to enter the workforce well-prepared and familiar with the concept of Industrial Symbiosis, bringing with them the skills needed to identify opportunities, develop business cases and drive implementation [2].

2.1.2 Skills needed for Energy Efficiency

Building an understanding of the knowledge, skills and experience needed to deliver robust energy efficiency outcomes is essential for establishing a professional development pathway [35].

A range of skills are required to implement effective energy efficiency strategies and practices. These skills generally cannot be found in one person, which means a team-based approach is essential for the energy implementation in large businesses [35,36]. The most effective approaches require involvement of people from across an organisation, bringing a diversity of backgrounds and skill sets. This might include staff from corporate management, procurement, site management and operations, with appropriate backing and resources from senior management [35,37]. Not only multi-disciplinary teams of individuals, but also teams of firms with complementary expertise will be critically important for the well-developed energy efficiency strategies in EU [35].

Functional skills in the energy efficiency assessment context are the practical skills needed in a range of discipline areas that allow individuals and teams to confidently and effectively complete energy efficiency assessments [37]. The key skills needed to conduct energy efficiency assessments in the companies belonging to the energy intensive industries (EEI) can be mainly categorized as follows:

(1) Project planning and management: the ability to direct and guide a group in completing tasks and attaining goals of energy efficiency assessment. (2) Communication planning and implementation: the ability to exchange, engage, convey and express knowledge and ideas in an energy efficiency context. (3) Understanding energy use: the ability to arrange and retrieve data, knowledge and ideas, research and investigation of specific technical and financial knowledge. (4) Identification of potential opportunities: the abilities to think logically and creatively. (5) Decision-making: the ability to develop and assess business cases for implementation of energy efficiency opportunities. (6) Monitoring and investigating: the abilities to install appropriate monitoring equipment and develop analysis systems

[37]. Identified additional skills, knowledge and experience consist of understanding the legislative and compliance requirements of energy efficiency programs, financial planning, accounting and audit skills, understanding of new trading and reporting mechanisms, and their strategic business implications [36,37].

Building the number and capability of energy efficiency service delivering system optimisation and business transformation strategies would boost energy efficiency outcomes. Therefore, energy efficiency professionals – particularly those working in the industrial space – are expected to have sufficient expertise in system optimisation, as it interacts so directly with their core energy efficiency knowledge. Business model transformation is an area that far fewer energy efficiency professionals have deep expertise in and they need to develop their knowledge in this area [35]. The need for broader and deeper industry knowledge on sector specific best practices and processes, globally relevant emerging trends and business challenges is extending well beyond issues of energy use [35].

Specifically, the ability to think critically, creatively and strategically, especially in the identification of opportunities for improvement, would be enhanced through knowledge of and experience in approaches such as Lean Manufacturing, Six Sigma and Continuous Improvement [35].

To develop a comprehensive energy efficiency offering, the professionals providing energy efficiency would need more complex financial analysis skills, and knowledge of new methods of calculating value to support system optimisation projects and business model transformation [35].

Some of the revealed skills gaps and shortages that may have prevented companies from realising the full potential of their energy efficiency assessments are related to [36,37]: (1) energy data collection and analysis (2) selection and use of metering and monitoring equipment (3) development of business cases for energy efficiency projects (4) the ability to integrate energy efficiency findings into cross-business operational plans and practices. These skills gaps were not limited to a lack of formal qualifications, but also related to a lack of specialised knowledge, skills and experience needed to adapt to new technologies and methods of working [36].

2.2 The effect of the digital transformation on the skills needs

In recent years, manufacturing industry has undergone profound, rapid and constant changes because of the ongoing industrial revolution, Industry 4.0. Digital transformation is a predominant factor of the current industrial revolution leading to the revolution of the traditional industry through intelligent manufacturing [38,39].

Digitalization provides incredible opportunities for industry: first and foremost, the optimization and the interactions of the individual production units, within the entire production chain (and beyond). Industry 4.0 presents an incalculable opportunity for industry as it reshapes and improves not only all the production processes, business models but also the quality of their services and the way that the sector adds value [40].

Adaptive online control, through-process optimization, through-process synchronization of data, zero-defect manufacturing, traceability, intelligent and integrated manufacturing will be the most important digitalization trends in the future. Digitalization offers a range of opportunities to increase quality of products, reduce lead time and increase productivity by improving the overall production efficiency of a plant [24,41,42]. Digital technologies, through the continuous adjustment and the optimization of the processes online, aim to improve the flexibility and the reliability of processes, to maximize the yield, to improve the product quality and the maintenance practices. Such technologies further contribute to increase the energy efficiency and to monitor and control the environmental performance of processes in an integrated way [24,41,42]. Real-time decision making in production chain considering technological, economic and environmental aspects at the same time is only possible through the

integration of new IT, automation and optimization technologies.

The digital transformation also presents tremendous opportunities for the fulfilment of sustainable and resource-saving manufacturing. Collection and use of real time data makes it possible to maximise energy efficiency and use fewer resources more efficiently. Thus, digital technologies are crucial in making a difference towards a more circular manufacturing industry.

At the same time, flexible, progressively interconnected and complex processes, technological developments are transforming the organizational structure, job profiles and skills requirements of the companies continuously [43-47]. The technological developments will change occupations and force the sectors to improve quality and relevance of skills to meet the industry needs.

The main observed consequence of the mentioned technological changes is that the demand for technological skills will grow rapidly as companies deploy automation, robotics, AI, advanced analytics, and other new technologies [24,41,48]. This surge will affect demand for basic digital skills as well as advanced technological skills such as programming [41]. Awareness of data security and protection will acquire importance as will trust in new technologies [24].

The Future of Jobs (2020) report published by the World Economic Forum assesses that by the year 2025, 85 million jobs would be moved by a shift in the division of labour between humans and machines, while 97 million new jobs which do not exist today would appear. 84% of employers would engage in digitalized working processes, along with a significant expansion of remote work [49,50]. Thus, because of digitalization, competition for high-skill workers will increase, while displacement will be concentrated mainly on low-skill workers, continuing a trend that has exacerbated income inequality and reduced middle-wage jobs. High-skilled workers are most likely to be hired and retrained, and to see rising wages. Firms in the forefront of automation adoption expect to attract the talent they need, but slower adopters fear their options will be more limited [24,51,52]. While changes resulting from technological progress and globalisation in the world of work affect everyone, adults with low skills are most at risk of experiencing a deterioration in their labour market prospects [53]. The demand for their skills is decreasing, as many jobs they traditionally do are automated or off-shored in advanced economies. OECD research shows that occupations that require no specific skills and training have the highest risk of being automated. Therefore, addressing the specific training barriers of low-skilled adults is imperative for them to progress in the labour market and access better jobs [53]. As well, reskilling of lower-skilled workers is a very critical issue for the industrial sectors.

One of the main observed consequences of digitalisation is that workers have great difficulties to the increasingly automated, robotized and digitized processes [54]. To overcome the skills needs emerging with digitalization, companies can collaborate with educators to reshape school and college curricula. Industry associations can help build talent pipelines, while labour unions can help with cross-sector mobility [55].

One of the tools that the EC has released to support the digitalisation is the DigComp – Digital Competence Framework through providing a common understanding of what “digital competence” is [56]. It also hands over a basis for framing digital skills policy.

3. Methodology

3.1 Description of the methodology

This chapter details the methodology which we have followed to obtain our results in this report. The initial goal of the methodology is to generate the list of the current job profiles related to industrial symbiosis and energy efficiency for six of the SPIRE sectors* through using ESCO occupations database. (*6 Spire sectors are chemicals, steel, minerals, water, cement, ceramics. Originally, there are eight energy intensive industrial sectors represented in SPIRE: chemicals, steel, engineering, non-ferrous metals, minerals, water, cement, and ceramics. However, due to the lack of engagement of industrial partners from engineering and non-ferrous metals sectors, we proceeded with the six mentioned sectors). A five-step methodology is developed as presented in the figure below. The five steps of the methodology have been completed up to now. Each step of the methodology is detailed in ANNEX I.

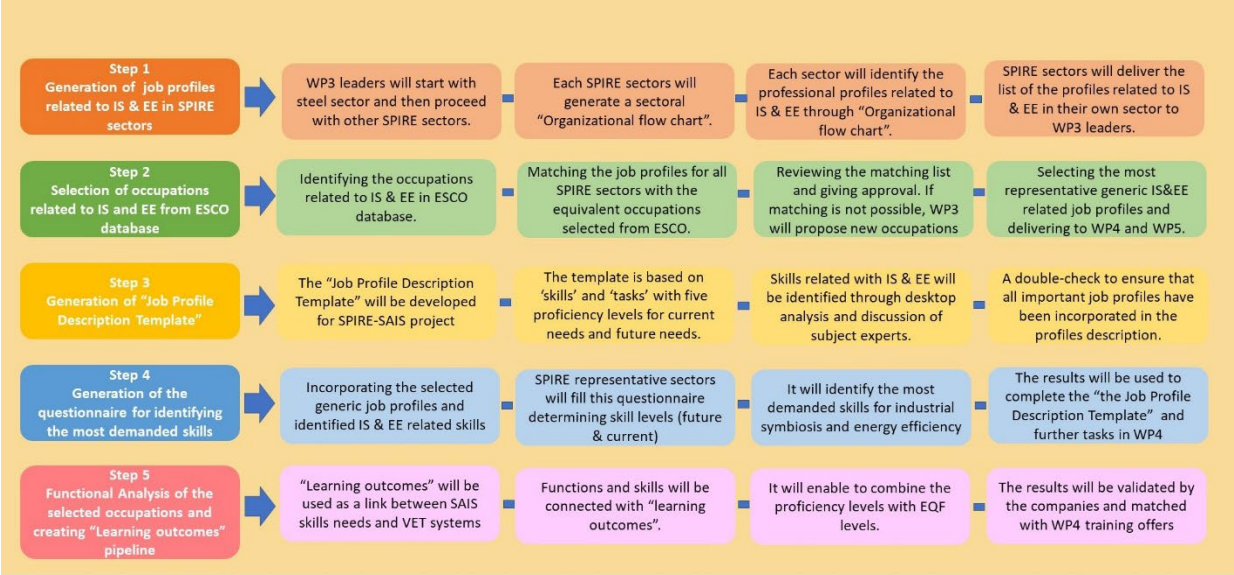

Figure 1. Summary of WP3 methodology

"Organizational flow chart" definition for identifying the Professional role profiles *related with Industrial Symbiosis & Energy Efficiency.*

Based on the "Job Profile Organizational flow charts" of each SPIRE sector, an analysis is carried out to identify which profiles are related to Industrial Symbiosis & Energy Efficiency. Each SPIRE sector generates an organizational flow chart for the job profiles and identify the professional role profiles related with IS & EE in their sector with the support of the industrial partners.

Figure 2. Steps followed to obtain the sectoral job profile organisational flow chart

Group similar sectoral job profiles and find equivalences with ESCO database Occupations & ISCO groups

ESCO, European Skills/Competences, Qualifications and Occupations, is a European Commission sponsored EU-initiative that provides a common European classification of Skills, Competences, Qualifications and Occupations [57]. The ESCO Database provides very useful information about occupations description, hierarchy (ISCO groups), essential/optional knowledge, skills, etc.

Once job profiles related with IS & EE has been identified for each SPIRE sector, the next step is to group the job profiles that perform similar tasks, for example, profiles related to operations with furnaces, profiles related with refractories, with wastewater, environment, energy, etc.

After these groups are formed, their equivalences are examined within the ESCO database for those occupations whose tasks are adapted to those of the groups defined previously. As each occupation in ESCO database, it is within a hierarchical level defined in turn by a code or ISCO group, it will be possible to find the equivalences between the occupations and the ISCO group numbers (see Figure 3).

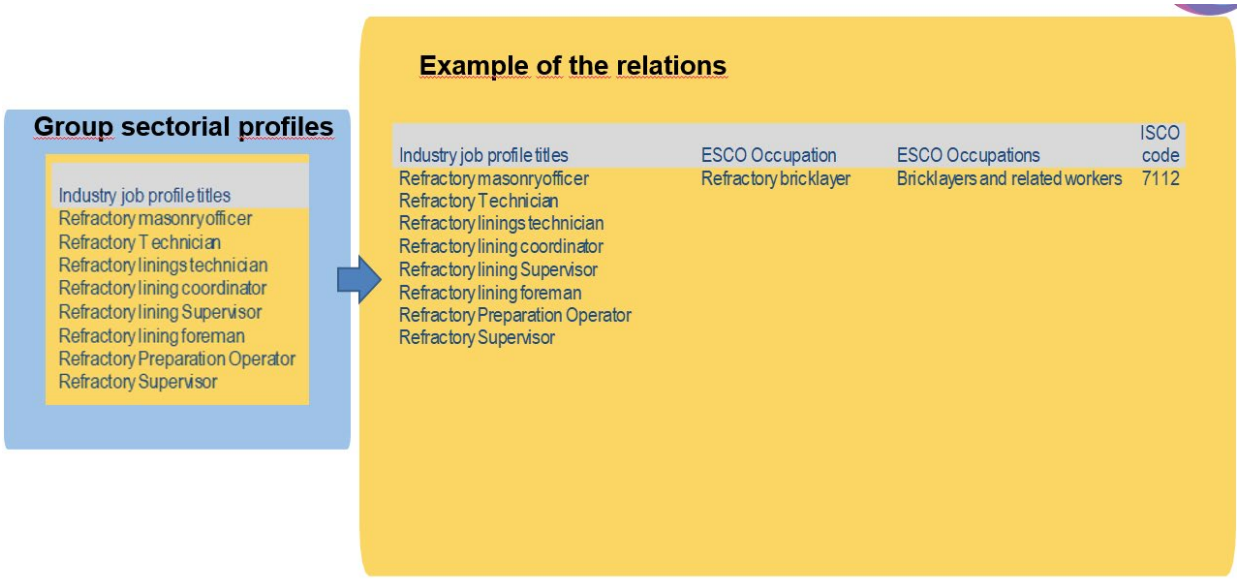

Figure 3. Finding the equivalences of the job profiles in ESCO occupations which are defined by ISCO group numbers.

The ISCO code will be used in two ways:

- As ESCO is designed to improve communication between the education and training sector, WP4 can use the ISCO code to identify training programs for European VET systems matrix elaboration.
- ISCO code can be used to automatically fulfil the job profiles description templates for each group of sectoral profiles.

English (en)

bricklayer

Discuss this topic in the Online Forum

Code

7112.1

Description

Bricklayers assemble brick walls and structures by skilfully laying the bricks in an established pattern, using a binding agent like cement to bond the bricks together. They then fill the joints with mortar or other suitable materials.

Scope notes

Includes people working with industrial oven brickmasons.

English (en)

Bricklayers and related workers

ISCO-08 code

7112

Description

Bricklayers and related workers lay bricks, pre-cut stones and other types of building blocks in mortar to construct and repair walls, partitions, arches and other structures.
Tasks include -
(a) laying stone, brick and similar building blocks to construct or repair walls, partitions, fireplaces and other structures such as smokestacks, furnaces, converters, kilns and ovens, piers and abutments;
(b) laying footpaths, kerbs and pavements;
(c) laying bricks or other masonry to build patios, garden walls and other decorative installations.
Examples of the occupations classified here:
- Block layer
- Bricklayer
- Chimney builder
- Refractory bricklayer
Some related occupations classified elsewhere:
- Stonemason - 7113

Hierarchy

- 7 - Craft and related trades workers
  - 71 - Building and related trades workers, excluding electricians
    - 711 - Building frame and related trades workers
      - 7112 Bricklayers and related workers

Narrower occupations

bricklayer

Concept URI

http://data.europa.eu/esco/isco/C7112

Figure 4. Example of ESCO description for "bricklayers and related workers"

With the job profile description and tasks, the profile description template is automatically generated from ESCO database with a software developed by Deusto University, to achieve a more common ground and reduce the complexity of creating the descriptions of all IS & EE related jobs for each SPIRE sector.

The “SPIRE sectoral job profile descriptions” will be constructed consistently to provide a common template. A standard template makes it easier for users to compare different profiles and to provide a fast start for developing new profiles or contributing to designing new job descriptions. More detail is provided in Chapter 3.3 about the Sectoral Job Profile Description Template.

This template includes the skills related with IS & EE. The most relevant skills are selected and incorporated into the template after a detailed desk research and a discussion about the **Skill Classification** with subject matter experts among the industrial and academic partners. The selected skills are presented in the Chapter 3.3.

At first, the template will be used for the most generic job profiles for the SAIS industries. These are selected after a detailed analysis and discussion in coordination with project partners, as demonstrated in Chapter 3.2.

Current and future skills evaluation and gaps definition.

By generating a questionnaire for identifying the most demanded current and future skills related to EE and IS in SPIRE sectors and delivering it to the industrial partners, the evaluation of current and future skills is carried out. A selection process is executed to choose the most representative occupations. Each selected occupation will represent a particular ISCO group (ISCO code). The number of the selected occupations should be limited, so that they are manageable when incorporating them into a questionnaire.

The results of the survey will be used to complete the template with the professional role profiles description and will be the base for further work (of WP4) about incorporation of the skills needs concerning industrial symbiosis (IS) and energy efficiency (EE) in VET systems and frameworks at national and EU level. The methodology to be applied is described in greater detail in Chapter 3.2 and 3.3.

3.2 The SPIRE-SAIS Sectoral Job Profile "Organizational Flow Chart" concept

Stakeholders and experts consider that job profile "Organizational flow chart" is a valid view which can be used to facilitate navigation and demonstrate relationships between job profiles. It also gives us a clear idea about the organizational structure that the family belongs to.

The job profile family concept is principally analogous to a human family tree where characteristics from one generation pass to the next but are also incorporated with new characteristics [58]. We can think it as viewing a subject from a distance through a camera lens and making an outline of that subject. As we gradually focus the lens we can see progressively and more sharply and can better understand the detail of the subject we are viewing. Likewise, the job profile "Organizational flow chart" provides us a distant viewpoint with a clear outline but with inner details that are intentionally generalized. During the development of job profiles, the "Organizational flow chart" provides us an additional perspective and the option to modify content and to incorporate detailed granularity to meet specific requirements while maintaining the original profile outline [58]. Thus, utilizing the job profile "Organizational flow chart", the profiles may be used for reference or alternatively as a base to develop further profile levels [58].

WP3 adopted the SPIRE sectoral job profile "Organizational flow chart" approach to facilitate the identification of the occupations related to IS and EE in each SPIRE sector. The process is carried out with the collaboration of the companies related to each SPIRE sector to have an accurate industrial point of view. Each sectoral "Organizational flow chart", incorporates the profiles for all the production and maintenance functions, starting from the manager profiles reaching down to blue collar profiles. The final version of the generated "Organizational flow chart" for each SPIRE sector is aimed to be used as reference for that specific SPIRE sector.

As an example, job profile "Organizational flow chart" for the steel and ceramic industry were generated in order to set a principle for the other SPIRE sectors:

(A) For the steel sector, there is a big complexity when trying to define the "Organizational flow chart". Structured from one production process, "Electric arc furnace", products could be different depending on the markets to which they are aimed and the final application. Downstream, level 1 profile groups can be found in the flow chart and currently 37 profiles related with Industrial Symbiosis & Energy Efficiency, will intend to reflect the **Electric arc furnace steel sector.** This concept allows to adapt the core components of the level 2 profiles as needed to user generated profiles with higher level of detail (see figure 5 and 6)

(B) For the ceramic sector, eight functional areas are defined (operations management, quality management, purchase management, human resource management, financial and administrative management, commercial management and marketing). For all of them, the ceramic sector organizational flow chart was completed until intermediate management level. Nevertheless, in the case of the production and maintenance departments, the organizational flow chart was expanded down to the blue-collar profiles (see figure 7).

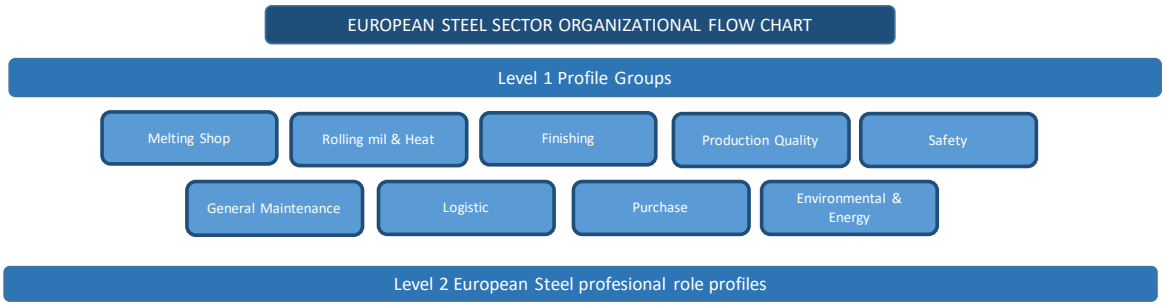

Figure 5. European Steel Sector Organizational Flow Chart: nine profile groups (level 1) at the top of the organigram

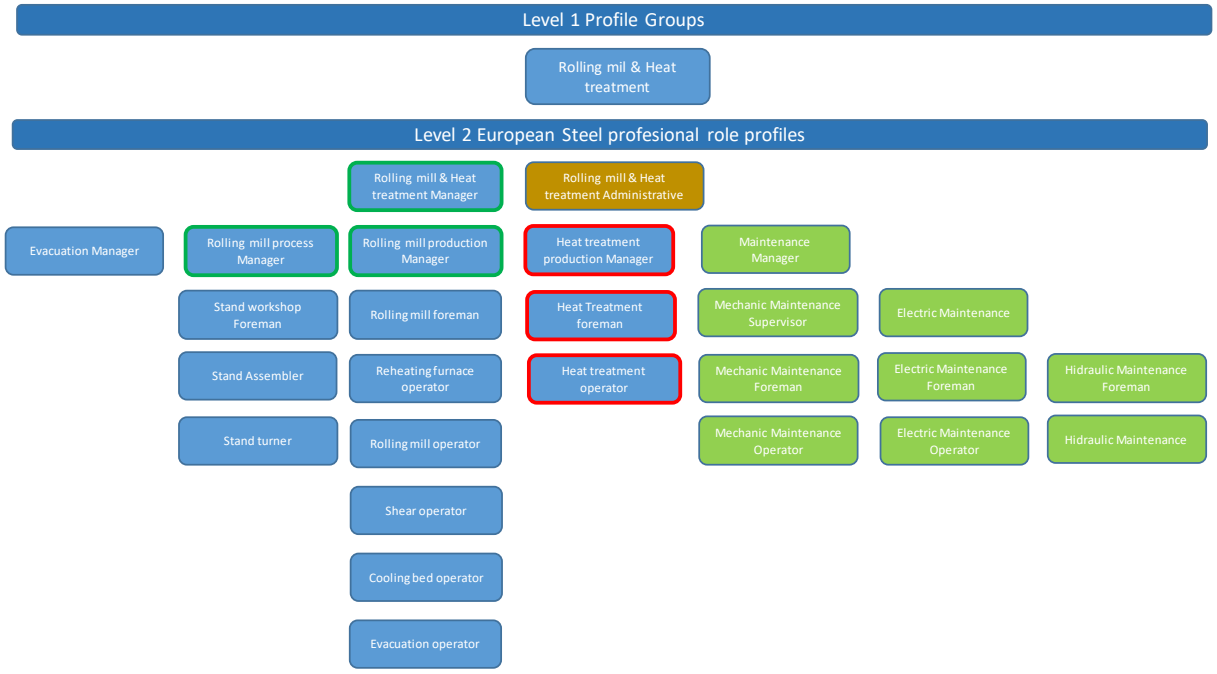

Figure 6. European Steel Sector Organizational Flow Chart: professional profiles (level 2) of Melting Shop Profile Group at the downstream of the organigram. (In order to see the professional profiles belonging to other profile groups, please see ANNEX II.)

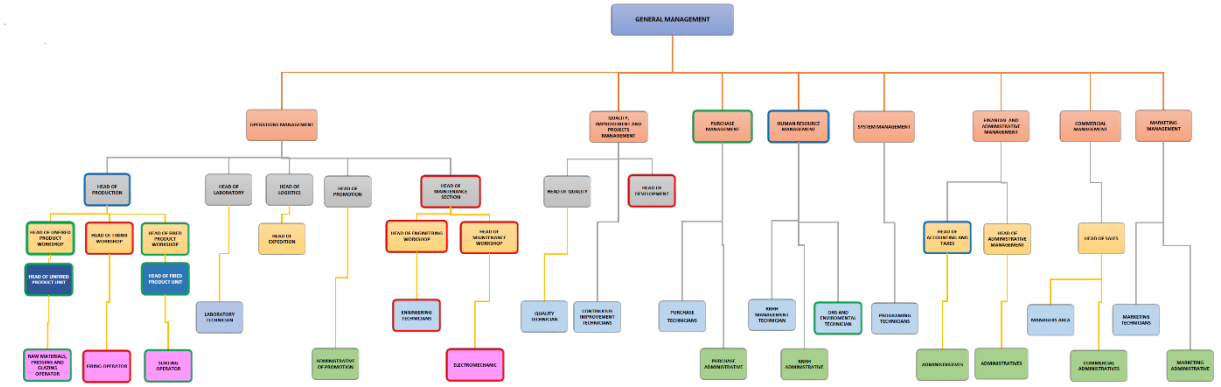

Figure 7: European Ceramic Sector Organizational Flow Chart. (For a detailed view and further information about the chart please see ANNEX III)

Once Steel and Ceramic SPIRE sectors generate their "Organizational flow charts", they identify the professional role profiles related with IS & EE using these charts and getting the support of SPIRE-SAIS industrial partners. In Figure 6 and Figure 7, the job profiles connected to IS, EE and both IS and EE are framed in green, red and blue respectively. (The flow charts of the other sectors: chemical, mineral, water and cement are presented in Annex IV, V, VI and VII respectively.)

There is a huge range of different job titles across these SPIRE sectors and they are created for a variety of purposes including attracting new recruits and providing recognition for organisation loyalty through the promotion and construction of enhanced job titles. Jobs are unique, but a similar title can be used to describe widely different jobs, conversely similar jobs with equivalent tasks can be described by different titles. This can be confusing and prevent clear understanding between different sectors and stakeholders of the job described and its associated tasks and responsibilities.

Therefore, once the job profiles related to Industrial Symbiosis & Energy Efficiency are identified, a standardisation, reduction and merger of similar profiles in the "Organizational flow chart" of different SPIRE sectors is carried out. This process is performed by finding common ground between as many profiles as possible and merging them. ESCO framework was used as a reference during this merging process and further detail is given next.

The ESCO approach

As the SPIRE sectoral job profile "Organizational flow chart" provides a structured information during the generation of the occupation related to IS and EE as well as their skills requirements, which will be the foundations for the work with VET Systems (WP4) and will set the ground for the Blueprint development (WP5), it was agreed by the SPIRE-SAIS partners that in order to create competent occupation & skill profiles, the SPIRE sectoral job profile "Organizational flow chart" needs to be consolidated and simplified. In this way, it will ensure a constant view on the changing skills needs in the SPIRE sectors, linked to the main drivers, emerging technologies and trends that are influencing the change.

Once the SPIRE sectoral job profile "Organizational flow chart" is completed with the contribution of the partners, it will be evaluated and consolidated to reflect the whole families and profiles covering the SPIRE sectors. The ESCO occupations data base is used for this comparison and consolidation.

In the previous chapter, a brief definition of ESCO was already provided. Nevertheless, to explain the ESCO approach, further information about ESCO is needed.

ESCO, which is an EU-initiative, is used as a dictionary, identifying, describing and classifying professional

occupations, skills, and qualifications relevant for the labour market and education and training. ESCO grants a common classification since it is directly linked to the International Standard Classification of Occupations (ISCO) which is the classification of occupation groups managed by the International Labour Organization (ILO), since the information and data in ESCO is based on an original work published by the ILO under the title ”International Standard Classification of Occupations”, ISCO-08.

Group similar sectoral job profiles and find equivalences with ESCO database Occupations & ISCO groups

In ESCO database, each occupation comes with an occupational profile, in which the knowledge, skills and competences that are relevant for the respective occupation are listed. ESCO’s skills pillar contains knowledge, skills and competences.

Since in ESCO profiles “competence”, “skill” and “task” are usually referred as same concepts and there is no clear distinction between them, we modified these concepts and generated profiles based on “TASKS” and “SKILLS” to achieve a more common ground and reduce the complexity.

The SPIRE sectors job profiles are created in a generic and simple way, to enable reference and use by all types of organisations, whatever their size and their structure. In consequence, the SPIRE sectors job profiles will provide high level outlines of typical SPIRE sectors Professional Roles; easy to break down to the next context specific application level, for instance job descriptions.

Once job profiles related with Industrial Symbiosis & Energy Efficiency have been identified for each SPIRE sector, the next step is to group the job profiles that perform similar tasks. Then, once these groups have been formed, equivalences will be searched in the ESCO database of those occupations whose tasks are adapted to those of the groups defined below (Figure 8). As each occupation in ESCO database, it is within a hierarchical level defined in turn by a code or ISCO group, it be possible to find the equivalences between the occupations and the ISCO group numbers.

It is important to note that the relationship between the two structures does not represent an equivalence but could be the starting point to create such equivalence between ESCO and the titles in the SPIRE sectors.

Area	Level	Job Profile	Equivalent ESCO occupation
Production	Management	Production Manager	Industrial Production Manager
Production	Operational	Production / Processing Line Operator/Foreman	Production Engineering Technician
Functional	Management	Materials / Products Manager	Product Manager Materials Engineer
Functional	Operational	Materials Operator/Foreman	Production Supervisor
Functional	Management	Energy Manager	Energy Manager
Functional	Operational	Energy Technician	Energy Analyst
Functional	Management	Environmental Manager	Environmental Engineer
Functional	Operational	Environmental Technician	Environmental Technician
Functional	Management	Waste Manager/Responsible	Waste Management Supervisor
Functional	Operational	Waste Management Technician	Waste Management Supervisor
Functional	Management	Maintenance Manager/Supervisor	Maintenance and Repair Engineer
Functional	Operational	Maintenance/Repair Operator/Foreman	
		(a) Water, Gas, Stream, Air Foreman	Maintenance and Repair Engineer
		(b) Mechanical/Electrical Technicians	Electrical Supervisor Electromechanical Engineering Technician
Functional	Management	Purchase Manager	Purchasing Manager
Functional	Operational	Purchase Technician	Purchaser
Functional	Management	Logistic Manager	Logistics and Distribution Manager
Functional	Operational	Logistic Technician	Logistics Engineer
Functional	Management	Legal/Regulatory Manager	Regulatory Affairs Manager
Functional	Operational	Legal/Regulatory Technician	Environmental Engineer
Functional	Management	HR Manager	Human Resource Managers
Functional	Operational	OHS Responsible	Environmental technician
Functional	Management	Quality Manager (quality of recycling materials)	Industrial Quality Manager
Functional	Operational	Quality Technician	Quality Engineer

Figure 8: Cross sectoral SPIRE-SAIS job profiles and their equivalent ESCO occupations

Only the job profiles related to IS & EE and the main manufacturing processes of the manufacturing companies will be described in detail. These profiles and the skills needed by them will be defined through generating "Job Profile Descriptions".

The SPIRE sectors occupations which are present in ESCO database will be taken as the basis for the "SPIRE sectoral job profile descriptions". Therefore, the next step is to match the Industrial Symbiosis & Energy Efficiency related job profiles of all SPIRE sectors (identified through flow chart) with the equivalent ESCO occupations. For this aim, a map in the table format indicating the equivalences will be generated. It will simplify and speed up the general process.

One of the issues that arise is that not all the SPIRE SECTORS titles, or profiles are covered by the ESCO occupations database and new occupations must be created during the profile definition task. In this way, the work developed during the compilation of the profiles in the industry will feed the ESCO database, enriching it with new occupations and descriptions. To align the "SPIRE sectoral job profile description" with the ESCO database and to coordinate a common development process, a joint meeting between ESCO and SPIRE-SAIS project & WP3 leaders has been arranged. As a result of the meeting, ESCO and SPIRE-SAIS project & WP3 leaders have analysed how the data from the "SPIRE sectoral job profile descriptions" can be integrated in ESCO database when needed. It could be foreseen not to elaborate a standalone database for the Industrial Symbiosis and Energy Efficiency but to integrate it in existing databases like ESCO.

The selection of the most representative IS and EE related cross-sectoral occupations.

To select the most representative cross-sectoral profiles, the following criteria are considered:

a) Relative importance of the job profile in the context of IS & EE in SPIRE industries.

b) Potential added value of the analysis of the job profile for the Blueprint of the project.

c) Relative coverage of the job profiles that are differently affected by IS & EE in the future (operational and management level is a good example)

d) Covering more generic occupational groups such as 'production managers', who can have all sorts of occupational backgrounds and have many job profiles in that occupation group in ESCO database.

e) Representative coverage of ISCO major groups: occupations selected from varying occupational groups of ESCO will increase representativeness.

f) Being among most in-demand jobs

After defining the criteria, the generic profiles are identified in collaboration with VET System perspectives (WP4) and the blueprint design perspective (WP5). The main aim is to reduce the complexity for the translation of industrial demand into VET Systems (WP4). As a result, the following 10 job profiles are selected (see Figure 9):

(1) Production manager (ESCO equivalence: 132.2.1 Industrial production manager)

(2) Production / Processing Line Operator/Foreman (ESCO equivalence: 81 Stationary plant and machine operators)

(3) Energy Manager (ESCO equivalence: 1349.12 Energy Manager),

(4) Energy Technician (ESCO equivalence: 3112.5 Energy Analyst)

(5) Maintenance Manager/Supervisor (ESCO equivalence: 2141.8 Maintenance and Repair Engineer)

(6) Maintenance / Repair Operator / Foreman, (ESCO equivalence: 7112.1 Refractory Bricklayer)

(7) Waste Manager/Supervisor* (ESCO equivalence: 2143.1 Environmental Engineer)

(8) Environmental Manager*(ESCO equivalence: 2143.1 Environmental Engineer)

(9) Environmental Technician (ESCO equivalence: 3111.2 Environmental Technician)

(10) Waste Management Technician (ESCO equivalence: 3132.2 Liquid Waste Treatment Operator).

*These 2 profiles will be covered by the same ESCO occupation "Environmental Engineer"

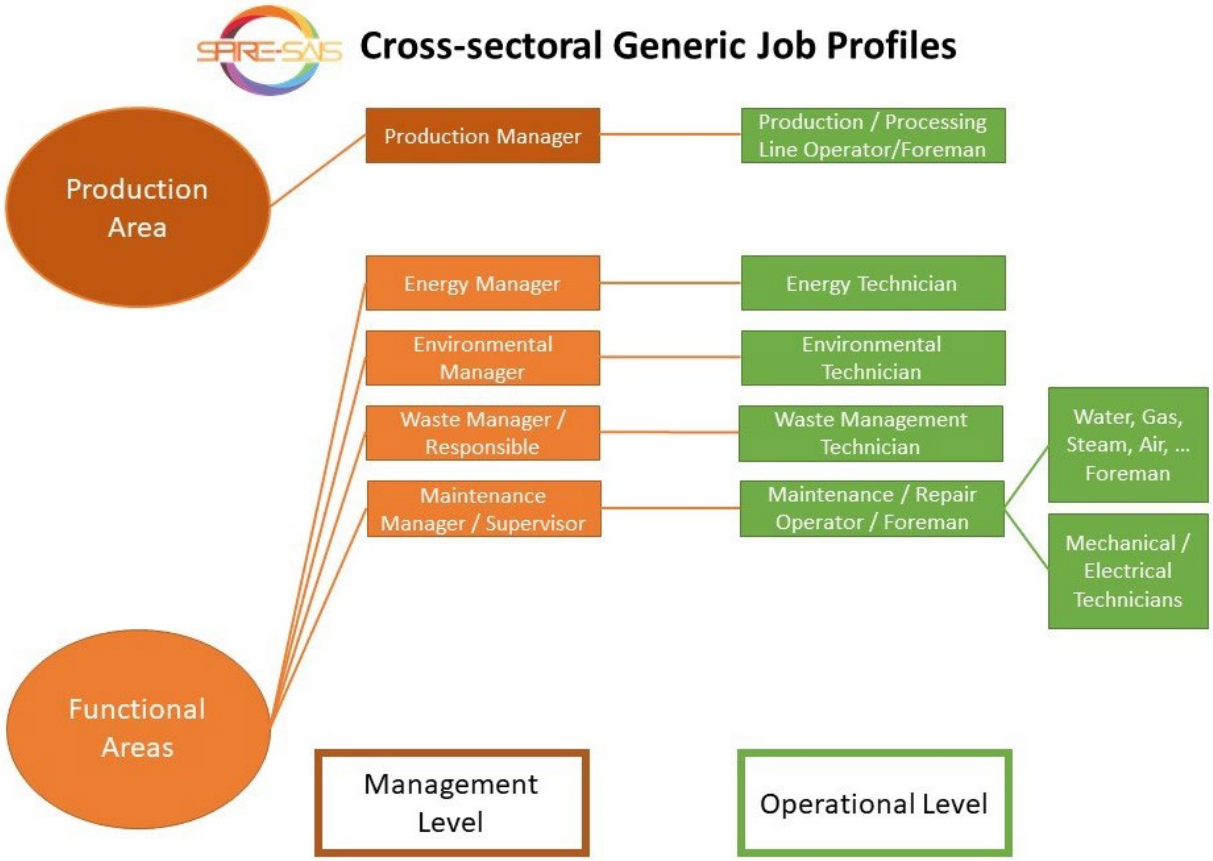

Figure 9. SPIRE-SAIS selected cross-sectoral generic job profiles both in management and operational level.

3.3 The SPIRE-SAIS Sectoral Job Profile Description Template

This chapter focuses on identifying the current and near-future skills requirements for the SPIRE sectors. After comparing existing and future skills demands, the main result that will be obtained is an identification of workforce skill gaps, which will be set as a basis for next tasks, particularly the integration of the demanded skills in VET offer (WP4).

The SPIRE sectoral job profile "Organizational flow chart" approach is highly useful from a sectoral-organizational point of view; nevertheless, it is unnecessarily complicated for VET framework providers during the generation of lifelong learning training programs. In order to cope with this complexity and achieve effective occupation and skills profiles, **a common ground for the profile database** needs to be generated including the point of view of both companies and VET providers. Occupation and skills profiles should combine the company and training perspectives. Thus, this common ground would allow to simplify and consolidate the job profiles in SPIRE sectors.

The potentiality for the equivalence between ESCO and the titles in the SPIRE sectors opens the door to the automatization of the description of the "SPIRE sectors job profiles" taking the ESCO description of occupations as the basis for a full description of the Industrial Symbiosis & Energy Efficiency related job profiles in SPIRE sectors. As an example, the ESCO "refractory bricklayer" or "recycling specialist" descriptions could be used to describe a group of titles or job profiles related with these ESCO occupations. In summary, ESCO gives a description of these occupations that could match the mission and tasks of the job profiles dealing with "refractories" and "waste recycling" in the SPIRE sectors, with only small modifications.

ESCO shows also as a potential alternative to match the essential and optional knowledge, skills and competences for the SPIRE sectoral job profiles.

Using the ESCO database for Occupations, associated partner DEUSTO University has developed a software that will allow automating the description of the different Industrial Symbiosis & Energy Efficiency related profiles of the SPIRE sectors. The result of this first description of the profiles should be checked and refined through the knowledge of the industrial partners in SPIRE sectors that are collaborating n this work.

The job profiles are the basis for the next profiles description, defining the needed skills for those profiles. Those profiles should be understandable to both companies and VET system institutions. Therefore, it has been decided to take the occupations defined by ESCO database related with IS and EE as the basis for the profile description. This concept was inspired from the European Steel Professional role profiles created in the ESSA project [43] as well as European ICT professionals role profiles framework created with the support of CEN (European Committee for Standardization) and CEPIS (Council of European Professional Informatics Societies) [59].

The template was designed to respond to the questions included in Figure 10, to assist users in communicating the purpose and potential application of the profiles within their organization.

Question	Template Descriptor
What is the role about?	***Title*** Formed of a few words, the title offers a common name for the role
What is done in this role?	***Summary statement*** Formed of a single sentence, this summary presents a brief, concise description of the role.
Why is this role needed?	***Mission*** Within a maximum of three sentences this element describes the rational and context of the role within the organisation.
Which actions should be performed?	***Main tasks*** A list of inputs that can be considered as the content of jobs.
What skills are required?	***Technical & transversal skills*** Each defined by a proficiency level, provide the overview of the skills, knowledge and attitudes required of the role.

Figure 10. Explanation of the SPIRE-SAIS professional role profile description template

The main principle applied to constructing the profiles was to focus on the most essential characteristics that accurately represent the profile and effectively differentiate one profile from another.

A template for the "SPIRE sectoral job profile description" is offered (shown in Figure 11) that is of generic value and can in principle be applied to any sector. A standard template makes it easier for users to compare different profiles and provide a fast start to developing new profiles or contributing to designing new job descriptions: Adopting the structure and format of the professional profiles template but using different content to establish significantly different roles is possible. Sharing the same format beyond sectors will contribute to increased transparency across organisations, countries and sectors.

This template will include the skills related with Industrial Symbiosis & Energy Efficiency as well as the skills in other categories such as transversal and technical. Industry skills requirements have already been identified through detailed research in Chapter 2. Therefore, the skills categories that will be incorporated into the template are determined after a discussion with the partners and SPIRE-SAIS project leaders.

PROFILE TITLE	PROFILE NAME		
Summary Statement			
Mission	Direct information from ESCO		
TASKS	Current	Future	
Main task/s	ESCO description	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	This information will be collected during our study		
SKILLS		Current Level	Future Level
Skills Category	Skill 1		
	Skill 2		
	Skill 3		
	Skill 4		

0	Novice
1	Awareness/Basic Actor
2	Practitioner
3	Expert
4	Master

Figure 11. SPIRE sectoral job profile description template.

Each element of the job profile description template is showed below in Figure 12.

PROFILE TITLE ***Define***	**Gives a commonly used name to a profile.** The names proposed for the job profiles must match the names indicated by ESCO for occupations. Profiles not described in ESCO occupations, should be defined as new names for job profiles. These new titles created for the SPIRE sectors do not have to be in conflict with the names of ESCO occupations overlapping with existing ones.
SUMMARY STATEMENT ***Adapt from ESCO***	**Indicates the main purpose of the profile.** The purpose is to present a brief, concise understanding of the specified SPIRE Sector Job/Professional Profile. It should be understandable by SPIRE sectors professionals, managers, Human Resource personnel and education and training institutions. The structure should consist of a short sentence (up to approximately 15 words). It should not repeat the entire Job/Professional Profile name. It should provide a statement of the job's main activity. *Note:* Ensure that the statement discriminates between other profiles.
MISSION ***Adapt from ESCO or add***	**Describes the rationale of the profile.** The purpose is to specify the designated job role defined in the SPIRE Sector Job/ Professional Profile. It should provide the performance context of the job within an organisational structure.

	The following verbs *may be* used within the description or at least for structuring the thinking about how to express the mission: Guarantees, Ensures, Contributes
MAIN TASKS ***Adapt from ESCO or add***	**A list of typical tasks to be performed by the profile.** A task is an action necessary to turn a set of inputs into valuable outputs. Tasks are what needs to be done. Tasks may be associated with deadlines, resources, goals, specifications and/or the expected results; however, this depends upon the context of the task and they may be omitted, however the action must always be described. A task is defined by a short description using a verb and the objective or goal of the action. List no more than ten. Each task should contribute in defining a Profile.
SKILLS	**A list of necessary skills, technical and transversal** Some examples are provided by ESCO data base.

Figure 12: The definition of each profile element in the "SPIRE sectoral job profile description" template.

Furthermore, the 5 proficiency levels used to identify current and future skills levels are described as follows [43]:

0 = Novice: Does not have knowledge and skills

1 = Basic Actor: basic level of skills and knowledge, semi-skilled level, Rudimentary knowledge and some basic skills. Can't perform the activities independently.

2 = Practitioner: solid skills, knowledge and ability, guidance needed to handle novel or more complex situations. Can perform the activities with enough knowledge and skills but requires some guidance and assistance in unexpected or not frequent situations and direct supervision.

3 = Expert: advanced knowledge and ability, guides other professionals, applies skills in new or complex situations and develops new procedures or methods. Can perform required activities with high level of knowledge and skills, without any guidance, assistance or direct supervision; can monitor, mentoring, advice others.

4 = Master: highly advanced skills, knowledge and abilities, proactively and personally capability building. Can perform the activities showing the highest level of knowledge and skills, demonstrate initiative and adaptability to special problem situations and can lead and teach others in the activities.

A brief definition of the different terms about skills development that will be used in the SPIRE-SAIS project is provided in ANNEX VII.

Referring to the job profile description template, each described topic may be addressed and converted to the 'language of the SPIRE sectors' to form the basis of a profile that will inevitably contain different content but formatted in an easy to understand the structure.

The SPIRE sectoral job profile description is constructed consistently to provide a common template. A standard template makes it easier for users to compare different profiles and provides a fast start for developing new profiles, contributing to designing new job descriptions, or adjusting job descriptions.

The selection of the most relevant IS and EE related skills

Even though workers use multiple skills to perform a given task, for the purposes of simplifying the work and finding a common base for the SPIRE sectors, we identify the predominant and most relevant IS and EE related skills. They are identified after a detailed desk research and a discussion about the skill classification with the SPIRE-SAIS partners.

As a preliminary proposal (Figure 13), we end up with a set of skills across four broad categories: technological, individual and personal, regulatory and business related. Within each category are more specific skills. After presenting the first draft, a condensed and shorter version of the skills list is created with collaboration of WP5. After the WP3 partners´ review, the skills list has reached to its final version (Figure 14).

Technological	Individual/Personal	Regulatory	Business related
Industrial Symbiosis			
environmental monitoring	environmental awareness	general regulatory awareness	commercial
sustainability	multidisciplinary thinking and acting	waste management legislation	economics
circular economy	complementary thinking	legislation about CO2 emissions	networking
field experience	cooperation	legislative and compliance requirements	fostering cooperation
Industrial Symbiosis core concepts	collaboration		encourage collective decisions
Industrial Symbiosis basic understanding	working autonomously		develop an entrepreneurship mindset
Industrial Symbiosis methodologies	think systemically		financial management
waste management	effective communication		business model transformation
waste reduction & prevention	team-based approach		identification of potential opportunities
resource, re-use and recycling	decision-making		globally relevant emerging trends
eco-design of product, technology and processes	critical thinking		development of business cases
water conservation	creativity		integrate energy efficiency findings into cross-business operational plans
sustainable resource management	strategic thinking		complex financial analysis & planning
product life cycle thinking assessment	awareness of consequences of energy use		project planning and management
	initiative taking and entrepreneurship		financial planning
Energy Efficiency			accounting and audit
understanding energy use & costs			
system optimisation			
industry knowledge & field experience			
energy data collection and analysis			
selection and use of monitoring equipment for energy consumption			
monitoring and investigating			
manufacturing principles to reduce energy consumption			
process analysis			
complex information processing and interpretation			
developing and installing analysis systems for energy use			
energy management of equipment and plants			

Figure 13: Preliminary proposal of skills for Industrial Symbiosis & Energy Efficiency.

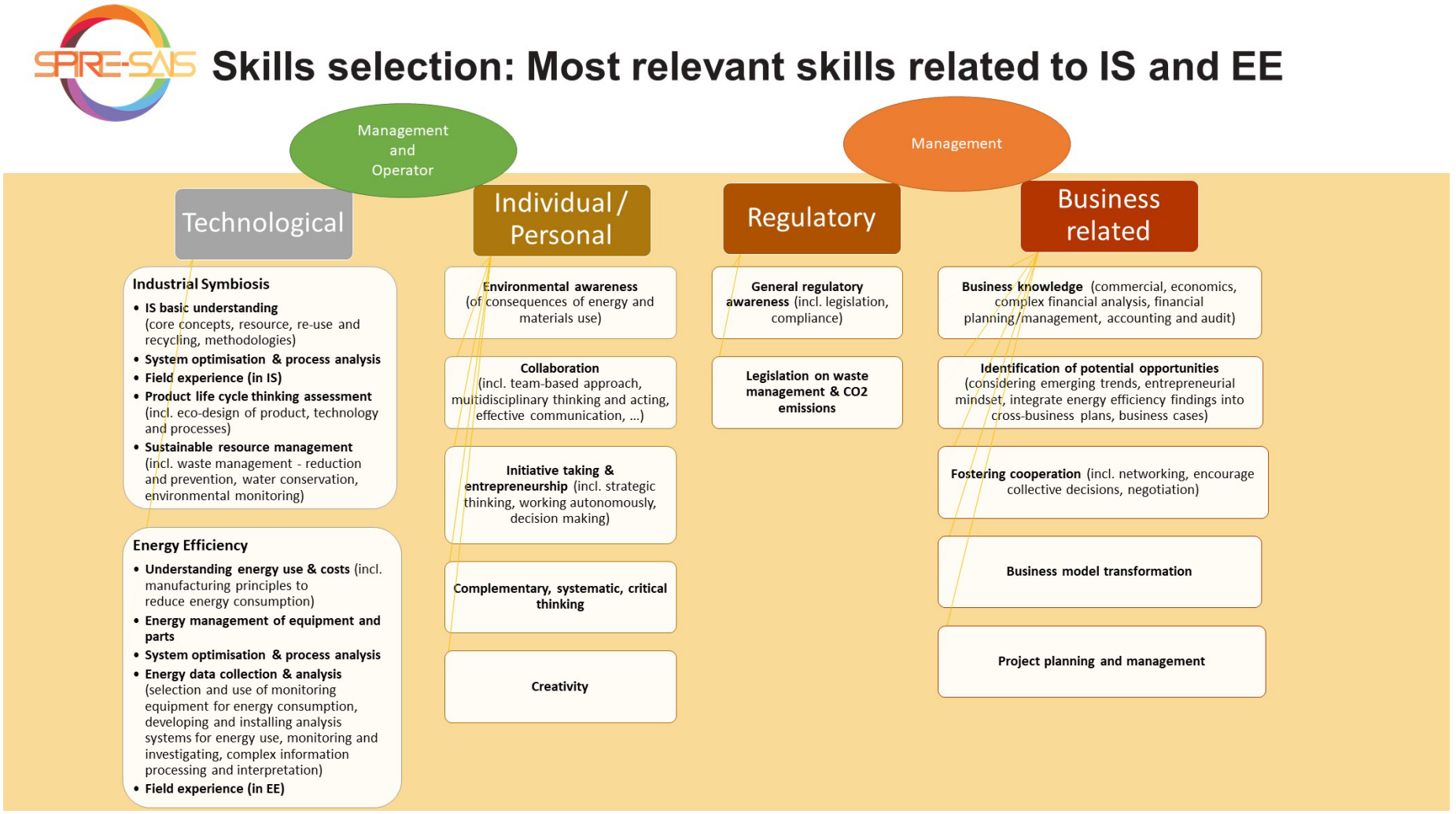

Figure 14: Final version of the list of the most relevant skills for Industrial Symbiosis & Energy Efficiency.

Once the most relevant IS and EE related skills are identified for the SPIRE sectors, “SPIRE sectoral job profile descriptions” are generated for the selected 10 cross/sectoral occupations. In other words, Standardization of these IS&EE related job profiles is completed by using the "job profiles description template" and it is then shared with VET Systems, for their adaptation to the identified skills needs (WP4). Figure 15 shows the job profile description for the “Maintenance and Repair Operator” profile, of which the ESCO occupation “7112.1 Refractory Bricklayer” is equivalent. The job profile descriptions for the rest of the selected profiles can be found in ANNEX VIII.

PROFILE TITLE	Maintenance & Repair Operator (Refractory Bricklayer)		
ISCO Code	7112.1		
Mission	Bricklayers assemble brick walls and structures by skilfully laying the bricks in an established pattern, using a binding agent like cement to bond the bricks together. They then fill the joints with mortar or other suitable materials.		
TASKS	Current	Future	
Main task/s	Lay bricks, pre-cut stones and other types of building blocks in mortar to construct and repair walls, partitions, arches and other structures such as smokestacks, furnaces, converters, kilns and ovens, piers and abutments;	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	Refractory masonry officer Refractory Technician Refractory linings technician Refractory lining coordinator Refractory lining Supervisor Refractory lining foreman Refractory Preparation Operator Refractory Supervisor		
SKILLS		**Current Level**	**Future Level**
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		**Current Level**	**Future Level**
Transversal skills			
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
	Project planning and management		

Figure 15: The job profile description for “Maintenance and Repair Operator” profile, of which ESCO occupation is “7112.1 Refractory Bricklayer” is equivalent. The job profile descriptions of the rest of the selected profiles can be found in ANNEX VIII.

SPIRE-SAIS selected cross-sectoral generic job profiles both in management and operational level.

3.4 SPIRE-SAIS Skills Assessment and Foresight Questionnaire

The Objective, Design and Key Facts

A survey has been carried out with the participation of SPIRE companies in Europe to get an overview of skill needs in the European industry in the coming years related with Industrial Symbiosis and Energy Efficiency. A multilingual survey is designed to identify the (1) current and future skills needs within occupational profiles, (2) the most relevant technological developments, as well as (3) further developments related to skills and jobs in companies of the SPIRE sectors.

At the beginning of the questionnaire, participants were asked about the future of job profiles and technologies in their companies and also for what occupational profiles they considered themselves as experts (see Figure 2). Subsequently, for each of the selected profiles, a specific question section related to skill development followed. For this, the SPIRE-SAIS skill categorisation developed within WP3 were used. The detailed description of all the skills categories within SPIRE-SAIS skill categorisation, and SPIRE-SAIS skill proficiency levels were generated. The participants were asked to define the needed current and future levels of the selected skills. Moreover, they had an optional question asking if they think any additional skills are needed for the chosen profile. The aim was to gain an initial insight into the views of people from the industry and to generate some assumptions, which should later on be validated within the project.

Survey results

The survey produced very detailed results for each job profile, technology type and skill category, as well as partly combinations of these elements.

3.5 Skills Pipeline for the Learning Outcome

The categorisation of the skills described in the previous section is necessary to create the SPIRE-SAIS Skills Assessment and Foresight Questionnaire; however, the general approach of this categorisation makes it difficult to connect the skills with training and education programs (developed by VET system and other training providers), which is the target analysis of WP4. For this reason, WP3, WP4 and WP5 implemented a methodology that has been called "**Pipeline for the Learning Outcomes**". This methodology aims to connect the general approach of the Assessment and Foresight Questionnaire and the specific descriptions needed to analyse the training and education programs. This section explains the methodology in detail.

"Learning outcomes" are defined by CEDEFOP as the statements of what a learner knows, understands and can do on completion of a learning process, defined in terms of knowledge, skills and competences. Education and training institutions are increasingly describing their qualifications in terms of learning outcomes following the approach adopted by the European Qualifications Framework (EQF). Learning outcome descriptions form part of the metadata of qualifications in ESCO. Member States or awarding bodies include information on learning outcomes when providing data on qualifications for the ESCO qualifications pillar. Learning outcomes descriptions were also used as an input during the development of the skills pillar of ESCO.

The learning outcomes principle is systematically promoted in the EU policy agenda for education, training and employment. The learning outcomes approach binds together important European tools developed during the last decade, notably the European Qualification Frameworks (EQF). Therefore, its application will bind our work directly to EQF. At national level, the learning outcomes form the basis on which national qualifications frameworks are built. They are increasingly influencing the definition and writing of qualifications and curricula as well as the orientation of assessment and teaching and training.

It is important not to confuse occupational competence and skill. They are not the same thing. People need skills to be competent, but competence is about applying skills (and knowledge) to achieve a work function (Guide to Developing National Occupational Standards, Geoff Carroll and Trevor Boutall Revised June 2011). Welding is a skill. *Repairing a broken plough* (which involves welding) is a function valued by the farmer. Welding has no purpose for an employer or customer. Repairing a plough does. On the other hand, from a Vocational Education Institute, the Skill definition is enough to create a training program to qualify a student and the application of that skill in the context of an Occupation is not very relevant. These two points of views, require the need of a solution that present an occupation in two formats.

1. According to functions needed in a particular occupation.
2. General skill and knowledge category in a particular occupation.

To ensure that the skills terminology covers use cases in both the *world of employment* and of *education and training*, WP3 integrated the National Occupation Standard (NOS) approach and the ESCO skill and knowledge definition into a General Skill Structure.

Let us describe the general approach used by ESCO and NOS to make evident the need of the integration of both methodologies.

National Occupation Standard

In the NOS, functional analysis is the main tool used to define the nature of an occupational sector and the functions performed within it. This is an essential process in defining occupational competence and in setting boundaries between different occupations. A detailed functional map allows us to establish the unique contribution of each occupational area - what makes it different from all others. In technical terms this is referred to as "delimiting the occupational domain". This is essential to ensure that all

primary (main) and secondary (sub-) functions are identified that the relationship between them is clearly established and the direct contribution that they make to the global purpose of the sector is understood.

Functional mapping also allows NOS – after a suitably detailed process of teasing out the functions (known technically as "disaggregation") – to get to a level of specific activity that allows us to define occupational competence through the creation of new or adoption of existing National Occupational Standards (NOS). NOS describe what employees in any occupation should be able to do, the standard they should achieve and the knowledge and understanding they need. This definition is used to re-write Learning Outcomes and connect with ESCO and SPIRE-SAIS Skill Structure.

When talking about "functions", that means the activities a person is expected to do as part of their job. Functions are not random activities. Functions must have a clear purpose and outcome that are valuable to an employer. Once the functions people are expected to perform are knowing, it becomes easier to identify the standard they should achieve and the knowledge they need. By using functional analysis is possible to take any area of work and break it down until is possible to see the functions that individuals are expected to perform – in other words what people need to be able to do. Once we know what these functions are, we can work with employers to agree everything else that should go into the NOS. (Guide to Developing National Occupational Standards, Geoff Carroll and Trevor Boutall Revised June 2011)

ESCO

ESCO is organised in three pillars.

1. the occupations pillar;
2. the knowledge, skills and competences pillar;
3. the qualifications pillar.

These three pillars are interrelated with each other. Overall, this three-layered structured approach allows ESCO to organise terminology for the European labour market and the education/training sector in a consistent, transparent and usable way.

In the "**occupation pillar**", each occupation concept describes the meaning of the occupation, and provides a number of useful pieces of information about it (metadata). The core element that defines an ESCO occupation is the main idea or understanding of what the occupation is about and how it differs from other occupations. These are captured in the description and scope note.

- A **description** in ESCO is a text field providing a brief explanation of the meaning of the occupation and how it should be understood. Most importantly, it clarifies its semantic boundaries. For this reason, a description is always provided for each ESCO occupation.
- A **scope note** in ESCO is sometimes used to make things less ambiguous. It clarifies specialisms that are considered to be within the scope and it redirects the user to similar occupations that are out of scope of an occupation.

Into the description of the occupation, ***there is a definition of Task or Functions that this Occupation includes.***

On the other hand, the "**skills pillar**", which contains the knowledge, skills and competences, provides a comprehensive list of skills that are relevant for the European labour market. ESCO v1 contains 13.485 skills.

As for the occupations, ESCO provides metadata for each concept in the skills pillar including the following:

- A preferred term that is used to present the concept.
- Non-preferred terms (synonyms, spelling variants, declensions, abbreviations, etc.).
- Hidden terms (e.g. outdate, misspelled or politically incorrect terms).
- A scope note that clarifies the semantic boundaries of the concept.
- The skill type: i) skill/competence concepts or ii) knowledge concepts.
- The relationship with ESCO occupations. This shows for which occupations the knowledge, skill or competence is typically relevant including those for which it is essential and those for which it is optional. In some cases, a relationship will show how the knowledge, skill or competence is relevant for other knowledge, skills and competences. The relationship also includes the distinction between essential and optional.
- The reusability level, which indicates how widely a knowledge, skill or competence concept can be applied. This is crucial for supporting occupational mobility. ESCO distinguishes four levels of skill reusability:
    - **Transversal** knowledge, skills and competences are relevant to a broad range of occupations and sectors;
    - **Cross-sector** knowledge, skills and competences are relevant to occupations across several economic sectors;
    - **Sector-specific** knowledge, skills and competences are specific to one sector, but are relevant for more than one occupation within that sector;
    - **Occupation-specific** knowledge, skills and competences are usually applied only within one occupation or specialism.

This is a valuable information, but due to the generic description to consolidate the information into "Generic Skill Basket", it requires extra work to define measurable functions. In other word, Learning Outcomes and Evidence can make this useful for Academia and Industry world.

Integration

The pipeline methodology was suggested to connect the functions (tasks) of a job profile with the skills needed to perform these tasks and then link the identified skills with their related knowledge, and then associate each knowledge with its learning outcomes. Since the training offers come with their learning outcomes, this concept can connect the training offer with the industry skill needs. The pipeline is created through the following steps:

1) The pipeline starts with the definition of SPIRE-SAIS conceptual and standard model following the guidelines of ESCO.

2) The tasks of each ESCO occupation are defined using "Functional Analysis Methodology". They are identified as "Functions" in the SPIRE-SAIS conceptual model.

3) These functions relate to the National Occupation Standard (NOS) to have a detailed description of each function in each Occupation, which are the bases to create the Learning Outcomes or Evidence.

4) The Learning Outcomes and Evidence relate to the SPIRE-SAIS Skill Category.

5) Each Learning Outcome and Evidence is level using the EQF level structure from 1 to 8.

6) Connect the Learning Outcomes and Evidence with the learning solutions.

The following figure shows the process explained.

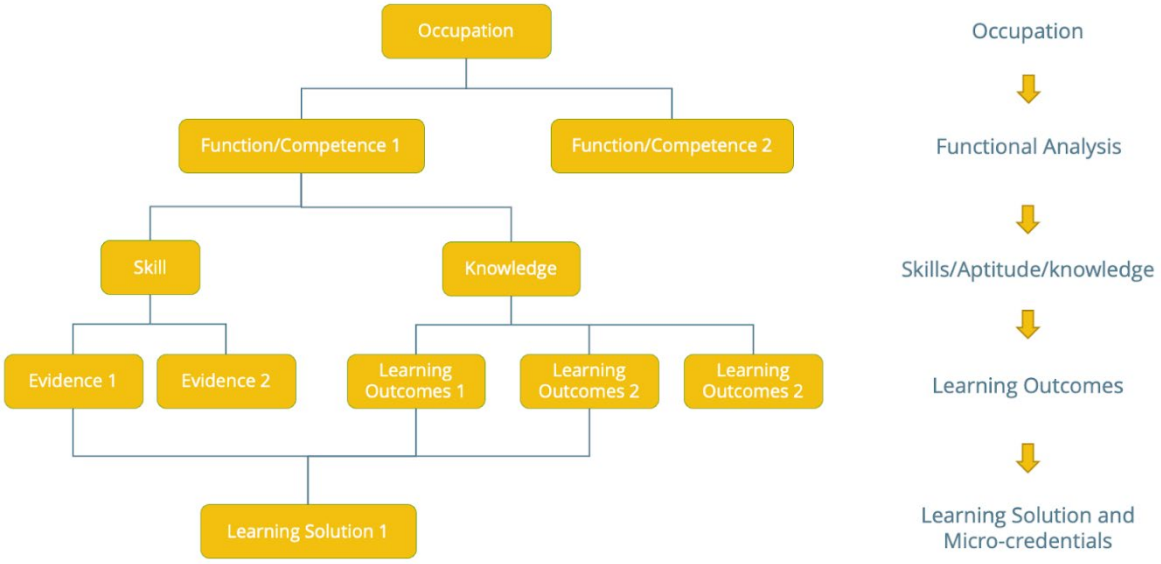

Figure 16: Hierarchy structure of Occupation, Functions, Skill/Knowledge, Learning Outcomes and Learning Solutions.

3.6 Integration of the SPIRE-SAIS Role Profile Descriptions into the Skills4Planet Hub

The European perspective of SPIRE-SAIS intends to focus on the European level by an Online Training Eco-system (digital platform) and on the level of steel regions by national/regional specific Regional Training Eco-System (analog networking). Both systems are complementary and could be combined by adding specific advantages to each other (such as combining online and regional on-site analog training modules that could be integrated in a broader training program of the companies and VET providers.

The Skills4Planet Hub as the centre of the SPIRE-SAIS Online Training Eco-system (OTS) (*Figure* 17) is an exchange platform for training offers (input and output). The Skills4Planet Hub is engaging all the relevant and willing stakeholders (such as associations, industry, other blueprints, VET Systems, other training providers, research and development organisations, individuals) and will continuously integrate and update job profiles and competences as well as a people profile database (human resources databases). It is a continuously updated inventory of training offers and modules curated with standard competences data base. The development of training activities and modules, including training the trainers, is carried out by the different companies and training providers, coordinated by Steeluniversity as a platform coordinator. Courses are described in a comparable way and customer oriented. General training courses but also modules for specific technology demands are developed.

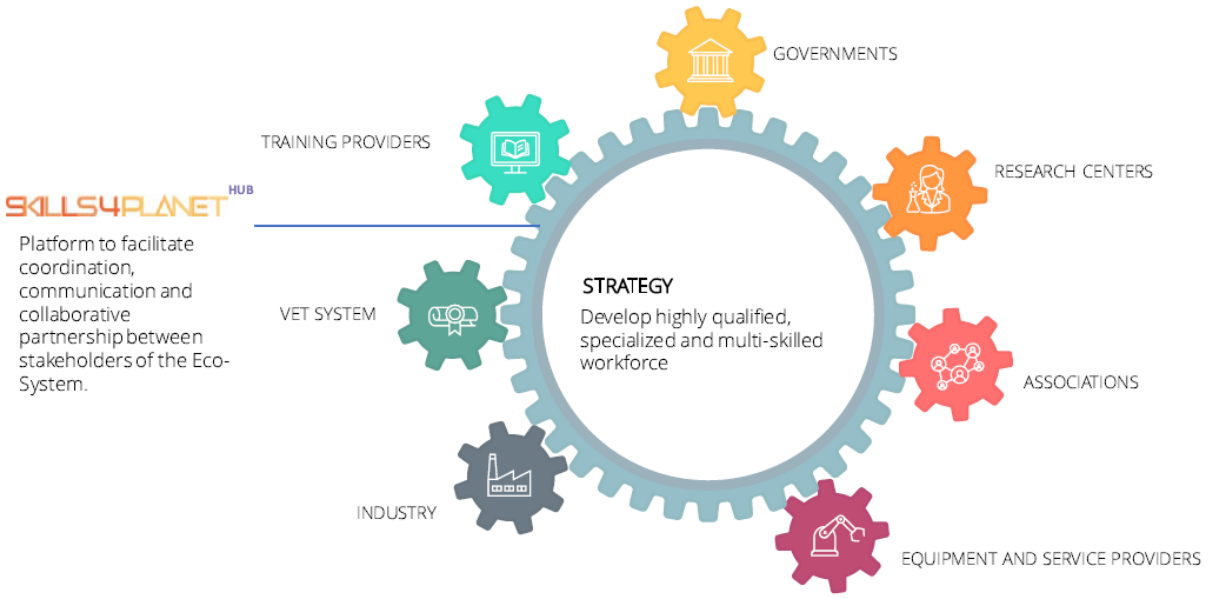

Figure 17: A representation of the SPIRE-SAIS Online Trainings Eco-system.

Figure 18 describes the modules included into Skills4Planet Hub and the relationship between them. As an open platform, the Skills4Planet Hub training offers could be used by individuals, companies, VET providers (including VET institutions like vocational schools). Training could be integrated into VET provisions at company, national and sector level (incl. interrelation to existing EU tools like EQF, ECVET, ESCO, etc.). The centralized nature and standard protocols of communication of this collaborative platform support the development of training content in partnership between stakeholders of the training ecosystem, for example, between companies and universities, reducing the development cost and allowing the possibility to create better, innovative and high-tech learning experiences.

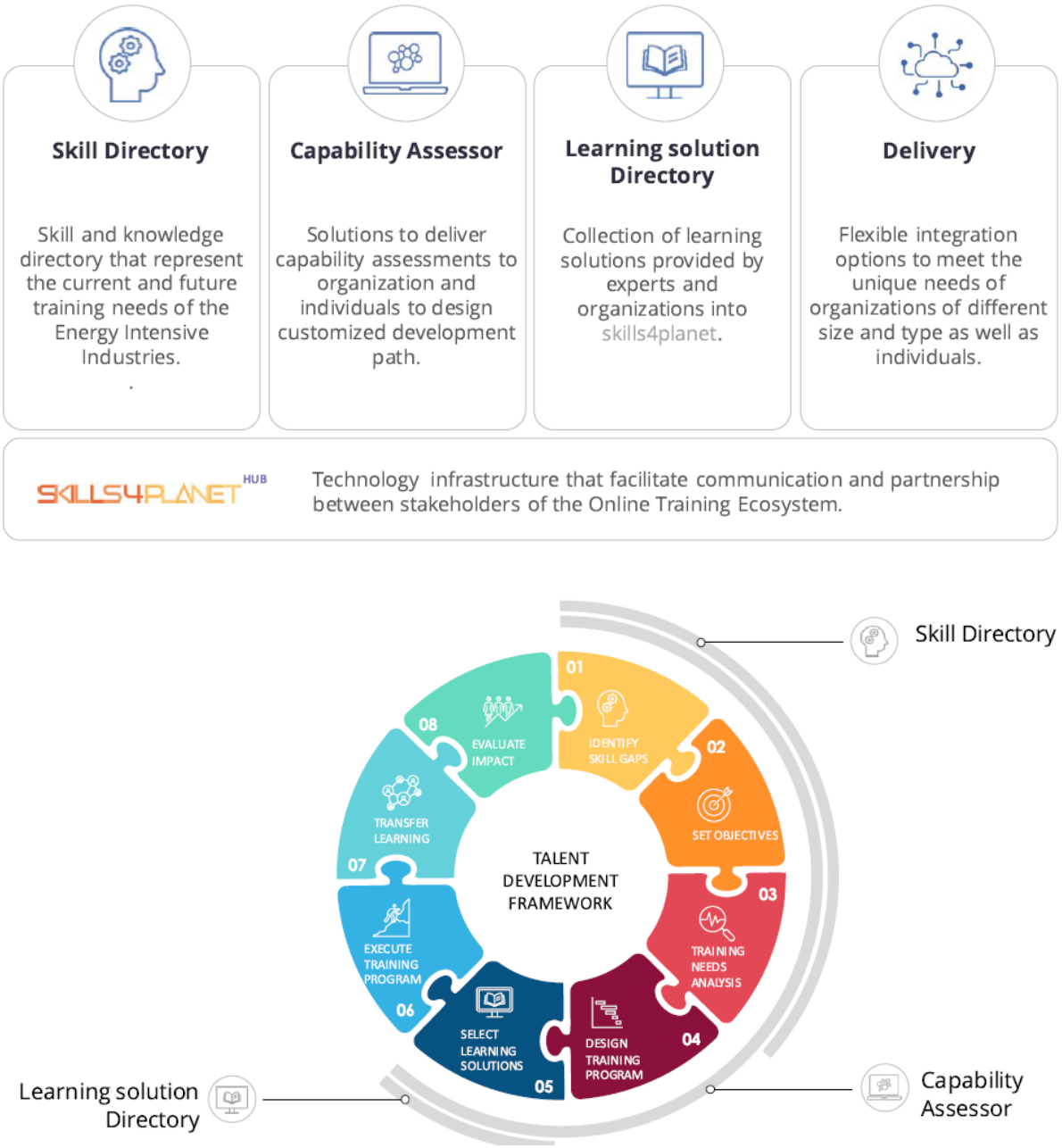

Figure 18: Modules included into Skills4Planet Hub

As an online platform SPIRE-SAIS OTS is considering new possibilities of digital learning and support (social media, moodle, successfactors, 360 Learning, …) and workers participation and empowerment (e.g. workplace innovation, but also by using digital tools like tablets, smart phones, laptops, etc.). The main components of this central Blueprint platform are:

- "Learning solution directory" for hosting training courses for up and reskilling existing profiles.
- "Skill Directory" module for hosting the SPIRE-SAIS Conceptual Model. This dynamic module will be updated regularly to include new job profiles to follow the constantly change of the industries.

The SPIRE SAIS Conceptual Model has been integrated into Skills4Planet Hub. The SPIRE Sectors Professional Role Profile Description Models are integrated into the Skills4Planet Hub database to simplify the process for the end-users. It will facilitate the users to select the job profile they are interested in, to understand what kind of skills the profile requires, and to reach to the training offers to acquire the skill that they desire.

The EQF level for each learning outcome and evidence have been included into Skills4Planet.

The further development and running of the Skills4Planet will be coordinated by Steeluniversity, done collaboratively with divided responsibilities due to the expertise and preferences of the involved companies and training providers.

3.7 Talent Management and Recruitment

Use in assessment and career

Increasingly rapid advances in technology and the labour market require graduates and professionals in the workforce to be familiar with state-of-the-art knowledge, and to possess the skills and competences needed to make full use of technological and non-technological know-how. Content-laden degrees are not always effective for adult learners in today's fast paced environment and employees also need 'just-in-time' skills development that is immediately applicable. Therefore, the demand for short learning options and their *recognition* and *validation* is likely to further increase.

To tackle this situation, a European approach to micro-credentials is on development with the objective to facilitate validation, recognition and portability, and to foster a larger uptake to support individual learners to gain and update their knowledge, skills and competences in any subject area, at all stages of their career and in any learning environment. [35] A micro-credential is a qualification evidencing learning outcomes acquired through a short, transparently assessed course or module. Micro-credentials are offered by higher and vocational education and training (VET) institutions, as well as by private organizations.

The Micro-Credential is based on validation of Learning Outcomes, which is aligned with the Learning Outcome Pipeline described in previous section as part of WP3. Therefore, the training content uploaded into Skills4Planet Hub is curated with learning outcomes to connect them with a particular occupation. The learning outcomes acquired and validated during the training process represent the evidence of the competence of the student for a particular occupation. This information can be recorded into Skills4Planet Hub and reported to Europe Tools, like EuroPass, to facilitate portability.

The "SPIRE sectoral job profile description" may be used to implement an effective competence assessment process in SPIRE sectors.

Defining and implementing an internal competence assessment process enables verification of an organisation's existing roles and aids identification of competence gaps.

The result of the assessment can be used to improve accuracy of different processes:

- In training, the competence gap analysis can be used to design accurate training paths that can, for example, develop the proficiency levels required to meet organisation requirements.

- In the development of an organisation, the result of the assessment can be used to guide the design of the organisation itself, allocating resources optimally and identifying the competence shortcomings to inform the recruitment process.

- In career development, recruitment and talent management, the outcome of individual assessments can be used to identify optimal career development paths of the professionals in SPIRE sectors, benefiting the employee and the organisation.

To make an assessment process accurate and effective, a working tool can be developed integrating the skills and the organisation Job Profiles; they can be derived starting from the Role Profiles described earlier.

Use in Curricula design

In the context of qualification development and VET system curricula design, the “SPIRE sectoral job profile description” can be used,

- As a communication tool between employers and educators which improves consultation process and outcomes
- As a starting point for more detailed Role Profiles and curricula design in specialised fields (e.g. Security, Data and Big Data)
- Within VET system curricula

The Professional Role Profile concept is also generated to be used in the process of curricula design. One of the key challenges of effective curricula design is managing how different stakeholders communicate and cooperate to design curricula that meet both educational and employer objectives. The Role Profile descriptions and the skills shift can provide a useful shared language and starting point so that discussions between these stakeholders are quickly focused on useful content rather than constantly re-explaining the foundations of the debate. Different stakeholders have different perspectives, terminologies and ways of thinking about knowledge, skills and competence. The SPIRE-SAIS Professional Role Profile description template is in line as much as possible with the ESCO terminology and it can be used to provide a bridge or communication tool to facilitate this process.

Professional Role Profiles add a crucial step by providing informative examples of which skills are needed for which tasks. This means that the employer can easily start with the tasks that need to be done and work back to what skills can be included in the curricula by educators. This will significantly speed up the agreement on curricula design between employers and educators.

This means that in terms of updating curricula for new or changed activities in the workplace, a structure is in place to inform that debate. For example, when analysing the educational needs of a specific job, an aligned Professional Role Profile may be adopted to form a common vision of the role and its associated educational requirements. The competences within a profile provide guidance on skills and knowledge items that can be developed to inform VET system curricula design and desired learning outcomes.

3.8 Train the trainers

Overall approach for Train the Trainer in SPIRE-SAIS:

In addition to identifying job profiles and new skills for tutors and trainers, the SPIRE-SAIS project is developing concrete strategies and guidelines on the topic of train the trainer. These guidelines will enable trainers to teach newly identified future skills of the industries to employees. Accordingly, the demand side and thus the question of what training needs arise from the use of new technologies must be considered. The results are compared with the supply side to identify what is already done by companies and training providers to train trainers. The main objective is thereby to close the gaps in terms of teaching new skills.

The topic of train the trainer plays an important role both in the online training ecosystem, i.e. the Skills4Planet Hub, and in the regional training ecosystem, i.e. the rollout. The SPIRE-SAIS tools - first and foremost the online platform Skills4Planet Hub - will also serve as a digital facilitator that supports teachers and trainers in the application and implementation of digital technologies in training.

Concrete measures taken to develop a Train the Trainer concept:

As a starting point, special attention is paid to the support for trainers in teaching transversal skills, i.e. digital, methodological, social and personal skills in accordance with the results mentioned above. In empirical social research, qualitative results (see e.g. the European H2020 research project BEYOND 4.0) show that combinations and interactions of these skill categories are particularly important for the digital and green transformation. Thus, it is often digital skills in combination with other skill categories that are required of employees. For example, problem-solving strategies in practice often require the handling and evaluation of big data and, at the same time, knowledge about job-specific processes. Thereby a combination of digital, methodological and job-specific skills is required. Trainers should therefore be put in a position to teach such combinations of transversal skills.

As a next step, best practice examples are currently identified and collected: The aim is thereby to find cases where such combinations of transversal skills are taught. This can be done in different forms, e.g. via online courses, face-to-face seminars, different resources such as simulations, online games, etc. Finally, a repository for such pilot courses and best practice examples is being developed and will be made available in the Skills4Planet Hub.

The third step is to identify what the implications are for trainers and what changes are emerging in terms of the role of trainers. In this context, digitalisation and the teaching of digital content, as well as the green transformation, play a major role, as this goes hand in hand with changed tasks and roles for trainers. Trainers could for example take on the role of facilitators and coaches, especially in connection with digitalisation and the teaching of transversal, interacting skills.

The final step refers to the development of a concrete train the trainer concept that considers the changes in the working environment. This includes the consideration of the collected best practice examples, as well as the consideration of the changed roles and tasks of trainers. Work is currently underway to develop strategies and guidelines that offer real added value for trainers. SPIRE-SAIS is thereby also considering active learning methodologies which have been proven as more efficient than the traditional methods. These so-called “learner-centred methodologies” provide learning based on tasks, problems, projects, challenges, case studies, etc., aiming at engaging and motivating the involved learners.

In the SPIRE-SAIS project, during the development of training activities and modules, “training the trainers” is also integrated into VET provision at national and sector level. Trainers which are responsible from the IS&EE implementation in the industry, require well-developed training to make their courses more effective. These trainers are not only the educated training professionals but also supervisors at the workplace.

During the ‘train the trainers’ process, for each different case, the most appropriate of these active learning methodologies can be easily adapted.

On the other hand, a wider project working group is generated to proceed the work about “train the trainer” subject. The aim is to identify which skills of the trainers and supervisors will be affected by industrial symbiosis and energy efficiency requirements and to what extent. First proposal of the changing skills was already achieved.

Talent Management

McKinsey & Company defines best practices for effectively identifying, attracting, developing, and retaining the talent that organisations will need to thrive in the years ahead [60]. The study demonstrated that these practices are correlated with higher-performance organisations (the report is initially designed for the automotive sector which will be highly affected by future’s trends and can be easily applied to SPIRE industries).

These are the six best practices [60]:

1. Create a group of 3 (G3)—a close collaboration of the CEO, CFO, and chief human resources officer (CHRO)—to ensure the strategic, business, and talent plans are tightly linked to create a competitive advantage and an attractive value proposition for talent.

2. Reinvent and elevate the HR function to be a valued, strategic leader in the business.

3. Identify the critical 2 percent of roles that create outsized value, regardless of their level in the organisation, and focus on developing the talent that fills these roles.

4. Transition to an agile organisation to rapidly assemble small, cross-functional teams that bring the right mix of capabilities for a given task and that work in short cycles to quickly learn and respond to shifting strategic and operational priorities. Over time, such agile teams become the critical organisational construct for an organisation, without diluting accountability and responsibility.

5. Leverage new digital and analytical tools across all elements of workforce planning, talent identification, selection, onboarding, learning, performance management, succession planning, and retention.

6. Build the workforce of the future informed by a deep understanding of the skills the organisation will need to execute its strategy.

In addition, about "image and recruiting" and “train the trainer” tasks, a steel workshop/interview has been conducted by the TUDO team in Sidenor.

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ANNEX I. A guide to apply the WP3 methodology in SPIRE sectors

Goal: To generate the list of the current job profiles related to industrial symbiosis and energy efficiency for the 6 SPIRE sectors*. The information obtained at industrial level will be compared to

ESCO occupations database and will be useful to identify gaps.

**Spire sectors within SAIS project: chemicals, steel, minerals, water, cement and ceramics.*

Set up the definitions for IS and EE

Establishing the most accurate and present-day definitions of "Industrial Symbiosis" and "Energy Efficiency" concepts, is the key condition to identify the correct and harmonized job profiles in different target sectors. Therefore, before the selection of the job profiles, WP3 partners searched for the conventional definitions of these concepts.

Industrial Symbiosis *("Study and portfolio review of the cluster of projects on industrial symbiosis directorate Prosperity in DG Research and Innovation: Findings and recommendations". European Commission. March 2020).* The definition is from a CEN Workshop Agreement on Industrial Symbiosis in 2018:

"Industrial symbiosis is the use by one company or sector of underutilised resources broadly defined (including waste, by-products, residues, energy, water, logistics, capacity, expertise, equipment and materials) from another, with the result of keeping resources in productive use for longer."

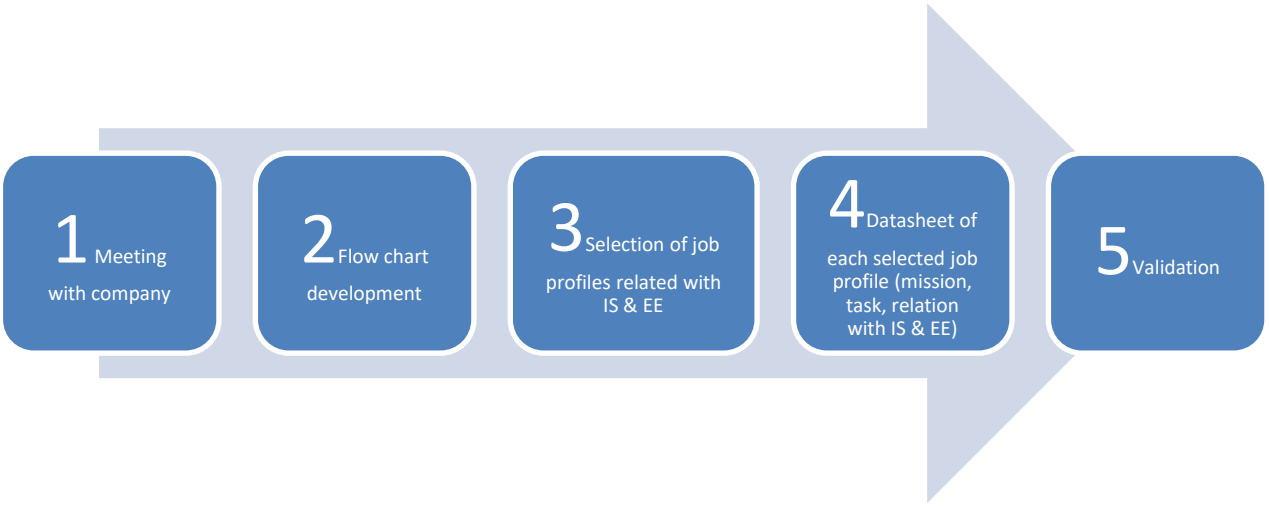
Energy Efficiency

'Energy efficiency' means the ratio of output of performance, service, goods or energy, to input of energy. [DIRECTIVE 2012/27/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC]

In an industrial context, *Energy efficiency* simply means using less energy to perform the same tasks required to provide products and services. It refers to more efficient, conservative use of energy across all sectors– that is, eliminating energy waste. Energy efficiency brings a variety of benefits: reducing greenhouse gas emissions, reducing demand for energy imports, and lowering our costs on a household and economy-wide level [EESI, CEDEFOP, SPIRE-SAIS WP3].

STEP 1. Generation of the job profiles <u>related to IS and EE</u> in SPIRE sectors

Six of the SPIRE sectors (Ceramic, Minerals, Chemical, Water, Cement, and Steel) generate a company flow chart identifying the job profiles related with IS & EE in their sector. To achieve this goal, the following methodology is developed and applied by the defined sectoral working teams ideally made up by the industrial partners and as well the correspondent Business Associations (National and/or European ones).



. The first step encompasses meetings with companies to explain the project and the main objectives of WP3.

a) Advise 1: It is recommended to work with companies that can be considered as "average" of the sector. If possible, with Quality Management System implemented (for example ISO 9000), because these types of companies have nearly available all the information that this step requires.

b) Advise 2: After the first meeting with the company/s it is advisable to provide them with the definitions of Industrial Symbiosis and Energy Efficiency, included at the beginning of the present document, this information will help them to identify the job profiles related to target topics.

c) Advise 3: It should be highlighted that, although industrial partners and collaborative companies have the highest workload, the partner in charge of each spire sector will be responsible for supporting the company during the process, reviewing the documents presented and ensuring that they are in line with the objectives of the project. In fact, each working team must develop a document in which the methodology applied, and the data representativeness is described and assessed.

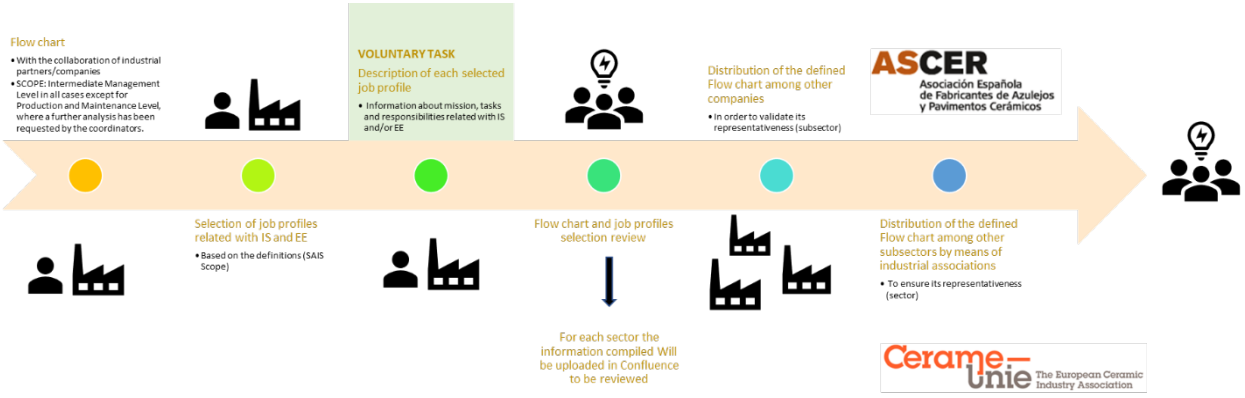
1) To develop the flow chart, it is proposed to go in detail till "intermediate management level" and to start with one or two companies trying to obtain a generic company flow chart. After it, in the case of production and maintenance, it is recommended to go beyond intermediate management level (if possible).

2) The company performs the job profiles selection (based on the previously discussed criteria).

3) The company prepare a datasheet of each selected job profile, related to IS and EE, detailing its mission, tasks and main relation with IS& EE. This task is volunteer, but it helps to justify

job profiles selection.

4) Once the company flow-chart is obtained, its representativeness has to be ensured via a double check validation: First, the company flow chart is distributed among other subsector companies and, secondly, the obtained flow chart is validated by all the subsectors by means of the Business Associations at National and European level.



Example of step by step procedure applied in the ceramic sector

Note: although industrial partners and collaborative companies have the highest workload, the partner in charge of each spire sector will be responsible for supporting the company during the process, reviewing the documents presented and ensuring that they are in line with the objectives of the project.

It is recommended for all those partners that are involved in the same sector to discuss among them to organize this mentioned process to avoid overlapping or misunderstandings.

***STEP 2.* Selection of occupations related to IS and EE from ESCO database.**

First, SPIRE sectors, selects IS and EE related job profiles in their industry. Then, they identify equivalent ESCO occupations for the selected IS&EE job profiles. In summary, each SPIRE sector matches their pre-selected job profiles related with IS&EE, with the equivalent occupations from the ESCO database, using an excel datasheet (job profile matrix). By this process, transversal occupations through the sectors are identified clearly. The matching list is finalized, reviewed and approved.

Ceramic	Other sectors (example)
Operation manager	Technical Director
Quality manager	Head of quality improvement
Purchase manager	Sales and marketing manager
Human resource manager	Human Resource person
Finantial and administrative manager	-

Example of the comparison matrix of high management levels

Ceramics	Minerals	Chemical	ESCO equivalence
	Extraction manager		mine manager
Head of production	Production line control manager	Chief technology officer	industrial production manager
Head of unfired product/raw materials			raw materials warehouse specialist
Head of firing workshop			head of workshop(NO) materials engineer
Head of fired product workshop			head of workshop(NO) materials engineer
Head of unfired product unit			materials engineer
Head of fired product unit			materials engineer
Raw materials, pressing and glazing operator			mineral processing operator
Firing operator			clay products dry kiln operator (NO) heat treatment furnace operator
Sorting operator			packing machinery engineer
Energy manager	Energy manager	Energy excellence manager	energy manager
		Energy excellence technician	energy engineer
		Product line planner	operations manager
			refractory bricklayer
Process engineer	Production efficiency manager	Process control manager	production engineering technician
Head of maintenance	Maintenance manager		industrial maintenance supervisor
			industrial maintenance supervisor

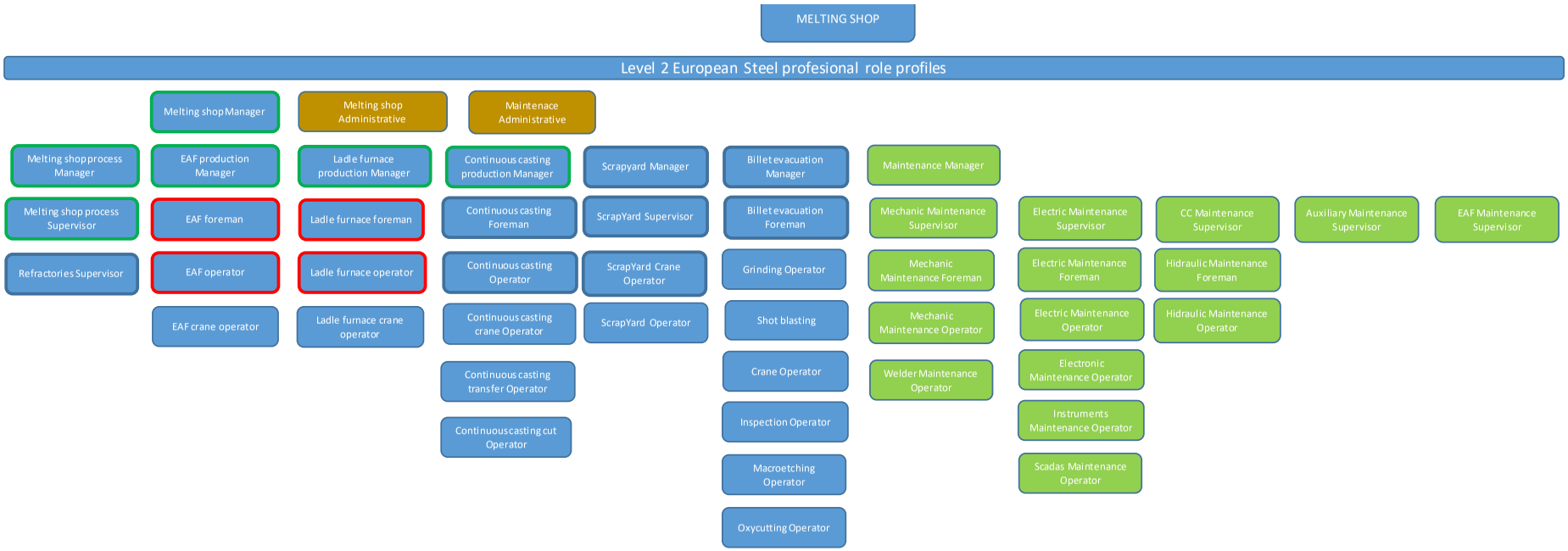
Example from job profile matrix in the excel format: equivalent profiles from different sectors and their ESCO equivalence

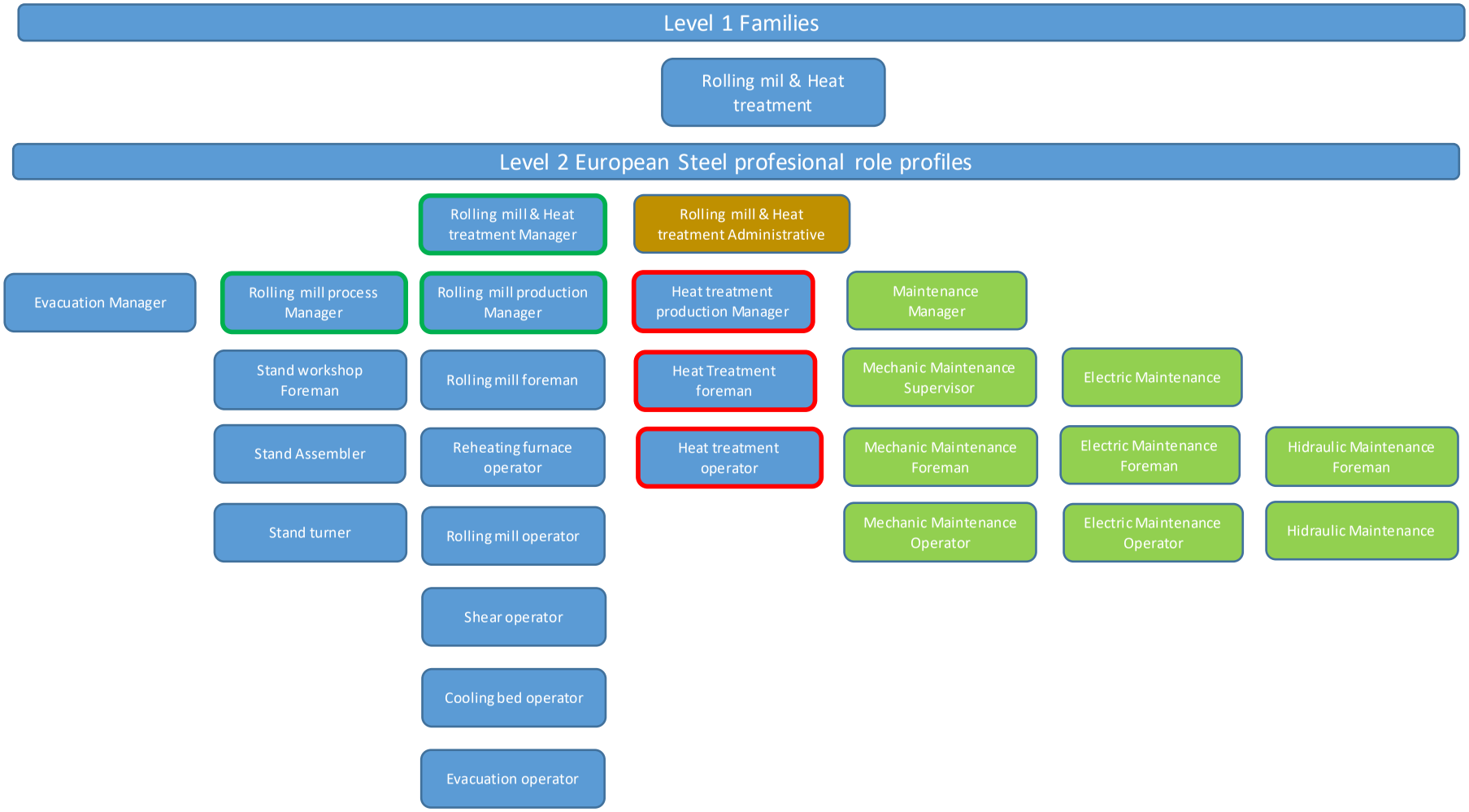
STEP 3. Generation of Job Profile Description Template

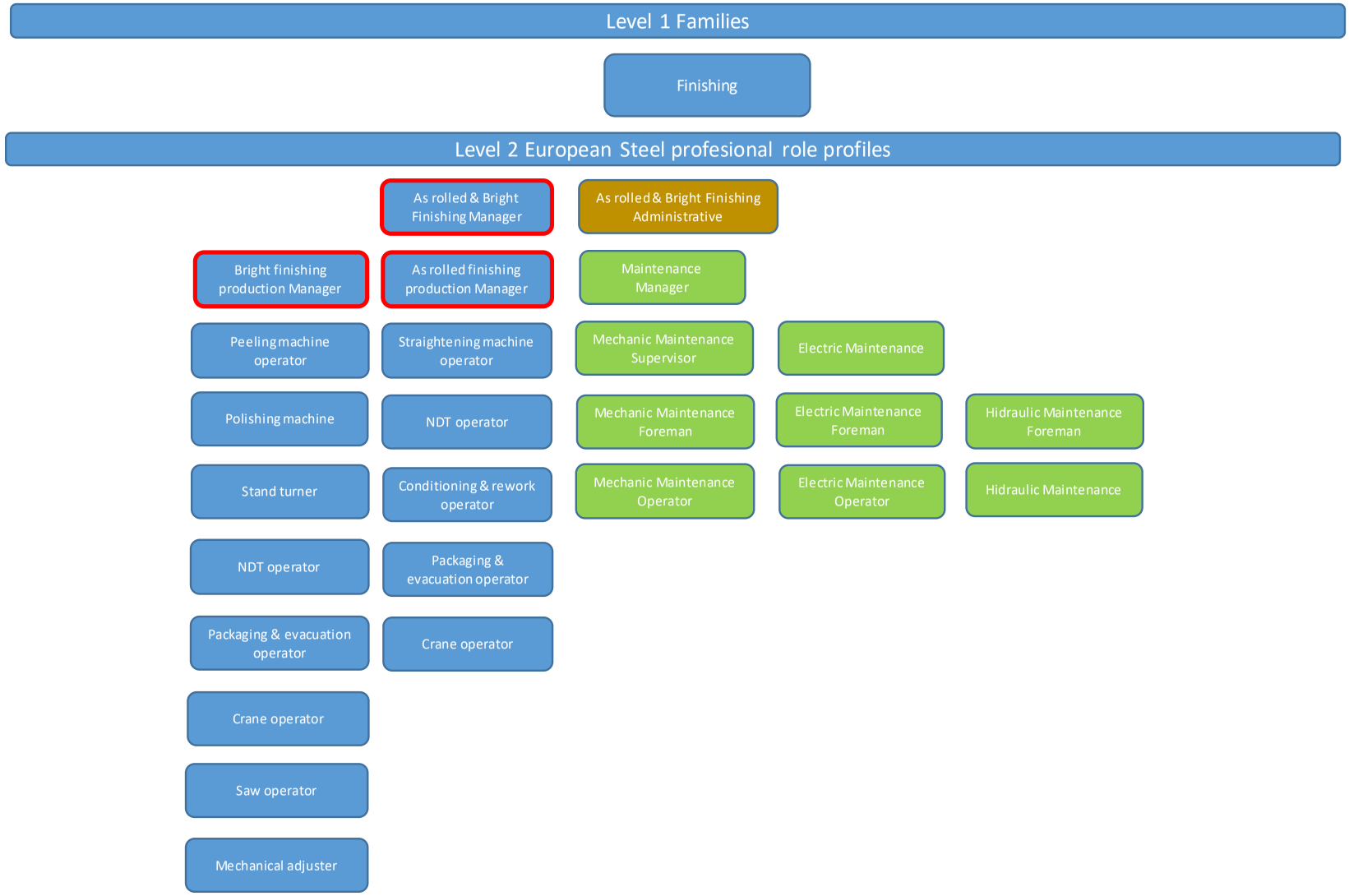
"The job profile description template" that can be applied to any sector is defined based on 'skills' and 'tasks'. In order to use in the template, most relevant skills related with IS&EE are identified through a detailed desktop analysis and discussion of the subject with experts. "Tasks" will be retrieved from the ESCO data base. To define current and future needs of the identified skills, five proficiency levels are defined (0-Novice, 1-Awareness, 2-Basic Actor, 3-Practitioner, 4-Expert, 5-Master).

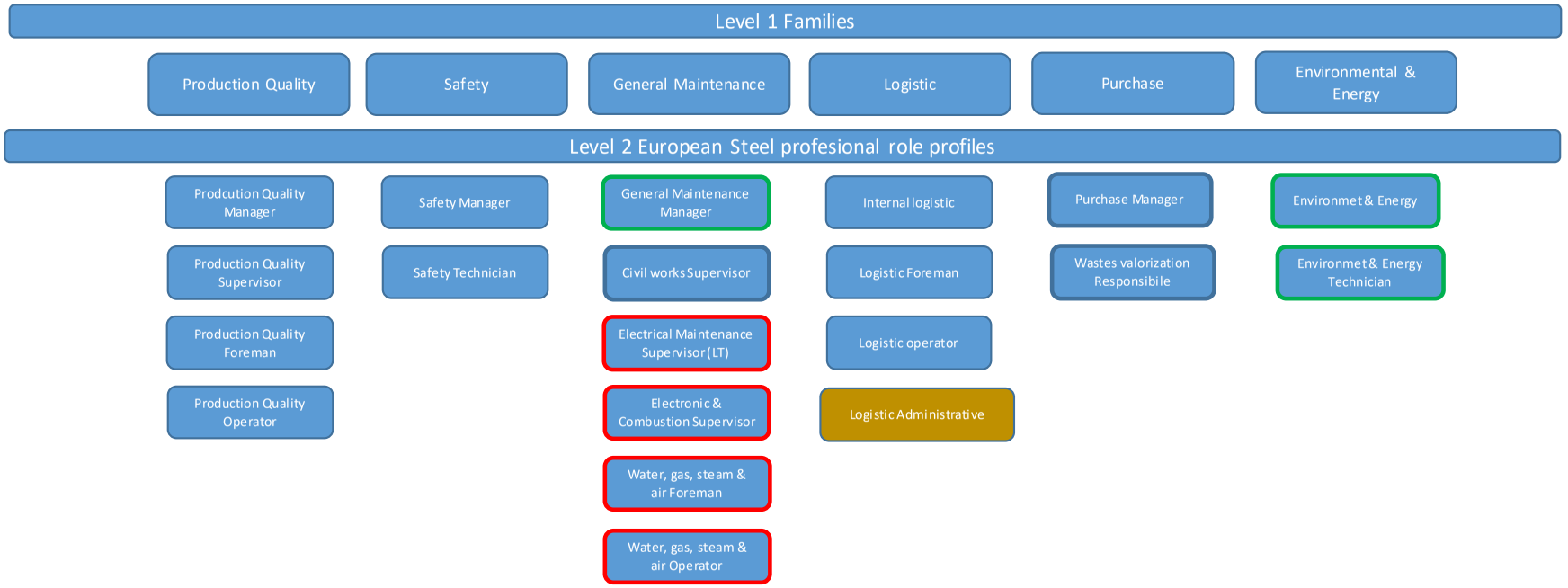
Step 4 "Questionnaire for identifying the most demanded skills" and **Step 5 "Functional Analysis of the selected occupations and creating a "Learning outcomes" pipeline"** are the next stages of the related methodology to identify skills gaps and there adjustment necessities.

ANNEX II. SPIRE-SAIS Steel Sector Job Profile Organizational Flow Chart

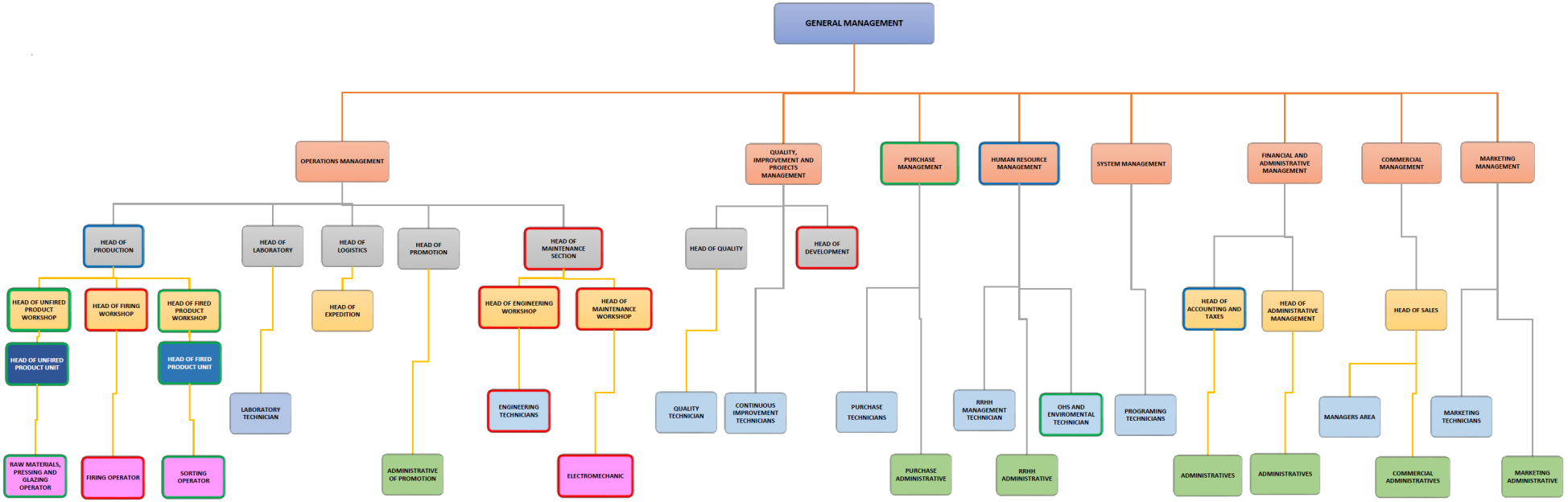

MELTING SHOP
Level 2 European Steel profesional role profiles
Melting shop Manager
Melting shop Administrative
Maintenace Administrative
Melting shop process Manager
EAF production Manager
Ladle furnace production Manager
Continuous casting production Manager
Scrapyard Manager
Billet evacuation Manager
Maintenance Manager
Melting shop process Supervisor
EAF foreman
Ladle furnace foreman
Continuous casting Foreman
ScrapYard Supervisor
Billet evacuation Foreman
Mechanic Maintenance Supervisor
Electric Maintenance Supervisor
CC Maintenance Supervisor
Auxiliary Maintenance Supervisor
EAF Maintenance Supervisor
Refractories Supervisor
EAF operator
Ladle furnace operator
Continuous casting Operator
ScrapYard Crane Operator
Grinding Operator
Mechanic Maintenance Foreman
Electric Maintenance Foreman
Hidraulic Maintenance Foreman
EAF crane operator
Ladle furnace crane operator
Continuous casting crane Operator
ScrapYard Operator
Shot blasting
Mechanic Maintenance Operator
Electric Maintenance Operator
Hidraulic Maintenance Operator
Continuous casting transfer Operator
Crane Operator
Welder Maintenance Operator
Electronic Maintenance Operator
Continuous casting cut Operator
Inspection Operator
Instruments Maintenance Operator
Macroetching Operator
Scadas Maintenance Operator
Oxycutting Operator


Level 1 Families
Rolling mil & Heat treatment
Level 2 European Steel profesional role profiles
Rolling mill & Heat treatment Manager
Rolling mill & Heat treatment Administrative
Evacuation Manager
Rolling mill process Manager
Rolling mill production Manager
Heat treatment production Manager
Maintenance Manager
Stand workshop Foreman
Rolling mill foreman
Heat Treatment foreman
Mechanic Maintenance Supervisor
Electric Maintenance
Stand Assembler
Reheating furnace operator
Heat treatment operator
Mechanic Maintenance Foreman
Electric Maintenance Foreman
Hidraulic Maintenance Foreman
Stand turner
Rolling mill operator
Mechanic Maintenance Operator
Electric Maintenance Operator
Hidraulic Maintenance
Shear operator
Cooling bed operator
Evacuation operator


Level 1 Families
Finishing
Level 2 European Steel profesional role profiles
As rolled & Bright Finishing Manager
As rolled & Bright Finishing Administrative
Bright finishing production Manager
As rolled finishing production Manager
Maintenance Manager
Peeling machine operator
Straightening machine operator
Mechanic Maintenance Supervisor
Electric Maintenance
Polishing machine
NDT operator
Mechanic Maintenance Foreman
Electric Maintenance Foreman
Hidraulic Maintenance Foreman
Stand turner
Conditioning & rework operator
Mechanic Maintenance Operator
Electric Maintenance Operator
Hidraulic Maintenance
NDT operator
Packaging & evacuation operator
Packaging & evacuation operator
Crane operator
Crane operator
Saw operator
Mechanical adjuster


Level 1 Families
Production Quality
Safety
General Maintenance
Logistic
Purchase
Environmental & Energy
Level 2 European Steel profesional role profiles
Prodcution Quality Manager
Production Quality Supervisor
Production Quality Foreman
Production Quality Operator
Safety Manager
Safety Technician
General Maintenance Manager
Civil works Supervisor
Electrical Maintenance Supervisor(LT)
Electronic & Combustion Supervisor
Water, gas, steam & air Foreman
Water, gas, steam & air Operator
Internal logistic
Logistic Foreman
Logistic operator
Logistic Administrative
Purchase Manager
Wastes valorization Responsibile
Environmet & Energy
Environmet & Energy Technician

ANNEX III. SPIRE-SAIS Ceramic Sector Organizational Flow Chart

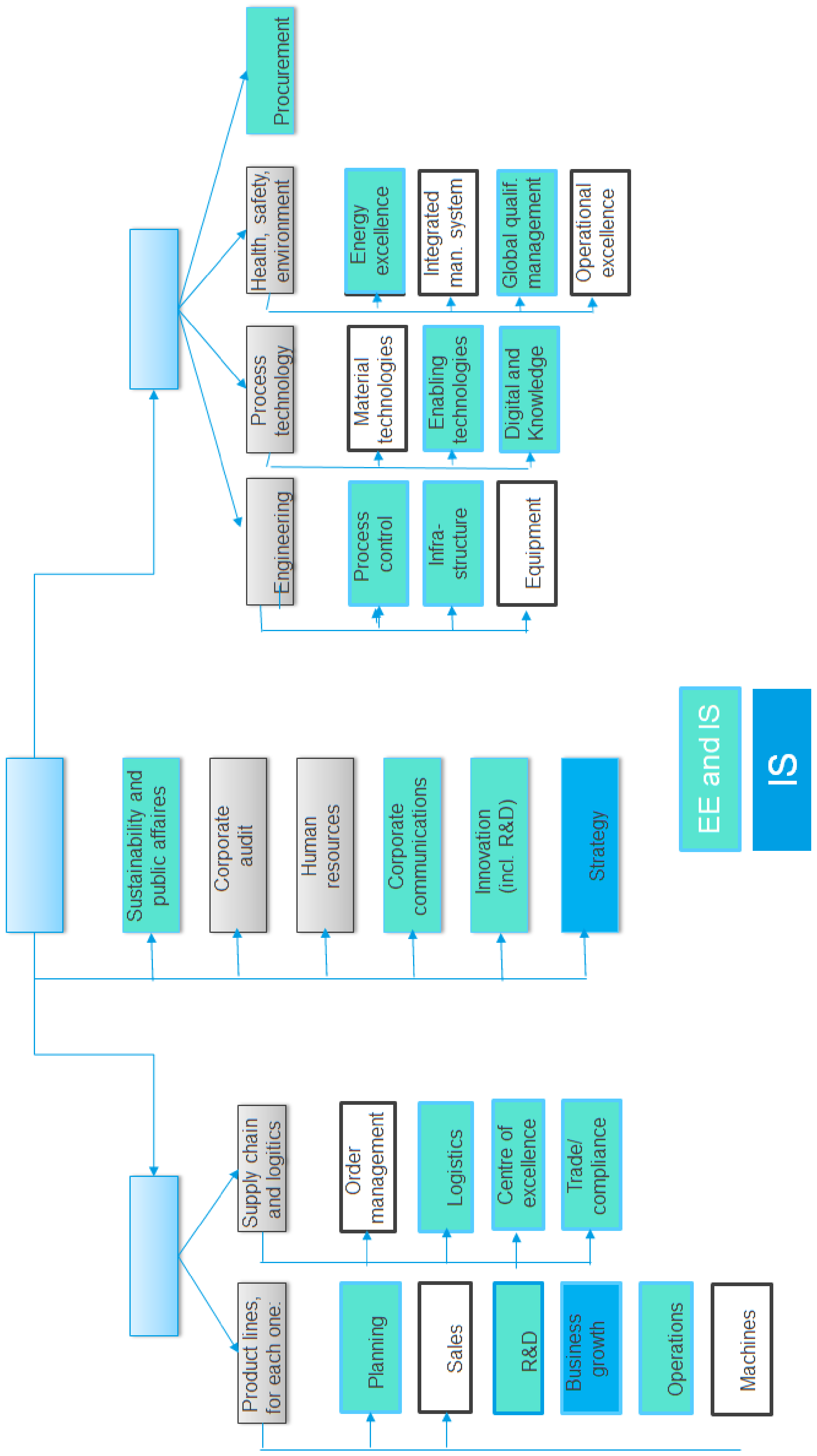


HEAD OF MAINTENANCE **POSITION WITH FUNCTIONS LINKED TO INDUSTRIAL SYMBIOSIS** (HEAD OF PRODUCTION, HUMAN RESOURCE MANAGER, HEAD OF ACCOUNTING AND TAXES)

HEAD OF MAINTENANCE **POSITIONS WITH FUNCTIONS RELATED TO ENERGY EFFICIENCY** (HEAD OF FIRING WORKSHOP, HEAD OF MAINTENANCE, HEAD OF ENGINEERING WORKSHOP, HEAD OF MAINTENANCE WORKSHOP, HEAD OF DEVELOPMENT)

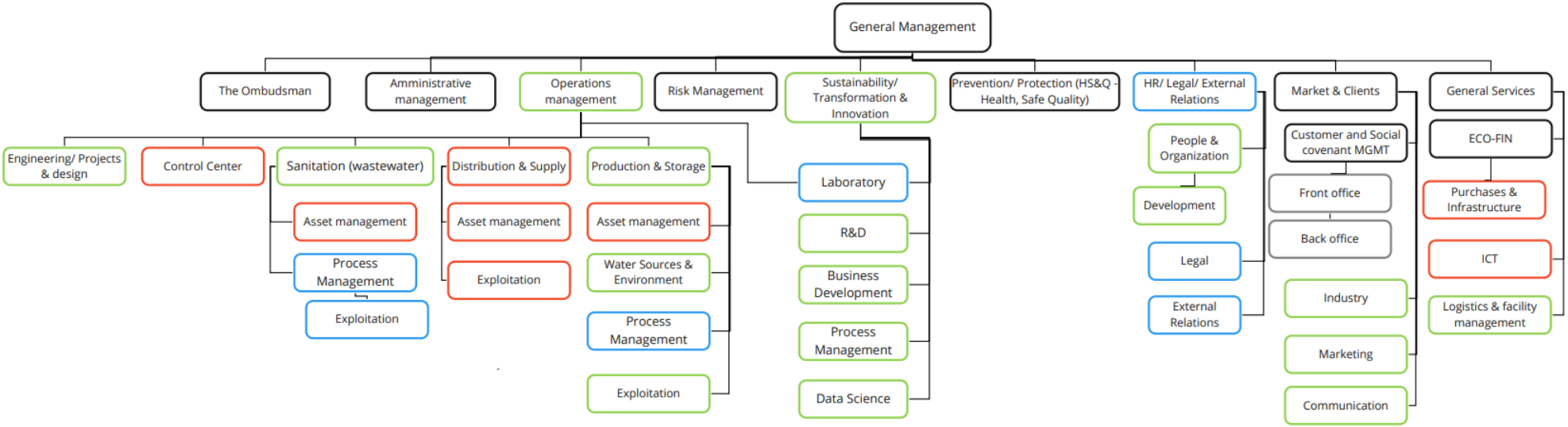
HEAD OF MAINTENANCE **POSITION WITH FUNCTIONS LINKED TO INDUSTRIAL SYMBIOSIS AND ALSO TO ENERGY EFFICIENCY** (HEAD OF UNFIRED PRODUCT WORKSHOP, HEAD OF FIRED PRODUCT WORKSHOP, PURCHASE MANAGER, OHS AND ENVIRONMENTAL TECHNICIAN)

ANNEX IV. SPIRE-SAIS
Chemical Sector
Organizational Flow Chart

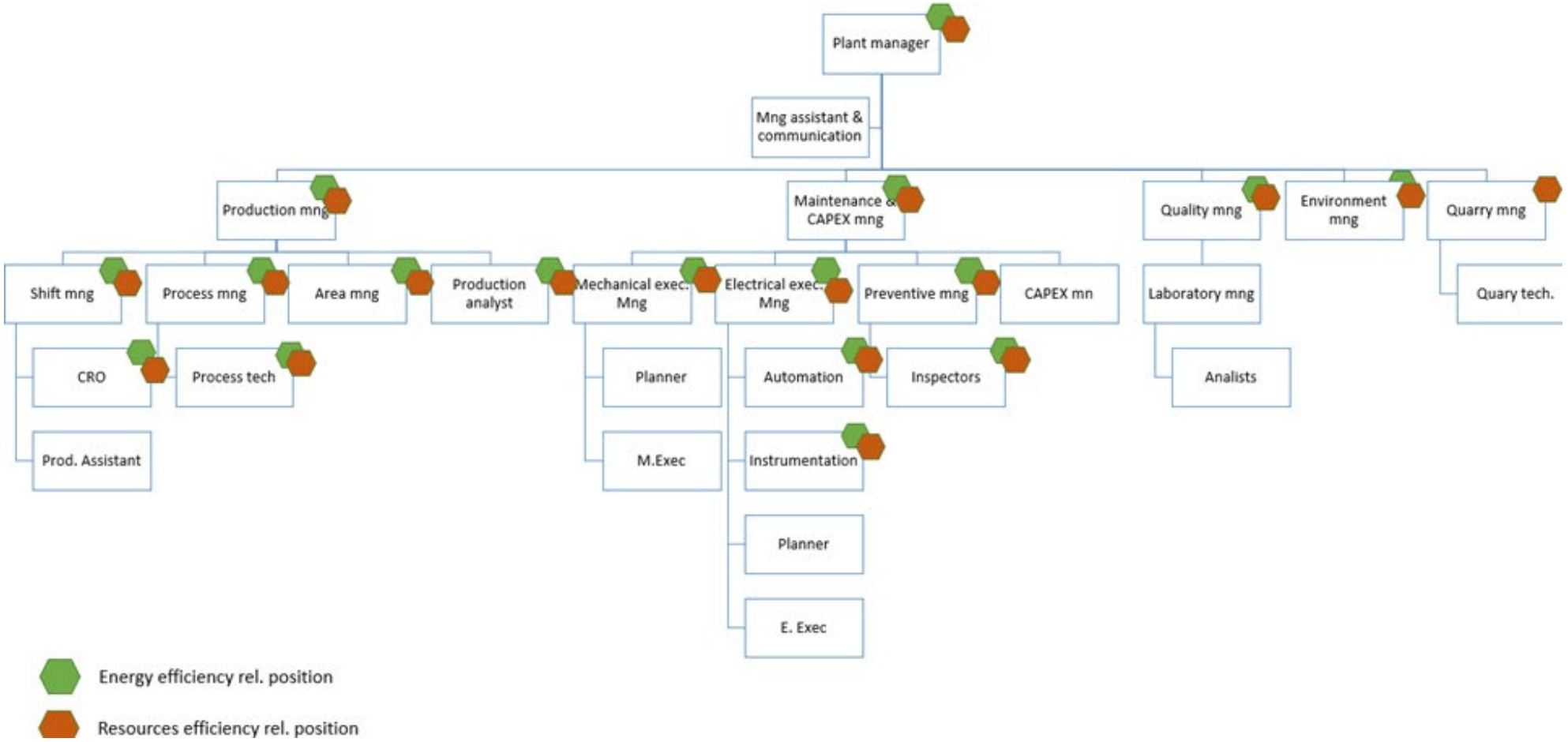


Procurement
Health, safety, environment
Process technology
Engineering
Energy excellence
Integrated man. system
Global qualif. management
Operational excellence
Material technologies
Enabling technologies
Digital and Knowledge
Process control
Infra-structure
Equipment
Sustainability and public affaires
Corporate audit
Human resources
Corporate communications
Innovation (incl. R&D)
Strategy
EE and IS
IS
Supply chain and logitics
Order management
Logistics
Centre of excellence
Trade/ compliance
Product lines, for each one:
Planning
Sales
R&D
Business growth
Operations
Machines

ANNEX V. SPIRE-SAIS Water Sector Organizational Flow Chart


General Management
The Ombudsman
Amministrative management
Operations management
Risk Management
Sustainability/ Transformation & Innovation
Prevention/ Protection (HS&Q - Health, Safe Quality)
HR/ Legal/ External Relations
Market & Clients
General Services
Engineering/ Projects & design
Control Center
Sanitation (wastewater)
Distribution & Supply
Production & Storage
Asset management
Process Management
Exploitation
Asset management
Exploitation
Asset management
Water Sources & Environment
Process Management
Exploitation
Laboratory
R&D
Business Development
Process Management
Data Science
People & Organization
Development
Legal
External Relations
Customer and Social covenant MGMT
Front office
Back office
Industry
Marketing
Communication
ECO-FIN
Purchases & Infrastructure
ICT
Logistics & facility management
POSITION WITH FUNCTIONS LINKED TO INDUSTRIAL SYMBIOSIS
POSITIONS WITH FUNCTIONS RELATED TO ENERGY EFFICIENCY
POSITION WITH FUNCTIONS LINKED TO INDUSTRIAL SYMBIOSIS AND ALSO TO ENERGY EFFICIENCY

ANNEX VI. SPIRE-SAIS Cement Sector Organizational Flow Chart


Plant manager
Mng assistant & communication
Production mng
Maintenance & CAPEX mng
Quality mng
Environment mng
Quarry mng
Shift mng
Process mng
Area mng
Production analyst
Mechanical exec. Mng
Electrical exec. Mng
Preventive mng
CAPEX mn
Laboratory mng
Quary tech.
CRO
Process tech
Planner
Automation
Inspectors
Analists
Prod. Assistant
M.Exec
Instrumentation
Planner
E. Exec
Energy efficiency rel. position
Resources efficiency rel. position

ANNEX VII. Definitions of the terms about skills development

According to the European Qualifications Framework (EQF) and European e-Competence Framework (e-CF), skills, knowledge and attitudes are components of competences. Competences are therefore defined as the ability to use skills, knowledge and attitudes to achieve results. Skills and knowledge are mainly regarded separately, even though some sources define skills as the ability to apply knowledge, describing skills as a synonym for competences.

***Skills*:** In general, skills can be defined as capabilities to complete a task.

ESCO applies the same definition of "skill" as the European Qualifications Framework (EQF): "skill means the ability to apply knowledge and use know-how to complete tasks and solve problems". Skills can be described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments) [a].

Knowledge: According to the e-CF, knowledge represents the set of know-what, such as programming languages or design tools, while the EQF describes knowledge (theoretical and factual) as the assimilation of information (body of facts, theories, practices and principles) through learning

ESCO applies the same definition for knowledge as the European Qualifications Framework (EQF). According to this, "knowledge means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. Both skills and competences rely on factual and theoretical knowledge, the difference lies in the way this knowledge is applied and being put into use [b].

***Attitude*:** With skills and knowledge being the main components of competences, attitudes can be regarded as the glue that keeps them together. Attitudes are described as the cognitive and relational capacity as well as the motivation to do something

***Qualifications*:** Qualifications are understood as "the formal outcome of an assessment and validation process, which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards"[c].

Competences: are defined as demonstrated ability to apply knowledge, skills and attitudes for achieving observable results in e-CF.

ESCO applies the same definition of "competence" as the European Qualification Framework (EQF): "competence means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development". They are described in terms of responsibility and autonomy [d].

Tasks: as the actions necessary to turn a set of inputs into valuable outputs. Tasks can be considered as the content of jobs. In essence: Tasks are what needs to be done and skills define the capacity to do them.

References

[a] ESCO skills definition https://ec.europa.eu/esco/portal/escopedia/Skill (Accessed on January 2021).

[b] ESCO knowledge definition https://ec.europa.eu/esco/portal/escopedia/Knowledge (Accessed on January 2021).

[c] CEDEFOP qualification definition https://www.cedefop.europa.eu/node/11256 (Accessed on January 2021).

[d] ESCO competence definition https://ec.europa.eu/esco/portal/escopedia/Competence (Accessed on January 2021).

ANNEX VIII. Job Profile Descriptions of the 10 selected IS and EE related occupations

PROFILE TITLE	Industrial production manager		
Summary Statement	1321.2.1		
Mission	Industrial production managers oversee the operations and the resources needed in industrial plants and manufacturing sites for a smooth running of the operations. They prepare the production schedule by combining the requirements of clients with the resources of the production plant. They organise the journey of incoming raw materials or semi finished products in the plant until a final product is delivered by coordinating inventories, warehouses, distribution, and support activities.		
TASKS	Current	Future	
Main task/s	adhere to organisational guidelines adjust production schedule assess impact of industrial activities check material resources control financial resources create manufacturing guidelines define quality standards liaise with industrial professionals manage budgets manage resources manage staff manage supplies meet deadlines oversee assembly operations oversee production requirements plan health and safety procedures	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	production manufacturing supervisor industrial production and manufacturing manager production line manager production control manager area production manager production control supervisor industrial production supervisor production manufacturing manager head of production production line control manager		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
	Project planning and management		

0	Novice
1	Awareness/Basic Actor
2	Practitioner
3	Expert
4	Master

PROFILE TITLE	Stationary plant and machine operators (SPIRE-SAIS: Production / Processing Line Operator/Foreman)		
Summary Statement	81		
Mission	Stationary plant and machine operators monitor and operate stationary industrial plant, machinery and equipment, or for which mobility is not an integral part of operation. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. The work mainly calls for experience with and an understanding of the industrial plant, machinery or equipment being operated and monitored. Ability to cope with machine-paced operations and to adapt to innovations in machinery and equipment are often required.		
TASKS	Current	Future	
Main task/s	set up, operate and monitor a variety of stationary plant and machinery detecting malfunctions and take corrective action examine outputs for defects and conformity with specifications and adjust machine settings accordingly perform maintenance, repairs and cleaning record data and maintain production records supervise other workers	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	Production / Processing Line Operator/Foreman		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
	Project planning and management		

0	Novice
1	Awareness/Basic Actor
2	Practitioner
3	Expert
4	Master

PROFILE TITLE	Energy Manager		
Summary Statement	1349.12		
Mission	Energy managers coordinate the energy use in an organisation, and aim to implement policies for increased sustainability, and minimisation of cost and environmental impact.		
TASKS	Current	Future	
Main task/s	adhere to organisational guidelines advise on systems energy efficiency advise on utility consumption analyse energy consumption carry out energy management of facilities compose energy performance contracts conduct energy audit adhere to organisational guidelines develop energy policy develop manufacturing policies manage staff manage supplies promote environmental awareness promote innovative infrastructure design promote sustainable energy promote sustainable management supervise daily information operations	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	energy and sustainability manager energy procurement manager energy policy manager energy monitoring manager energy excellence manager		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
	Project planning and management		

0	Novice
1	Awareness/Basic Actor
2	Practitioner
3	Expert
4	Master

PROFILE TITLE	Energy analyst (SPIRE-SAIS: energy technician)		
Summary Statement	3112.5		
Mission	Energy analysts evaluate the consumption of energy in buidings owned by consumers and businesses. By analysing existing energy systems, they recommend cost-effective alternatives. Energy analysts suggest efficiency improvements, make business analyses and participate in the development of policies concerning the use of traditional fuels, transportation, and other factors relating to energy consumption.		
TASKS	Current	Future	
Main task/s	advise on heating systems energy efficiency analyse energy consumption analyse energy market trends carry out energy management of facilities collaborate on international energy projects conduct energy audit develop energy policy develop energy saving concepts forecast energy prices identify energy needs inform customers on energy consumption fees prepare energy performance contracts promote sustainable energy	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	energy and sustainability analyst energy procurement analyst energy efficiency analyst energy regulation specialist energy performance analyst senior energy analyst energy advisor energy technician energy excellence technician		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
	Project planning and management		

0	Novice
1	Awareness/Basic Actor
2	Practitioner
3	Expert
4	Master

PROFILE TITLE	Environmental engineer (SPIRE-SAIS: environmental manager and waste manager/responsible)		
Summary Statement	2143.1		
Mission	Environmental engineers integrate environmental and sustainable measures in the development of projects of various natures. They seek to preserve natural resources and natural sites. They work together with engineers from other fields to envision all the implications that projects might have in order to design ways to conserve natural reserves, prevent pollution, and deploy sanitary measures.		
TASKS	Current	Future	
Main task/s	abide by regulations on banned materials address public health issues adjust engineering designs advise on environmental remediation analyse environmental data approve engineering design carry out environmental audits conduct environmental surveys develop environmental remediation strategies ensure compliance with safety legislation perform scientific research process customer requests based on the REACh Regulation 1907 2006 use technical drawing software	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	air protection environmental engineer environmental engineering expert environment engineer industrial environmental engineer water pollution engineer environmental engineering adviser chemical environmental engineer environmental engineering specialist environmental engineering consultant sanitary engineer pollution engineer environmental analyst environmental specialist for water management agricultural conservation engineer environmental manager environment manager environmental & CO2 manager		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
	Project planning and management		

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PROFILE TITLE	Environmental technician		
Summary Statement	3111.2		
Mission	Environmental technicians investigate sources of pollution and aid in the development of pollution prevention and environment protection plans. They take samples of soil, water or other materials and perform tests to analyse the pollution level and identify its source.		
TASKS	Current	Future	
Main task/s	advise on environmental remediation advise on environmental risk management systems advise on soil and water protection analyse environmental data analyse experimental laboratory data assess environmental impact collect samples for analysis conduct environmental site assessments document analysis results perform laboratory tests report on environmental issues test samples for pollutants	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	environmental protection technician pollution prevention technician pollution control technician groundwater protection technician environmental conservation technician		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
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PROFILE TITLE	Liquid waste treatment operator (SPIRE-SAIS: waste management technician)		
Summary Statement	3132.2		
Mission	Liquid waste treatment technicians remove hazardous chemicals and pollutants from liquid waste such as oil so that it can be safely used for new applications. They operate and maintain liquid waste treatment equipment, monitor operations, and test samples to ensure the safety standards are met.		
TASKS	Current	Future	
Main task/s	analyse experimental laboratory data document analysis results drain hazardous liquids ensure compliance with environmental legislation handle chemicals handle waste measure density of liquids perform laboratory tests perform water treatments test chemical samples	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	liquid waste treatment plant worker liquid waste plant monitoring operator liquid waste tester liquid waste treatment plant operative liquid waste treatment plant operator liquid & solid waste treatment plant operator		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
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PROFILE TITLE	Refractory bricklayer (SPIRE-SAIS: maintenance / repair operator / foreman)		
Summary Statement	7112.1		
Mission	Bricklayers assemble brick walls and structures by skilfully laying the bricks in an established pattern, using a binding agent like cement to bond the bricks together. They then fill the joints with mortar or other suitable materials.		
TASKS	Current	Future	
Main task/s	Lay bricks, pre-cut stones and other types of building blocks in mortar to construct and repair walls, partitions, arches and other structures such as smokestacks, furnaces, converters, kilns and ovens, piers and abutments;	Lay bricks, pre-cut stones and other types of building blocks in mortar to construct and repair walls, partitions, arches and other structures such as smokestacks, furnaces, converters, kilns and ovens, piers and abutments; Recovery of refractory waste & recyling	
Equivalent profiles	Refractory masonry officer Refractory Technician Refractory linings technician Refractory lining coordinator Refractory lining Supervisor Refractory lining foreman Refractory Preparation Operator Refractory Supervisor Maintenance operator		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
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PROFILE TITLE	Maintenance and repair engineer (SPIRE-SAIS: maintenance manager/supervisor)		
Summary Statement	2141.8		
Mission	Maintenance and repair engineers focus on the optimization of equipment, procedures, machineries and infrastructure. They ensure their maximum availability at minimum costs.		
TASKS	Current	Future	
Main task/s	advise on efficiency improvements conduct quality control analysis conduct routine machinery checks create solutions to problems inspect industrial equipment inspect machinery maintain equipment maintain machinery manage budgets perform machine maintenance perform test run resolve equipment malfunctions troubleshoot use testing equipment work safely with machines write technical reports	(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
Equivalent profiles	machine engineer mechanical engineer production engineer plant repair engineer site superintendent manufacturing engineer repair engineer maintenance engineer manufacturing systems engineer maintenance and repair superintendent maintenance and repair manager equipment engineer plant maintenance engineer engineering manager plant engineer Maintenance manager Head of maintenance Head of maintenance workshop General maintenance manager Engineering technician Water, gas, steam & air foreman		
SKILLS		Current Level	Future Level
Technological skills			
Industrial Symbiosis skills	IS basic understanding		
	System optimisation & process analysis		
	Field experience (in IS)		
	Product life cycle thinking assessment		
	Sustainable resource management		
Energy efficiency	Understanding energy use & costs		
	Energy management of equipment and parts		
	System optimisation & process analysis		
	Energy data collection & analysis		
	Field experience (in EE)		
SKILLS		Current Level	Future Level
Transversal skills			
Regulatory skills	General regulatory awareness		
	Legislation on waste & energy management & CO2 emissions		
Individual, personal skills	Environmental awareness		
	Collaboration		
	Entrepreneurship and initiative taking		
	Complementary, systematic, critical thinking		
	Creativity		
Business related skills	Business knowledge		
	Identification of potential opportunities		
	Fostering cooperation		
	Business model transformation		
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