Blueprint “New Skills Agenda Steel”: Industry-driven sustainable European Steel Skills Agenda and Strategy (ESSA)

Final Report

Deliverable D1.5

(Status: 30th of June 2023)

Project acronym:	ESSA
Project title:	Blueprint “New Skills Agenda Steel”: Industry-driven sustainable European Steel Skills Agenda and Strategy
Project number:	2018-3059 - 600886-EPP-1-2018-1-DE-EPPKA2-SSA-B
Coordinator:	TU Dortmund University (TUDO)
Funding Scheme:	Erasmus+
Due date of deliverable:	June 2023
Actual submission date:	June 2023
Project duration:	01.01.2019 – 30.06.2023 (54 months)
Work package:	WP 1 - Management
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Dissemination level:	Public

Co-funded by the Erasmus+ Programme of the European Union

Remark

There are overlaps and double text passages with the ESSA Deliverables D5.1 Training Framework and D5.3 Blueprint. This was done due to the possibility that readers will not read all of these Deliverables and to keep the relevant information for understanding the frame of the specific Deliverable.

Content

Introduction

This report summarises the progress of the European Steel Skills Alliance and Agenda (ESSA) and its implementation strategies until the end of the project (June 2023), done in an iterative way. Starting with (1) the ESSA overview, objectives and methodology, (2) the results of the technological and economic development will be summarised as a background for (3) the industry skills demands and (4) VET system requirements. Against this backdrop (5) outlines of the European Blueprint will be presented as well as (6) its transfer and implementation strategies, leading to related policy recommendations aligned with the legislative frameworks (7).

In line with the strategies and measures of the European Commission's "New Skills Agenda", ESSA is especially committed to the "Twin Transformation: Digital and Green", the "Pact for Skills" and as well with existing VET tools and measures (such as EQF, ESCO, EQAVET, Europass and ECQA). Additionally, the ESSA Blueprint benefited highly from the Steel Sector Careers Blueprint (White Research et al., 2020) by integrating its valuable results.

Executive Summary

The European Steel Skills Alliance ESSA will continue and further develop the Blueprint after the project duration. The Blueprint for an industry driven long-term skills strategy for steel companies and VET institutions focuses on elaborating the background for proactively adjusting the workforce to deploy and implement new technologies aimed at an optimisation of the production process. The research activities were conducted to get a comprehensive overview of the recent and future technologies for the steel industry. Digitisation in all its facets is shaping the steel industry and informing production processes by digital data, automation, connectivity across production areas, and digital customer access. Digitalization concerns the integration of all systems (e.g. sensors, automation, and IT systems) and all productions units in different dimensions (horizontal, vertical and transversal). In this context, the steel industry's expectations from digitalization focus on quality, flexibility and productivity through optimization and interactions of individual production units.

Against this backdrop, company requirements for new skills were analysed, leading to a focus on production and maintenance jobs and a mainly incremental re- and upskilling of existing job profiles. A T-shape skills approach with professional and transversal skills is characterising the developed assessment for adjusting the job profiles. Based on a comprehensive overview of task and function-oriented job profiles within 26 family trees (main production units) and more than 200 related job profiles, nine representative pilot job profiles were selected. The selected professional job profiles are matching company job profiles with existing ESCO occupations and cover the major ISCO groups; they are further differently affected by Industry 4.0 and digitalisation and selected because of their importance to steel production, the most in-demand jobs, their coverage across production and maintenance, and the potential added value for other sectoral (industry) Blueprints. Additionally, the coverage of different qualification levels was considered. Additionally, train the trainer/teacher profiles were added, as well as the "Manufacturing Manager" as a blueprint for managers skills to train their employees.

The VET system perspective was analysed and its regulation and contents contrasted with the industry perspective and the technological demands for the steel industry, focusing on formal qualifications (mainly IVET) related to production and maintenance occupational profiles. The analysis (combining scientific evidence with practical experience via desk research and

surveys) concentrated on VET regulation and provision in five case study countries: UK (market-orientated system), Germany (dual system), Spain (company orientated system), Italy (regional system) and Poland (centralised system) and the main European frameworks and tools related to VET. These countries have recently undergone (or are currently undergoing) VET reforms devised to cope with the industrial and labour market challenges. Most commonly, reforms aim to activate dual training arrangements, relaunch and strengthen apprenticeship schemes, extend VET at the post-secondary level (EQF 4-6), increase flexibility, better integrate social partners in the design of qualifications and in the training provision, and adopt a T-shaped skills approach. Nevertheless, differences between systems reduce the likelihood that a complete harmonization is achieved in terms of meeting skill needs.

Relevant EU frameworks and tools (e.g. EQF, ECVET, ESCO etc.) have been reviewed to better understand how these can be leveraged to support skilled workers' mobility and transparency of qualifications. Benefits for the industry that would come from an effective implementation of such tools and frameworks include: increased flexibility of vocational paths; shortened distance between IVET and CVET and improved lifelong learning; easier recognition and transferability of qualifications; easier update of qualifications and possibility to combine core technical modules with additional ones (e.g. new digital training).

The evidences collected point to the need of a holistic approach to vocational training. In this perspective, modularisation has to be put in practice in a way that preserves and supports a holistic training. However, it emerges the need to overcome the latent tension between flexibility and modularisation (typically embodied by the UK model), on the one hand, and a holistic approach to occupational training (e.g. Germany’s approach), on the other. Such tension becomes more evident in consequence of the changes brought in by Industry 4.0: rapidly changing industrial landscapes and labour markets require not just timely but coherent and strategical responses. Germany's greater involvement of social partners and its more regulated and holistic approach lends itself to broader based and incremental (as well as specific) skills development. This contrasts with the UK's more fragmented system that is focused more on modular delivery and seemingly ad-hoc approach to skills needs.

Although research points to similar skills demands associated with the penetration of industry 4.0, it must be noted that the European steel industry remains uneven in terms of technological advancements and industrial composition. This highlights the need to frame our findings in terms of “reasonable skills landscapes” associated with an ideal-typical "Steel 4.0 scenario". In particular, the paramount importance of transversal skills within the context of Industry 4.0 has been noted. Evidences suggest that VET systems already equipped with programmes and arrangements that aim for a more holistic workforce development (e.g. longer programmes, balanced contents, co-determination and co-delivery, dual arrangements) are better prepared to respond to current industry demands and economic challenges in this respect.

Finally, a skills-set matrix was produced to map a sample of the nine steel sector occupations to the case study countries’ VET most relevant programmes and qualifications to identify potential skills gaps and scope for improvement/integration of contents. A framework and methodology for further development of the matrix by industry stakeholders beyond the project's duration will also be provided.

The results of the current and future technological and economic development in the steel industry, the related company skills requirement and the VET system framework to support the skills adjustments lead to the ESSA Blueprint with three core elements:

1. The European Steel Technology and Skills **Foresight Observatory** as the main European coordination unit, conducting a regular European Steel **Technology and Skills Foresight Panel** (ESSA ETP)
2. The Online Training Ecosystem **"steelHub"**
3. The **European Community of Practice of Steel Regions** (ECoP Steel), connecting and supporting steel related member states and the main European steel regions with a European platform for the different **National-Regional Training Ecosystems (RTS)**: mutual learning by exchanging, initiating, developing, and implementing good practice for skills and training.

These ESSA governance elements are integrated in existing structures of the steel sector (esp. the FG People of ESTEP, supported by EUROFER, and industriALL) ensuring the sustainable coordination and running of the Alliance beyond the project funding time.

As stated by the Steel Sector Careers Blueprint, most companies lack a systematic process for assessing and forecasting skills needs. Therefore, ESSA established the European Foresight Observatory (already recommended by the Steel Sector Careers Blueprint) bundling all the necessary activities to monitor and evaluate regularly:

- Technological and Economic Development
- Industry Skills Requirements
- and VET Systems Anticipation and Support of Future Skills.

Central part of the ESSA Foresight Observatory will be a regular foresight survey: European Steel Technology and Skills Foresight Panel (ESSA ETP) based on the experiences of already two conducted surveys.

The online training platform **steelHub** is integrating inputs and exchange (a) of associations, companies, individual learners and training providers, (b) (current and future) industry skill requirements, (c) EU tools and institutions (such as ESCO, EUROPASS, Skills Panorama, CEDEFOP), (d) VET system institutions and anticipating future VET system requirements, (e) other sectoral Blueprints, and last but not least (f) individual informal and non-formal learning. Central elements of the steelHub are the Learning Solution Directory, Skill Directory, Capability Assessor, and the Integration in different learning paths.

Already the Steel Sector Careers Blueprint stressed that multi-sectoral, multi-stakeholder cooperation is an important factor to support up-/reskilling actions and to enhance competitiveness of the steel sector by a well and high skilled workforce. Therefore, the ESSA project partnership was already composed by main European Steel Sector stakeholders, integrating steel companies, education and training providers, associations and social partners, and research institutions. This partnership of 24 relevant steel industry stakeholders was enhanced by a growing number of associated partners (20 up to now) showing the great attention and relevance of this alliance and leading to a sound ground for sustainability already since the start of the ESSA project. The ongoing European Steel Skills Alliance is systematically linking the European Blueprint with the European, national, and regional level of steel regions.

Based on the pilot rollout activities ESSA established National-Regional Training Ecosystems, which will be strongly connected to the Foresight Observatory and the steelHub. The European-national-regional coordination will be bundled in a **European Community of Practice of Steel Regions (ECoP Steel)**, including additional national and regional stakeholders via the training ecosystems. Beside the nine pilot regions:

- steel regions in national level in Finland (because there is no specific conglomerated steel region)
- national-regional level in Czech Republic, Germany and Spain (combining national and regional perspectives)
- regional level in UK (Wales), Italy, Poland, Romania, and the Netherlands (concentrated steel regions).

further steel regions especially from France and Austria are foreseen to be integrated.

However, the ESSA Blueprint dissemination and collaboration is very much in line with an exchange within the steel industry organisations' regular activities and annual meetings: At the European level e.g. ESTEP, SSDCS; on the national level via the national steel platforms and associations such as Federacciai, Wirtschaftsvereinigung Stahl, CIELFFA, OS KOVO, UNESID. Additionally, an extensive cooperation took place with the Steel Sector Careers project (EASME/COSME) completed by first collaborations with other industry related Blueprints (esp. SPIRE-SAIS, DRIVES, Skillman).

The European Commission aims to avoid discrimination based on sex, race, religion, age, disability, and sexual orientation and to improve the working conditions contained in labor laws, including part-time work, fixed-term contracts, working hours, and informing and consulting employees. In addition, member states support the EU-level directives created by enacting complementary national-level legislation and there are similar commitments introduced at sector level. The aim and approach of ESSA are completely in line with the philosophy of the EU and national-level legislation. Therefore, the policy recommendations created by ESSA align with these directives.

The policy recommendations target various levels, including the European, national, regional, and company levels. These recommendations are formulated based on input from the steel industry and research conducted throughout the ESSA project timeline. In order to facilitate these policy recommendations, we allocated them to specific stakeholders to bring them into action.

ESSA is the main founder of the **LargeScale Partnership Energy Intensive Industries** under the Pact for Skills, integrating the European Steel Skills Alliance and Agenda ESSA and the Skills Alliance for Industrial Symbiosis SPIRE-SAIS. Based on a Memorandum of Understanding the two Blueprints will merge under a common umbrella with two specific foci:

- SAIS = industrial symbiosis skills specific blueprint across different process industries
- ESSA = example of a specific sector (steel) related blueprint including an incremental upskilling of representative job profiles (t-shaped skills: technical and transversal skills (green, digital, social, individual, and methodological)).

ESSA will also take up the concept of **Industry 5.0** and operationalise it to a **Steel Industry 5.0**. The paradigm Industry 5.0, to which the European Commission recently dedicated a conceptual report, focuses besides a sustainable industry also on a human-centric and resilient industry.

1 The ESSA Project: Approach, Objectives and Methodology

Economic, digital and technological developments, as well as increasing energy efficiency and environmental demands, present the European (and global) Steel Industry with many challenges, not least of which is to continuously update the qualification, knowledge and skill profile of the workforce. The aim of this project was to realise an industry driven, sustainable and coordinated Blueprint for a *European Steel Skills Agenda* (ESSA), addressing the aforementioned challenges in immediate and enduring ways. ESSA now delivers a Blueprint strategy for human capital development through Sector Skills Alliances obtained within a social innovation process involving a broad range of key stakeholders: companies, education and training providers, research institutions, social partners (European and national steel associations and trade unions) as well as sector experts. Building on the solid foundations provided by sector level initiatives (e.g. ESTEP, EUROFER, SSDCS), previous and ongoing research activities (see project list in ESSA Deliverable 2.1; Murri et al., 2023), ESSA is based on a consolidated approach for addressing industry skills demands and challenges, focussing particularly on the workforce and skills necessary for a globally competitive steel industry. ESSA developed and will further improve concrete and practical *strategies* and *programmes* (modules and tools) in anticipation of skills demands. Two principal objectives of the Blueprint are supported by an underpinning strategy framework:

1. Proactive identification of skill needs and demands for building appropriate training and curricula, including strategising for the implementation of new vocational education content and pedagogies (incorporating training practitioner development) across the sector (thus enabling mutual recognition of skills and training across the sector and promoting mobility), within both companies and education and training institutions.
2. Identification, development and promotion of successful sectoral recruitment and upskilling schemes (including the exchange of existing tools and good practice) and the development of (framework) training tools for (a) the efficient management of knowledge towards talent development and mobility, and (b) tackling recruitment difficulties (e.g. industry attractiveness) for widening the talent pool and establishing a more diverse workforce.

The two aforementioned objectives are supported by:

1. Establishing a database of relevant industry occupations, job profiles and skill requirements for facilitating (a) recruitment, (b) job-seeking, (c) skills and training provision at the local/regional, member-state and EU sector level, and (4) skill needs analysis.
2. Securing political support measures through the Skills Alliance for mobilising and integrating (sector) stakeholders and policy makers at the EU and member-state level.
3. Developing Key Performance Indicators (KPIs), within the remit of an established Skills Alliance, for monitoring the social innovation process and success continuously in respect of objectives above, as well as the proactive adjustment of ESSA for addressing emerging challenges.

1.1 Background for Establishing a European Steel Skills Alliance and Agenda (ESSA)

Across recent decades the European steel sector has undergone substantial transformation. The industry has restructured and consolidated, with ownership now largely comprising several large multi-national companies, and following merger and acquisition activities. The latter went

hand in hand with transforming the steel industry towards high-technological production processes and products. Such developments have had implications for the industry workforce, which is now much reduced: i.e. as the sector has consolidated, it has retrenched, plants have closed and jobs have been shed. Parallel to this, and driven by processes of consolidation, technological developments and changing market conditions have led to changes in the workforce profile in a number of ways:

- First, new technologies (including digital and green transformation processes, Industry 4.0) have contributed to a smaller, more streamlined and higher skilled workforce.
- Secondly, and relatedly, the old recruitment patterns based on employing workers from generations of families with experience have given way to the hiring of more highly skilled workers (There are, however, serious recruitment problems - the age structure in most European steel producing companies is such that more than 20% of the workforce left the industry in the period 2005-2015, and almost 30% will leave in the following decade until 2030).
- Third, the reduction of workforce numbers, technological developments and changes in patterns of recruitment have facilitated changes in work organisation and the introduction of high-performance working systems.

The restructuring of the European steel sector has been necessary to meet (a) increasing consumer demands and preferences for high specification products (e.g. lighter and stronger steel); (b) stringent energy efficiency targets and reduce carbon emissions; and (c) compete globally in a world sector that whilst manifesting cyclical patterns of market demand operates with excess capacity – European markets, in particular, have experienced dumping from outside the EU region (e.g. China, India).

The rapid and constant changes detailed above require the industry to continuously update the skills of its workforce. To remain competitive the industry must facilitate the development of a highly qualified, specialised and multi-skilled workforce. **However, the industry faces skills shortages, recruitment difficulties and talent management issues**. Hence, it is necessary to improve the capacity of the industry to forecast, identify and anticipate skill needs – towards the optimisation of skill use and skill utilisation in the immediate and long-term, including recruiting skills. Thus, sector stakeholders aim to identify skills shortages and mismatches – as a precondition for the efficient design of employment, skills and training policies and strategies.

The core objective of this project is the foundation of a Skills Alliance and Blueprint Strategy to develop the approaches necessary to sustain a competitive industry, which is digitally upgraded, environmentally responsible and promotes sustainable growth, innovation and the creation of highly skilled jobs.

The skills sets that comprise the typical occupations and job specifications for the European steel sector must be transparent, recognisable and comparable as a basis for the development of training content in correspondence with national VET systems, utilising EU and international classifications, mechanisms and frameworks, such as, ISCED, ISCO, EQF, ESCO, ECVET, EQAVET, Europass and ECQA for the standardisation of a sector occupation skill-sets database - informed by a proactive skill needs analysis via foresight measures, training programme design and delivery. In the future, the steel industry will produce digital and cleaner (e.g. hydrogen-based steel production, direct carbon avoidance, capture and utilisation), more energy-efficient (e.g. through industrial symbiosis) and high-quality specialised products, requiring complex technical and broad skills that are currently being developed. However, a

stakeholder partnership (Skills Alliance) is needed for the development of a holistic blueprint sector strategy to address current and emerging skills needs in a systematic and timely manner.

The sectoral focus on the steel sector is underlined by the Steel Sector Careers Blueprint results by stating that currently:

- Skills-related policies **do not address** the skills needs in the **steel sector specifically**
- Several policies target **technical industries as a whole**, with a specific focus on the promotion of **STEM and digital skills.**

The corollary of this overview analysis of the industry situation is that the sector is faced with the **twin transition challenges** of **digitalisation and greening**, which create specific skill demands.

Twin Transition: Digital and Green Skills

Digital and green skills of the workforce are of high importance for the future development the steel industry and therefore for ESSA. First, technological development, and digital technologies in particular, is changing the way the industry produces steel products and the way work is organised and conducted. Hence the way skills are used and utilised across the industry is changing, with implications for the development of sector skill profiles (including the recruitment of talents). In the interrelated development of Industry 4.0 and Work 4.0, the sector is innovating toward integrated intelligent manufacturing and the trend is towards digital work. Metals, for example, is the third largest sector for adopting industrial robots (after electronics and automotive) and the role of the steelworker is shifting from the execution of tasks to monitoring and supervising (see for example projects like COCOP, Facts4Workers, ROBOHARSH in Deliverable D2.1). Manufacturing will become safer and more efficient, but skills will increasingly focus on collecting, processing and analysing data – for example, for product quality improvement. Such shifts are cognisant with the development of a new automation and information paradigm for integrated intelligent manufacturing in the steel industry following EC investment in innovation and research development (e.g. European Fund for Strategic Investments (EFSI); European Structural and Investment Funds (ESIF), Research Fund for Coal and Steel (RFCS), etc.).

A related and second critical dimension of Industry 4.0 is a focus on improved systems of energy management and the development of carbon reduction technologies. Energy management and carbon reduction are together part of wider efforts to develop sustainable manufacturing across the EU and reflected in HORIZON Europe and Commissions aims and objectives. The steel sector is energy intensive and highly polluting (emissions to water and air, including carbon) and regulation, at EU and member state level, drives innovation (e.g. carbon capture) as a beneficial constraint – for reducing costs and innovating towards a more environmentally and socially responsible industry (Porter & van der Linde, 1995). The challenge is strategy development for greater environmental awareness (i.e. green steel production and products) and integrating skills for greener ways of working (e.g. energy saving skills through the training of energy auditors and energy managers) and green innovation (e.g. recycling of process gases to produce electricity) within training programmes. Hence, the sector has pledged its commitment to sustainable steel production and meeting environmental/economic challenges, as well as ‘greening’ (or upskilling) the workforce in line with such processes (Evans & Stroud, 2016). The greening of skills and occupations across the industry is required, not only to secure competent and environmentally safe performance

of specific job roles, but also because such knowledge and skills can facilitate worker involvement in proposing (and implementing) suggestions for further green improvements. Previous projects, such GT-VET, point the way towards the integration of green skills within the industry.

The need for digital and green skills needs to be systematically identified (e.g. through the ESSA occupational profile and skills database and predictive analysis) and integrated into national VET programmes for occupations in the steel industry. Finally, ESSA leads to sustainability, within the strategy itself, its governance, and the substantive goals of the Blueprint. ESSA established a network (Skills Alliance) for skill needs identification, which place digital and green skills requirements at its core. An iterative process involved engagement with policy, social partners, European and national representatives, and other Blueprints (esp. SPIRE-SAIS: steel sector related results on skills for industrial symbiosis and energy efficiency) took place to review and update the implementation of the European skills agenda and strategy. The European ESSA Blueprint is in line with European-national-regional skills agendas for anticipating digital and green skills demands for fostering smart, inclusive and sustainable growth.

1.2 ESSA Approach

ESSA contributes to developing a sectoral skills strategy in relation to two main priorities outlined in Communique COM(2016) 155 Final ‘Steel: Preserving sustainable jobs and growth in Europe’ (European Commission, 2016). In accepting the wider aims and objectives of the communique, for a globally competitive and sustainable industry, ESSA developed its skills strategy across two related concerns: (1) investing in a modernised and sustainable steel industry, which involves investments in future solutions and technologies for a more competitive industry, and (2) investing in the workforce. It builds moreover on the ‘New Skills Agenda’, which calls for investment in a broad array of economic sectors (including steel) and the Erasmus+ approach on sectoral Blueprints for different sectors.

As a goal for supporting a globally competitive and sustainable industry the Commission has invested significantly in innovation and technological development and in this way created the foundations for investment in people. In the first instance it is necessary to acknowledge the wider implications of technological developments and innovation, which may lead to structural change and job losses. The consequences of restructuring are serious for those concerned and their families. Funding from the European Global Adjustment Fund (EGAF) supports active labour market measures and others EU instruments and measures are in place to achieve a fair and socially responsible transition. However, an important part of skills development within the sector is developing employability and transferability of skills, which will contribute to mitigating the deleterious effects of such processes. Indeed, by identifying avenues for transferable skills development and employability within future industry needs, mobility will be enhanced for those continuing to work within the industry, as well as those exiting. The integration of the latter within national VET (and degree) programmes from which the sector draws its recruits, provides the foundations for sustainable workforce recruitment, development and retention (i.e. management of talents).

The ESSA approach to develop the Blueprint is based on a sequential and cyclic work programme. Beside Management and Quality Assurance (WP 1) and Monitoring and Evaluation (WP8) ESSA is working in an iterative way. Starting with exploring the main current and future Technological and Economic Development (WP2), ESSA provides a reliable sector

account for the subsequent work packages on industry skills requirements (WP3) and VET system context and support (WP4). These work packages feed into the Blueprint development (WP5) to be transferred and implemented in the sector (WP6). On the background of these work packages (mainly the blueprint and its implementation) policy recommendations are elaborated and dissemination activities were conducted (WP7) (see Figure 1 below with the related main questions or activities). The results of the work packages will be presented in the following chapters 2 to 7 (numbered in the same way as the work packages).

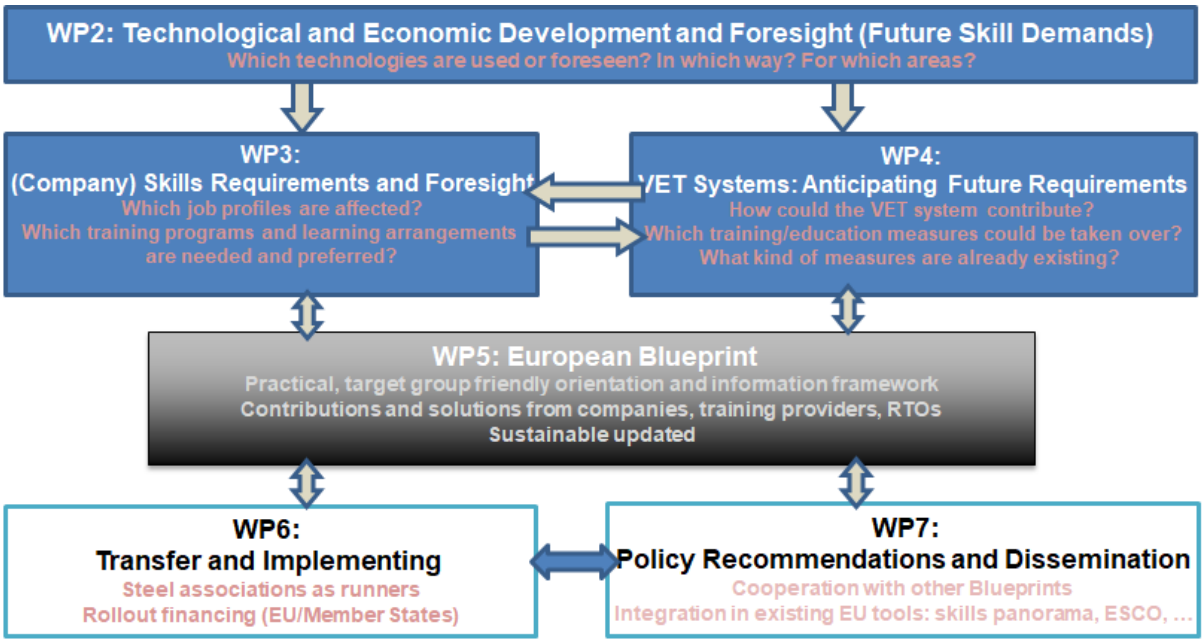


Figure 1: ESSA approach

By bringing together information from partners and governing body members, together with market information and technological development strands, this approach and its work programme:

- ensures a constant view on the changing skills needs in the steel sector, linked to the main drivers (emerging technologies and trends) that are influencing the change.
- aggregates and continuously updates sectoral knowledge and skills intelligence at European level, thus defining and continuously update the Blueprint strategy for skills in the sector.
- provides direction for the Blueprint development and its transfer and implementation as well as for policy recommendation and dissemination - ensuring that future skills needs are met.

Within a comprehensive social innovation process, development and implementation affords a cyclical iteration of research, solutions and strategies. Therefore, two rounds of Blueprint development were conducted, leading to five phases of the project:

- **Phase 1:** Identifying skills requirements and basics for establishing the Blueprint, first contours of the Blueprint
- **Phase 2:** Reflecting the first research results and network development with policy, social partner, European and national representatives
- **Phase 3:** Implementing a prototype of the European skills agenda and strategy / upgrading the results of phase 1

- **Phase 4:** Reflecting the upgraded research results and networks approach as well as the comprehensive European skills strategy in a first implementation and transfer phase with policy, social partners, European and national representatives, setting the ground for the future sustainable strategy
- **Phase 5:** Optimisation and finalisation of a concerted European Blueprint in line with national skills agendas for anticipating skills demands and fostering smart, inclusive and sustainable growth.

In parallel to these phases European, national and regional events have been used strategically, to consider the different perspectives and VET systems of the involved Member States, emphasizing a strong focus on exploitation and sustainability of the Steel Sector Blueprint right from the beginning of the project. The first step to sustainability was placing the ESSA homepage as part of the ESTEP website (https://www.estep.eu/essa).

Against this backdrop, the *industry driven pro-active skills strategy* of the Blueprint is focusing on:

- Identifying and promoting successful sectoral upskilling schemes, including the exchange of existing tools and best practice examples (e.g. on national occupational standards), as well as the efficient management of knowledge on skills and qualifications for the sector.
- Development and exchange of training activities and modules, including for leadership, training the trainers, to be integrated into VET provision at European, national and sector level.
- Strategising on improving the attractiveness of the Steel Industry and careers for talented people (recruitment and retention), including the identification of strategies for overcoming recruitment difficulties and widening the talent pool for a more diverse workforce.
- Strategising for the implementation of measures to meet defined skill needs.
- Implementing the Skills Alliance by strategising for necessary political support measures and the means for mobilising and integrating stakeholders and policy makers of the EU, national and regional level to meet Blueprint aims and objectives.

Building on the described activities implementation and transfer of the Blueprint was done in a collaborative way at European, Member State and regional level, incorporating steel associations, VET system institutions, national roll-out preparation, collaboration with other blueprint developing sectors. Key Performance Indicators (KPIs) monitor success and adjust needs continuously in respect of implementation of Blueprint goals so that the agenda and strategy can be adjusted in time to upcoming new developments and environments.

Finally, policy recommendations were developed related to the main challenges identified:

- Definition of policy recommendations, individuation and analysis of the main issues to be covered
- Compliance with the legislative framework at European and national level
- Planning and conducting dissemination actions to make the defined policy recommendations effective
- Actively identify, implement, promote and secure political support measures for mobilising and integrating stakeholders and policy makers of the EU and national level.

1.3 Objectives

The identification and anticipation of skill needs is a core European objective for many years (e.g. Maastricht and Helsinki Communiques (Council of the European Union, 2004, 2006b); the European Council's integrated guidelines for employment for 2005-08; Regulation (EC) No 1083/2006 of the European Social Fund (Council of the European Union, 2006a) and currently supported by funding and support measures (such as the renewed New Skills Agenda, the Erasmus+ program, up till now 28 sectoral Blueprints, the CEDEFOP Skills Intelligence, and the Pact for Skills). The objectives in this respect are for skills 'fit for the future' and their implementation within education and training pathways and curricula, with the aim of addressing skill shortages and bottlenecks; better matching supply and demand, and anticipating emerging skill needs and gaps for European labour markets.

In particular, early identification and anticipation of skill needs is important for the timely development of appropriate training policies and programmes. There is, for example, a likely time-lag between what is happening at a sector level (e.g. technological innovations) and the skill requirements that subsequently emerge and require integrating within education and training programmes. The time-lag will, moreover, differ according to member-state institutional, legal and regulatory contexts. The impacts of globalisation, an aging labour force and productivity gaps bring further pressures within the European region to forecast future skill needs in effective ways, including the need to develop transferable skills that address issues of sector restructuring and job losses.

The challenges faced by European steel sector, as detailed in the sections above, make the identification and anticipation of skill needs necessary for the continued competitiveness of the European Steel Industry. The Blueprint for the **industry driven long-term skills strategy***,* as the principal outcome, facilitates steel companies and VET institutions efforts to transition the workforce and meet future needs in relation to, for example, the deployment and implementation of new technologies, the material and environmental optimisation of the production process, energy efficiency improvements, high-performance materials development, and so on. In meeting the emerging demands of the industry, the basis for highly skilled employment is established and the foundations for attracting and retaining talented people to the steel sector laid down, thus keeping jobs in Europe and fostering smart, inclusive and sustainable growth.

This background is of high relevance for the skills development in the steel sector. Hence, the aim of ESSA is to contribute to achieving European objectives in skills identification and anticipation within the steel sector in direct and immediate ways. The ESSA Blueprint was set-up and is still running as a **social innovation process**, combining technological development with skills and social impact by integrating the different and relevant stakeholder groups and beneficiaries in a co-creation process. Therefore ESSA:

- combines a European, cross-border sectoral approach with national/regional specifications by including national and regional system requirements - thereby reflecting different national conditions and VET frameworks and ensuring interconnectedness with the European labour markets;
- sets up a foresight scheme to identify current and future demands and requirements in a pro-active way, driven and run by the steel industry;
- comprises the cooperation of companies, education and training providers supported by research institutes and the involvement of the social partners to anticipate skill needs and develop appropriate content;

- develops concrete tools and activities together with the people concerned (such as HR managers, technicians and engineers, workers, trainers and teachers); a high number of workers of involved steel companies participated directly via internal workshops to integrate their perspectives right from the beginning of the project;
- fosters an interrelated and joint development of Industry 4.0 and Work 4.0 specific to the industry;
- ensures a cross-sectoral development and exchange of industry representatives, companies, policy, science and education.

In achieving the above ESSA is a **Blueprint for an industry driven long-term skills strategy** for steel companies and VET institutions that:

- Recommends proactive skills adjustments to the workforce in response to the deployment and implementation of new technologies aimed at optimisation of the production process;
- Monitors and shortens the implementation of industry relevant qualifications in national VET systems, continuously;
- Develops and exchanges modules, tools and the experiences with the implementation process of the new skills agenda and strategy;
- Develops a Blueprint to be discussed and compared with the solutions/blueprints of other sectors.

The project partnership in its entirety is concerned to deliver the necessary skills to industry and invest in the employability of its workers. Close cooperation between industry stakeholders will contribute to enhanced '**skills intelligence**': the monitoring and forecasting of skills needs, understanding skills mismatches and improving dialogue between education and the labour market. ESSA is strongly supported as the appropriate platform to provide the permanent basis for setting skills agendas and developing the right skills policies in close cooperation with European policymakers. Doing this, an ongoing platform and sustainable innovation process was perceived, run by the industry, taking up future challenges and improving the Blueprint continuously - affording a cyclical iteration of research, solutions and strategies, which reflect European objectives in the field of skills identification and anticipation (see social innovation process description and Figure 3 below).

Hence, the main objective was to develop an *industry driven pro-active skills strategy* or Blueprint that is able:

1. to identify in proactive, rather than reactive, ways the skills needs and demands of the industry, considering skills gaps and shortages, and forecasts of supply and demand;
2. to identify training and curricula requirements, including ways to implement new vocational education content in immediate and effective ways, within both companies and formal education and training institutions;
3. to improve and update training for high quality and develop new programs for train the trainer and leadership
4. to identify, implement and secure necessary political support measures by mobilising and integrating stakeholders and policy makers of the EU and national level;
5. to identify and promote successful sectoral upskilling schemes (including exchange of existing tools, best/good practice exchange, knowledge) and efficient management of knowledge;
6. to improve the attractiveness of the steel industry and careers for talented people (recruitment and retention), including the identification of strategies for overcoming recruitment difficulties and widening the talent pool for a more diverse workforce;

7. to establish Key Performance Indicators (KPIs) to monitor success and adjustment needs continuously in respect of these goals and to adjust the agenda and strategy in time to upcoming new developments and environments.

ESSA utilises existing European tools like ESCO, ECVET, EQF, Europass, ECTS, EQAVET and ECQA (in addition to international classifications, such as ISCED and ISCO) for job profiles and skills content assessment to fed company skills demands for specific job profiles in line with existing occupation databases. Therefore, ESSA connects the skills classification, assessment and foresight as much as possible with the steel sector relevant ESCO occupations and certification and acknowledgement tools (listed above).

In addition, relevant national programmes were included especially when it came to the rollout to the member states. For example, in the UK National Occupational Standards for the steel sector are set and reviewed by SEMTA for the rigorous and high-quality skills infrastructure for occupations within engineering and advanced manufacturing and these set out skills, knowledge and understanding for steel jobs and occupations. Understanding of national programmes and standards is imperative for improved worker mobilisation but also for a more consolidated approach to tackling skill needs in immediate ways.

1.4 ESSA Partnership: A European Steel Community Involvement

The European Commission's Sectoral Blueprints Program and the results of the Steel Sector Careers Blueprint underline that multi-sectoral, multi-stakeholder, and multi-level cooperation is an important factor to support up-/reskilling actions and to enhance competitiveness of the steel sector by a well and high skilled workforce. Therefore, the ESSA project consortium was composed by the main European Steel Sector stakeholders, integrating steel companies, education and training providers, associations and social partners, and research institutions. All in all, ESSA comprises now more than 40 partners (24 consortium partners and 20 additional associated partners) from 13 EU countries (Belgium, Czech Republic, Finland, France, Germany, Italy, Lithuania, Netherlands, Poland, Romania, Spain, Sweden, and Slovakia) and, following Brexit in January 2020, the former EU member state, the United Kingdom. The transnational and multi-stakeholder composition of the partnership based on already existing platforms and networking on the European and national level is ensuring the European, member states, and steel regions integration.

The core partnership comprises 24 partners (some are placed in more than one area; e.g. the central training centres of large steel companies):

- **Steel companies:**
  ThyssenKruppSteel Europe (also training provider), ArcelorMittal Poland, ArcelorMittal Spain, Salzgitter AG, Sidenor, Celsa Group/Barna Steel, Tata Steel
- **Education and training providers:**
  Steel Institute VDEh, IMZ, Scuola Superiore Sant'Anna, Worldsteel Steel University, DEUSTO, Cardiff University (also research institution), ThyssenKruppSteel Europe Training Centre (part of the steel company)
- **Steel associations and social partners:**
  EUROFER umbrella organization of the steel industry employers, World Steel Association (also training provider), UNESID Spanish Steel Association, Belgium Steel Platform, German Steel Federation, Federacciai - Italian Steel Federation, European Cold Rolled Steel Association CIELFFA, Association of Finish Steel and Metal Producers, OS KOVO (trade union)

- **Research institutions:**
  TU Dortmund University, Cardiff University, CSM/RINA, Visionary Analytics VA

Completed by a high number of associated partners:

ESTEP European Steel Technology Platform, industriALL (European Industry Union), EIT RawMaterials, Industriarbetsgivarna (Swedish Industry Federation), Polish Steel Technology Platform, Enrico Gibellieri (European Steel expert), Unite and Community (UK unions), CEPIS Council of European Professional Informatics Society, University of the Basque Country, Warwick University, Swansea University, ArcelorMittal Italy, Fédération Métallurgie CFE-CGC, Metalowców NSZZ „Solidarność", UK Steel, SAAT Consulting, ArcelorMittal Germany, Commercial Metals Company (CMC), Liberty Steel / GFG Alliance.

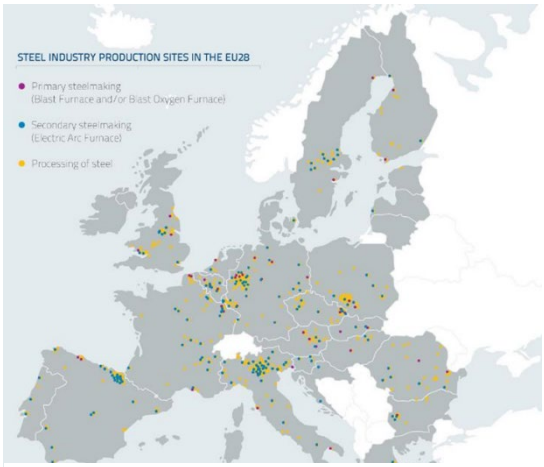


Figure 2: Steel making and processing in Europe

(source EUROFER, for more information see EUROFER (n. d.))

The partnership builds on previous and existing networks and skill alliances which were supported by the EC (e.g. European Steel Skills Council of the Sectoral Dialogue SSDCS). It is designed to deliver on industry led concerns as identified through EC funded pilot projects and, more particularly, EC funded steel research (e.g. via RFCS, SPIRE) and steel industry development mechanisms (e.g. ESTEP). This is the ground for a *sustainable* European Steel Skills Alliance (ESSA) *beyond the project life span* with reliable leadership governance - systematically linking the European Blueprint with the European, national, and regional level of steel regions. Via the main European and national Steel Associations and Platforms ESSA covers the European Steel Industry entirely (see Figure 2:). ESSA is embedded and run within

these existing governance structures to continuously update, initiate and launch stakeholder activities for skills adjustment, strategies, measures, and tools for associations, companies, and training providers.

The dedicated main roles of the different stakeholder groups are:

- Steel companies and social partners are central and engage with ESSA aims and objectives for skills needs identification and analysis, and the upskilling of the workforce for the overall contribution to competitiveness, through database and foresight tools as well as training module development.
- Education and training providers contribute to the creation and development of the network by assisting in conducting analysis of existing training and qualifications frameworks and development of new programmes and curricula as well as supporting training modules development.
- Universities and research institutions offer state of the art knowledge of the technical and social dimensions of the European steel industry. These partners have long-evidenced engagement with the steel industry through project partnerships and training module development, as well as technological research and development activities. The research institutes provide the social and technical basis of the skill needs analysis and contribute to skill requirements and foresight in respect of Work 4.0, as well as contributions to the analysis of national VET requirements, regulations and systems and Blueprint development, including training and train the trainer modules and the interrelation to existing EU tools (like ESCO, EQF, ECVET, etc.). A contribution to policy recommendations (including collaboration with EU and Member State Stakeholders, national funding institutions) is also coordinated by the research institutes.
- European and national associations and social partners provide their expertise, give feedback, access to their respective members, and support measures for transfer, implementation and monitoring, cooperation and dissemination activities at EU and Member State Level, supporting national-regional roll-out preparation and collaboration with other Blueprint developing sectors. In this framework the European Cold Rolled Steel Association CIELFFA is guaranteeing with its membership the perspective of small and mediums sized companies.
- The contribution of sector experts is for integrating their knowledge of areas covered by the project, to get sound feedback on Blueprint processes and progress, as well as key contribution to policy recommendations and transfer, implementation and monitoring processes.

The partners bring together the full range of stakeholders and perspectives required to establish a sustainable strategic sector Skills Alliance (ESSA) in order to ensure the Europe-wide delivery of a sector-wide skills Blueprint that engages with national VET systems and cross-European frameworks to meet skill needs. Especially the integrated steel federations, associations and unions are not only essential for representing the economic sector form different perspectives but also for contributing directly to the roll-out of the Blueprint and informing its strategic direction.

In particular, the European Steel Technology Platform (ESTEP) – within the European initiative to improve the competitive situation of the European Union by the establishment of European Technology Platforms in central sectors – provides a critical basis for linking ESSA (a) to the current and future technological development with the consolidation of skill development approaches, and (b) for leadership and government of the Blueprint. ESTEP is led by a

Strategic Research Agenda (SRA) conducted by its Focus Groups (where most of the ESSA partners are involved) (https://www.estep.eu/estep-at-a-glance/working-groups/):

- Low Carbon & Energy Efficiency (Breakthrough and Continuous Improvement)
- Circular Economy (Circular Economy & Sustainability)
- Smart Factory (Integrated Intelligent Manufacturing)
- Transport and Mobility (Better Steels for Better Transport)
- Construction and Infrastructure (New Steels for Construction)
- Energy Market & Engineering (Steel in the Energy Sector)
- People (Steelworkers for the Future).

ESTEP and its Focus Groups in line with steel related innovation projects of the RFCS, Processes for Planet, and Horizon Europe programs are addressing the challenges faced by the industry until 2030 and the foresight of the major changes driven by new scientific and technological discoveries. While six Focus Groups are mainly dedicated to technological development, ESTEP is the only one of more than 30 European Technology Platforms with a dedicated People Focus Group – which became the main coordination unit of ESSA after the project duration. The transformation of the European steel industry, led by science, technology and innovation, necessitates the development and recruitment of people to drive these changes and the ESSA project provides a consolidated framework for building on existing approaches.

In short, partnership and skills alliance are integrating the complementary competences of all partners for stakeholder networking, policy making, training delivery and integration, and Europe wide dissemination and implementation – all of which is needed to create such a competitive initiative. The partnership is for a sustainable running Blueprint that creates a future vision for the industry and engages companies, trade unions, universities, training bodies, and industry and dissemination networks for the continuous development of a competitive set of skills for the European steel sector. It is innovative and covers the entire industry and associated expert networks within *one* consortium for the effective delivery of the Blueprint and its further proceeding.

1.5 Target Groups

The beneficiaries of ESSA are directly involved and represented in the consortium: steel companies, training providers, steel associations and social partners (and thus indirectly involving the perspective workers and students as learners). Via its partnership ESSA is a continuous topic of existing steel organisations (a) on the European level: European Steel Technology Platform ESTEP, EUROFER, Sectoral Social Dialogue Committee Steel (SSDCS, including EUROFER and industriALL), CIELFFA and Worldsteel, and (b) on the national level via the involved national associations and platforms: UNESID, GSV, Federacciai, Wirtschaftsvereinigung Stahl, Finnish Steel and Metal Producer Association, Polish Steel Technology Platform, OS KOVO.

This guaranteed will guarantee further the exploitation, transfer and dissemination of the results (of the Blueprint) to steel companies and those national associations not directly involved. ESTEP informs the research and training developers of its support and working groups (including the RFCS related technical support groups), the social partners are informed on the regularly Sectoral Social Dialogue Committee Steel (SSDC, industriALL, EUROFER). Therefore, all the potential beneficiaries are targeted as well. Roll-out strategies and activities

encompassed ways to transfer and implement the Blueprint on the level of the involved member states focusing on dedicated steel regions.

As for target groups, firstly, the main direct target groups of this project are the company training centres and HR departments as well as the VET providers and institutions that we recommend adapt their curricula to the new realities of the steel sector (also to a certain degree to the industry sector as such), following ongoing technological and market demands. Through the companies, the education and training partners as well as through the national steel associations involved, we are able to disseminate the project results, utilizing their networks and connections also to the national relevant institutions. Some of which recognized the importance of the work being carried out by ESSA, since our efforts are in sync with their national Industry 4.0 strategies.

The second group of beneficiaries are the workers and students themselves. By disseminating our Blueprint and training framework to the steel companies, its associations and social partners, apprenticeships, dual and tertiary education as well as continuous VET and lifelong learning within the companies and training providers we will deliver qualification requirements to the existing and upcoming staff of the steel industry (and the industry sector as such) based on the needs of the employers and the workers. Further, workers and apprentices will be able to participate and access information, through online courses of the steelHub, meaning that their employability will be improved directly.

1.6 Social Innovation Process

The common development of the Blueprint Strategy and Alliance with such a huge consortium is desirable but not easy to handle. Different perspectives, interests and inputs of the involved stakeholder groups have to be aligned and harmonised; new measures and tools to be developed; European, national, and regional levels to be considered (including different working cultures, VET systems, legal frameworks, etc.) and incorporated; and others. Therefore, ESSA started as a *social innovation process combining technological and social innovation* (Howaldt, 2019; Kohlgrüber & Schröder, 2019; Kohlgrüber et al., 2019): ensuring to work in synergy, providing an overarching account of industry developments and skill needs for integration within European and national VET frameworks. Setting up the development of the Blueprint as an industry driven social innovation process means that technological, organisational and social aspects and impacts were considered right from the beginning of the process in an interrelated way. It also means that the workers, trainees and responsible managers of the companies were included in the development process, integrating their know-how and ensuring their view on both demands and solutions. Within such a social innovation process a constant view on the changing skills needs in the steel sector, linked to the main drivers (emerging technologies and trends) of change, aggregating and continuously updating sectoral knowledge and skills intelligence at European level, thus defining and continuously updating a Blueprint strategy for skills in the sector is guaranteed.

The social innovation process is a mutual learning process, discussing different perspectives and leading to a common strategy to establish new social practices solving the skills adjustments of the industry better than the existing ones. This process does not stop at the end of the project, but rather set the ground for a continuous improvement process embedding technological innovations and their impact on the skills needs of the workforce leading to a proactive adjustment process.

Starting with the **challenge** of adjusting skills needs because of new technological and economic development, the **idea** of a sectoral Blueprint offered by the European Erasmus+ program was taken up, leading to the **intervention** of setting up a European Steel Skills Agenda and Alliance (Blueprint) with the interested stakeholders from companies, training providers, social partners (steel associations and unions). Testing the developed Blueprint during an **implementation** phase, and setting the claims for **institutionalisation** and impact right from the beginning was the next step. Already in the planning of the project **iterative and cyclical feedback loops** were designed, ensuring upgrading of the interventions and implementation of the Blueprint during the course of the project and beyond.

To monitor this process and consider appearing modification ESSA defined process-oriented Key Performance Indicators (KPI) (such as stakeholders' involvement and endorsement of the Blueprint). Feedback loops helped and will help to adjust our ideas, objectives, intervention, implementation strategies and the institutionalisation procedures and structures as well as the impact also beyond the project life span.

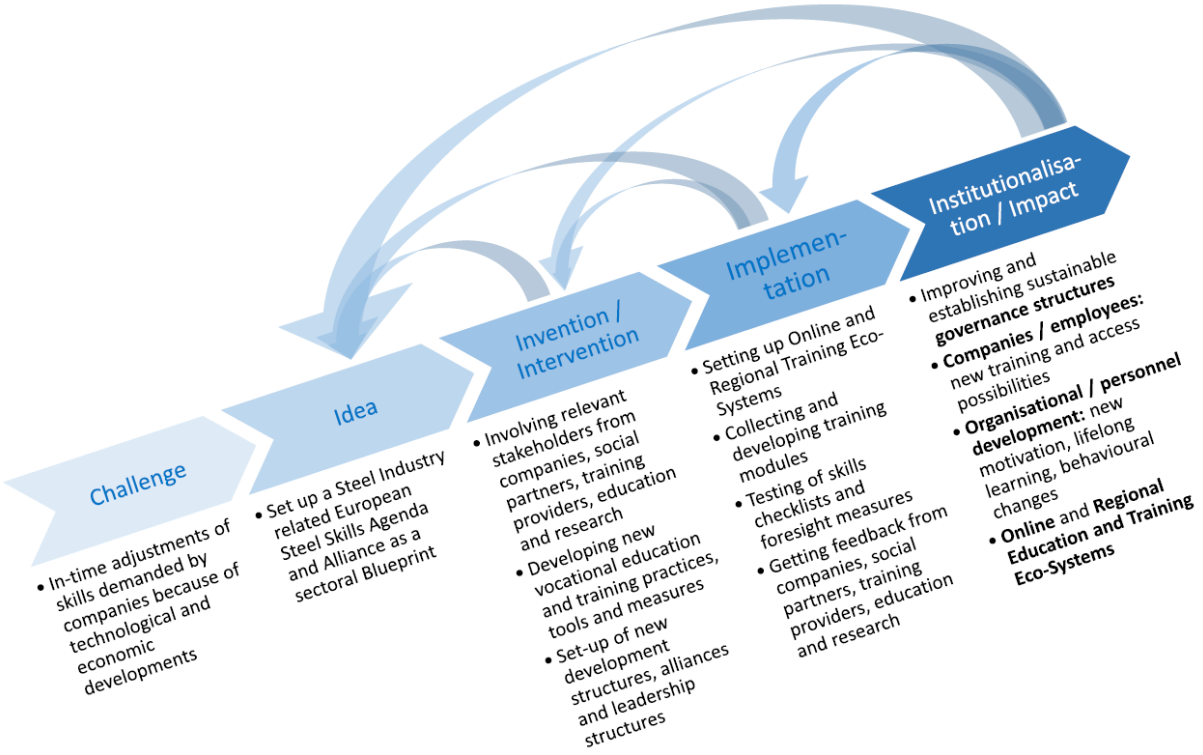
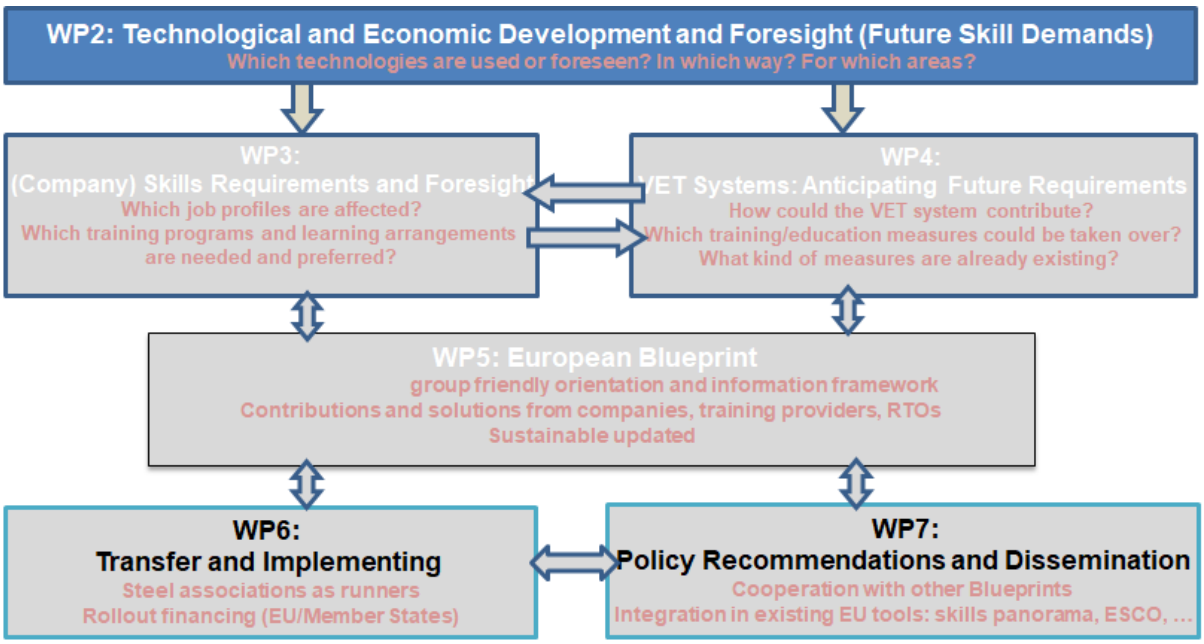


Figure 3: Blueprint development as a social innovation process

2 Technological and Economic Development and Foresight (WP2)

In line with the general ESSA approach and objectives this work package is the starting point of ESSA by evaluating the technological and economic development in the steel industry of today and tomorrow. It is setting the ground for the analysis of the (company) skills requirements and the anticipation of the (future) support of the Vocational Education and Training (VET) systems to close the skills gaps in the steel industry shortly and systematically across the sector.



2.1 Objectives

Technological development is an ongoing process, which also affects the European steel industry. New high-performance IT systems, the diffusion of system networking, the mobility of equipment, the ever-increasing number and variety of monitoring devices and the consequent massive application of advanced technologies exploiting the huge amount of collected data are just some examples of technological innovations that affect all areas of steelworks involving all the workers: from top management to technical personnel and plant operators.

Against this backdrop ESSA assessed the current state and the future development of the **digital and green transformation** of the Steel Industry. Based on the current state, the upcoming techniques and developments were and will be analysed on the basis of the main digital transformation levers and related projects and technological market trends. In close cooperation with steel companies and their training providers, enhanced by feedback and inputs of all partners of the consortium a first future scenario was elaborated describing the industrial steel production in the next three years (and beyond as far as possible), by identifying the main categories of technological and related economic developments and the related required skills and competencies. Each of the previously identified categories is linked to the affected processes/areas of the production cycle and to the affected personnel, in order to assess the adequacy of the present skills and the gaps to be filled, the competencies to be provided to the already employed personnel and the eventual new professional profiles to be searched and formed.

The determination of the current state of the digital transformation of the European Steel Industry as well as current and upcoming developments in digital transformation and Industry 4.0 are examined in a first phase; while the development of a future scenario of a digitised Steel Factory and digital technologies as enabler of green technologies inclusive of economic evaluation and impact on the personnel, looking towards the perspective outlined by Industry 5.0, was examined in the second phase of the project.

2.2 Methodology

The adopted methodology is based on an integrated approach. It foresees to collect all the necessary information through *desk research* (European funded projects and literature) and a *survey* addressed to European steel companies. A review paper (Branca et al., 2020), deriving from this analysis, was recently published.

2.2.1 Desk research

Concerning the desk-research and literature analysis the following sources have been analysed:

- European Innovation Projects (e.g. RFCS, HORIZON 2020, etc.)
- Journal/Conferences Articles, Reports, EC Document
- Best Available Technologies for the Steel Sector
- Technologies for low-carbon steel industry in EU funded project
- Technology for Additive Manufacturing.

European innovation projects provide useful information about the main developments funded by EU Research Programs achieved in the technological transformation in terms of advanced tools for the optimization of the whole production chain and specific technologies for low-carbon production. In particular, in the European steel sector, the most important funding programme for the technology development is the Research Fund for Coal and Steel (RFCS). This funding programme concerns aspects related to the innovation in the digitalization of the steel industry to a high degree. In the last years more and more RFCS projects developed innovative solutions based on the application of several KETs (Key Enabling Technologies) opportunely customized to be implemented in the different (production and maintenance) areas of the steel companies. Some of the analysed projects are shown in Figure 4 where it can be observed that (1) the main innovation technologies are covered and (2) many innovative solutions require the application of more than one technology opportunely integrated: such as internet of things, big data, simulation, cyber physical systems, cyber security, augmented and robot assisted work.

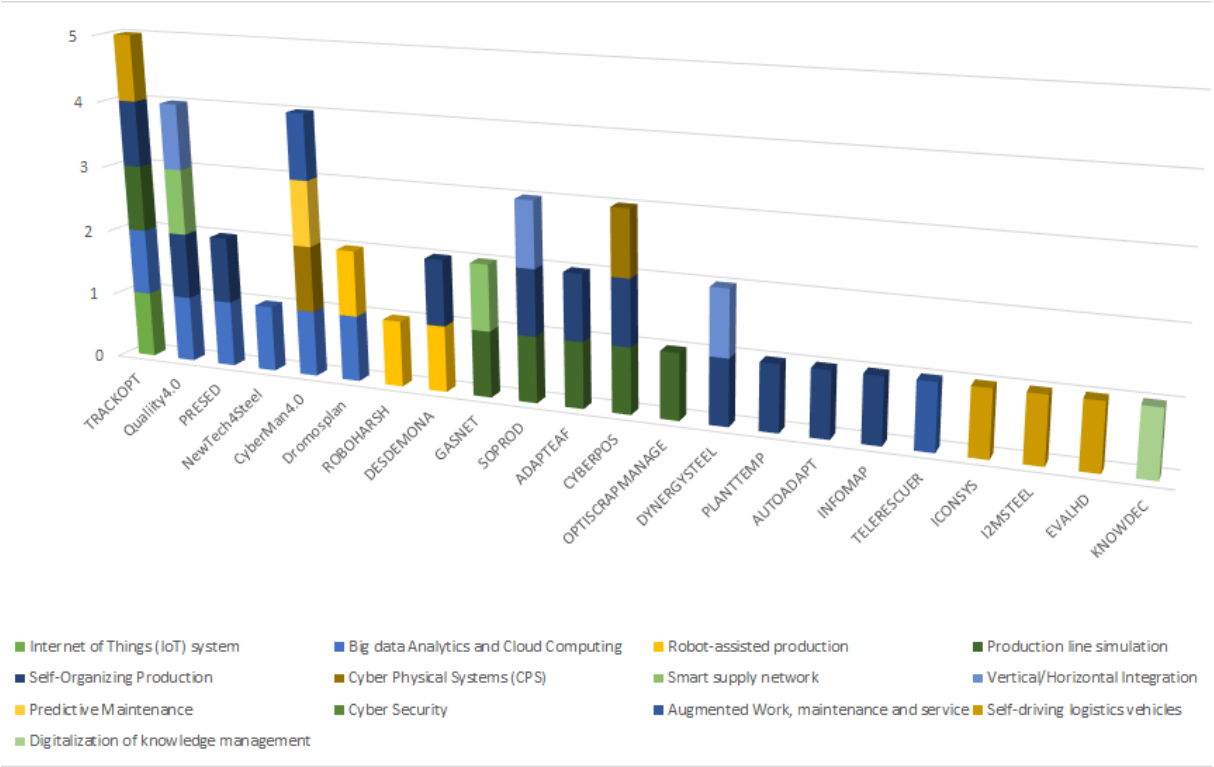


Figure 4: RFCS projects and the applied key enabling technologies

In the field of **CO2 mitigation technologies**, the RFCS and H2020 programs - the latter with particular focus on the energy intensive process industry under the Public Private Partnership SPIRE (2014-2020) - provide important information about the status of development of the technologies for low-carbon steel production, focused on three pathways: Carbon Direct Avoidance (CDA), Process Integration (PI) and Carbon Capture, Storage and Usage (CCU). According to Figure 4, several EU projects have been funded in the Process Integration pathway in order to develop technologies for reducing the use of carbon: Process Integration (14 of the analysed projects), Carbon Capture Storage and Usage (7), CDA Technologies (5).

Not only current and upcoming developments in digital transformation, according to the four levers of the digital (Digital data, Automation, Connectivity and Digital Customer Access), but also their combination with the development of the green technologies, to achieve the objectives of the green transition, have been analysed. Therefore, digital technologies as enabler of green technologies are defined by the recent EU initiatives for the steel industry, such as the “Green Steel for Europe” project and the Clean Steel Partnership (CSP). In particular, the “GreenSteel for Europe” project aims at developing an innovative approach based on the combined assessment of promising technologies, industrial transformation scenarios, and policy options and impacts to face the decarbonisation of the European steel industry. On the other hand, data source for such topics is represented by the document describing the **Clean Steel Partnership Strategic Research and Innovation Agenda (SRIA**) (ESTEP, 2021). The European Commission in 2019 launched the European Green Deal, which includes a binding climate law to achieve net-zero greenhouse gas emissions by 2050. This policy initiative aims at improving process industries performances and make Europe the world's first climate-neutral continent. In the steel sector the concepts of climate change have been translated into the SRIA that outlines the road-map to achieving the goals set by the Green Deal. According to the CSP roadmap, digitalisation, as enabler, is included among the six areas of intervention comprising different technological pathways (and combinations thereof) with the target of a carbon-neutral steel production. The CSP roadmap also defines

the specific contribution of the digital technologies to the development of the different green performances.

Another important data source is represented by the **Best Available Techniques** document (Remus et al., 2013). It provides information, mainly based on the application of digitalization systems, in particular in the Energy management, Water and Wastewater management and in some production processes. The application of BAT aims at achieving continuous improvements in the steel sector, in particular regarding quality, costs, energy consumption and environmental performance. In this context, digital technologies help to reach these objectives, adapting and integrating them with the traditional ones and with the new process. For this reason, the analysis of this document is an important step to understand the innovative and emerging techniques for the steel production processes.

2.2.2 Survey

A survey addressed to steel companies has been implemented in order to collect information directly "from the field", that is from the various company's representatives, in order to provide the current state of the digitalization in the European Steel Industry. The existing level of plant automation and the adoption of the new paradigm of Industry 4.0, including the resulting impact on the workforce, have been and will be further assessed. To this aim, a questionnaire has been developed and launched during the early stages of the project organized by considering different sections, as shown in Figure 5 (below).

Figure 5: The questionnaire structure

The first section mainly includes general information: country, company size, such as small, medium, and large enterprise, type of product, production route and production output.

The second section includes questions related to the implemented strategy, such as the traditional solution applied before the Industry 4.0 paradigm, the state of digitalization, the priorities on digital technologies and what of them will be adopted, how they will affect the workforce, and the company involvement in research projects on digitalization (past, current and future/planned project).

The third section proposes questions related to technical aspects, such as the awareness of the opportunities and threats from additive manufacturing, areas of applications of digital technologies, and expected benefits and major barriers.

The fourth section, concerning the human resources, includes questions about the gender balance, the age profile, the percentage of each category of employers with higher education, the size evolution of the workforce in the next few years, the awareness of the staff categories about the needs for digital competences, training programs on Industry 4.0 topics.

The questionnaire was launched in June 2019, and made online available in order to facilitate its compilation.

The described survey was not repeated during the second part of the WP2 activities since it was decided to integrate a part of it to form a forecast survey carried out in 2023: ESSA European Steel Technology and Skills Foresight Panel (ESSA ETP). It included not only

technological aspects, but also questions from other surveys carried out in other WPs of the project and related to industry steel skills requirements (WP3) and VET (Vocational Education and Training) systems anticipation and support of future skills (WP4). The survey was carried out during the last year of the ESSA project.

2.3 Results

According to the above described methodology the results so far are exploited in the ESSA Deliverable 2.1 “Digital transformation in European Steel Industry: state of art and future scenario”. The first results version has been released in September 2019 and updated with the results of the survey (October 2019; Murri et al., 2019). Due to the rapid technological changes other versions were updated in the following years (June 2021 (Murri et al., 2021) and June 2023 (Murri et al., 2023)) integrating new data from the desk research, survey, and the project partner discussions and feedback.

The following general results provide a comprehensive overview of the current state of Industry 4.0 implementation and its continuous application in steel sector. In addition, results concern the crucial role of digital technologies in the green and digital transition to achieve more sustainable production systems. They also consider the emerging skill requirements as the transition towards the new paradigm of Industry 5.0.

In Industry 5.0, technology and machines collaborate with human workers in a synergistic manner, enabling seamless interaction and leveraging the unique capabilities of both. Consequently, the results emphasize the importance of acquiring new skills that empower individuals to work effectively in multidisciplinary teams, think critically, embrace change, and effectively navigate the interface between humans and intelligent systems.

2.3.1 Desk research

In the following the main results of the desk research are summarised related to the main objectives above.

Current state of digital transformation in steel industry:

- The identified new Key Enabling Technologies (KETs) under the paradigm Industry 4.0 are represented by: new generation of sensors, Big Data, Machine Learning, Artificial Intelligence (AI), Internet-of-Things (IoT), Internet-of-Services, Mechatronics and Advanced Robotics, Cloud Computing, Cybersecurity, Additive Manufacturing, Digital Twins, Predictive Maintenance.
- The application of new technologies in the steel sector already supports and can further sustain the optimization of the entire production chain, although the steel production is already automated to a certain extent and often the systems work in an isolated way.
- The steel industry is becoming smart and more agile evolving towards industry 4.0:
    - The European steel industry has been involved in several policy activities, R&D projects, activities and patents in the field of digitalization.
    - The European Commission plays a crucial role in order to maintain the competitiveness of the European steel companies.
    - The new technologies can really support the optimization of the entire production chain through real-time operational data providing better and faster decision-making.

- The steel industry expectations from digitalization focus on **quality, flexibility and productivity** through the optimization and the interactions of the individual production units.

Current and upcoming development in digital transformation:

- The challenge of digitalization concerns the integration of all systems (sensors, automation, and IT systems) and productions units in different dimensions:
  - Vertical Integration → Integration of systems across the classic automation levels from the sensor to the Enterprise Resources Planning system;
  - Horizontal Integration → Integration of systems along the entire production chain;
  - Life-cycle Integration → Integration along the entire lifecycle of a plant from basic engineering to decommissioning;
  - Transversal Integration → based on the decisions taken during the steel production chain, considering technological, economic and environmental aspects at the same time. This will only be possible by new IT, automation and optimization technologies and by their combination in an integrated way.
- The identified digitalization trends are represented by adaptive online control, through-process optimization, through-process synchronization of data, zero-defect manufacturing, traceability, intelligent and integrated manufacturing.
- Knowledge (Data and Human expertise) Management is a key factor for achieving improvements in the digitalization process, through new approaches based, for instance, on the methodology knowledge-based decision support system.

Digitalization and its Economic/Environmental Impact:

- The most important economic factors, related to technological applications, as real-time production chain optimization, human robot collaboration, smart energy management, predictive maintenance, analytics, are related to:
  - Reduction of energy and raw material consumption;
  - Lower OPerational EXpenditure (OPEX);
  - Reduction of losses;
  - Increased product quality and productivity;
  - Improved flexibility and reliability of processes.
- New business models & organizational structures are requested based on a stronger networking between business processes, creation of efficient interfaces, integrated data exchange and management.
- Environmental impact can benefit from innovative tools able to monitor and assess the environmental performance of processes by combining digital and CO_2 mitigation technologies, i.e. Carbon Direct Avoidance (CDA), Process Integration (PI) and Carbon Capture, Storage and Usage (CCU), leading also to new ways of circular economy and industrial symbiosis across different industry sectors (see SPIRE-SAIS Blueprint, where steel is embedded).
- Digitalization plays a strategic role in improving the technology performance with the aim of reducing energy and materials consumptions. Process optimisation and monitoring, as well as systems integration, are fundamental for the energy management along the steel production routes. AI-based predictive models can be used for the optimized maintenance and production scheduling. Therefore, digitalisation effectively supports the transaction to

the new green technologies, and, at the same time, it will contribute to their development currently at early stages.

Digitalization and Impact on the Workforce:

- The World Manufacturing Forum has identified a top-10 of skills that will be needed in future manufacturing, four of them refer to digital skills, such as "digital literacy, AI and data analytics," "working with new technologies," "cybersecurity", and "data-mindfulness". The other six skills are more transversal and linked to creative, entrepreneurial, flexible and open-minded thinking.
- The transition from Industry 4.0 to Industry 5.0, focusing on human-machine interaction, necessitates the development of competences and knowledge in new technologies, leading to employee retraining and lifelong learning. Industry 5.0 will create new jobs in human-machine interaction, intelligent systems, AI, robotics, and more.
- From future labour market, new skills are requested from the workers, so a proper training from the education system, the governments and interested companies has to be redesigned in order to fill up the actual skills mismatch (failure of skill supply to meet skill demand)
- Concerning education, the study of science, technology, engineering, and mathematics (STEM) should be promoted and encouraged, because they are fundamental for developing sustainable technologies, according to the Circular Economy and Energy Efficiency concepts.
- Including such concepts into vocational education & training (VET) programmes with flexible, cooperating and innovative approaches.
- The workforce should increase their ability to be flexible and adaptable and develop the habit of continuous learning in an interdisciplinary perspective. In particular soft-skills as collaboration, communication and autonomy are required for employees in order to be able to carry out their jobs in hybrid operating systems
- The skills demand analysis for steel sector led to three main complementing strategies: incremental up-skilling of existing job profiles or buy-in of digital competences from external experts or recruiting and retaining talented people with digital skills.
- Continuous training activities and updated programs represent the key aspects for the steel companies in order to achieve a successful future and to improve the interdisciplinary skills.
- The effects of digitalization on workforce, in terms of reduction or increase, remain an open question that requires further discussion. This includes the potential impact on low-skilled workers, which could be experienced in various ways such as through upskilling initiatives, the reduction of "middle" workers through job polarization, or the utilization of external personnel.

2.3.2 Survey

The **survey results** underline and confirm the desk research results by providing direct answers from company representatives. The answers collected up to the end of October 2019 allowed to form a sample of 28 valid observations. Although the size is not optimal, the sample has a good representativeness in terms of general information: country of origin of respondents, company size, production route and product types. Figure 6 reports the characterization elements of the sample.

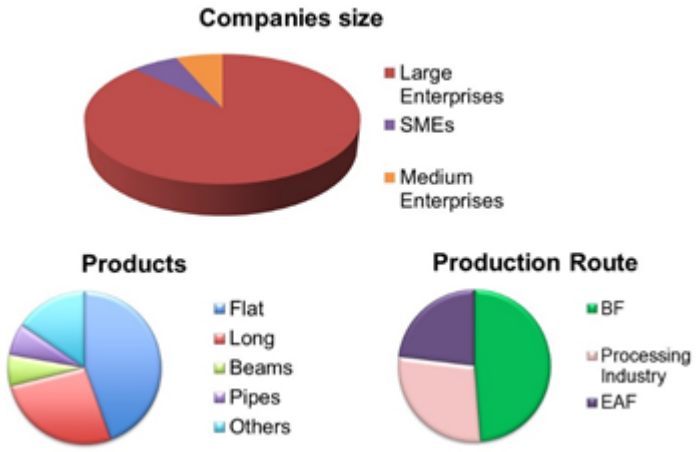


Figure 6: Sample characterisation

The respondents are from steel companies located in several European countries. Most of the data come from large enterprises, involving different professional profiles, i.e. board of director, plant managers, ICT, HRs, etc. All the production routes are represented (with a prevalence of blast furnace route), as well as the product type (with a majority of flat products).

As mentioned above, the aim of the survey was to determine the current state of the digital transformation in the European Steel Industry, starting from the existing level of plant automation and considering the possible adoption of the new paradigm of Industry 4.0 (i.e. the adoption of innovative digital technologies to enhance both the production operation and the information management) as well as the resulting impact on the personnel in terms of skills needs and development in the steel sector.

These survey results were complemented by more recent results from a survey conducted in WP3 (for methodological details see D3.2; Bayón et al., 2023).

Below the main results for technological implementation of the questionnaires are described.

The **strategy** section aimed at assessing the state of digitalization and plant automation in the steel industry before the Industry 4.0 paradigm, and the level of both knowledge and interest concerning the Industry 4.0 enabling technologies. In addition, an evaluation of the impact of digitalization on workforce was required as well as the participation to European funded projects.

The survey analysis highlights an already significant level of automation in the steel plants (Figure 7) as a starting point to evolve towards a technological improvement: standard solutions such as CAD, product data management, production control systems are mainly in place as well as Manufacturing Execution System and Maintenance and Lifecycle Management Systems with a lower implementation up to now in the companies.

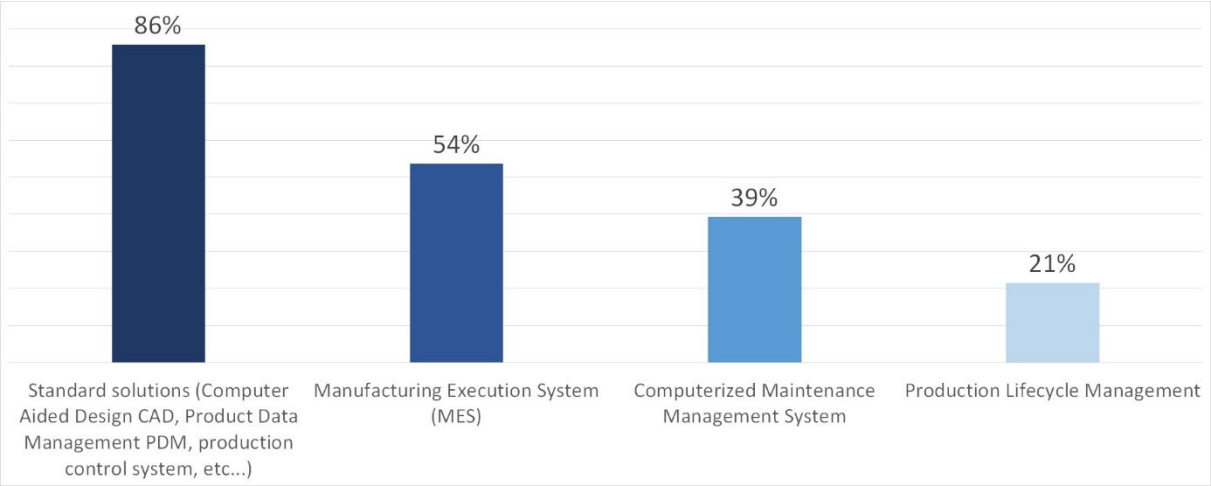


Figure 7: Traditional solutions currently applied in the steel companies

Among the broad range of relevant Industry 4.0 technologies, in general widely known, the companies' current usage is oriented on Cybersecurity, Predictive Maintenance, Advanced Process Monitoring and Control, cloud computing as well as Internet of Things (IoT). Looking at planned introductions and expansion of Industry 4.0 technologies within the next 3 years, especially Big Data and Analytics, Virtual & Augmented Reality, as well as Digital Platforms for Circular Economy stand out technologies growing in importance (see Figure 8).

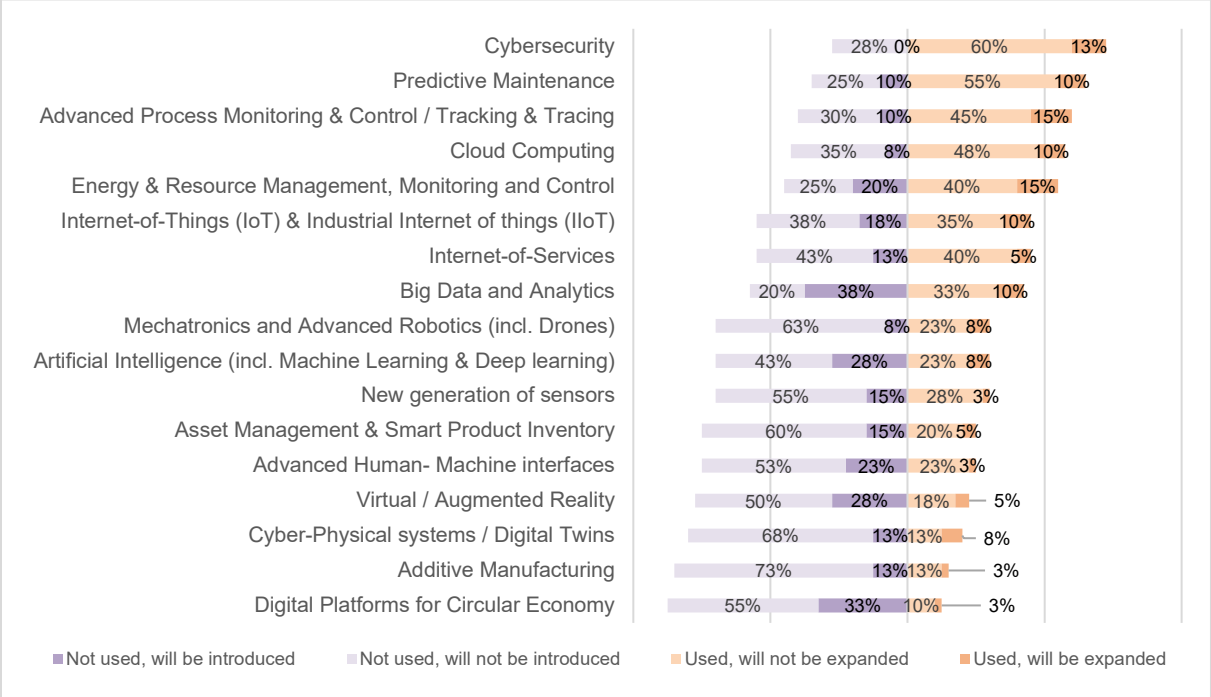


Figure 8: Current and future company usage of different technologies
(ESSA survey results 2023, percentage of participants)

The impact of the digital technology on the workforce is considered relatively high both for the need of suitable skills and other aspects directly affecting the employees (like general improvement of the work conditions, for the workplace environment and health and safety, as well as increasing of working time and work-life balance).

There is also a growing interest on joint European research projects (no funding programme mentioned for the current and planned ones), although one of three respondents state no involvement in such projects.

Technical Information part of the survey aimed at awareness of the opportunities, implementation areas, expected benefits and major barriers within the companies.

The digitalisation is generally widespread applied in all the company's areas, as shown in Figure 9, especially in the production area and where the management of large amounts of data is required, i.e. production, business, etc., administration, quality control and HR management are also mentioned among the areas where digitalisation is mostly applied.

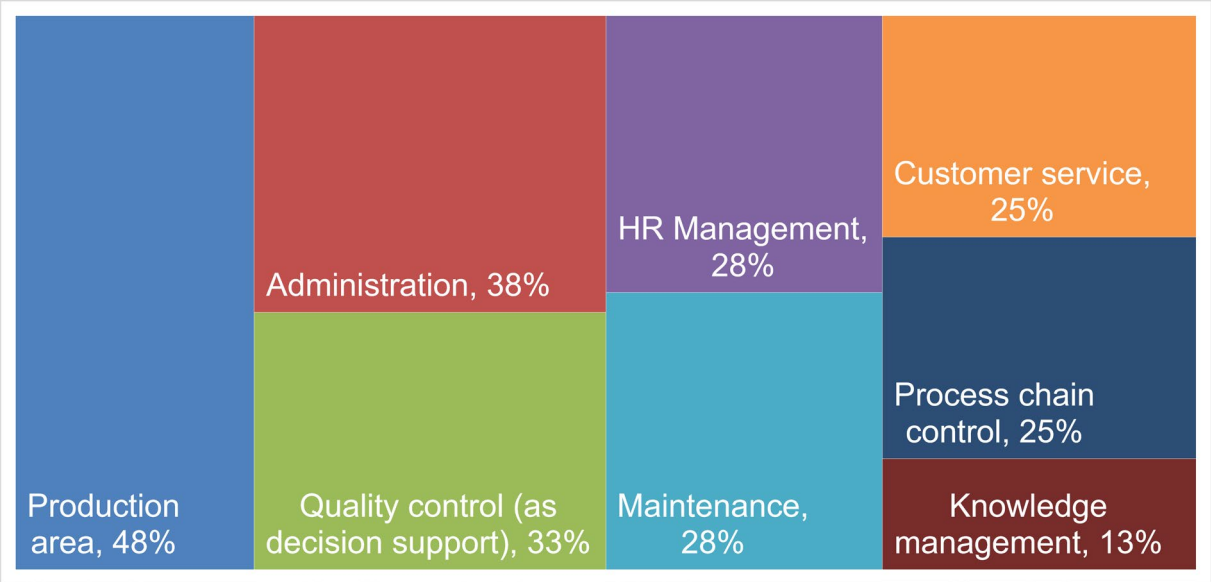


Figure 9: The most digitised areas of the companies
(TOP3, ESSA survey results 2023, percentage of participants).

The major expected benefits are focused on production (i.e. cost reduction), a positive impact on workforce in terms of safer and healthier workplaces. Environmental improvements, i.e. reduction of wastes, emissions, and resources consumption seem to stand more in the background. Figure 10 is reporting the ranking of the expected benefits and shows that this is reflecting a broad range as well.

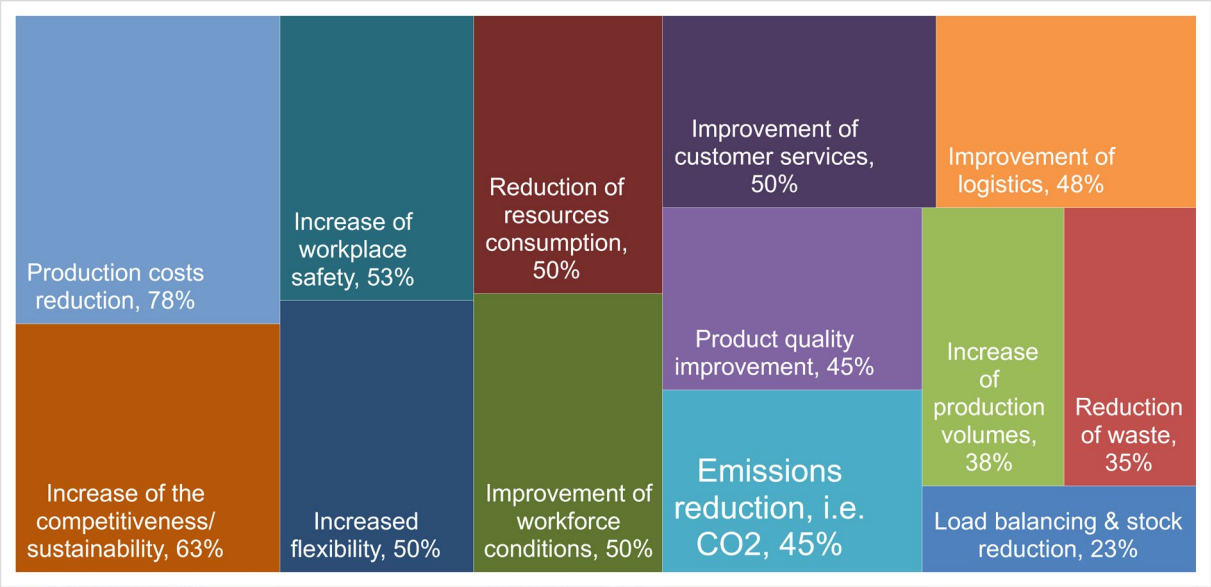


Figure 10: Main expected benefits from the adoption of the enabling technologies
(ESSA survey results 2023, multiple answers, percentage of participants)

The main barriers for the adoption and the application of the enabling technologies has been essentially individuated in the costs of the investment, that need to be also evaluated considering the obsolescence of plant/infrastructures and equipment as well as the compatibility to existent technologies. It is important also to highlight the barriers related to workforce topics, such as the lack of highly skilled workforce, skills gap and acceptance of the new technologies by the workforce. Figure 11 shows the ranking of the main barriers grouped in three classes of importance.

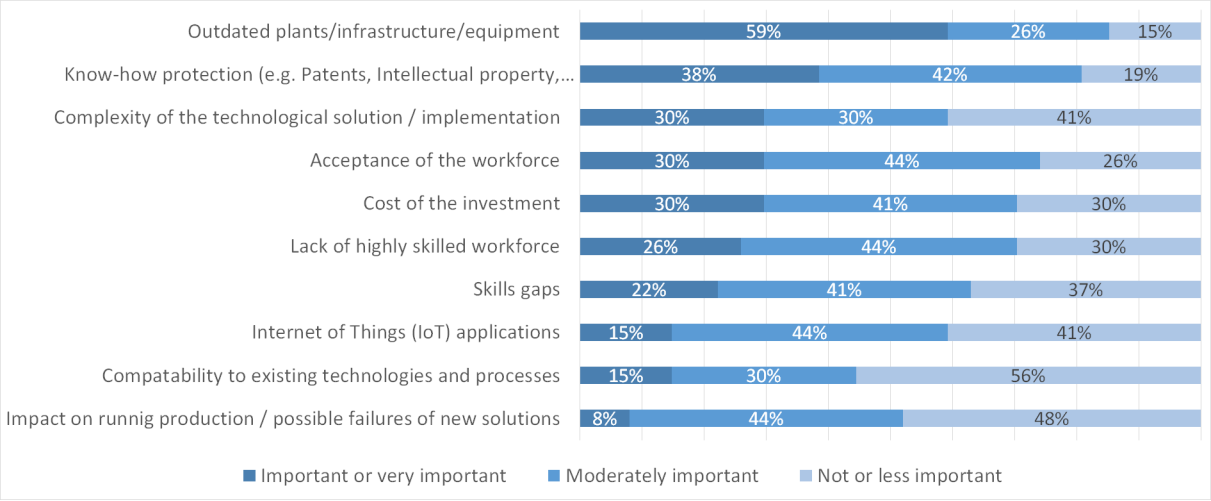


Figure 11: Main barriers for the application of the enabling technologies.

Concerning **human resources** and the **current and future workforce organization** the workforce profile in the last five years considering age and education was in focus. Despite the lack of data and/or data inhomogeneity characterizing this section of the questionnaire, some results can be highlighted:

- There is a general imbalance of male and female percentage in favours of males in all the three considered areas: operations, administration and services.

- Regarding the age profile, according to the few valid data, a certain stability in each presented age class can be estimated, with a substantial rising in the last two years for the personnel from 35-44 years old.
- Higher education (i.e. Universities, Occupational Colleges, etc.) is a requisite for most of the production managers and engineers respect to technicians, operators and apprentices/trainees.
- Concerning the future evolution of the workforce (in the next 3-5 years), the sample was quite divided about growth in workforce numbers or not (50% yes, 50% no); in the positive case, it appears a higher interest to employ more women and high qualified people, mainly because of the use of new technologies.

Production managers and engineers are the most aware of the needs of digital competences, while technicians, operators and apprentices/trainees seem less aware.

Concerning the training aspects, few training programmes are currently scheduled on company's digital products and services, communication, technology and innovation.

However, the data background has been improved by skills related surveys (see skills checklist in chapter 3 and survey in the Annex) and the uncertain evolution of the number of workforces shows that ESSA has to raise future awareness for a proactive adjustment on skills due to the technological developments described above.

2.3.3 EU Projects repository

As reported in the methodology description, RFCS projects represent one of the most important data sources concerning updated applications of Industry 4.0 enabling technologies in steel plants. Significant information is related to the customization of these technologies in order to be applied in complex plants, as the steel ones, in well-defined use cases referring to the different company's areas.

In this context, to effectively utilize the information from EU-funded projects, we have worked on arranging a concise summary of each project in a project card. These project cards can be accessed directly through the ESSA project website, which serves as a structured and organized repository. This approach enables easy, open, and continuous access to project information, facilitating wide dissemination of such information within the steel sector. The project card includes essential project details, such as title, acronym, start/end date, funding programme, and keywords. It also provides a brief description of the project, its objectives, relevance to technological transformation, and a link to the webpage or report for further information.

The repository is organized to present project information grouped based on the primary technologies applied (Figure 12). Within the Digital Technologies branch, projects developing Industry 4.0 Key Enabling Technologies (KETs) in different steel areas are grouped under 11 specific topics. The Green Technologies branch includes projects focused on reducing environmental footprint, also supported by digital technologies as enablers for Circular Economy (CE), Process Integration (PI), Carbon Direct Avoidance (CDA), and Carbon Capture Usage and Storage (CCUS). These projects are organized into 6 specific topics, as shown in Figure 12.

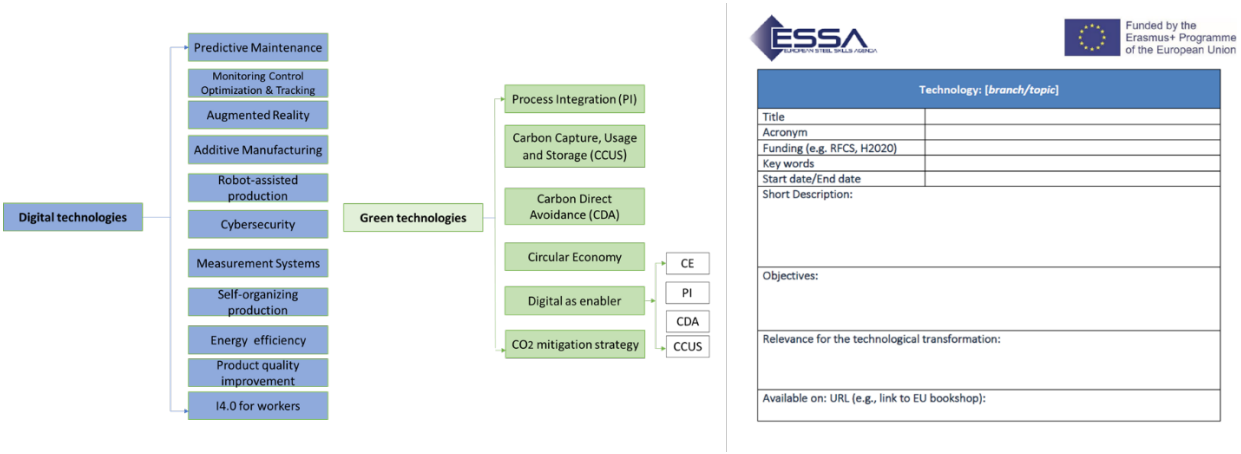


Figure 12: Projects repository organization and project card

After the completion of ESSA activities, the repository now houses a collection of 93 project cards, spanning the past decade. Among these, 52 project cards are dedicated to Digital Technologies, while the remaining 41 cards highlight advancements in Green Technologies.

The project card template can be opportunely filled by any steel sector actor in order to report own projects (i.e., national/regional projects) in the field of innovative technological applications. This template-based reporting and an improved method for the technological and economic foresight is part of a European Steel Technology and Skills Foresight Observatory (ESSA ETF) (see chapter 5.3.1 "Blueprint Development").

2.4 Conclusion

The work carried out by means of an integrated approach of *desk research, dedicated survey and team discussions* allowed to individuate the elements for the Blueprint development relatively to the technological developments in the steel industry.

The primary contribution of this work was to identify the key elements that the steel sector is adopting during its path of innovation, considering both technological advancements and workforce aspects. These elements serve as the guiding road for the steel industry's progress and transformation.

- The steel industry is currently undergoing a deep transformation driven by the new industrial revolution, known as Industry 4.0. This transformation is being realized through the widespread adoption and implementation of cutting-edge technologies, known as Key Enabling Technologies (KETs). These technologies are represented by new generation of sensors, Big Data, Machine Learning, Artificial Intelligence (AI), Internet-of-Things (IoT), Internet-of-Services, Mechatronics and Advanced Robotics, Cloud Computing, Cybersecurity, Additive Manufacturing, Digital Twins and Predictive Maintenance.
- Digital technologies are also increasingly becoming a fundamental element in enhancing energy efficiency and controlling the environmental performance of processes, in line with the guidelines set forth by the European Green Deal initiated in 2019.
- The drive for technological development in the coming years is confirmed globally through the market analysis of the Industry 4.0. The analysis shows that Industry 4.0 market is still growing, from $130.90 billion in 2022 to $377.30 billion by 2029, at a CAGR of 16.3% in forecast period, 2022-2029. In the Steel Industry investments in digitalization are forecast to reach nearly US$6 billion by 2031, growing at a Compound Annual Growth Rate (CAGR) of 10.9%.

- Under a financial point of view, the process of implementing innovative technologies requires significant costs. However, their implementation can quickly lead to expected results in reducing operating costs as well as the use of material or energy resources, etc. In particular, companies focused on innovation and digitalization can also change their business model, resulting in an increase in their financial results.
- Both the transition of Industry 4.0 and Industry 5.0 (focusing on human-machine interaction) require the development of competences and knowledge in new technologies, leading to employee retraining and lifelong learning.

In this context, **further research is necessary to address** several important areas.

- Ensuring the sustainability of digital manufacturing is crucial. It is essential to develop methodologies for assessing the environmental impact, providing a basis for future indicators that quantify and measure the actual benefits.
- Additionally, given the rapid pace of digitalization and the numerous environmental challenges we face, new strategies must be developed to enable swift and effective intervention by political and administrative decision-makers.
- Furthermore, there is a need to gain a better understanding of digital circular business models and provide the necessary support and enabling environment for their implementation.

It is necessary to focus on future **workforce development** through:

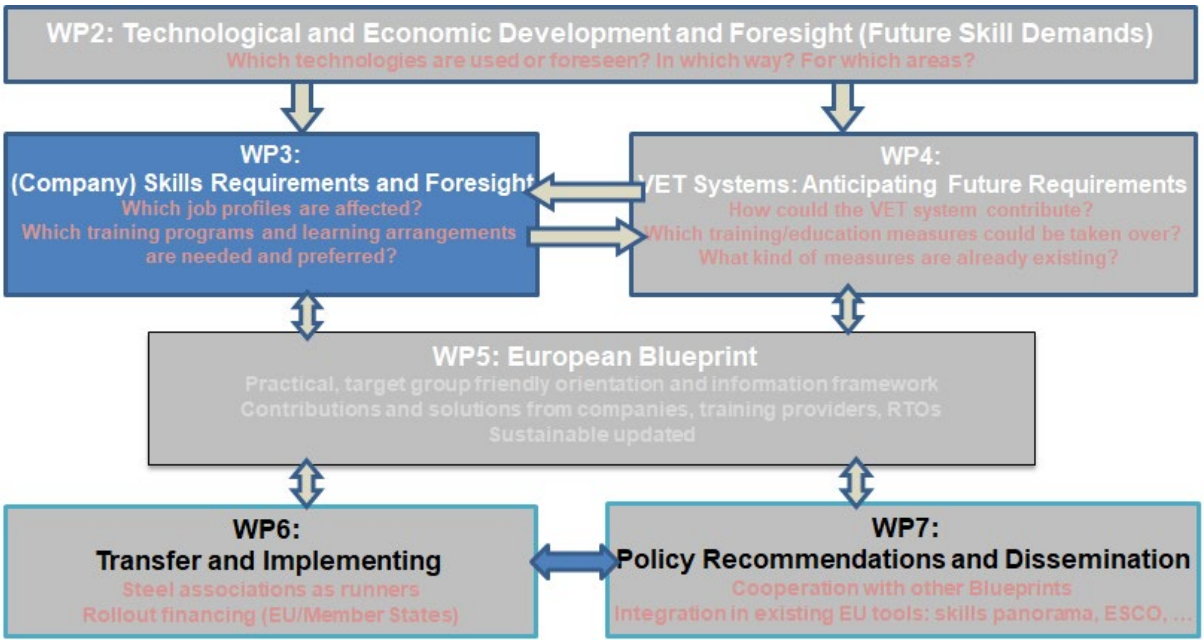
- Continuous training activities and updated programmes that aim to enhance interdisciplinary skills. Furthermore, there is a growing demand for a future workforce that is more inclusive, with a higher representation of women and highly qualified individuals, especially due to the increasing use of new technologies.
- Monitoring the impact of digitalization on low-skilled workers, considering potential measures such as upskilling initiatives, potential reduction of "middle" workers (resulting in job polarization), and utilization of external personnel.
- Developing the Knowledge Management as crucial role in achieving improvements in the digitalization process. This includes the implementation of new approaches, such as knowledge-based decision support systems, as well as the preservation and transfer of the valuable expertise acquired by experienced workers to younger generations.

To effectively address the **skills challenge** in the steel sector and tackle climate change and decarbonization, various actions need to be taken.

- Enhancing the **quality of work by investing in training and professional development**, while involving workers in decision-making processes. Training programs should focus on developing versatile skills for the green transition, such as advanced digital competencies, entrepreneurship, sustainable development, and analytical thinking.
- **Collaboration among universities, research networks, and industries** is crucial for improving the training opportunities available to employees. It is also important to allocate more resources to training programs that promote environmental awareness. Enhancing social dialogue, both within companies and at the sectoral level, fosters a cooperative approach.
- **Establishing channels that allow employers to systematically gather feedback from workers** about their training needs and concerns regarding skill gaps related to the green transition is essential. Proactively anticipating and managing change, both at the government and company levels, is necessary to ensure that workers are not left behind. Regional authorities may play a role in this process.

3 (Company) Skills Requirements and Foresight (WP3)

Based on the results of the technological and economic development the company related current and future skills requirements are defined and assessed - as a foundation for developing the potential for industry driven VET systems support, as well as informing the European Steel Sector Blueprint development.



3.1 Objectives

The objective is to identify and specify new skills and training needs within the steel sector, considering a framework of growing digitalization and increasing environmental regulation and efficiency concerns, which are to be incorporated into VET and tertiary education training curricula. We thus aim to define recent and future skill needs and incorporate redefinition of professional role profiles. Clarifying the industrial changes and relevant tasks to be performed in the Steel Sector, it is possible to interpret data on the expected evolution of skills needs.

ESSA will serve steel companies to specify and identify the skills and knowledge needs (recent and future), adapting them to their future scenarios and redefine steel sector professional profiles. The latter is conducted by means of an analysis of existing professional role profiles within steel companies and the definition of skills that are related to those profiles and required by steel companies to be more competitive in the future.

By comparing existing and future skills demands and needs of the steel industry, an identification of workforce gaps will be obtained.

3.2 Methodology

The analysis of current and future company skills requirements was based on the **definition of skills needs (recent and future) and redefinition of professional profiles**. Based on a short literature review (see Deliverable 3.2; Bayón et al., 2023) and a reflection of the technological and economic developments on the background of concrete company demands (based on the results of the proceeding chapter, WP2) the focus was on the analysis of existing professional profiles within steel companies and the knowledge that is related to them. Skills

and capabilities that are required by steel companies to be more competitive in the future were delineated.

After this preliminary analysis, steel companies of the ESSA consortium reviewed their current professional profiles in meetings, interviews and workshops and related them to workers' skill formation and any complementary training engaged with by workers to build the competences demanded.

Based on this a first identification of current and future skills for job profiles was made, leading to a common database of professional job profiles related to steel production. Because the technological and economic foresight stressed that almost all production areas are affected by new (digital) technologies, this list comprised all the job profiles of all steel production areas, including maintenance and each proficiency level (management and leadership; high, middle and low skilled workers).

Finally, a classification and assessment scheme of current and future skills demanded for each professional profile (or profile group) was developed, allowing a comparison of existing and future skills demands and needs of the steel industry.

The impact of the results for the steel company's organization and their staff was reviewed, conclusions obtained were shared with the partners, and main finding integrated into the European Blueprint (chapter 5).

3.3 Results

Most steel companies are digitizing and greening their processes, incorporating ICT and Industry 4.0 technologies to melting, casting, rolling and other sub-processes. However, the steel sector has always been considered a mature sector with a low level of technological development, and most of workers, although experienced in industrial manufacturing and metallurgical issues, lack of skills related to the new implemented technologies. The main observed consequence is that companies have difficulties to find workers with these required new skills that could maximize the benefits that these increasingly automated, robotized and digitized processes are offering. New skill needs are emerging and a more highly skilled workforce is required by the steel sector companies.

Strategic investments of the steel sector are aimed at addressing the main challenges that the steel sector is facing, notably preserving competitiveness (through production responsiveness and flexibility, efficient processes and resource savings, increased product quality, maximised plant performance and minimised maintenance and low capital lock-up) and reducing environmental impact of steel production. When investing in new technologies, one has to consider the overall production process as optimisation should happen throughout. Moreover, it is important to consider that difficulties may arise in uptake by the workforce, especially among older workers. Strategic investments are motivated by the future directions of the industry, which concern automation (Industry 3.0), digitalisation (Industry 4.0), decarbonisation and energy efficiency (greenhouse gas emission reduction). These lead to work becoming less physical and more creative, but also create a need for integrated data exchange and management and for efficient interfaces to facilitate the interconnections between business processes as well as for new technologies that can help achieve CO_2 reductions in the value chain.

3.3.1 Skills Definition

Technological developments are expected to change skills needs in the near future. More and more monotonous tasks will be absorbed by assistant systems and machines, while operators (if re-/up-skilled) can perform more qualified work and, most importantly, make decisions based on the integrated data that machines will provide. Automation and smart devices will allow workers to make more informed decisions in short timespans to deal with complex situations. Teamwork will become increasingly important, not only between co-workers, but also between workers and assistant systems. Artificial intelligence tools mean that organisations must become more collaborative and team oriented. Decisions will rest with small and agile teams of operators led by high-skilled engineers and human resources will be concentrated mainly in the control rooms. Human intervention will become more important in the maintenance and supervision of machines and overall a reduced number of operators will be able to coordinate the various operations of the plant. These changes will affect the demand for **professional/technical and transversal skills**: green, digital, methodological, personal, and social (T-shaped Skills Approach, see Figure below). Beneath also called soft skills (social, individual/personal, methodological) we added digital and green skills, because of its general transversal importance for the current and future steel industry.

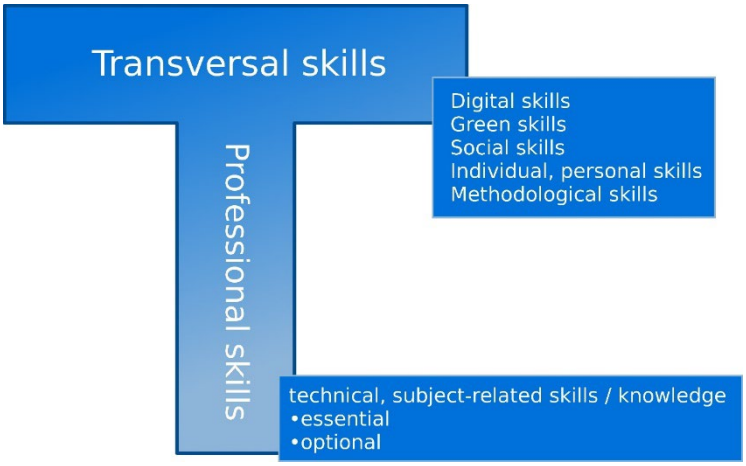


Figure 13: T-shaped skills approach

In summary, it was concluded that most early automation efforts focus on repetitive, predictable, low-value tasks in an effort to gain quick wins from labour reduction, cost savings, and productivity. The main observed consequence of the technological developments introduced by Industry 4.0, is that the need in (digital) **technology related skills** will grow rapidly as companies deploy automation, robotics, AI, advanced analytics, and other new technologies (see figure 8 in chapter 2).

This is underlined by the survey results of nearly 200 steel sector respondents conducted by the Steel Sector Careers Blueprint (White Research et al., 2020):

- Specialised technical skills and advanced technology skills remain high in the ranking
- Less importance is given to manual dexterity, while digital skills rise
- Increasing importance given to managerial skills (problem solving, critical thinking, decision making): technicians are more autonomous and independent; engineering positions are management role in small operational teams
- Data skills are still perceived as pertaining to specialised skillsets
- Greater attention is given to green skills.

Overall, the profiles that are sought by the industry are not expected to be replaced altogether, but they will be expected to perform more tasks with a much broader scope. Workers will need to have a wider knowledge and need to be able to do more because there are less and less specialised single jobs. Instead, the industry tends to need people who are able to work in multiple parts of the plant and on multiple operations throughout the career, i.e. increased flexibility and wider skills and knowledge base (White Research et al., 2020). The main observed consequence of the mentioned technological changes is that the demand for technology demanded new skills will grow rapidly as companies deploy automation, robotics, AI, advanced analytics, and other new technologies (Bughin et al., 2018; Deming, 2017; Stroud & Weinel, 2020; White Research et al., 2020). This surge will affect demand for basic digital skills as well as advanced technological skills such as programming (Bughin et al., 2018). Awareness of data security and protection will acquire importance as will trust in new technologies (White Research et al., 2020). Accompanying the adoption of advanced technologies into the workplace will be an increase in the need for workers with finely tuned social and emotional skills - skills that machines are a long way from mastering (Bughin et al., 2018; White Research et al., 2020). So, the demand for social and emotional skills will grow also rapidly. While automation and digitalization of work processes increase, workers will be required to take charge of less automatable and more complex tasks, whose completion necessitate solid literacy, numeracy, problem-solving, and ICT skills together with soft skills of autonomy, coordination and collaboration (Grundke et al., 2017; Karacay, 2018). Flexibility and transferability will become key, as nearly all steel shop workers will move away from monotonous and repetitive jobs and incorporate more varied tasks (White Research et al., 2020).

Work activities that require only basic cognitive skills will particularly decline as automation advances. The decline will be more important, as machines increasingly take over straightforward data input tasks and cause a drop in the need for basic data processing. Demand for cognitive skills will generally shift from basic to higher ones (Bughin et al., 2018). As a result, higher cognitive skills such as creativity, critical thinking, teamwork, problem-solving, decision-making will increase in importance through 2030, together with an aptitude for continuous improvement and lifelong learning (White Research et al., 2020, p. 172).

There will be higher demand placed on all members of the workforce in terms of managing complexity, complex information processing and higher levels of abstraction for obtaining simplified representation of the bigger wholes (Karacay, 2018). Skills like critical thinking, problem-solving and decision-making are perceived as crucial, which reflects the new roles that steelworkers will take on in the flat organisational structure of collaborative and team-oriented industrial environments. Abilities such as critical thinking and independent problem solving were deemed important in several reviewed technical positions such as steel fabricators, welders, production operators and control technicians (White Research et al., 2020). Moreover, there will be a need to coordinate between virtual and real machines as well as between manual and robotic systems, hence employees will be expected to act more on their own initiative, have excellent communication skills and be able to organize their own work (Karacay, 2018). The importance of managerial skills increases significantly on a five-year forecast (White Research et al., 2020). Other types of higher cognitive skill - such as advanced literacy and writing (language proficiency), transversal (soft) skills and quantitative and statistical skills - will not see a similar increase in demand, the need for them could remain stable or even decline to 2030 (White Research et al., 2020).

The mix of physical and manual skills required in occupations will change depending on the extent to which work activities can be automated. General equipment operation (skills used by

manufacturing workers) and inspecting and monitoring skills will decline faster than other physical and manual skills. So, the demand for physical and manual skills, which include general equipment operation, will also drop, but it seems that still will remain the largest category of workforce skills in 2030 in many places (Bughin et al., 2018).

As a consequence of the increased focus on sustainable steelmaking, environmental awareness, green skills are projected to become highly important among European companies over the next five years. This can be explained by the efforts that the industry is making to meet the EU's 2050 environmental targets. It appears to be more common for companies to expect shop floor workers to have competences in resource efficiency, material reutilisation and recycling. Green skills are considered key to maintain the competitive edge of the European manufacturing industry (Evans & Stroud, 2016; White Research et al., 2020).

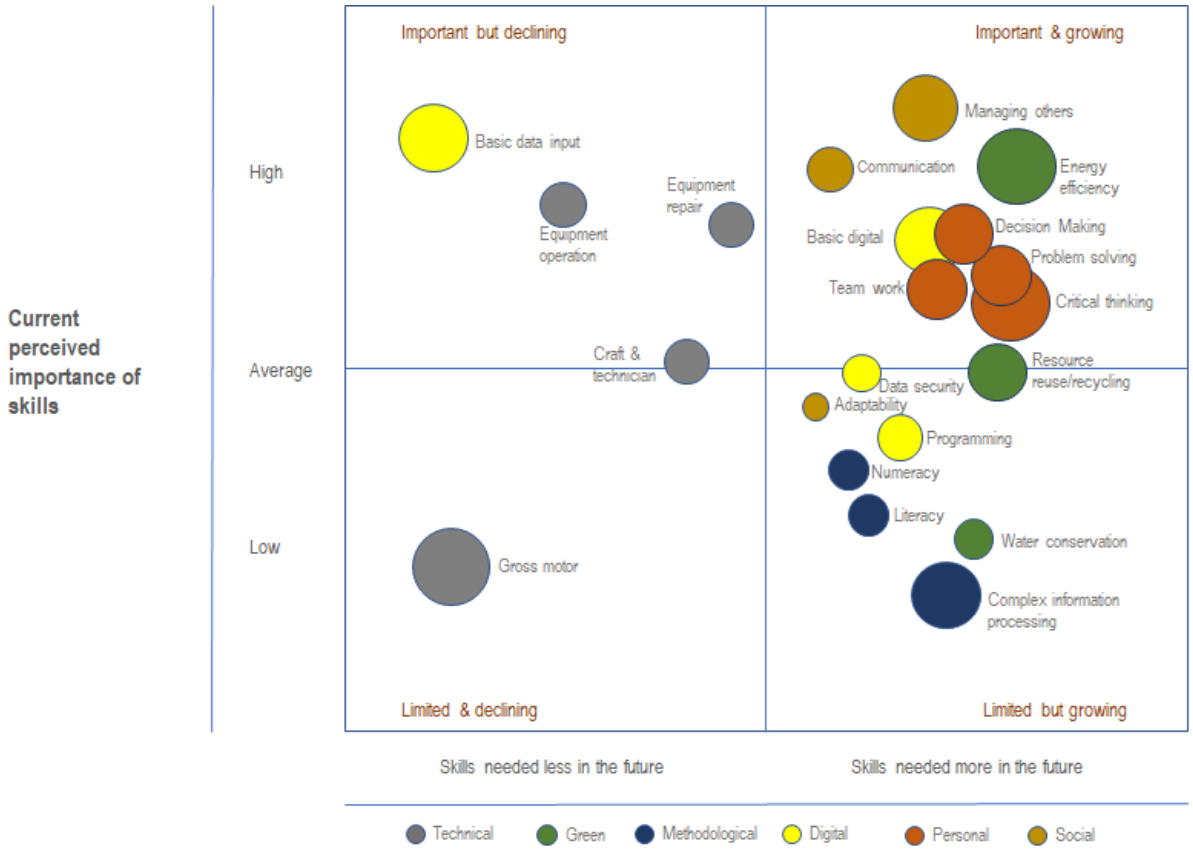


Figure 14: Current and future importance of skills (Bayón, 2020)

As a conclusion and based on the findings presented in "Steel Sector Careers Final Conference 28/04/2020 - Strategic investments and skills" (see Figure 13), the skills forecasts for 2030 could be summarised in this way:

- Top technical/professional skills (important, but with declining relevance): Equipment operation; Equipment repair; Craft and technician
- Top digital skills (limited perceived importance, but growing): Basic digital; Programming; Data security
- Top green skills (already relevant, with growing importance): Energy efficiency; Resource reuse/recycling; Water conservation
- Top personal skills (already relevant, with growing importance): Critical thinking; Problem solving; Decision making

- Top social skills (already relevant, with growing importance): Managing others; Communication; Adaptability
- Top methodological skills (limited perceived importance, but growing): Complex information process; Literacy; Advanced numeracy

Against this backdrop, a first classification and definition of relevant future skills was made leading the following overview (table 1, see detailed description in the Annex).

Level 1	**Technical skills**	**Transversal skills**				
Level 2	Physical & Manual	Digital	Green	Social	Individual / personal	Methodological
Level 3	General equipment operation General equipment repair and mechanical skills Craft and technician skills Gross motor skills and strength Inspecting and monitoring skills	Basic digital skills Advanced data analysis and mathematical skills Cybersecurity Use of complex digital communication tools Advanced IT skills & Programming	Environmental awareness Energy efficiency Water reduction Waste reduction and management Resource reuse/ recycling	Advanced communication and negotiation skills Interpersonal skills and empathy Leadership and managing others Entrepreneurship and initiative taking Adaptability and continuous learning Teaching and training others	Critical thinking & decision making Personal experience Adapt to change Work autonomously Active listening	Basic numeracy and communication Basic data input and processing Advanced literacy Quantitative and statistical skills Complex information processing and interpretation Process analysis Creativity Complex problem solving

Table 1: ESSA skills classifications and definitions (overview)

Based on the results of the technological and economic development and foresight (in chapter 2) different applications of Industry 4.0 are expected to affect more or less (and with uneven progress) almost all the job profiles in production and maintenance of the steel industry. No specific game changer could be identified leading to a high number of disruptive new digital jobs and emerging occupations. The main skills adjustment is on **digitisation of existing occupations and job profiles** by upgrading of existing skills or adding new skills leading to an incremental change of former job descriptions, roles and functions. Besides this there will be moderate upskilling, changing a lot of or almost all existing job profiles and occupations (digitalisation of unchanged occupations). Changes leading to new jobs and emerging occupations are not yet discernible.

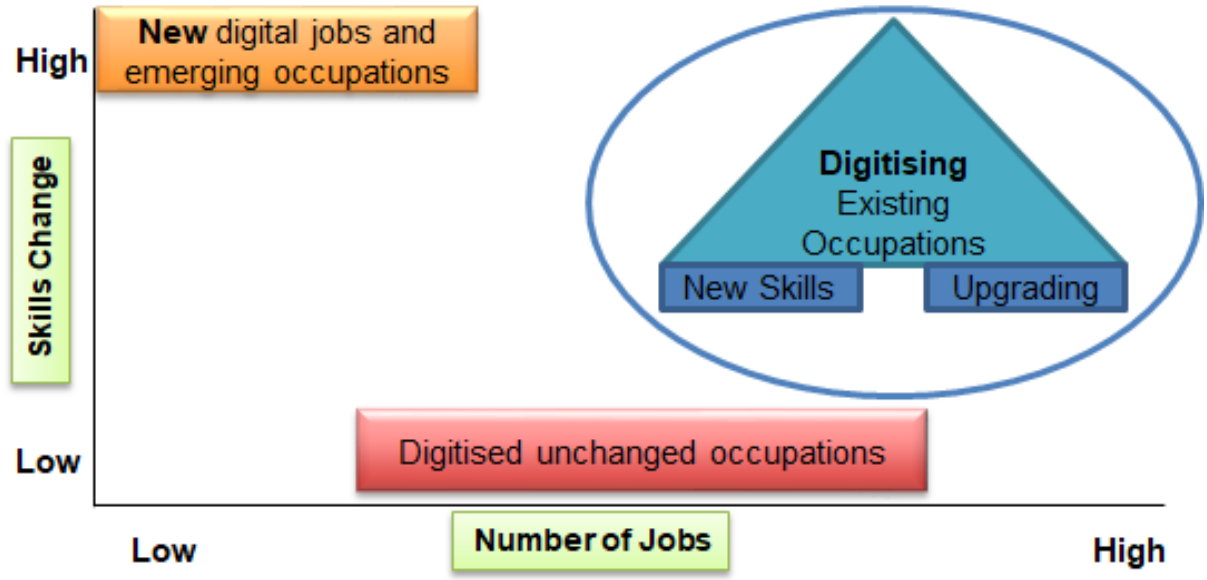


Figure 15: Number and skills degree of affected jobs (based on Schmid, CEDEFOP, World Congress on TVET, 13-16 May 2012)

Although ESSA is focusing on *incremental* technological changes in production we will be mindful of emerging *disruptive* technological changes (mainly based on automation and concerning the unfolded potential of digitalisation in maintenance) and related new digital jobs and emerging occupations in the steel industry, but the main company strategy nowadays is to buy-in missing digital know-how externally and to upskill the existing workforce. Whilst this buy-in strategy might meet emerging needs in the short-term, it might be proven costly in the long-term. So besides recruiting problems this increases the necessity to develop missing skills within the directly employed workforce also from a cost-benefit perspective.

3.3.2 Database of Job Profiles

Based on these demands the current professional steel industry profiles were checked to create, analyse and standardize the job profiles of the steel sector, leading to a **European Steel Sector Profiles Family Tree**. Professional role profiles were elaborated in a family tree basis for all the production and maintenance functions in steel companies. The family tree is a valid view which can be used to facilitate navigation and demonstrate relationships between job profiles. It also gives a clear idea about the organizational structure of a company. Thus, utilizing the family tree, the profiles may be used for reference or alternatively as a base to develop further profile levels. The final version of the family tree aimed to be used as reference for the whole steel sector.

The First European Steel Profile Family Tree was generated by Sidenor, shared with ESSA partners and completed with the contribution of other industrial partners. The Family Tree reflects the whole map of profiles covering the European Steel Industry. In the end, 26 main families (level 1) and more than 200 professional role profiles (level 2) belonging to each family were generated in order to reflect the European Steel Sector Profile Family Tree. Figure 15 is listing the (level 1) families and Figure 16 is showing an example of the functional role profiles within the Melting Shop family (level 2). The complete overview of the Family Trees and related Job Profiles are listed in the annex.

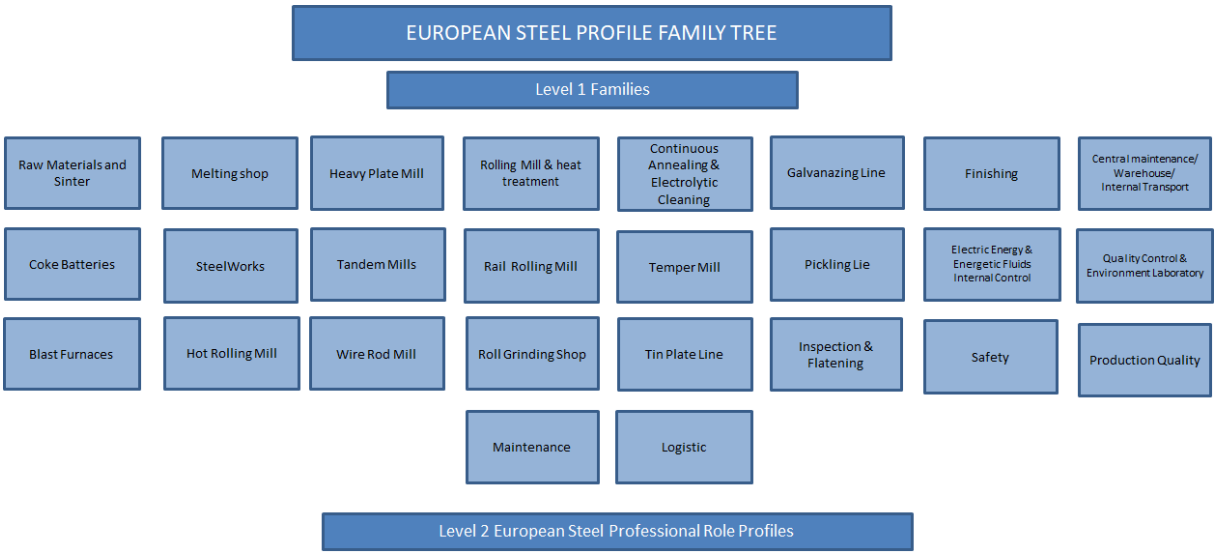


Figure 16: European steel sector profiles family tree: 26 families (level 1) at the top of the European steel sector

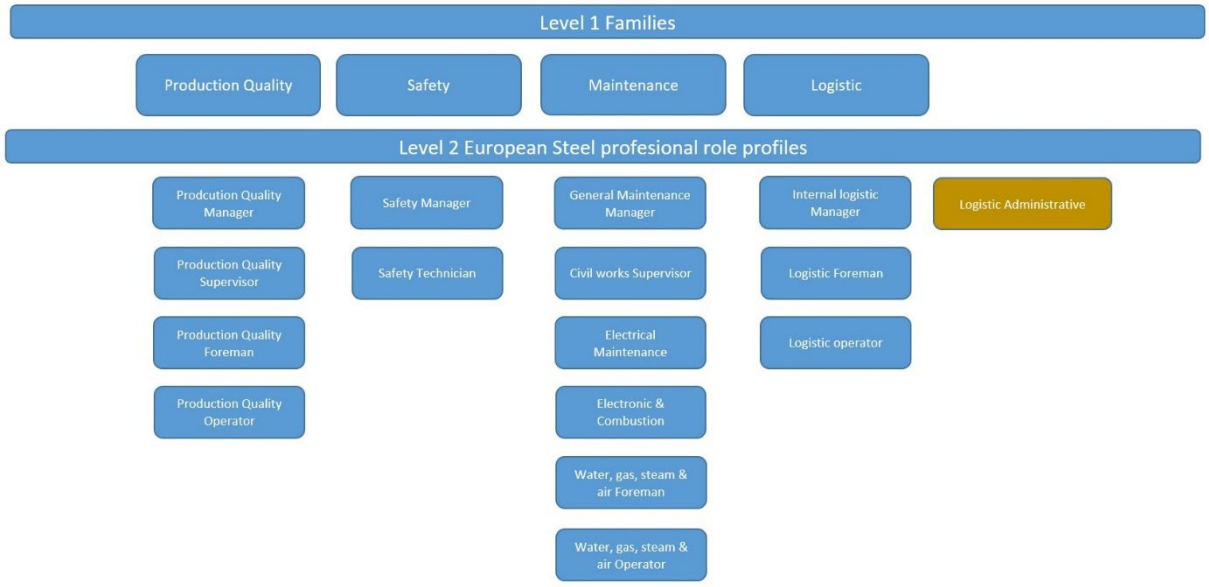


Figure 17: Job profiles (level 2) example melting shop family (blue: production, orange: administration)

The European Steel Sector Professional Role Profiles are constructed consistently to provide a common template, since a standard template makes it easier for users to compare different profiles and provide a fast start for developing new or adjusted profiles or contributing to designing new job descriptions.

The description template was designed to respond to the questions included in the following table, 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 oft 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?	**Professional/Technical & Transversal Skills:** Each defined by a proficiency level, provide the overview of the skills, knowledge and attitudes required of the role.

Table 2: European steel sector professional role profiles template description

The European Steel Sector Professional Role Profiles offer a template that is of generic value and can in principle be applied to any other sector. Sharing the same format beyond sectors will contribute to increased transparency across organisations, countries and sectors. It also supports the creation of 'dual thinker' profiles combining Steel Sector specific roles with business and specific knowledge from other fields.

Against this backdrop and based on the skills categories, levels and definitions above a **job profile skills assessment template / professional role profile (description) template** was developed to define specific job profiles, identify their skills demands, evaluate and assess their current and future skills levels. The detailed skills definitions could be found in the annex (Skills Classifications and Definitions).

PROFILE TITLE	PROFILE NAME			
Summary Statement				
Mission				
TASKS	Current		Future	
Main task/s	ESCO description (if applicable)		(here it should be listed, which tasks are changing/modified in which way, and if new tasks appear)	
SKILLS		Current Level (0 to 4)	Future Level (0 to 4)	Description of changes
Technical, subject related skills / knowledge				
Physical-manual skills	General equipment operation			
	General equipment repair and mechanical skills			
	Craft and technician skills			
	Gross motor skills and strength			
	Inspecting and monitoring skills			
SKILLS		Current Level (0 to 4)	Future Level (0 to 4)	Description of changes
Transversal skills				
Digital skills	Basic digital skills			
	Advanced data analysis and mathematical skills			
	Cybersecurity			
	Use of complex digital communication tools			
	Advanced IT skills & Programming			
Green skills	Environmental awareness			
	Energy efficiency			
	Water conversation			
	Waste reduction and waste management			
	Resource reuse/recycling			
Social skills	Advanced communication and negotiation skills			
	Interpersonal skills and empathy			
	Leadership and managing others			
	Entrepreneurship and initiative taking			
	Adaptability and continuous learning			
	Teaching and training others			
Individual, personal skills	Critical thinking & decision making			
	Personal experience			
	Adapt to change			
	Work autonomously			
	Active listening			
Methodological skills	Basic numeracy and communication			
	Basic data input and processing			
	Advanced literacy			
	Quantitative and statistical skills			
	Complex information processing and interpretation			
	Process analysis			
	Creativity			
	Complex problem solving			

Table 3: Job profile skills assessment template.

Assessment of the current and future skills for each job profile is done by five skill proficiency levels from an industrial perspective. Being in practice in several big steel companies these levels were taken and improved on the background of the skills classification:

- **0 = Novice:** Does not have knowledge and skills specific to the job role
- **1 = Basic Actor:** basic level of skills and knowledge, semi-skilled level, rudimentary knowledge and some basic skills.
  Can't perform the activities independently. Does not possess the proficiency level to perform the job role 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, with direct supervision and assistance, in unexpected or infrequent situations
- **3 = Expert:** advanced knowledge and ability, guides other professionals, applies skills in new or complex situations, 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

The job function and profile classification chosen for an incremental upskilling of all the job profiles in the production (and related maintenance) area of steel companies is leading to a huge range of different job titles across the Steel Sector professions. Jobs are unique but a similar title can be used to describe widely different jobs, conversely similar jobs can be described by different titles. This can be confusing and prevent clear understanding between different actors and stakeholders of the jobs described and its associated tasks and responsibilities. Therefore, standardisation, reduction and merger of similar profiles across the whole job family tree is required. For the demanded skills adjustments we need to reduce and cluster the number of job profiles in the family tree through finding common ground between as many of them as possible and then merging the ones with equivalence. A first step in this direction was taken through the alignment of steel sector job profiles with the relevant occupations in ESCO database. For ease of reference, an example relationship map between ESCO Occupation titles and Steel Professional Profiles (generated by ESSA) in both directions is provided in Table 3.

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 Steel Sector.

MELTING SHOP		
iscoGroup	Ocupation ESCO	STEELSECTOR ROLE PROFILES
1219	department manager	Blast Furnace Manager
2141	process engineer	Blast Furnaces Process technician
3119	process engineering technician	Blast Furnaces Process professional
1321	industrial production manager	Blast Furnaces Production Manager
3122	machine operator supervisor	Blast Furnaces foreman
3135	metal furnace operator	Blast Furnaces Operator
	machine operator	Blast Furnaces Joint operator
8343	mobile crane operator	Loads and unloads operator
	Refractories Coordinator	Blast Furnaces refractory lining coordinator
	Refractories Supervisor	Blast furnace refractory lining Supervisor
	Refractories Operator	Blast furnace refractory lining foreman
		Iron Pig coordinator
3122	machine operator supervisor	Iron Pig desulphurisation Supervisor
	machine operator	Iron Pig desulphurisation operator
	mobile device operator	hot-metal transfer car overturning operator
1219	department manager	Melting shop Manager
2141	process engineer	Melting shop process Manager
3119	process engineering technician	Melting shop process Supervisor
1321	industrial production manager	EAF production Manager
3122	machine operator supervisor	EAF foreman
3135	metal furnace operator	EAF operator
8343	mobile crane operator	EAF crane operator
	Refractories Supervisor	Refractories Supervisor
1219	department manager	SteelWorks Manager
1321	industrial production manager	Converter Production Manager
3122	machine operator supervisor	Converter Shift Manager
	machine operator	Converter Operator
3122	machine operator supervisor	Blowing supervisor
	machine operator	Transfer pig iron Operator
	machine operator	Torpedo tipping Operator
3122	machine operator supervisor	Oxigen converter gas recovery system Supervisor
	machine operator	Oxigen converter gas recovery system Operator
1321	industrial production manager	Secondary Metallurgy & Ladle Production Manager
3122	machine operator supervisor	Secondary Metallurgy Supervisor
	Secondary Metallurgy operator	Secondary Metallurgy operator
	Refractories Supervisor	Ladle & Refractory Supervisor
	Refractories Operator	Ladle Preparation Operator
1321	industrial production manager	Continuous casting Production Manager
3122	machine operator supervisor	Continuous casting Shift Manager
3122	machine operator supervisor	Continuous casting Supervisor
8121	casting machine operator	Continuous casting operator
7223	oxy fuel burning machine operator	Oxycutting Operator
		Slabyard and forwarding Manager
		Slab yard and forwarding Shift Manager
		Slabyard and forwarding Supervisor
		Slabyard Operator
	product engineering technician	Solid Steel Product Technician
1321	industrial production manager	Ladle furnace production Manager
3122	machine operator supervisor	Ladle furnace foreman
		Ladle furnace operator
8343	production plant crane operator	Ladle furnace crane operator
1321	industrial production manager	Continuous casting production Manager
		Continuous casting Foreman
8121	casting machine operator	Continuous casting Operator
		Continuous casting transfer Operator
7223	oxy fuel burning machine operator	Oxycutting Operator
8343	mobile crane operator	Crane Operator
		Billet evacuation Manager
		Billet evacuation Foreman
		Grinding Operator
		Shot blasting Operator
		Inspection Operator
		Macroetching Operator
7223	oxy fuel burning machine operator	Oxycutting Operator
8343	mobile crane operator	Crane Operator

Table 3: Relationship map between ESCO Occupation titles and STEEL SECTOR Professional Role Profiles, defined by ISCO group numbers.

The potential equivalence between the European Skills Competences Occupation Database (ESCO) occupations and the job profiles in the Steel Sector opens the door to the automatization of the description of the European Steel Sector Professional Role Profiles

taking the ESCO description of occupations as the basis for a full description of the Steel Sector Professional Role Profiles. Therefore, DEUSTO University developed an excel-based software for ESSA that will allow partly automating the description of the different steel-related job profiles by the ESCO description.

At this point, it is compulsory to give a clear definition of ESCO. ESCO is the European multilingual classification of Skills, Competences, Qualifications and Occupations. In other words, it is a dictionary that describes, identifies and classifies professional occupations, skills, and qualifications relevant for the labour market, education and training. It is directly linked to the International Standard Classification of Occupations (ISCO) which is a classification of occupation groups managed by the International Labor Organization (ILO), since the information and data in ESCO are based on an original work published by the ILO under the title “International Standard Classification of Occupations”, ISCO-08 (International Labor Office, 2012).

The objective of the database is to be able to introduce the current and future skills and the current and future levels that are not present in ESCO, interactively to the ESCO database. In this way, the work developed during the compilation of the profiles in the steel industry would feed the ESCO database, enriching it with new occupations and descriptions, and vice versa. Consequently, a common and automated database of professional profiles related with steel sector has been generated.

In addition, collaboration between ESSA and ESCO experts have been carried out in order to explore potential synergies of the ESSA project and ESCO and to unify the outcomes as much as possible. Given ESSA’s objectives on the skills front, ESCO aims connect to the work of ESSA and advance on it in collaborative way through updating the ESCO database according to ESSA findings (e.g., identifying missing occupations or skills in ESCO and updating outdated concepts). This, in turn, can help promoting the results of ESSA’s work and ensuring their longevity even after the project has ended, as the ESCO content is used by a variety of stakeholders for a variety of reasons. In addition, a close collaboration with ESCO has been carried out regarding the “Pilot project for linking learning outcomes of qualifications with ESCO skills”. The project aims at testing a semi-automated approach for linking learning outcomes of qualifications with ESCO skills using a combination of automation and human intervention. The qualifications relevant for the steel industry which were identified by ESSA WP4 were presented to ESCO to be linked with ESCO skills automatically.

3.4 ESSA Skills Assessment and Foresight Questionnaire

Complementary to the previous bibliographic study about the skills requirements, a survey has been carried out with the participation of steel companies in Europe to get an overview of skill needs in the European steel industry in the coming years. A multilingual survey is designed to identify the (1) current and future skills needs within nine occupational profiles, (2) the most relevant technological developments for the steel industry, as well as (3) further developments related to skills and jobs in companies of the European steel sector (detailed information could be found in Deliverable D3.2; Bayón et al., 2023).

After a detailed analysis for the most representative occupations of the steel sector, there were not only sectoral but also more general VET occupations across different industry sectors in the final list. For the first pilot test of the skills assessment, nine job profiles were selected on the background of matching company job profiles with existing ESCO occupations and representative coverage of all major ISCO groups, by importance for the steel production,

covering production and maintenance, most in-demand jobs and potential added value for other sectoral (industry) Blueprints. Additionally, the relative coverage of jobs/occupations differently affected by Industry 4.0 and digitalisation was considered. Finally, the following nine job profiles / occupations were selected, representing different production areas, organisational and skills levels:

1. **Metallurgical managers** coordinate and implement short and medium term metallurgical or steel-making production schedules, and coordinate the development, support and improvement of steel-making processes, and the reliability efforts of the maintenance and engineering departments. They also partner with ongoing remediation initiatives.
2. **Process engineers** apply engineering concepts in order to improve all kinds of production and manufacturing processes in terms of efficiency and productivity. They evaluate the variables and constraints present in given processes and present engineering solutions to optimise them.
3. **Maintenance and repair engineers** focus on the optimization of equipment, procedures, machineries and infrastructure. They ensure their maximum availability at minimum costs.
4. **Process engineering technicians/supervisors** work closely with engineers to evaluate the existing processes and configure manufacturing systems to reduce cost, improve sustainability and develop best practices within the production process.
5. **Production supervisors** coordinate, plan and direct manufacturing and production processes. They are responsible for reviewing production schedules or orders as well as dealing with staff in these production areas.
6. **Industrial electricians** install and maintain electricity cables and other electrical infrastructure in large industrial buildings. They perform inspections and repair defective parts of electrical systems to ensure efficiency.
7. **Metal processing plant operators** (including Continuous Casting Operator) monitor, operate, adjust and maintain single-function process machinery and equipment to process and convert mineral ores and refine, harden, roll and extrude metals.
8. **Metal working machine tool setters and operators** set and/or operate various machine tools, working to fine tolerances.
9. **Factory hands** assist machine operators and product assemblers. They clean the machines and the working areas. Factory hands make sure supplies and materials are replenished.

40 people participated in the survey, most of which used the English questionnaire (13), the Spanish questionnaire (11) and the Czech questionnaire (9). In average each of the participants assessed 3.6 job profiles, resulting in 144 job profile assessments. The participants were predominantly employed by large companies with over 1,000 employees (25/40) and mostly worked in the human resources / training department (24/40). This biased distribution can be attributed to the way of recruiting as well as the rather small number of participants.

Each respondent was asked to what extent their company has already been using the determined key technologies and whether they plan to introduce or expand them. The result show that there is a great deal of variation in the use of technologies. The participants were also asked what they consider as their most digitised area within their company. Here the production area (48 %), the administration (38%) as well as the quality control (33%) came out as the most digitised area.

Participants where then also asked to assess the currently required skill levels as well as the needed skill levels for the future (in 3 years) on a five level scale (0: Novice, 1: Awareness / Basic Actor, 2: Practitioner, 3: Expert, 4: Master).

One of the most basic findings is that the different job profiles require very different levels of skills in general. The job profiles Metallurgical manager as well as the supervisors (Production supervisor and Production engineer supervisor) and the engineers (process engineer, maintenance and repair engineer) apparently (and not really surprisingly) require a comparable high level of skills: Almost all required skill levels in the future and in the present are above the average of all job profiles taken together. Opposite to that are both the operator profiles (Metal processing plant operator, Metal working tool setters and operators), the Industrial electrician and (particularly) the Factory Hand profile which require a lower overall level of skills. Much speaks in favour to call the latter group the technical oriented job profiles and the first group the non-technical oriented job profiles. This seems reasonable when looking at the relevance of technical skills in these job profiles in the future: Whereas within the technical-oriented job profiles the technical skills are in 3 of 4 cases the most important ones, i.e. no other skills have a higher relevance within these profiles, these skills play subordinated roles within the non-technical oriented job profiles where they are the 4th, 5th or 6th most important skills. Often, they are also the only skills which are only needed on a below-average level within these job profiles.

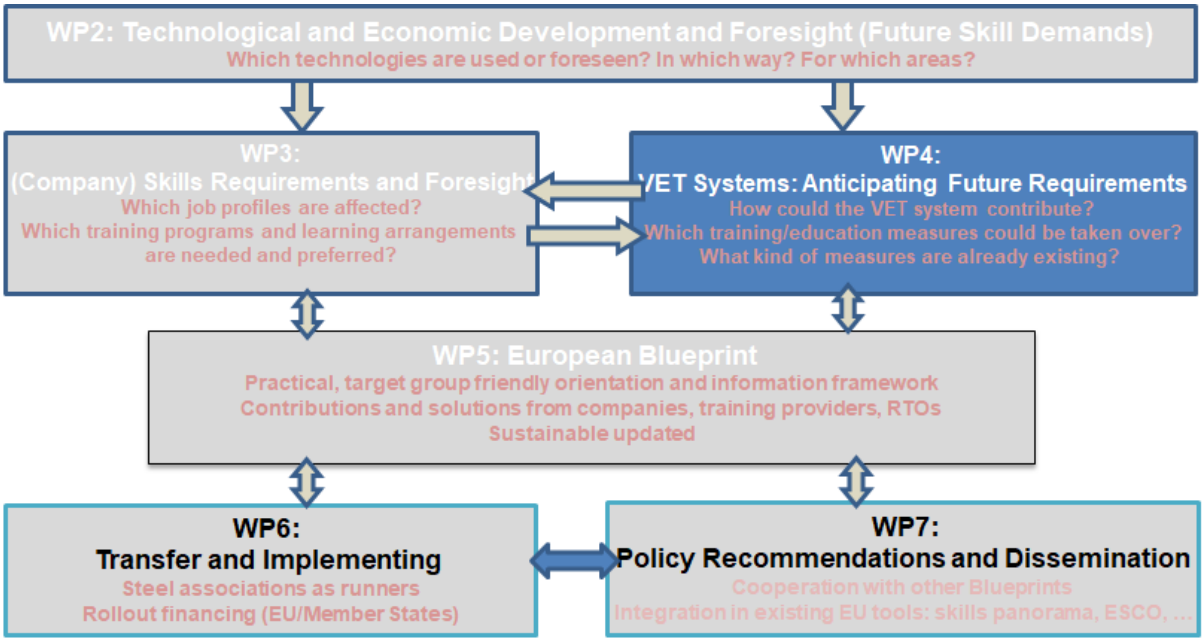
There are few further more characteristic differences between the job profiles: Within the non-technical-oriented jobs, the social and methodological skills seem to play a more important role. Other skills as personal skills are more transversal and are required within all job profiles to a more similar extent. Compared to these skill categories, Digital and green skills mostly play a more or less subordinated to moderate role *within* the job profiles (now and in the future).

With regards to future developments the degree of growth is quite diverse for the different skill categories. It is obvious that technical skills will not be largely growing in the future: The steel companies already seem to have a proper level of skills here which will only gradually grow within the next years. In turn, Digital and Green skills, which are not required at a high level overall, will nevertheless receive a considerable increase of importance in the future. In all job profiles, green skills have the greatest or second greatest increase in importance of all skill categories. For digital skills, this is the case for 6 of 9 profiles.

In general, it is also interesting to see that the growth in skill needs does not affect all job profiles to the same extent and seem to be concentrated on a part of the more high-skilled job profiles, whereas a part of the lower-skilled (technical) job profiles like the Factory Hand and the Industrial Electrician profile will only be developed to low degrees. This seem to entail the danger of a growing gap between certain job profiles and also impeding the upskilling of certain kind of occupations. However, this could be a potential contradiction to political goals related to employability, inclusion and job stability.

4 VET Systems Requirements (WP4)

Based on the technological and economic scenarios (WP2) and informed by the steel industry skills demands (WP3) the VET system analysis (WP4) explored the possible and necessary contributions of the different IVET and CVET systems in the member states, focusing specifically on five case study countries (Germany, Italy, Poland, Spain, United Kingdom) but commenting more widely with regard to regional patterns of skill formation.



4.1 Objectives

Based on the technological and economic developments, and in relation to the industry skills requirements that subsequently emerge, the focus turned to how Vocational Education and Training (VET) systems and frameworks at the national and EU level meet (and deliver) steel industry skills needs, and in this way how they are able to support the sector's technological transition to Industry 4.0. We also aimed to identify where and to what extent companies attempt to close skills gaps through internal training provision. Hence, this chapter addresses questions related to technological development and emerging skills needs within the companies, but focuses specifically on the ways in which company training (formal and informal) and national VET systems are able to meet these needs and respond to new demands.

The anticipation of skills demands and their integration into VET provision are two of the most challenging and ambitious objectives of ESSA. The identification of skills needs enables appropriate training curricula to be built and strategies for the implementation of new training content across the sector to be developed. However, this requires a clear understanding of how different national VET systems - as systems of skill formation - work, and to what extent they are designed to deliver skills relevant to the sector in timely ways. To address this objective, it was important to acquire a clear understanding of VET governance in different systems and identify the key players and nodes within the system. The findings on these matters inform the Blueprint recommendations.

As indicated, the research conducted in ESSA focused on identifying and analysing the regulatory framework, functioning and programmes of five national VET systems (Germany,

Italy, Poland, Spain, and the United Kingdom), and on setting out the patterns of relations between national VET provision and steel companies in these case study countries. A further strand examines how EU-level frameworks (e.g. EQAVET, ECTS, ECVET[1], EQF, ESCO, etc.) fit with the sector. This is critical for understanding, for example, quality and mobility aspects of steelworkers' training and qualifications. Recognising the state of implementation of such frameworks in the five case study countries helped us to understand how they can be leveraged for meeting the industry demands and to better support worker mobility. To support the European sector, it is important to provide accessible windows of opportunities for workers' mobility and encourage the exchange of information. This, in turn, requires that as far as possible national VET systems are harmonized and integrated in an overarching framework which guarantees the transparency of national vocational programmes and qualifications. Of course, the fundamental differences that exist between skill formation systems across Europe means that harmonizing systems in a more general way is not feasible (Clarke & Winch, 2006), but the aim here is to identify commonalities and differences within systems as far as they inform sector provision and contribute in this way to transparency and mobility.

Finally, we have produced an occupation-skills matrix to correlate national VET provision with nine relevant steel industry occupational profiles (listed in the previous section). The aim of the matrix is to help to identify how different VET programmes address the changing composition of skills and knowledge for each profile, and where the skills gaps reside. A key issue, discussed later, is the extent to which programmes inform directly the occupational profiles identified.

This VET system analysis comprised the following tasks:

- Identification of National (Sector) VET Qualification and Skills (Regulatory) Frameworks for Steel
- Analysis of cross-European VET frameworks and standards for sector skills recognition
- Development of European sector skills VET matrix framework
- Identification of mechanisms for application of sector skills VET frameworks.

4.2 Methodology

The research conducted was based on a multi-stage mixed method approach, combining an exploratory survey, desk research, and qualitative interviews and questionnaires. In a first stage, the exploratory survey was aimed at understanding the experience of partners with education and training as a basis for subsequent interviews. In a second stage, desk research and document analysis were useful to set up a picture of the field under investigation for each case study country and at the EU level. Finally, qualitative interviews and questionnaires have added additional dimensions, and helped to approach specific questions that had emerged from the desk research from a different angle, or in greater depth. A methodology was also developed for data to inform the skills matrix, which combined survey and workshop approaches.

The five case study countries (DE, IT, PL, ES, UK) were identified at the project outset because of the specificity of their VET systems, as well as their place as key sites of production within the European steel industry.

Exploratory review and partners survey

[1] ECVET is now defunct as a programme, but the principles are still applied.

An exploratory review of VET-related literature was carried out to identify the main scientific references and to establish a conceptual framework for carrying out the research. In parallel, an online survey was launched to start mapping partners' expertise in the field of vocational education and training and industry skills needs.

Desk research and document analysis

Once the main scientific references had been identified and a conceptual framework had been outlined, an extensive literature review and document analysis was carried out. This focused on the following areas and topics:

1. steel industry scenario at the national and European level
2. skills formation systems
3. skills gaps and forecasting programmes at the national and European level
4. national VET systems' regulatory frameworks, functioning and programmes.

The collected documents, which included scientific papers, institutional reports and national regulation, provided secondary data, insights and inputs to as a basis for the further stages of the research. The desk research had also been the foundation for the first iteration of the Deliverables (D4.1 (Antonazzo et al., 2020b), D4.2 (Antonazzo et al., 2020a), D4,3 (Weinel et al., 2020). D.4.4 (ESSA, 2020), D4.5 (Antonazzo et al., 2020c)) produced concerning VET system analysis and support.

Qualitative interviews and questionnaires

Further to the results of the exploratory survey and desk research, and thanks to the support of ESSA partners, qualitative interviews addressed to experts in the field of steel production and VET have been conducted remotely, given that it was not possible to travel because of COVID-19 restrictions. The planned fieldwork in the five case study countries had to be replaced by remote interviews conducted via online platforms such as Skype, Zoom, Microsoft Teams. Planned group interviews and workshops with workers and apprentices, as well as with experts and stakeholders, could not take place due to restrictions in mobility and social encounters in all the five case study countries. It was planned that should regulations allow, in-person workshops/interviews would be considered to integrate and validate the acquired data remotely but the opportunity i.e. opening up of restrictions came too late in the project. It was necessary to move forward with what data was collected to progress WP4 and the ESSA project as a whole.

In order to provide more options for participating in the research, in the understanding that more flexibility was needed to overcome the difficulties brought in by the pandemic, Cardiff University also developed an online questionnaire for steel company representatives as a substitute for interviews where these have been difficult to arrange (e.g. because of language issues or scheduling problems). The questionnaire had been tailored towards three categories of respondents: HR officers, Production Managers and Training Centre Managers. The online questionnaire was used to conduct research in the steel companies in Poland and to a lesser extent in Spain.

More generally, the interviews and questionnaires have been addressed to representatives of steel companies, employers' associations, workers' unions and VET experts. The qualitative data generated in this phase was used to integrate, refine and consolidate the insights emerged from the initial desk research, and informed the second and final iterations of the related WP4 Deliverables.

The table below summarises the reach of the empirical research activities (60 interviews/questionnaires). The numbers aggregate both interview and questionnaire responses. No further interviews were conducted beyond the end of 2020, but the data-set was viewed to be sufficiently comprehensive to meet aims of WP4. The distribution of the interviews/responses points to a strong industry component, in accordance with ESSA's industry-driven approach. This has helped to identify national and cross-national trends in terms of emerging skills needs and national VET programmes that feed into the industry.

	DE	ES	IT	PL	UK	EU	TOTAL
Unions	1	1	2	2	2	1	8
VET	5	2	4	1	4	1	17
Steel industry	11	6	4	10	2	1	35
TOTAL	17	9	10	13	8	3	**60**

Table 4: Conducted interviews and questionnaire in the case study countries and at EU Level

4.3 Results

WP4 comprises five deliverables. The final version of Deliverables D4.1 and D4.2 were submitted December 2022 (Antonazzo, Weinel, & Stroud, 2022; Antonazzo, Weinel, Stroud, et al., 2022). The project was awarded an extra six months till June 2023 to increase reach of the Blueprint roll-out activity and establish the European Community of Practice, as well as acquire a stronger evidence base for the WP4 Skills Matrix (i.e. Deliverables D4.3. and D.4.4) and these are now completed (ESSA, 2023b; Weinel et al., 2023). Deliverable D4.5 provides an overview summary of WP4 activity (Antonazzo, Weinel, et al., 2023).

Overall, the research followed a two-step approach, moving from outlining the regulatory framework and functioning of the five case study VET systems and the EU relevant frameworks, to identifying specific programmes and qualifications in each of the chosen countries (to be analysed more in depth in relation to the identified nine steel industry professional profiles).

The essential features (see Table 5) of the case study country VET systems and the identification of the vocational and technical programmes relevant to the steel industry in the five case study countries (Table 6) are summarised below.

DE	ES	IT	PL	UK
Technology neutral provision	Established procedures for the recognition of prior learning	Recently established national catalogue of occupations and qualifications	Mechanisms for the recognition of prior learning in place	Plurality of providers
Solid dual system	Double VET route (education & employment)	National and regional VET provision (alternative paths)	System undergoing structural reforms - transitioning until 2022	Modular VET provision
Responsibility shared between competent Ministry and Länder	Responsibility shared between competent Ministries and Regions	Responsibility shared between competent Ministries and Regions	Responsibility shared between Ministries, Regional authorities and local authorities (*Powiat*)	Complex and fragmented governance: responsibility shared between central Government and Devolved Administrations, and national VET regulators
Referenced to EQF	Not referenced to EQF	Referenced to EQF	Referenced to EQF	Referenced to EQF
Occupation-based approach	Recently introduced dual VET arrangements	Recently introduced dual VET arrangements	Recently introduced dual VET arrangements	Reforms or reviews of parts of the systems currently ongoing in the 4 countries (England, Northern Ireland, Scotland, Wales)
National standards	Modular and based on Learning Outcomes	Post-secondary VET more connected to industry	Based on learning outcomes	VET mostly taken at EQF levels 3-4
Holistic approach to occupational competencies	National catalogue of occupational standards	3 types of apprenticeship programmes	National catalogue of occupations and associated qualifications	Narrower understanding of occupational standards (compared to DE)
Consensus-based regulation	Mobility between programmes	Mobility between programmes	Distinction between programme and qualification (certificate/diploma)	Distinguishing role of awarding bodies
Co-determination of qualifications' contents	Mainly school-based with practical focus	Mainly school-based at secondary level	Mainly school-based VET	Raising demand in apprenticeships

Table 5: Identification of essential features of the five case study countries' VET systems

Table 6 highlights some convergence in VET practices (particularly a shift to dual system of organisation in most countries), but national differences remain significant and relevant. From the point of view of ESSA, national differences could point both to effective practices and shortcomings, which could affect the provision of skills to the steel industry.

	DE	ES	IT	PL	UK
Secondary level (EQF2-4)	Vocational schools (*Berufsfachschule*) Apprenticeship (*Ausbildungsberufe*)	Basic VET (FP *basica*) Intermediate VET (FP *grado medio*) Apprenticeship	Technical schools (*istituto tecnico*) Vocational schools (*istituto professionale*) IeFP (*istruzione e formazione professionale*) Apprenticeship	Sectoral programmes (*szkoły branżowe I stopni*) Technical programmes (*technika*)	College-based VET (BTEC, NVQ, SVQ) T Levels Apprenticeships
Post-secondary level (EQF4-6)	Technical schools (*Fachschule*) Advanced vocational training (*Meister*) Apprenticeship (*Fortbildungsberufe*)	Higher VET (FP *grado superior*) Apprenticeship	Higher technical education and training (*istruzione e formazione tecnica superiore*) Higher technical school (*istituto tecnico superiore*) Apprenticeship	Vocational schools (*szkoły policealne*)	College-based higher VET (BTEC, NVQ, SVQ, HNC, HND) Higher apprenticeships

Table 6: Vocational and technical programmes (relevant to the steel industry in the five case study countries)

It is clear, for example, as indicated above, that differences between systems reduces the likelihood that harmonization is possible in relation to the addressing of skill needs. Indeed, different systems are geared to incorporate skill needs in different ways - particularly differences between the UK and elsewhere in Europe, but differences between our other case study countries are notable too. Such differences have long been noted within the academic literature (e.g. Busemeyer & Vossiek, 2016) and result in quite different patterns of skill formation and the way skills needs might be addressed. For example, Germany's greater involvement of social partners and its more regulated and holistic approach focused on occupations lends itself to broader based and incremental (and specific) skills development, which contrasts quite heavily with the UK's more fragmented system that is focused more on modular delivery and a seemingly *ad-hoc* approach to skills needs. We noted this from our interview data, which evidenced that in the UK company needs are addressed in more direct and narrower task orientated ways with VET providers as and when needs become apparent. In Germany, however, the evidence suggests a broader and long-term consideration of the occupation and its development needs by a range of industry stakeholders. Other research on the steel industry over the last decade or so by some of those leading this WP confirm this particular pattern of skill formation (e.g. Evans & Stroud, 2016; Stroud & Fairbrother, 2006, 2008) and the importance of country context for the understanding of both skills needs and the insertion of new technologies (Stroud et al., 2020; Stroud & Weinel, 2020) Antonazzo, Stroud, and Weinel (2023) draw on the ESSA data to discuss these relationships).

Thus, as companies are embedded in national contexts, any new training arrangement and upskilling/reskilling proposal delivered by ESSA needs to consider the specificity of the national VET system, as well as patterns of technological innovation (and 'greening') (see Antonazzo et al. (2021) on the green skills aspect). A comparative overview allows for a more tailored set of recommendations for the different steel regions and facilitate foresight on how these can play out in the different contexts. In some regards this plays out at more local levels too, with differences in steel making technologies (e.g. EAF, BOF) requiring different skill and training needs within specific localities and this should be accounted for within ESSA (esp. for the rollout to the steel regions).

We further note the paramount importance of transversal skills within the context of Industry 4.0, with our evidence suggesting VET systems already equipped with programmes and arrangements that aim for a more holistic workforce development (e.g. longer programmes, balanced contents, co-determination and co-delivery, dual arrangements) appear to be better prepared to respond to current industry demands and economic challenges in this respect – we view the importance of transversal or 'soft skills' to facilitate Industry 4.0 developments to be a critical finding and it is documented in a journal article currently under-review (Antonazzo et al., forthcoming).

A last consideration is the extent to which national systems of VET shape formal and informal patterns of training provision at the company level. On this, we speak with more certainty about arrangements for Initial VET or IVET (as national arrangements tend to reflect what is delivered for this stage at company level), but Continuing VET or CVET arrangements tend to differ quite widely by company and there is some divergence within countries - for example, our evidence notes in Germany the different extent to which digital skills development within companies was embedded within working arrangements. Typically, we might also note that arrangements for CVET vary across the occupational hierarchy, with more qualified workers receiving more training opportunities (e.g. Ashton, 2004; Stroud & Fairbrother, 2006). However, ESSA is noting the necessity for all grades of worker to be upskilled in line with sector developments and receive the required training. Industry 4.0 will lead to some flux in occupations, jobs and tasks, but the emerging trend is for upskilling and some new occupations (e.g. Hydrogen Engineers) rather than job displacement

Overall, it is important to understand what is currently delivered within the programmes identified if the meeting of skill needs is to be improved. This relates to both Table 5 and Table 6. Table 5 provides an overview of national systems and how they operate as skill formation systems and Table 6 identifies the relevant VET programmes for steelworkers (the nine important professional profiles) common across national systems (as far as harmonization according to ESCO will allow when configuring profiles against programmes), which works towards building an occupation/skill-needs/VET system matrix for the ESSA Blueprint and, in this way, improvements for delivering on identified skill needs.

Beyond the overview of the different systems, the main results concerning the VET systems framework (collected in Deliverables 4.1 to 4.5 (Antonazzo, Weinel, & Stroud, 2022; Antonazzo, Weinel, Stroud, et al., 2022; ESSA, 2023b; Weinel et al., 2023)) can be summarised as follows:

Identification of common patterns in national VET systems

Our comparative research shows, in line with research conducted by Cedefop, that the five case study countries have recently undergone (or are currently undergoing) VET reforms

devised by the responsible authorities to cope with the current industrial and labour market challenges. Most commonly, reforms aim to:

- activate dual training arrangements
- relaunch and strengthen apprenticeship schemes
- extend VET at the post-secondary level (EQF 4-6)
- increase flexibility (e.g., allow changing between VET programmes and moving to higher VET and higher education; establish modularity and learning outcomes approach; establish procedures for the recognition of prior learning)
- better integrate social partners in the design of qualifications and in the training provision
- establish national quality assurance systems in line with the EU requirements
- increase transparency and define national catalogues of qualifications
- plan systematic reviews of qualifications
- bridge cross-sectoral and occupation-specific skills and incorporate soft skills (T-shape approach).

Looking at this listing it becomes evident that the reforms are pretty much in line with the ESSA approach and results (as reported by the industry skills requirements above and the Blueprint outlines in the following chapter).

Companies' view on new skills needs

Researching VET systems and skills gaps requires including the views of representatives of steel companies. This permitted a better understanding of the interrelation between companies and VET systems, and the extent to which companies' demands and expectations are met. This part of research merges with the research conducted on companies' skills requirements. The data collected support the approach defined by the industry skills requirements (WP3) with a strong focus on transversal skills, as noted above.

Most of the interviewed companies' representatives argue for the need of a more holistic approach to training, requiring workers to possess wider and more adaptable skillsets. From this stems the necessity of adopting a **T-shaped approach** to skills provision (as described in chapter 3) above.

Social skills, and in particular **communication** skills, are deemed to become of great importance, as for the need to connect with different roles in a dynamic working environment and to mutually explain/understand specific and complex needs. The importance of cross-boundary communication within a modern steel firm was confirmed by different interviewees across the case study countries. A whole range of skills such as communication, assertiveness, teamwork, is becoming more greatly valued. Enhancing **transversal skills**, in general, emerged as a strong target for several companies. Such skills have long been identified as important to the industry (see, for example, Stroud & Fairbrother, 2006), but have greatly increased in importance with the emergence of Industry 4.0 technologies (Antonazzo et al., forthcoming).

Digital skills will be of unquestionable importance for metal and machinery workers (as confirmed also by Cedefop's Skill Panorama), and need to be constantly updated, in line with technological advancements. The strategic importance of digital skills for the industry is confirmed by the interviews, but it was underlined that there is a need to build them on robust **foundational** and **methodological skills**, such as literacy, numeracy, comprehension and logic, which play a crucial role in fostering continuous learning. Indeed, whilst digital skills are

of undoubted importance, the extent to which they are identified as primary skill needs varies from company to company.

The need for enhanced **transversal skills** goes along with the need for stronger and more advanced **technical or professional skills**, especially where these incorporate IT competencies (particularly data-analysis skills). Furthermore, technical, digital and soft skills need to be complemented by practical knowledge picked up by on-the-job experience, which helps to understand the boundaries and the risks of the material working environment.

The need emerges for workers to adopt a more holistic and systemic view of the processes they deal with (overcoming narrow task-oriented learning), and for companies to foster a diffused and inclusive cultural change to accompany the re- or up-skilling of the workforce.

Also, a fast-changing environment and the need to tackle problems quickly and effectively put in evidence the need for **Lean Management skills**, to be developed at different qualification levels.

Where this demand seems to be likely associated with the penetration of industry 4.0 in different national contexts, it must be pointed out that the current European steel industry scenario appears quite uneven in terms of technological advancements and industrial composition. This highlights the need to frame these preliminary findings in terms of possible skills landscapes associated with an ideal-typical Steel Industry 4.0 scenario.

Identification of challenges and criticalities that need to be addressed

Rapidly changing industrial landscapes and labour markets require *not just timely but coherent and strategical responses*. The VET system comparative analysis shows a latent tension between fast responses and mid- to long-term incremental adaptation, as suggested above. This appears to be exemplified by the cases of the United Kingdom and Germany. Experts' interviews point out that while fast responses might lack coherence and do not point to a long-term strategy, too rigid (and unidirectional) vocational paths have shortcomings in meeting the flexibility required by labour markets.

This tension is reflected also in a different vision of occupational standards. In liberal market contexts, such as the United Kingdom, employers increasing importance in updating and designing new qualifications might lead to a proliferation of narrow-defined occupational standards. This, in turn, might undermine the capacity of the system to deliver what ESCO defines as skills with higher degree of reusability, so limiting workers as well as businesses' resilience. The German concept of "capacity to act" (*Handlungskompetenz*) and vocational principle (*Berufsprinzip*), instead, seem to point towards a more holistic vision of the occupation and its associated competencies. This clashes to some extent with the modularisation approach encouraged by the EU policies (Deissinger, 2015). From this point of view, a crucial challenge for future VET would be defining guidelines for a non-fragmentary use of modularisation (see discussion below), as well as the optimal balance between transversal skills, on the one hand, and technical cross-sectoral and occupation-specific skills, on the other (see Busemeyer and Trampusch, 2012 for an overview of such debates).

Another criticality concerns the degree of fragmentation of a VET system. Where governance is complex and localised, the consistency of the whole system and its capacity to align with a national (long-term) strategy might be undermined. A complex regulatory framework might also discourage the engagement of both social partners and learners. A challenge for European countries is to guarantee high-quality and internationally-transparent VET qualifications, at the same time rationalising the overall functioning of their system.

As pointed out earlier, it seems important to take into account the many differences still present in national VET systems (see table 5). While recent VET reforms appear to be based on a shared understanding of "good practices" in education and training provision (e.g. the implementation of dual training arrangements), it has to be underlined that the transfer of good practices is not a straight forward process and needs to be done in accordance with the specific characteristics of the local context (governance and VET side) and calibrated on the actual needs of the national and regional labour market (companies and skills side). This has to be especially considered for the national and steel region related rollout (see chapter 6).

Leveraging EU frameworks and guidelines

Flexibility has become an important requirement of VET paths. Flexible VET needs to consider the role of informal and non-formal learning and to establish mechanisms to incorporate this into VET systems, thus offering learners the opportunity to shorten their paths through the recognition and validation/accreditation of prior learning and the exemption of modules. Credit systems, as outlined by the ECVET Recommendation (this programme is now withdrawn since 2022/23, but its principles support an important foundation of mobility that is still adhered to by the EC and across the EU), are devised to support both modularisation and the acquisition of learning outcomes, and to facilitate mobility and transfer across different learning contexts.

Modularisation can support the creation of tailor-made curricula, that ideally respond to specific regional, sectoral or even individual needs. To different extents, most of the EU countries have introduced module-based qualifications in their VET programmes (in Germany and Italy modular structures are applied only to some qualifications, while countries like Poland and Spain have adopted a more comprehensive modular approach in line with the EU Recommendations).

Furthermore, in a scenario of increasing transnational mobility, transparency and cross-referencing of qualifications are crucial for the transferability of skills. The ESCO database provides an important referencing system by offering a common understanding of skills and occupations. Its complementarity to ISCO-08 establishes a hierarchical structure in terms of occupational groups that should make mapping jobs easier in different contexts. Using these referencing systems along with EQF and ISCED-F 2013 descriptors enhances the transparency and comparability of qualifications across different countries, thus potentially supporting talents mobility, or consistent upskilling and reskilling of the workforce in different national contexts (e.g. in the case of multinational steel companies).

As for digital skills and competencies, specific tools such as DigComp and the e-CF (already used for the industry related skills classification, see table 3) work as shared vocabularies and define useful proficiency benchmarks for companies, training providers, policy-makers, and learners.

VET system related findings at this stage of ESSA point to several benefits for the steel industry that would come from an effective implementation of the tools and frameworks described above:

- Increased flexibility of vocational paths
- Shortened distance between IVET and CVET and improvement of Lifelong Learning (it has to be noted here that CVET appears to be often highly fragmented in many countries and this undermines its effectiveness and recognisability as a part of the system, but a focus on micro-credentials provides an effective avenue for developing a coherent approach to facilitating lifelong learning opportunities)

- Easier recognition and transferability across countries of entire qualifications or specific learning/training modules
- Easier updating of the qualifications (e.g. adding digital and IT modules, or environmental regulation modules, on top of pre-existing qualifications)
- Possibility to ideally combine core modules (national, or even transnational) with additional ones (regional or sectoral). On a more abstract level, this could ideally open to the possibility of a European certified repertoire of sectoral vocational qualifications.

The emphasis on modularisation however requires a caveat. As mentioned earlier, the research points to the need of a holistic approach to vocational training. Occupational qualifications need to provide thorough set of interrelated (technical and transversal) competencies in a broad occupational area in order to cope with the challenges brought in by the fourth industrial revolution. From this point of view, modularisation should not be put in practice in a way that breaks down a holistic training, but rather in a way that favours and supports it.

Sector Skill-Set Matrix

Initially, working on a Sector Skill-Set Matrix from a VET system perspective, a matrix was designed to connect the steel industry professional profiles with relevant formal initial vocational training (IVET) provision available in the five case study countries (Germany, United Kingdom, Italy, Poland and Spain). As such the matrix (within the general objectives of ESSA) aimed to perform several functions:

- Provide an overview to which extent skills provision in the five case study countries have been affected by European-level initiatives to harmonise national VET provisions and VET documentations.
- Link future skill needs (FSN) that are either task-, job-, qualification-based or unspecific to the ‘best’ avenue in any specific context to deliver the missing skills to those who need them.
- Link job profiles to vocational qualification programmes, i.e. apprenticeships programmes, across the five case study countries as far as this is possible and feasible.
- Identify existing skills gaps in the national programmes/qualifications and potential scope for new learning and training arrangements.

The initial intention was for the Matrix to be of potential use for HR managers in companies who might need to assess the equivalence of occupational qualifications across Europe in case they hire workers who have received their qualifications elsewhere. Having an overview of steel-sector relevant occupational qualifications should also be of use to those who want to drive forward European initiatives to improve the quality and relevance of steel-sector relevant IVET programmes. To a large extent these aims and principles remain and the final Matrix design provides a useful foundation for delivering on the ESSA objectives set out in the proposal. There have however, been some notable developments in its design and the shape and form of its outputs.

The most significant difference between the final version of the SSM (D4.4) and previous iterations introduced in previous versions of this report, is a fundamental change of the main organising unit that structures the Matrix from a focus on learning outcomes to one on qualification levels. A second significant deviation from previous versions is that we do no longer include the United Kingdom as case study country.

In earlier versions of then Sector Skills Matrix (SSM Version 1 and 2) transversal learning outcomes (LOs) had been identified to act as comparative units across different occupational qualification programmes as well as across the case study countries. LOs are one of the rare common VET references applied throughout the continent albeit nation-specific variations in interpreting this concept remain (e.g. Cedefop, 2017; Markowitsch & Plaimauer, 2009). Learning outcomes are, according to Cedefop (2017) effectively 'statements of what a learner is expected to know, be able to do and understand at the end of a learning sequence.' Given that they focus on the outcomes of qualification programmes and not on their actual content or the form of delivery, the concept of learning outcomes is, in principle, capable of transcending the very diverse European VET system landscape. It thus constitutes, in principle at least, an excellent cross-country comparator when evaluating and comparing cross-continental occupational qualification programmes.

However, it emerged during the refinement of earlier Matrix versions that there are several problems that render learning outcomes practicably unusable for the purposes of this Matrix. First, complete lists of learning outcomes related to transversal skills of Occupational Qualification Programmes (OQPs) are often simply not available or obtainable. There is a lack of clear and accessible documentation of learning outcomes across many of the case study countries. Second, even where documentation of learning outcomes is available, it is very difficult to verify whether these represent complete or just partial representations of relevant learning outcomes.[2] Third, VET documentation makes only in very rare cases a clear and explicit distinction between learning outcomes related to technical and transversal competences. One fundamental aspect in this regard is that the acquisition of technical skills is inherently based on and necessarily requires a range of transversal skills, which makes the analytic distinction between difficult.

The practical unsuitability of learning outcomes as principal analytic unit has forced a significant modification of the proposed SSM. On the upside, it has led to a stark simplification of the Matrix which should improve its usability and also make continuous updating easier. The downside is that an important comparative dimension is being lost, although comparability would have also been negatively affected by including partial or incomplete lists of transversal learning outcomes into the Matrix.

The new design uses the 'qualification level' concept as the main organising unit. All European VET systems use National Qualification Frameworks to distinguish the value of qualifications according to the inherent difficulty in obtaining them. The more is required from a learner – in terms of time, skills, knowledge and responsibility, the higher the level that is attributed to a particular qualification. In recent years, qualification levels have been Europeanised and national qualification levels can be translated into European Qualification Levels which constitute the European Qualification Framework (EQF) (e.g. European Commission, 2018). EQF distinguishes like most national frameworks between 8 levels, with 1 denoting the lowest and 8 denoting the highest level. The explicit aim of EQF is to afford comparability with regard to the 'value' of qualifications across national VET systems. To some extent, the EQF succeeds as a comparative tool as long it is assumed that the same EQF level signifies broad equivalence between OQP in different European countries with regard to acquired skills, knowledge and competences.

[2] For example, we realised belatedly that Europass documentation available in a range of EU countries demonstrating the successful completion of an OQP tends to list only selective instead of complete lists of formal Learning Outcomes.

The second major development is that the United Kingdom is no longer represented in the Matrix. The main reason for this 'exclusion' is that the way in which UK VET systems – due to devolution there are actually 4 different systems in England, Northern Ireland, Scotland and Wales – are organised makes it very difficult if not impossible to represent them in the Matrix. The main problem is the hyper-fragmented nature of the UK VET systems, as noted in earlier sections. While UK-wide 'National Occupational Standards' exist, they must not be confused with occupational qualification programmes. The former tend to be focused on minimum requirements related to individual skills, particular pieces of knowledge or particular values and attitudes, while the latter are aggregations of a range of skills, knowledge and attitudes which then allow learners to perform particular jobs. Put differently, occupational qualifications can include modules or training units that are based on National Occupational Standards, but there are very limited if any standards that prescribe the make-up of whole occupational qualification programmes.[3] Responsibility for the scope and content of qualifications is either a matter of negotiations between employers and education providers or, in case of entirely school-based VET programmes, the responsibility of education providers who tend to be private businesses albeit often with a 'charitable status'. This way of organising VET provisions means that the content and scope of OQPs might actually differ from company to company even when they are located in the same nation or region and operate in the same sector. The Matrix, however, requires a certain level of (national or regional) standardisation at the level of occupational qualification programmes and this condition is not fulfilled in the UK.

Intensive efforts have been made to produce a useful and usable tool in the form of a Sector Skills Matrix (SMM) and D4.4 (ESSA, 2023b) is incorporated within the ESSA steelHub as a tool for industry stakeholders to understand the gap between VET provision and skill needs. However, at the moment the SSM is closer to a prototype than a functioning database. This is mainly due to the fact that we have not fully succeeded in gathering sufficiently robust and reliable data that inform the transversal skills gap assessment (see D4.3 (Weinel et al., 2023) for details). More and continued work is required to put the transversal skills gap assessment onto a methodological footing that is sound and robust enough to base meaningful decisions regarding the future development of occupational qualification programmes on to this particular element of the SSM.

Despite this setback, we still feel that the time and effort spent on trying to develop such a tool has not been in vain. Setbacks can be informative and valuable lessons can be learned from this experience. First, we suggest that systematically understanding and evaluating VET provisions relevant for particular sectors is an important element in an increasingly turbulent economic and social environment characterised by rapid technological and organisational change, increasing recruitment challenges and the as yet uncertain consequences of climate breakdown.

Second, we are not sure whether there is any additional value of creating sector skills matrixes on a European level, i.e. to look comparatively at various European countries. The main reason is the lack of meaningful Europeanisation of VET provisions. While the Europeanisation of VET provisions, despite recent efforts (see ESSA D4.2 (Antonazzo, Weinel, & Stroud, 2022) for an overview) is still at a rudimentary stage and also taken into account that worker mobility within the steel sector appears to be quite limited, a European approach to the Matrix, i.e. the attempt

[3] In Germany, to use a contrasting example, the broad content of whole occupational qualification programmes are standardised and prescribed, which establishes a minimum standard across the country.

to create European comparisons and benchmarks, might not be the most appropriate approach at this moment.

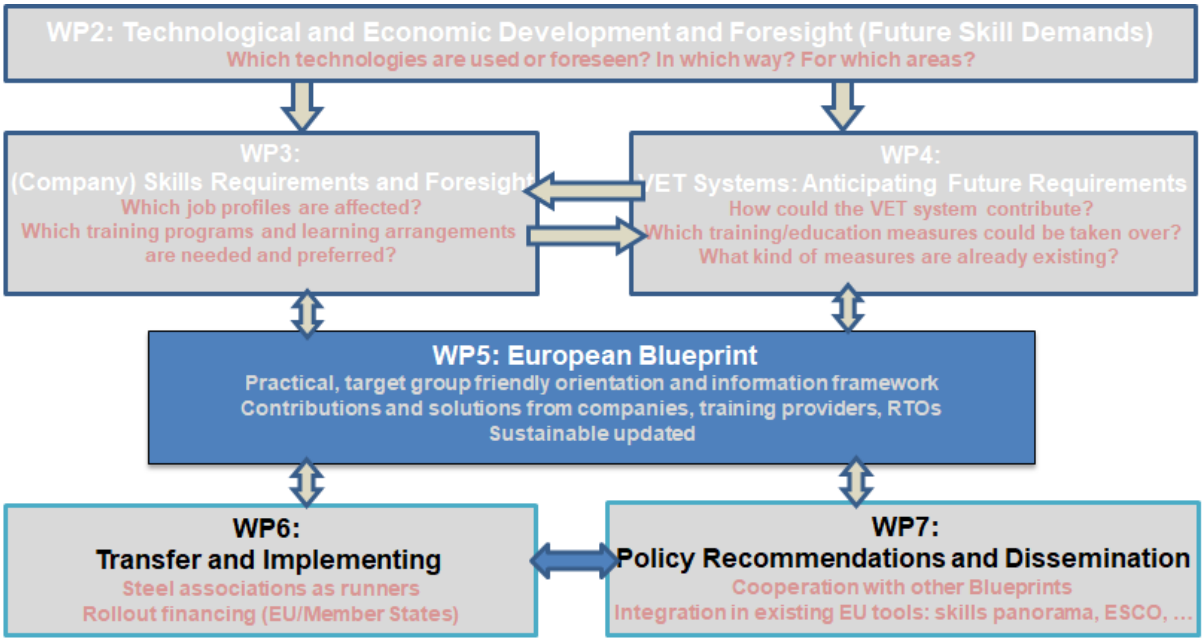
Third, we believe that performing skills gap analyses as an element of wider efforts in skills forecasting and skills requirement predictions is a valuable and important task. Rapid technological and organisational change in the face of Industry 4.0, intensified digitalisation and demographic and educational trends and global climate breakdown will inevitably lead to changes in the skill needs of companies including those operating in the European steel sector. Whether such skills gaps assessments are best made via a tool such as a Matrix or whether other approaches and methods are more accurate and reliable is impossible to tell, because the ESSA Matrix has not been able to achieve its stated aims in this regard and also because we have not been able to do a comparative study of various skills gap and skills forecasting methods.[4]

Fourth, based on our research and experience with the current Matrix we would make a number of suggestions how to take the development of such a tool forward. In line with the suggestion to drop the European dimension, in our view national or regional approaches appear more appropriate. National steel associations appear to be best placed to either engage in or commission skills gap analyses and skills forecasting as these organisations are ideally placed to bridge the gap between a specific sector needs and national and/or regional VET systems. They not only represent the sector companies but tend to be to some degree involved in the shaping VET system provisions. A purely survey-based approach does not seem to be a promising method, despite its potential advantages in terms of efficiency and effectiveness of data generation. The main drawback is the lack of possibility to understand the quality and reliability of data, but survey fatigue within companies is another good reason to avoid a purely survey-based approach.

[4] This might be a worthwhile research project in its own right.

5 European Blueprint Development (WP5)

The European Blueprint development is based on the results and inputs of the technological and economic developments and their impact on the steel companies' skills requirements and VET systems provisions. The ESSA Steel Sector Blueprint summarises and integrates these results in a practical, user friendly orientation, information, and support framework: **developed with the steel sector and for the steel sector**.



5.1 Objectives

The main objective is establishing a Blueprint for a sustainable, *steel industry driven* and coordinated European Steel Skills Agenda and Strategy (ESSA) assuring an ongoing and short-termed implementation of new skills demands. This was piloted by the development of related scenarios, strategies, framework training modules and tools, and new training methods and arrangements: Assessment, strategies and measures to anticipate and secure a skilled workforce needed for a global competitive industry, ready to anticipate new skills demands and to allow pro-active practical activities meet the future requirements of the industry.

This *industry driven pro-active skills strategy* is reflecting the (recent and anticipated) technological and economic strands and built on the upcoming technological and economic developments (WP2), the requirements of the companies (WP3) and their integration in and support by the VET systems (WP4).

Based on these results the Blueprint activities:

- Identify in proactive, rather than reactive, ways the skill needs and demands of the industry, considering skills gaps and shortages, and forecasts of supply and demand;
- Identify training and curricula requirements, including ways to implement new vocational education content in immediate and effective ways, within both companies and education and training institutions;
- Improve and update training more short-termed and with high quality by new training programmes, measures and arrangements (using new digital possibilities) as well as programmes for train the trainer (as key elements for the new skills agenda);

- Identify and promote successful sectoral upskilling schemes (incl. exchange of existing tools, best/good practice exchange, knowledge) and efficient management of knowledge;
- Improve the image and attractiveness of the Steel Industry and careers for talented people (recruitment and retention), including the identification of strategies for overcoming recruitment difficulties and widening the talent pool for a more diverse workforce.

The results of these objectives led to a comprehensive Blueprint developed first as a prototype, tested and improved to this final version (June 2023). The prototype framework served as an input and ground for the finalisation, implementation and transfer of the ESSA Blueprint and the policy recommendations, exploitation and dissemination activities.

Strategies for the implementation of measures to meet defined skill needs are built on the sector skills framework and improvement of sector occupations and job profiles. Defining, revising and creating new and upgraded occupational profiles – to fit with emerging and diminishing skill needs - are the ground for:

- Development of training activities and modules, including training the trainers, to be integrated into VET provision at national and sector level (incl. interrelation to existing EU tools like EQF, ECVET, ESCO, etc.). This includes the development of (a) training courses for up- and reskilling existing profiles, (b) new occupational profiles or parts of it, (c) new leadership and work 4.0, (d) train the trainer, improving training providers, (e) new training methods and arrangements, taking into account new possibilities of digital learning and support (social media, Moodle, virtual labs, online learning, etc.) and workers participation (e.g. workplace innovation, but also by using digital tools like tablets, smart phones, laptops, etc.).
- Development of strategies to overcome central human resources challenges and to improve the attractiveness of the Steel Industry and careers for talented people (recruitment and retention), including the identification of strategies for overcoming recruitment difficulties and widening the talent pool for a more diverse workforce as well as strategies increasing the workforce mobility and diversity (e.g. increasing the attractiveness of the steel industry for women).

5.2 Methodology

Based on the results of the entire activities within the project time, an integrative development, design, implementation, piloting of the industry driven European Blueprint and rollout on the company and national-regional level took place. Due to the iterative cyclical concept of ESSA, a first prototype development took place leading to a first piloting of the Blueprint Prototype in 2021 followed by an upgrade and finalisation of the Blueprint in 2023. Defining and identifying sector benchmarks for skills development and training programmes/curricula, but also a cultural change of the whole company to Industry 4.0 requirements was considered.

Assessment of the Blueprint and implementation of the established European Steel Skills Alliance (ESSA) was done within the dissemination, exploitation, and rollout activities. This included feedback and improvement by the steel associations and social partners as well as specific expert workshops (strategising for necessary political support measures and the means for mobilising and integrating stakeholders and policy makers of the EU and national level to meet Blueprint aims and objectives).

Within the test phase, necessary parameters for a sustainable integration in existing European and national/regional structures were elaborated, establishing interrelated Alliances and

Leadership on these levels, fostering joint Blueprint activities and setting the ground for a sustainable national/regional rollout. Furthermore, pilot training tools, measures and arrangements were tested, improved and adjusted. Within the test environment also additional training offers were checked, esp. train the trainer modules, and integrated in the Online Training Ecosystem **steelHub**. In parallel the connection of online tools and measures with on the job, on-site training in companies and VET schools of the National-Regional Training Ecosystems (ESSA RTS) was proved.

Beside the already established cooperation with ESCO, the Blueprint engaged with other European tools: such as ECQA (European Certification and Qualification Association) for certification of steel related skills and training modules, the CEDEFOP Skills Intelligence to exchange our results with the broader VET and industry community, the Pact for Skills to ensure a sustainable ongoing development of ESSA within the broader partnership of Energy Intensive Industries, and Europass to collect learning outcomes for the individual learner.

5.3 Results

This chapter is summarising the related Deliverable D5.3 "Blueprint New Skills Agenda Steel" (Schröder & Stroud, 2023).

The structure and work programme of ESSA (see Figure 1, and the illustration at the beginning of this chapter) in relation to the preceding work packages (WP2,3,4) is reflected in the general Blueprint outline (see Figure 18 below):

1. Current and future **technological and economic developments** new skills demands are reflected
2. Leading to **skills adjustment** based on related skills and job profile classifications and assessments, to be aligned to existing VET occupations if and where possible
3. **Strategies and measures** are generated to ensure a continuous and sustainable skills assessment and adjustment by the steel industry for the steel industry:
    - European Steel Technology and Skills **Foresight Observatory and Panel**: coordination of the technological foresight and skills needs on regular monitoring tools, continuous updating of the skills, job profile, and occupation databases
    - Training offers and learning arrangements made available via a common European Online Training Ecosystem Platform **steelHub** as well as **National-Regional Training Ecosystems** (ESSA RTS)
    - **Pilot measures and tests** will be launched in the future, using existing funding tools on the European (RFCS, Horizon Europe, Erasmus+, ESTEP tasks, and others), national and regional level (ESF, EFRE) (initiated and coordinated by the Foresight Observatory)
    - **Incentives** will complement activities by generating awards, online fora, best practice exchange and others (e.g. as part or integrated in the activities of the Foresight Observatory)
    - A **division of responsibilities** for ensuring the update of learning is established between companies/industry - VET systems - individuals, leading to new social practices for lifelong learning.
4. To sustainably run the Blueprint new **alliances and governance** structures have been integrated in existing sector structures, assigning leadership for specific elements of the Blueprint on the European and national/regional level as well as on the level of

cooperation in between associations, companies, training providers and other stakeholder groups.

5. European Open Coordination will **roll-out the Blueprint** via a **European Community of Practice (ECoP Steel)** concentrating on steel regions, including VET system support of the member states.

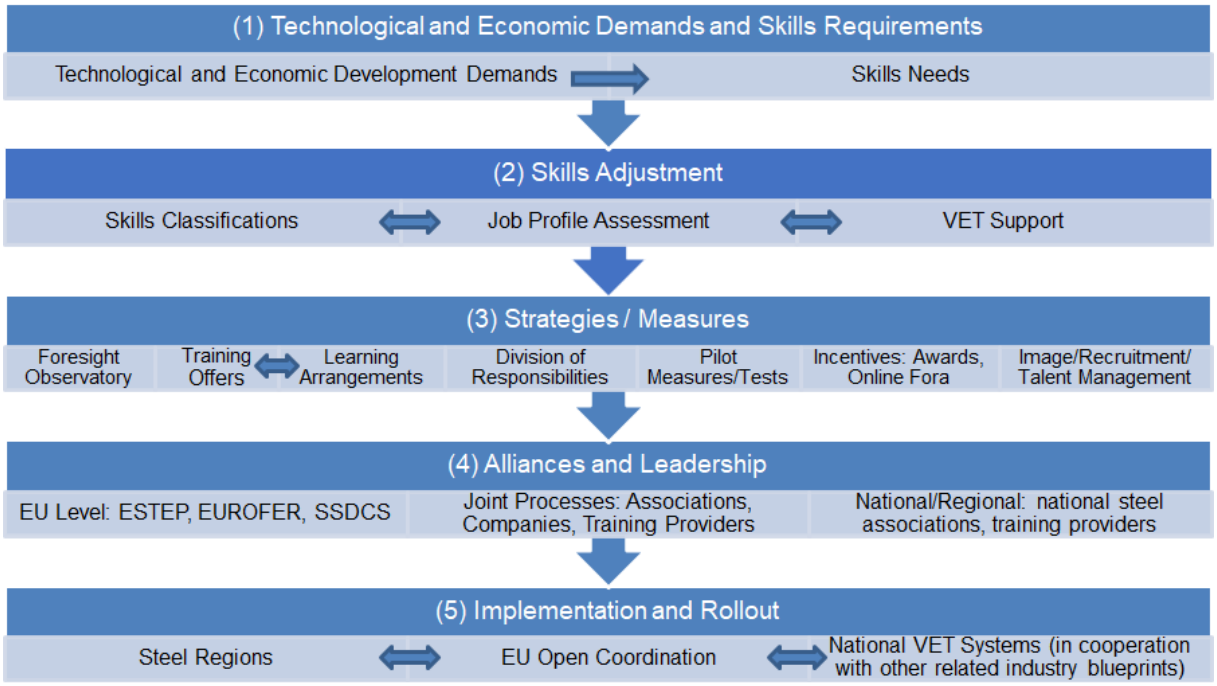


Figure 18: General Blueprint Outline

The holistic and industry driven approach of the Blueprint for **Technology and Economy Driven Skills Adjustment** (based on the results of WP2,3,4) led to a demand and supply flow chart. In the first (demand) cluster technology (and economy) are the genuine driver of new applications (implemented with specific company objectives) and leading to organisation implications. A second (supply) cluster is dedicated to the given needs by (a) the assessment of the affected job profiles and production areas (incl. maintenance) as well as the affected industry occupations (of the VET system) and (b) by related training and VET system offers (via curricula of initial and continuous VET). Last but not least the ground for a better industry orientation and basic digital skills has to be uptaken as early as possible by pre-VET education (Kindergarten, primary and secondary schools), especially concerning image and recruiting campaigns from an early stage on.

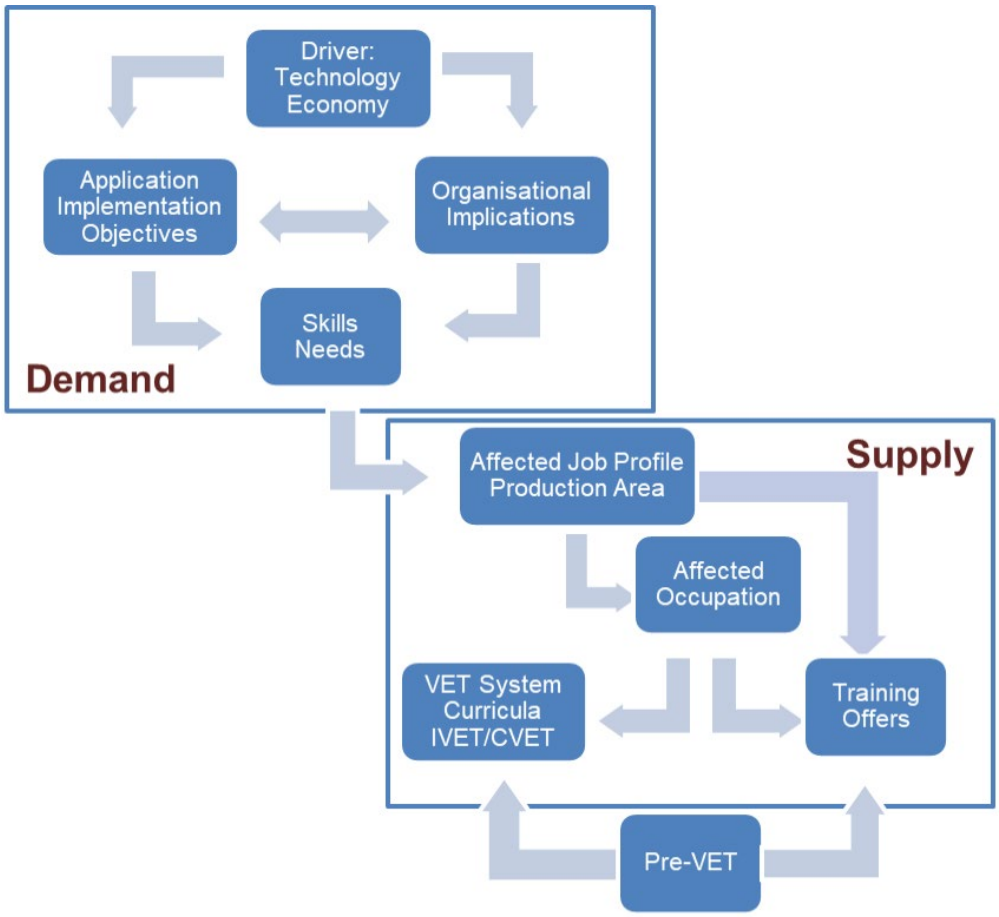


Figure 19: Industry and technology driven skills adjustment

Strategies and measures based on ESSA results so far and inspired by the Steel Sector Careers project will give a steadily upgraded answer to future skills requirements reflecting the ongoing technological and economic development in the steel sector. The core elements are

- The European **Foresight Observatory** with the **E**uropean Steel **T**echnology and Skills **P**anel (ESSA ETP) (demand side)
- Online Training Ecosystem **steelHub** (supply side)
- The ESSA National-**R**egional **T**raining Eco**s**ystems (ESSA RTS) and the related European Community of Practice (**ECoP Steel**) (supply side).

Through this structure, the demand side (skills requirements) and the supply side (training offers and exchange, industry image and recruitment activities) as well as an exchange and piloting / testing sphere for innovative solutions is given. Additionally, it serves a ground for a European Steel Regions interplay by a **European Open Coordination** as a **Community of Practice of Steel Regions**, integrating relevant national and regional stakeholders and their national-regional skills and training ecosystems.

This **European ESSA governance structure** is already implemented and accepted by the related main steel industry actors on the European level: ESTEP, EUROFER, and industriALL Europe. The core coordination unit taking over the ESSA Blueprint and Strategy is the Focus Group People of ESTEP which has agreed to run the Foresight Observatory and Panel and to establish a European Community of Practice of Steel Regions (National-Regional Training Ecosystems). EUROFER is supporting ESSA via its Social Affairs Committee (SAC) and industriALL via the Sectoral Social Dialogue Committee on Steel (SSDCS).

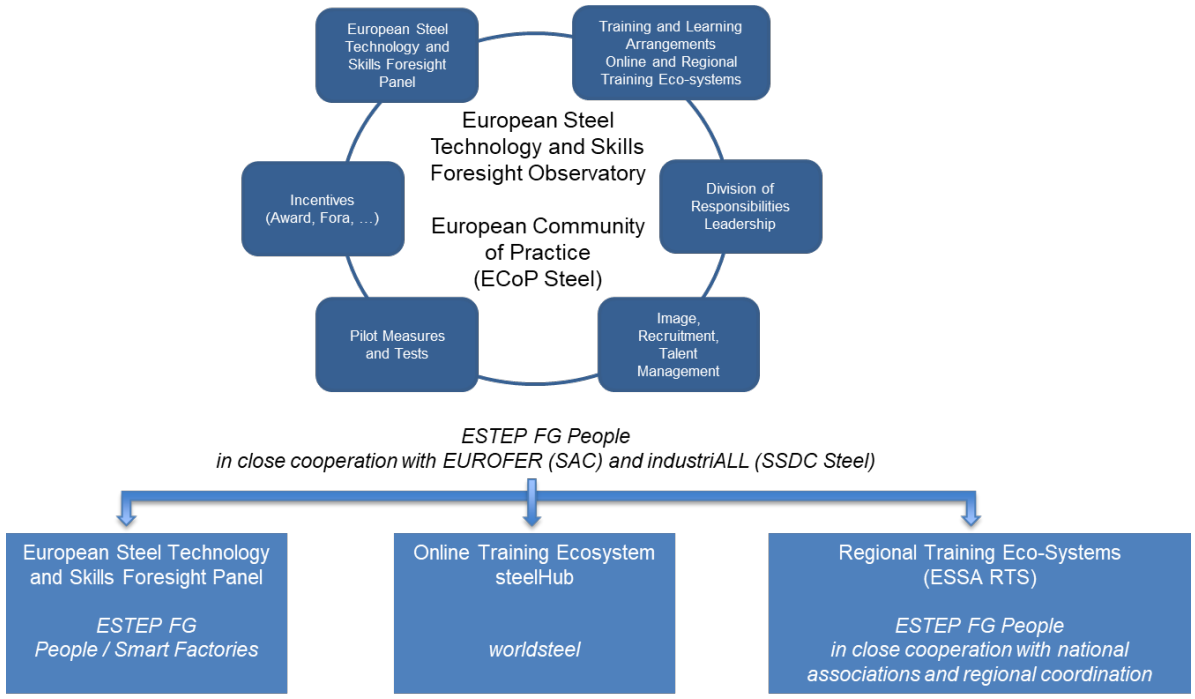


Figure 20: ESSA Governance Structure

5.3.1 European Steel Technology and Skills Foresight Observatory and Panel (ESSA ETP)

As already stated by the Steel Sector Careers Blueprint most companies appear to **lack a systematic process** for assessing and forecasting skills needs. Therefore, ESSA established the European Foresight Observatory (already recommended by the Steel Sector Careers Blueprint) bundling all the necessary activities to **monitor and evaluate** regularly:

- Technological and economic development
- Industry skills requirements
- and VET Systems alignment and support of industry demanded future skills.

Central part of the ESSA Foresight Observatory will a regular annual **foresight survey**: ESSA European Steel Technology and Skills Foresight Panel (**ESSA ETP**), run by the Foresight Observatory. The foreseen yearly survey is based on the results of already two conducted questionnaires (2020 and 2022/23, see detailed results in Deliverable D3.2 (Bayón et al., 2023),) and will consist of a standard set of questions to monitor the recent technological development and related skills demands repeated more or less in every issue, added by an important topic of the year. It is planned to create a **Steel Technology and Skills Foresight Index** to monitor, assess and compare the development over the years. A subsequent validation workshop of selected experts will discuss necessary implications for the steel industry concerning the main results of the survey. To integrate interdisciplinary perspectives and assessments the main stakeholder groups will be included:

- technicians and HR people of the companies, training providers, RTOs and universities, associations and social partners
- steel producing and processing large companies and SMEs.

Based on the regularly updated results of the ESSA Foresight Panel (ESSA ETP) the ESSA Foresight Observatory will coordinate the continuous refinement of all the other relevant measures and activities planned on the European level:

- Training Offers and Learning Arrangements (Online and Regional Training Ecosystems, train the trainer programs)
- Pilot Measures and Tests
- Incentives: Awards, Online Fora
- Division of Responsibilities / Leadership
- Image/Recruitment/Talent Management campaigns and recommendations
- Policy recommendations.

The Observatory will initiate and coordinate **pilot measures and tests** - supported, funded or framed by EU Programmes (such as Pact for Skills Large Scale Partnership Energy Intensive Industries, Erasmus+, Processes for Planet, Horizon Europe) and steel sector specific programmes (such as Clean Steel Partnership, RFCS) or platform activities (such as ESTEP, SSDCS with support of the social partners EUROFER and industriALL).

Incentives such as a Steel VET Award for best practices or Online Fora for "Hot Topics" could be hosted by the Observatory, together with ESTEP and the social partners EUROFER and industriALL.

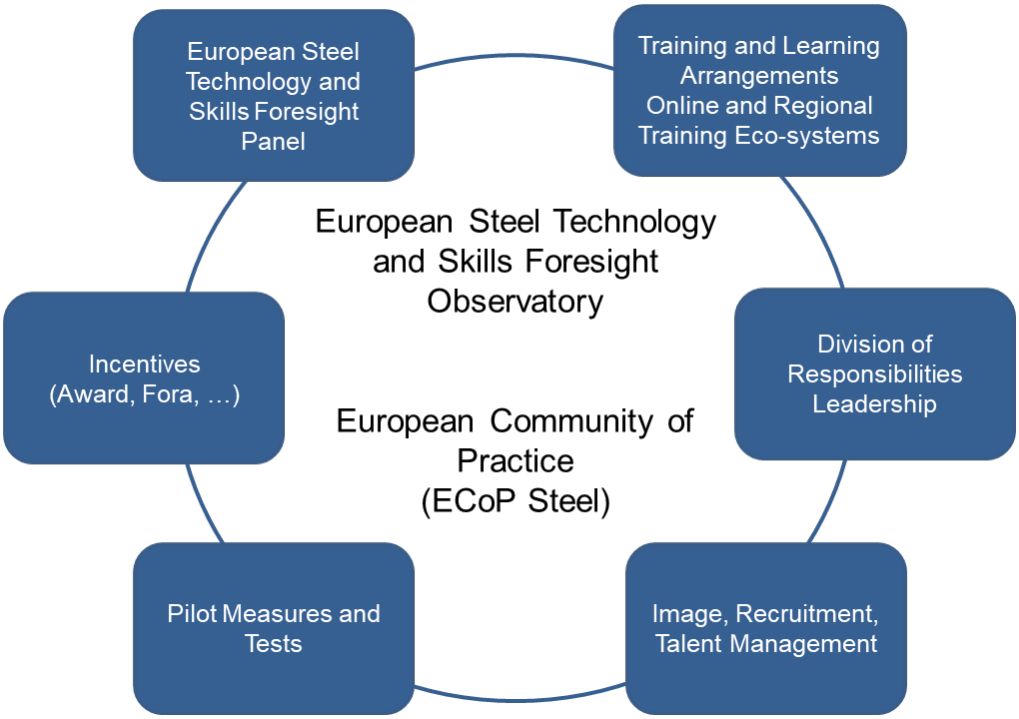


Figure 21: European Steel Technology and Skills Foresight Observatory

5.3.2 Online Training Ecosystem steelHub

To enable the Green and Digital transformation for the steel sector, ESSA developed a strategic Blueprint to facilitate communication, coordination, and collaboration between all the stakeholders of the training and development ecosystem to consolidate an Alliance to guarantee a **current and future *workforce highly qualified, specialized, and multi-skilled for the industry***.

Against this backdrop, the ESSA strategy focuses on the European level at an **Online Training Ecosystem** (steelHub) and on the level of steel regions by specific **National-Regional Skills and Training Ecosystems** (national-regional networking). Both systems are complementary and could be combined by adding specific advantages to each other (such as combining online and on-site training modules that could be integrated in a broader training program of the companies and VET providers and schools):

- virtual / online: independence of time and space, integration of relevant modules in company and individual learning paths
- on-site / workplace related: real working experience, interactive learning.

As a central element of the strategic Blueprint, ESSA developed the steelHub, a centralized digital platform to facilitate communication, collaboration, and coordination. steelHub sets the infrastructure for a worldwide exchange of training content, integrating offers of and to be used by all the relevant stakeholder groups from industry, VET systems, training providers, public authorities, research and education, associations, and equipment and service providers.

Figure 22: steelHUb Ecosystem Strategy

Central elements of the steelHub are the Learning Solution Directory, Skill Directory, Capability Assessor, and the Integration in different learning paths. The Learning Solution Directory is a collection of learning solutions delivered by Publishers into the framework of a marketplace business model. Another important component of the steelHub is the Skill Directory, which represents the current and future training needs of the steel sector. This Directory is used to curate the learning solutions. Using a standard terminology and big data infrastructure, steelHub is able to identify skill gaps and the most demanded skills for the steel sector to guide the training solutions development as well as analyze trends that can support governments to define new regulation and funding tools to support the transformation of the steel sector.

The integrated design of the platform offered by steelHub enable the possibility to develop new and innovative solutions into the context of Capability Assessor using a variety of methods to evaluate an individual's capabilities, including self-assessment, interviews, tests, and job

simulations. The goal of the assessment is to determine whether an individual has the necessary skills and experience to perform effectively in each role, task or skill and design a custom development plan for each organization or individuum.

The flexible integration of this platform offers organizations the ability to easily connect and integrate learning solutions with their own systems, which can improve productivity, reduce costs, and enhance overall efficiency. Besides, regional industrial and professional association are able to integrate these solutions to provide learning solutions to their members.

Figure 23: Modules of Digital Platform steelHub

5.3.3 National-Regional Skills and Training Ecosystem (ESSA RTS)

The Online Training Ecosystem steelHub will be complemented by National-Regional Skills and Training Ecosystems (ESSA RTS). This is important because it sets the focus on the "real" place where people live, learn and work. It includes not only the important company training and learning activities including work-based learning but also the integration of VET institutions, policy, research and science, and civil society activities within an ecosystem considering the responsibility, competences and activities for VET within a region. Therefore, in its rollout phase ESSA focused on the European Steel Regions giving an input to already existing and to be extended networking for new skills, recruitment and image of the steel industry in steel regions and countries, connecting them to the European Blueprint. Via the rollout activities to the pilot regions (see Figure below) ESSA integrated more than 100 additional stakeholders and established ongoing ecosystems led by national associations or ESSA partners (see also Chapter 0, and in detail Deliverable D6.2 (Schröder, Götting, et al., 2023)).

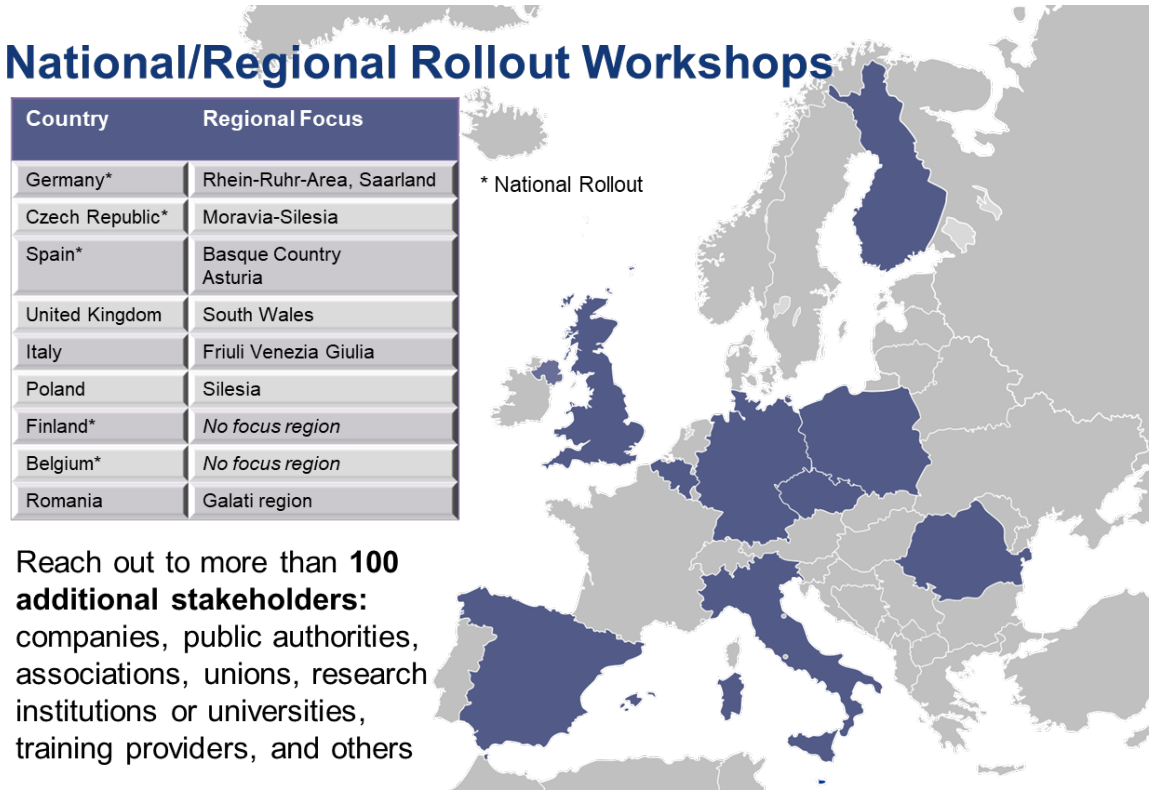


Figure 24: ESSA Rollout Activities

5.3.4 Additional Targeted Activities

Taking advantage of the Foresight Observatory and the training ecosystems infrastructure and activities (steelHub and ESSA RTS) ESSA is giving special attention to:

- Train the trainer activities
- Recruitment and image of the steel industry
- Talent management.

Train the trainers

As no training system is better than its trainers and teachers, ESSA has also considered strategies to further educate trainers and thus improve the quality of training modules. Train the Trainer profiles and related courses have been integrated into the steelHub. From the beginning of the project, the aim was to develop train the trainer programmes as off-the-shelf solutions based on the demand-side (what training needs arise out of the use of new technologies) and supply-side analysis (what are companies/ providers offering). As a result, concrete offers have been developed in the steelHub, which were refined, adapted and enriched in the course of the rollout workshops (ESSA RTS).

Roughly summarised, the work was thereby divided into the identification of trainer profiles and the corresponding skills (in the first step) and the collection of corresponding trainer courses, matching the identified skills (in the second step) – the trainer profiles, including the skills and the corresponding training courses are represented in the online platform **steelHub**.

Additional to the company job profiles identified in Work Package 3, ESSA added two job profiles specifically for trainers. This was due to the high relevance of training personnel as intermediaries between the training / teaching content and the learners / workers. The trainer profiles that have been added were the profile of the ‘Corporate Trainer’ and the ‘Vocational

Teacher' profile. Appropriate trainer skills are particularly important for these two profiles. These are skills that enable teachers to convey content and promote the skills of workers. In the context of ESSA, the focus is on teaching transversal skills, in line with the identified skill categories of the project (digital, personal, social, methodological, green/sustainable skills). At the same time, trainers themselves need these transversal skills. The job profile of the 'Manufacturing Manager' also includes trainer skills - in line with ESSA's objective to also bring middle managers into the role of trainers, thereby promoting the idea of 'learning on the job'.

In concrete terms, trainer skills are implemented in the online platform steelHub as follows: Primarily, the job profile of the Corporate Trainer is used, in which relevant skills for trainers are combined. Some of these skills are then also used for the profile of the Vocational Teacher and the Manufacturing Manager. The individual skills, altogether 18 functional skills of the Corporate Trainer, thereby reflect such skills that are important for trainer staff, not only in the steel sector, but in the context of energy-intensive industries in general.

Here are some examples of trainer skills covered in the Corporate Trainer profile. The profile primarily focuses on skills that the Corporate Trainer needs in order to provide appropriate training. Among the necessary skills are, for example:

- Coaching and mentoring employees
- Providing learners with opportunities to develop individually
    - *Trainers thereby not only have the role of teachers, but often also act as coaches, mentors or facilitators. Especially against the background of the importance of lifelong learning, it is important that trainers also support learners and clients in acquiring knowledge themselves.*
- Managing learning and development in groups
- Creating an inclusive learning environment
    - *These standards require and promote essential personal and social skills of trainers*
- Developing and preparing digital resources for learning and development
    - *This standard refers to the digital skills of trainers, including the provision of simulations and the use of online tools in general*
- Evaluating and improving learning and development provision
- Assess learner achievement
    - *These standards refer to the ability of trainers to both reflect on their own training methods and evaluate the learning success of learners/clients. Personal skills of trainers are crucial, also in the context of self-reflection and self-criticism.*

All developments of training methods aim to be sustainable in several ways, not only environmentally but also e.g. socially sustainable.

As mentioned above, trainer skills also flow into two other profiles in addition to the Corporate Trainer, namely the Vocational Teacher as well as the Manufacturing Manager. While the job profile of the Vocational Teacher is strongly related to vocational and occupational education, trainer skills of the profile of the Manufacturing Manager are connected to the aim of ESSA to bring middle managers into the role of trainers as well.

Regarding the 'train the trainers' approach, and within the mentioned job profiles, active learning methodologies which have been proven as more efficient than the traditional methods have been considered and also flow into the trainer skills of the mentioned job profiles. Accordingly, the functional skills are meant to enable trainers to use methodologies like e.g. 'Project Based Learning' or 'Problem Based Learning' as well as 'Learning on the Job', in order to engage and motivate the involved learners. Their goals are the construction of meaningful

learning, the provision of an active process of knowledge construction, keeping the learners' attention, emphasizing their independence and inquiry, and, in the last term, improving the pass rates.

Within the ESSA Blueprint, train the trainer modules and courses were collected and integrated in the **steelHub**, in connection with the identified job profiles and skills. These refer to modules relevant for on-site training in companies and VET schools. For collecting good practices as representative examples of the different approaches / measures, the Regional Training Ecosystem (ESSA RTS) and thereby the rollout workshops are also used.

ESSA is thereby ensuring to provide an overview of methodologies of trainer developments and specific training courses for trainers (e.g. on new training methodologies and technologies): (1) improving digital skills for trainers, (2) content around new technologies for training courses, (3) enabling non-trainers (peers, leaders) to train.

By embedding the trainer profiles and the corresponding modules and courses in the Online Training Ecosystem steelHub, which will continue to exist after the end of the project, the sustainability of the train-the-trainer measures is also guaranteed beyond the duration of ESSA.

Image and Recruitment

Due to the age structure in most European steel-producing companies, more than 20% of the actual workforce have left the industry in the period 2005-2015, and close to 30% will leave up to 2025. The industry thus needs to be able to attract young and creative talents – developing mobility within and across careers is one aspect of this - but should also focus more broadly on recruiting talented individuals of all ages (lifelong learning is an important dimension) and encourage inward migration to address skill shortages. To this end and based on the useful results, strategies and materials that were delivered by the Steel Sector Careers Blueprint, ESSA is integrating strategies for promoting the employment of young people in the sector through the reinforcement and updating of apprenticeship schemes as part of youth-oriented recruitment processes, and strategising for active training and lifelong learning with the aim of attracting, developing and retaining talent.

The image of the Steel Industry is still a major challenge for recruiting and retaining a high skilled workforce. This was also clearly stated during the ESSA rollout workshops of the Regional Training Ecosystems (RTS), where the topic of image and recruitment was always on the agenda. All in all, talent attraction is currently one of the most urgent challenges facing the European steel sector. In this context, the Blueprint emphasised that students and job-seekers having had already had contact or experiences with the steel sector rate the image more positive. Nonetheless, large-scale industry job losses, shift working, low salaries for low skilled work, and environmental impact are still remaining arguments against a job in the Steel Industry. This has to be reflected in image and recruitment campaigns and talent management strategies. Additionally, more students than before are undertaking higher education instead of VET, after graduation they do not see in the steel sector a suitable employer matching their qualification level. Finally, more students, especially female ones, would be needed in STEM subjects to supply the needed skills for manufacturing industries, including the steel industry.

Therefore, digital and green transformation by new Industry 4.0 technologies could be a chance to change the image of the steel industry and to attract (young) talents - from within and beyond the EU region - with digital affinity. Employer branding in a digital changing world could focus on future-oriented skills and leadership competencies in a digital changing surrounding within multifunctional workplaces for controllers, process mechanics, and

craftsmen. The briefing note of Cedefop "Not just new jobs: digital innovation supports careers" (Cedefop, 2019) underlines this by showing some good practices that digitalisation is attracting and supporting talented people. Consequently, digitalisation is a relevant strategy for the Steel Industry to attract (and retain) talented people.

To overcome recruiting obstacles the Steel Industry has to become an attractive employer of choice by presenting (**digital and green**) career paths and ensure future viability via an innovative digital and green steel production: digital optimisation and monitoring, new technologies for energy efficiency and CO2 reduction and substitution (like hydrogen, industrial symbiosis and circular economy). This new image of a clean and green steel industry is underlined by the European "Clean Steel Partnership" (ESTEP, 2020) and the "Green Steel" initiative (ESTEP, n. d.) of the European Steel Technology Platform (ESTEP). Steel has to be advertised as an important and necessary material for society and economy (see Steel Sector Careers posters) with and for new innovative products, being 100 percent recyclable.

Figure 25: Green Steel and Clean Steel Partnership

Additionally, beneath the global and especially the European orientation the relevance as a **regional employer** has to be highlighted by the importance for jobs and social responsibility for the region (also as a relevant player for improving education and training in the region, esp. within a Regional Training Ecosystems). Therefore, steel companies have to deal with activities that bind directly people from schools, internships and universities. There is a need to clarify how steel occupations can provide enough entry points for people with different interests, but also directly address specific target groups (e.g. increase diversity through migrants, refugees, women). At the same time, people who would never study and are locally inflexible (school drop-outs, disadvantaged people) should also be reached in order to be integrated not only into companies but also into society. This has to include continuous cooperation with (steel) universities (e.g. specific steel research programs, dual study) and VET schools (e.g. internship, apprenticeships, inhouse training for teachers) in the region, influencing new job orientation of young people (overcoming stereotypes of women and man and negative influences from parents and peer groups).

The Steel Sector Careers Blueprint already developed a series of campaign posters illustrating the digital and green transformation of the Steel Industry within renewable industries, automotive, construction, domestic appliances, electronics, and engineering. The campaign focused on showing how steelmaking is linked to many downstream industries (e.g. automotive, construction, electronics) and a majority of products that characterise people's daily life (e.g. home appliances) to increase audiences' connections with the steel industry. The communication materials (newsletter, factsheet, posters, brochure, infosheets) of the Steel Sector Careers Blueprint campaign "More Opportunities than you can imagine" are available for download in various languages[5].

Beside digitalisation also image improving activities concerning environmental issues and **community engagement** in the regional/local environment are of high importance. Within corporate social responsibility activities and regional development steel companies could support civil society at the regional/local level. For instance ArcelorMittal Poland (AMP) is continuously active in community engagement (see AMP Sustainability Report 2019; ArcelorMittal, 2019). Within up to 100 community projects with local NGOs, associations, schools, universities, health care and cultural organisations, AMP is engaged in three steel regions of Poland, contributing to solutions for a broad range of societal areas and challenges (beside environment: education, support of disadvantaged groups, safety, sports and culture), dedicated also to the related Sustainable Development Goals.

Talent Management

As the European steel industry is in a digital and green transition, people are needed to drive these changes and ensure their success – the steelworkers of the future. Especially the recruitment and retention of young qualified talents will mark the operations of the coming years, but the industry should also be open to recruiting talented people of all ages. Especially ESTEP Focus Group People is caring within its Research Agenda for the Workforce of the Future.

Therefore, ESTEP Focus Group 'People' together with EUROFER launched an EU-wide survey in 2015 answered by 268 talents identified by steel companies estimating their values, ambitions and needs (see Echterhoff & Schröder, 2015). The survey points out clearly that the talents attach importance to personal career development and progression. Talents ask for new company culture and leadership style adapted to their needs as well as support in managerial competencies. To manage skill shortages in the future, it is important to support female employees and their career and to develop related work-life-balance models (for men and women).

As the survey shows, the European steel companies are already in a good position for these demands and they have diverse instruments in place to improve practice. However, the change of values and the vision of how the steel companies will work have to find their way into the organizations. Companies have to work on topics like corporate culture to attract young talents. Existing resources in large companies ought to focus on learning, on development of talents or talent management as a whole. Therefore, a comprehensive set of measures is necessary for a great variety of needed competences (ESSA will take care of this in the further Online and Regional Training Ecosystems. Understanding change as a chance to react and adjust the industry to the talents' needs is a matter of survival in the steel industry competing with other industries.

[5] https://ec.europa.eu/docsroom/documents/37463

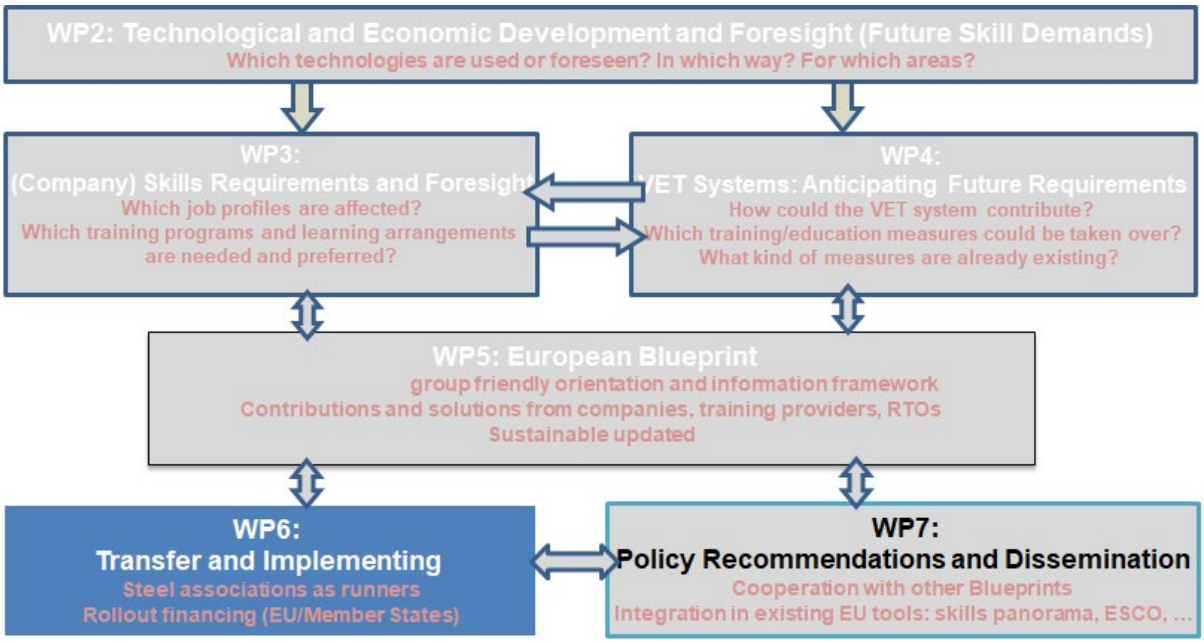
ESSA Repository for Image and Recruitment Materials

In addition to the results, studies and campaigns already described above, ESSA collected further best practice examples around the topic of image and recruitment. These recruitment measures and results are presented and collected in an online repository on the ESSA homepage. During the project duration of ESSA, the topic of image and recruitment was looked at from different angles, but the discussion once again illustrates the urgency of the topic for the entire European steel sector. Image and talent attraction are closely intertwined and of utmost importance for the success of the green and digital transformation. At the same time, transformation topics can also have a helpful effect on the topic of recruitment as well as the steel industry's image, insofar as job profiles are modernised and the need for new job profiles arises - which can make the sector in general more attractive to applicants.

In this context, ESSA is currently collecting all materials at the end of the project term in order to make them available in a structured way. The repository of best practice examples also shows the results of the studies presented above and thus also addresses the requirements of applicants. After all, it is not only about improving the image of the steel sector, but actually creating structures that make working in the steel sector lucrative and attractive. This is also the only way to ensure that applicants remain in the companies and can be retained.

The recruitment measures collected in the ESSA Repository for Image and Talent Attraction are presented in the following four categories: First, information on current **European Recruitment Events** (1) is provided. The focus is of course primarily on the steel sector, but links to events from other energy-intensive sectors are also conceivable. Ultimately, the challenges in the process industry with regard to image and recruitment are very similar, so it can be very useful to also provide best practice examples from other sectors. Furthermore, **image and recruiting materials** (2) and measures are collected and shown, for example in the form of campaigns in different formats. This mainly means best practice examples, such as films or links. Concrete **job advertising** (3) is also presented in the ESSA repository. As the fourth and last point, **talent management** (4) will also be considered - whereby the requirements of applicants to steel companies are included as well as the task of retaining well-trained personnel in the company. As already mentioned, this repository can be found on the ESSA website.

6 Transfer and Implementation of the Blueprint (WP6)



Building out of the outcomes of the previous chapters (WPs 2, 3, and 4) and their transmission into the Blueprint (WP5) transfer and implementation plans, strategies and actions were developed in close cooperation with dissemination activities and policy recommendations (WP7). The European Blueprint was implemented and transferred during its different phases, esp. since the Prototype was ready (end of 2020). Rollout (and dissemination activities, see next chapter) run from the very outset of the project and through the whole project life-cycle to ensure relevant, applicable, visible and reflected results. All project partners are involved with their access to the European steel sector.

Piloting and implementation were conducted against the results of the current and future technological and economic development in the steel industry (WP2), the related company skills requirement (WP3) and the VET system framework to support the skills adjustments (WP4) (see final version of the related Deliverables D2.1 (Murri et al., 2023), D3.2 (Bayón et al., 2023). D4.5 (Antonazzo, Weinel, et al., 2023)). Against this backdrop, the following core elements of the Blueprint were initialised and tested, and finally accepted:

- The European Steel Technology and Skills Foresight Observatory as the main European coordination unit, conducting a regular European Steel Technology and Skills Foresight Panel (ESSA ETP);
- The Online Training Ecosystem "steelHub";
- The European Community of Practice of Steel Regions (ECoP Steel), connecting and supporting steel related member states and the main European steel regions with a European platform for the different National-Regional Training Ecosystems: mutual learning by exchanging, initiating, developing, and implementing good practice for skills and training.

During the implementation and testing phase this European governance structure was already implemented and accepted by the related main steel industry actors on the European level: ESTEP, EUROFER, and industriALL Europe. The core coordination unit taking over the ESSA Blueprint and Strategy is the Focus Group (FG) People of ESTEP which has agreed to run the Foresight Observatory and Panel and to establish a European Community of Practice of Steel

Regions (National-Regional Training Ecosystems). EUROFER is supporting ESSA via its Social Affairs Committee (SAC) and industriALL via the Sectoral Social Dialogue Committee on Steel (SSDC).

In addition, the Exploitation Plan (Deliverable D6.3; Schröder, Cuypers, et al., 2023), based on the findings and results of the ESSA project and its final Blueprint (Deliverable D5.3; Schröder & Stroud, 2023), aims at guaranteeing the further and sustainable implementation, dissemination, running and development of the European Steel Skills Alliance for proactive industry skills adjustment. All the relevant stakeholder groups of the project (companies, training providers, research institutions, and associations / social partners) were integrated in the Blueprint developments. In particular, as stressed during the ESSA Final Conference, the grounds for a sustainable running and further development of the ESSA Skills Alliance is given and will be supported by all the stakeholders beyond the project funding period.

The exploitation concept is in line with the integration of ESSA activities in existing European-national steel sector governance structures (European Steel Technology Platform (ESTEP) FG People, EUROFER Social Affairs Committee, industriALL Social Dialogue Committee, national steel associations) and as much as possible connected with European (funding) programmes (namely Pact for Skills and the Large Scale Partnership Energy Intensive Industries, Clean Steel Partnership, Processes for Planet, Research Fund for Coal and Steel (RFCS), European Centre for the Development of Vocational training (CEDEFOP) Skills Intelligence).

The process of developing and further running of the ESSA Blueprint organised as a social innovation process is integrating relevant and intrinsic motivated stakeholders of different areas and provinces right from the beginning in the consortium. This led to the ESSA intervention and the setting up the European Steel Skills Agenda and Alliance with interested stakeholders, testing the developed Blueprint during an implementation phase, and setting the basis for institutionalisation and impact right from the beginning.

ESSA continues following the end of the project's funded period within the European-national-regional governance structures of the steel industry. ESSA integration in the Large Scale Partnership Energy Intensive Industries of the Pact for Skills is a further step for future cooperation and development across sectors, raising awareness of the ESSA tools and measures as well as using them as "blueprints" for other industrial sectors.

6.1 Objectives

Implementation and transfer actions at both EU and Member State level (focusing on the Steel Regions) involve all ESSA partners. Steel companies, associations, training providers and VET system institutions are in place concerning the preparation of company and national Blueprint roll-outs. Collaboration is and will be further established with other blueprint developing industry sectors: such as Automotive (DRIVES https://www.project-drives.eu/en/home), Construction (http://skills4am.eu/theproject.html), Additive Manufacturing (http://skills4am.eu/theproject.html), Skills 4 Smart TCLF Industries 2030 (S4TCLF http://www.s4tclfblueprint.eu/), SPIRE-SAIS Industrial Symbiosis (https://www.spire2030.eu/sais) and others.

Transfer and implementation have to be targeted to the respected audience and national contexts, esp. by considering the differences in national VET systems (see chapter 4). Suitable Key Performance Indicators (KPIs) for stakeholders' involvement are used in order to monitor success and adjustment needs continuously in respect of implementation of Blueprint goals

and to adjust the agenda and strategy in time to upcoming new developments and environments.

Piloting and implementation of the ESSA Blueprint Prototype followed the principle of a smart, sustainable and forward-looking integration of a proactive skills adjustment in existing governance structures of the European and national steel industry. This allowed a direct connection of social, people related innovation in the regular activities of the steel sector's stakeholders and integrate continuously the skills (and in a broader sense non-technological and social) perception in upcoming technological developments.

The exploitation of ESSA will focus on the framework for guaranteeing the sustainable running and rolling out of the Blueprint on the European level, in partner countries and beyond. The exploitation strategy aims at: (1) transferring the Blueprint to national and regional decision makers; (2) convincing and integrating end-users in the further social innovation development process to implement new strategy measures.

6.2 Methodology

Methodologically transfer and implementation activities were done as follows:

- Piloting and sustainable implementation of the Blueprint framework within the companies and its training providers: The developed strategies, training tools and methods were piloted in the involved steel companies, supported by their training providers. This was based on the Blueprint Prototype testing and improving the solutions and to look at the conditions for a sustainable ongoing implementation.
- Implementation strategy for gaining political support, mobilizing human resources and engaging stakeholders for the Blueprint and Skills Alliance: As the present education programmes aim mainly at supplying people with *ad hoc* competencies, a communication and involvement strategy was developed in order to attract highly skilled people who can train the new generations and disseminate a new steel culture. In order to mobilize highly skilled people, the most suitable learning technologies, supports and tools were tested and included in educational and training programmes. National associations were involved in the national-regional rollout in order to provide information on the project to policy makers in their own countries, in order to gain political support in each country, as ESTEP, EUROFER, and industriALL do at EU level. Strategies were elaborated engaging the main stakeholders for the Blueprint and Skills Alliance and at creating a network of competencies (ECoP Steel) supporting the educational program by eventually sharing e.g. skilled teachers, young trainees and successful practices.
- Development of mechanisms for monitoring Blueprint implementation beyond the funding period and maintaining Skills Alliance: On the basis of the KPIs and strategies developed, mechanisms and detailed procedures were defined in order to monitor the Blueprint implementation beyond the funding period (see Deliverables D8.1 (Gaušas et al., 2019) and D8.3a-c (Gaušas et al., 2020a, 2021a; Gaušas, Sadauskaitė, Martinaitis, Christenko, & Čop, 2023)). Against this backdrop, protocols and framework agreements will be defined in the Foresight Observatory and ECoP Steel in order to maintain the Skills Alliance after the project completion, by exploiting the links and interactions with national VET systems and industrial partners. For instance, planning and agreements on specific programs for training periods and exchange of researchers and high-level technical personnel will be extended beyond the project duration and procedures for continuing such activities. The Focus Group People of the European Steel Technology Platform (dealing with social and

human resources-related issues and, among its goals, aiming at attracting and securing qualified people toward the steel sector) is the coordinating and monitoring ESSA after the project completion further within its already implemented task ESSA+ via the European Foresight Observatory.

- Development of an implementation and transfer plan for Blueprint strategy: A detailed implementation and transfer plan for the Blueprint strategy was elaborated with the national steel associations, with support of all the partners. Different implementation actions (rollout workshops) were scheduled focusing on the specific national-regional actors and skills demands aiming at the involvement of new companies in the Skills Alliance, sensitization of educational institutions: such as vocational and high-schools, universities, information and involvement of policymakers at national and EU level.
- Establish mechanisms for sector skills framework rollout and maintenance for the longevity of the sector skills framework and its continued updating and utilisation, integrated in the Foresight Observatory activities. The establishment of ESSA inputs in existing committees (e.g. of ESTEP Steering Group, SSDC Steel Training Group, EUROFER Social Affairs Committee) already started at the beginning of the project and will be further institutionalised.

The rollout activities of ESSA (see Figure 26) were conducted by setting up National-Regional Training Ecosystems (ESSA RTS) in nine selected pilot regions: Czech Republic, Finland, Germany, Italy, The Netherlands, Romania, Spain, Poland, and UK (Wales). Starting with the development of a common framework, up to four national-regional workshops or round tables were conducted in each region. The results of the first workshops were used to upgrade the framework and will be used for integrating further regions (France and Austria are still missing). Against this backdrop the European Community of Practice (ECoP) will bundle all the national-regional activities for exchange, common developments and activities.

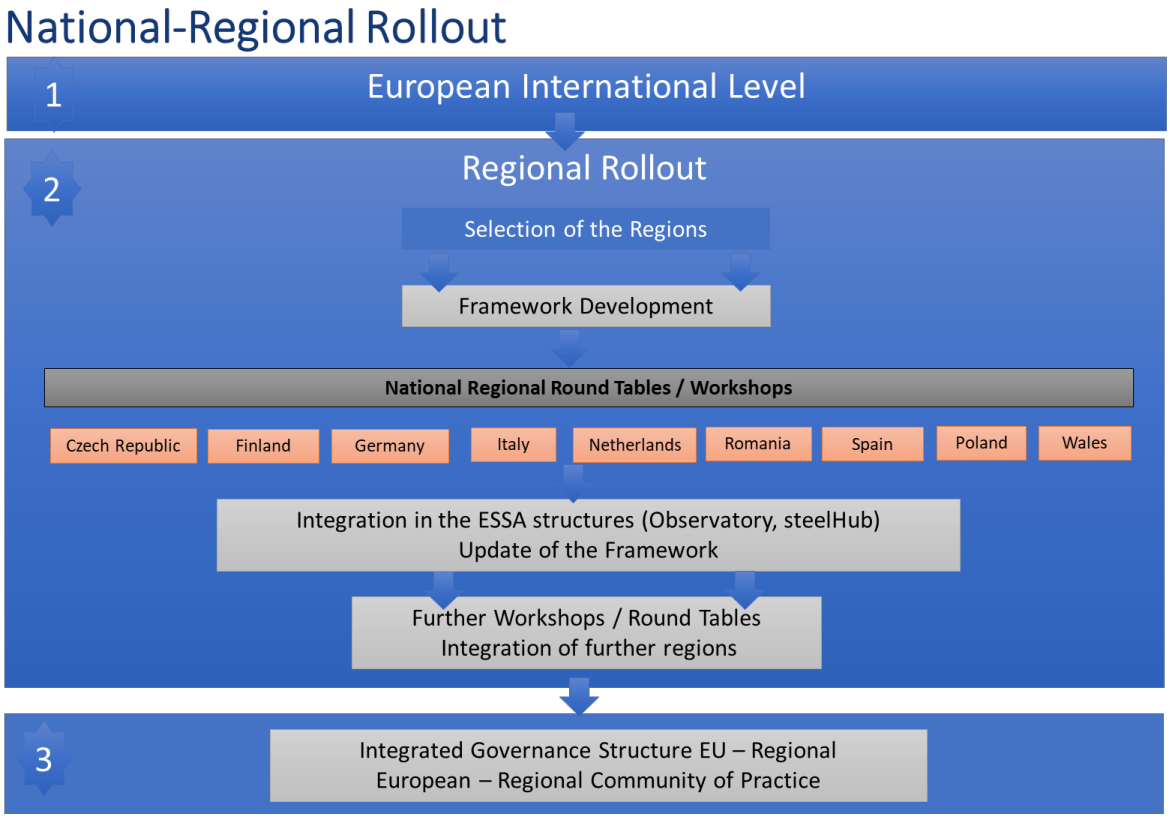


Figure 26: Rollout Concept of ESSA

The implementation of the national and regional rollout followed the ecosystem approach already used on the European level: integrating actors from economy, science and education, policy and civil society. In this regard and with the European framework and input from ESSA, the European steel regions are able to develop specific comprehensive territorial skills strategies, in line with economic, industrial, smart specialisation and innovation strategies, affecting the areas involved.

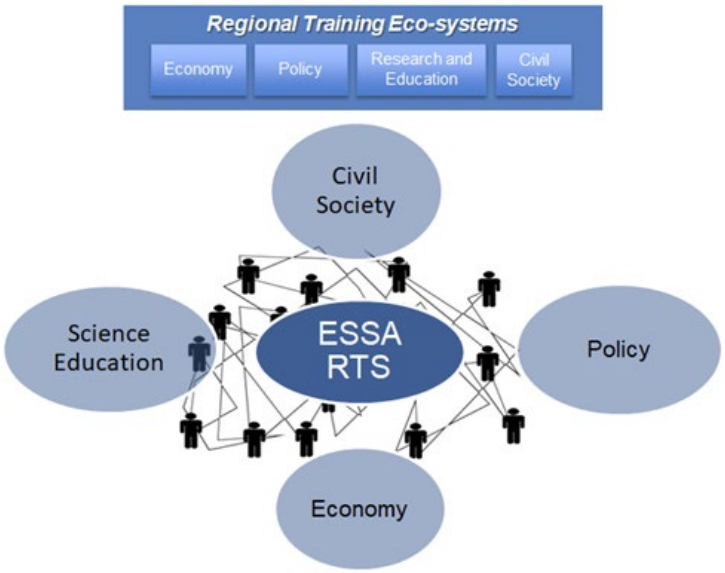


Figure 27: Ecosystem Approach

In the process to facilitate integrational developments, the relevant stakeholders and institutions at the regional level are connected along with their competences, responsibilities and cultures, by creating synergies in spending resources, and addressing the employees' professional competences, creativity, and willingness to cooperate for (see Figure 28):

- pedagogic integration: new or better learning opportunities, counselling and guidance services, new learning settings, a common learning culture, etc.
- organisational integration: common administrational or directing structures, common use of resources (staff, rooms, equipment, monitoring instruments), corporate identity
- regional integration: activities and projects which reflect local demands, central or de-central organisation of learning sites, local networking, continuous communication with politics and administration, with social partners and enterprises.

Against this backdrop, it is intended to establish specific and different steel region profiles, under the umbrella of the European Steel Skills Alliance, focusing on their specific regional demands, necessities, possibilities and involved actors.

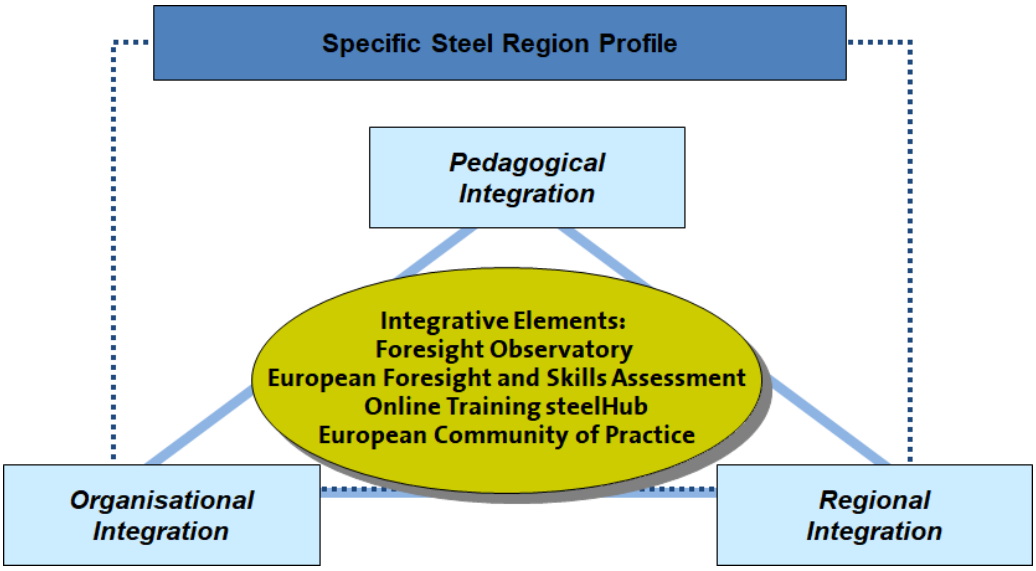


Figure 28: Steel Region Profile Elements

Finally, process and result oriented Key Performance Indicators (KPIs) monitor the stakeholder's involvement and endorsement of the Blueprint (see Deliverables D8.1 (Gaušas et al., 2019), D8.2 (Gaušas et al., 2020b, 2021b; Gaušas et al., 2022; Gaušas, Sadauskaitė, Martinaitis, Christenko, Maračinskienė, & Čop, 2023), D8.3a-c (Gaušas et al., 2020a, 2021a; Gaušas, Sadauskaitė, Martinaitis, Christenko, & Čop, 2023)). Furthermore, the exploitation strategy (see details in Deliverable D6.3) is based on:

1. Exploitation **during the project life span** via the rollout activities by focusing on countries represented by the project team. Each type of partner performed their specific exploitation activities.
2. Exploitation **after the project** to other countries and sectors, focused on integrating further steel regions and steel producing and processing member states as well as cooperating with other sectors and networks.

To monitor the exploitation, related indicators are covered already via the yearly monitoring and evaluation reports (Deliverables D8.2 (Gaušas et al., 2020b, 2021b; Gaušas et al., 2022; Gaušas, Sadauskaitė, Martinaitis, Christenko, Maračinskienė, & Čop, 2023)) during the project phase.

6.3 Results

Starting with the Blueprint Prototype (Deliverable D5.2; Schröder, 2020) the work of ESSA has been focused on deepening the aspects of national and regional outreach, in particular on establishing mechanisms for sector skills framework rollout and maintenance. Within these activities the Blueprint Prototype and its activities were aligned with national and regional activities, considering that each country has own regulations and VET systems which are different among the EU countries.

Against this background, ESSA concerns a European - National - Regional Implementation and Rollout structure. In order to provide an overview on EU level about the national outreach, a list of steel member states as well as a list of the steel associations for each country has been provided (see Figure 29), in order to involve them further in the process:

- On the European level ESTEP, EUROFER, and industriALL play a central role for the transfer and implementation of the Blueprint.

- The national steel associations are in place to support the transfer and implementation within their countries, informing their members and ensuring the link to the steel regions in their countries.
- The steel region level is of high importance for adjusting, modifying and further develop the European Blueprint in practice, due to the specific demands and actors in the different steel regions. Piloting National-Regional Training Ecosystems started supported by the European level.

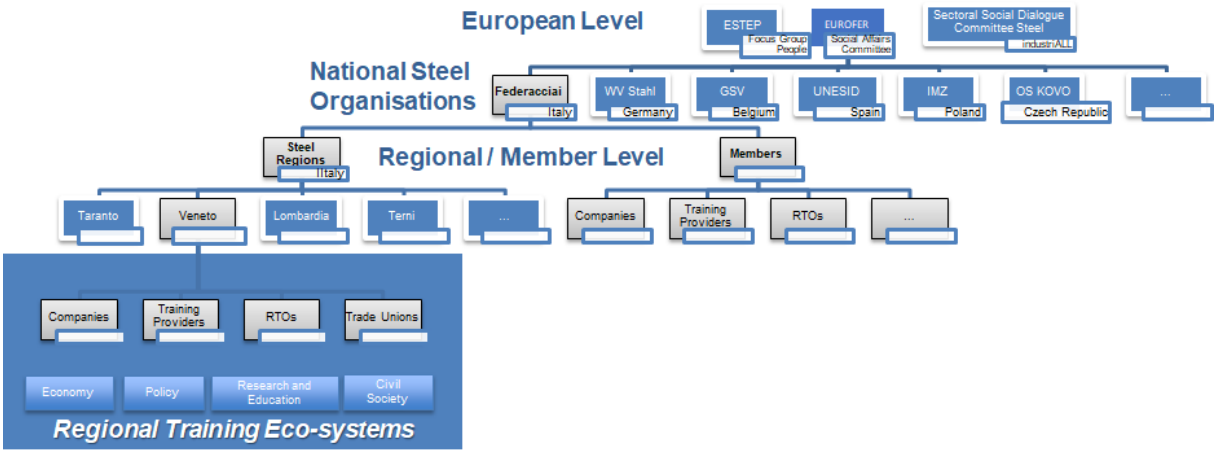


Figure 29: European - national - regional rollout structure of ESSA

With this approach ESSA is fostering alliances, collaboration and leadership on EU, national and regional levels, by including different stakeholders, such as associations, companies, training providers, unions, public authorities, and civil society organisations.

On the **European** level ESSA is linked with the European Commission's current and planned actions and frameworks: Digital Education Action Plan, Cedefop's work on skills, the Pact for skills, the Blueprints for Sectoral Cooperation, the New Skills Agenda, and others. All these initiatives of the Commission are connected with the full toolbox of the EU, including the EU semester (with country-specific recommendations to facilitate skills uptake), European funds (European Social Fund, European Regional Development Fund, Erasmus+, InvestEU Just Transition Fund, etc.) and the European Social Dialogue.

The further rollout to the **national and regional level** will be coordinated, supported and implemented by the European Community of Training Ecosystems (ECoP Steel) in collaboration with the ESSA Foresight Observatory and the European steel associations and platforms (ESTEP, EUROFER, SSDCS, and industriALL). Within the steel producing and proceeding countries there is a focus on steel regions (steel industry clusters). The selected clusters started already different specific (depending on the main regional employment, education and training, and social demands) Regional Skills Ecosystems connected with the steelHub (Online Training Ecosystem). With these main steel regions in Europe the ESSA Blueprint will support and be combined with national/regional skills approaches. A key element is the integration of companies, VET institutions, science, policy, social partners (esp. unions), public authorities, and (if possible and reasonable) civil society organisations at the regional level within the ecosystem structure and governance.

To collect and describe the main steel **regions** a template was developed to identify the main stakeholders and players to set up a Regional Training Ecosystem: listing the steel companies, training providers, RTOs and trade unions. This first collection was completed by relevant policy makers and public VET institutions as well as civil society not-for-profit or non-

governmental organisations. Against this scanning of steel regions and specific selection criteria (see details in Deliverable D6.2; Schröder, Götting, et al., 2023) the national-regional rollout activities started with:

- a quick start within a "corridor of possible developments";
- identifying new possibilities to get hold of and mobilise potential training;
- an increased potential for education to become a "location factor" for integrated national-regional-local development (e.g. including the attraction of young people to the steel (and process industry) sector).

National/Regional Rollout

During the implementation phase, European–national-regional connection nodes were identified in order to sustainably stimulate and coordinate the national-regional rollout activities. In particular, we looked for ESSA partners (including associated partners) to start and coordinate the establishment of national-regional training ecosystems. Finally, against the background of the rollout concept, the steel regions analysis and the defined selection criteria, nine representative steel regions were selected for a first rollout to the member states and steel regions. Instead of the solely regional perspective a combined national-regional approach was developed, due to the recommendation of the national stakeholders to start in some countries with an integration of the main national stakeholders (from educational authorities, employment and economic agencies, unions). In particular, the rollout processes started on the:

- national level in Finland (because there is no specific conglomerated steel region)
- national-regional level in Czech Republic, Germany and Spain (combining national and regional perspectives)
- regional level in UK (Wales), Italy, Poland, Romania, and the Netherlands (concentrated steel regions).

With national-regional workshops and round tables we rolled out the European results, tools and measures of ESSA within the following steps:

1. Developing a common Framework for the National-Regional Workshops;
2. Conducting a first round of workshop in the pilot regions (autumn 2021): Information, verification of interest, willingness to participate of stakeholder groups in the dedicated region (companies, trade unions, training institutions, research institutes, public employment and education institutions, and civil society);
3. Review of experiences, development and events and integration in the ESSA structures, tools and measures (beginning of 2022);
4. Conduction of further in-depth workshops with specific topics that were raised in the pilots (round 2 and 3), supporting the further activities within a social innovation process (spring / summer 2022);
5. After focusing on the eight pilot regions an integration of other regions is foreseen (spring 2022), conducting first workshops in the new regions (summer 2022);
6. Setting up of a European-national-regional European Community of Practice for supporting National-Regional Training Ecosystems, exchanging good practice and mutually learning from each other (from 2023 on).

Concerning rollout activities, all the ecosystem developments were different, depending on the composition of the actors, the defined priorities and processes, and the specific regional demands. Specific national-regional/local activities were launched, reaching more than 100

additional external stakeholders for our Skills Alliance (companies, training providers, education, public authorities, national employers' associations and unions, research institutions, universities, vocational schools, civil society organisations, and others).

Based on the national-regional challenges the following topics were discussed for specific national-regional solutions, to be supported by ESSA measures and tools:

- Recruitment problems / the poor image of the steel industry
- Need to attract female and new talent
- Unattractive job profiles for new people
- Shortage of skilled students
- Disconnection between formal training and companies' requirements
- Poor relationships among Companies, Universities and Public Administrations
- Introduction of new technologies and the decarbonization topic
- Consideration of the SME perspective
- Need of the steelHub in all the languages of the selected regions

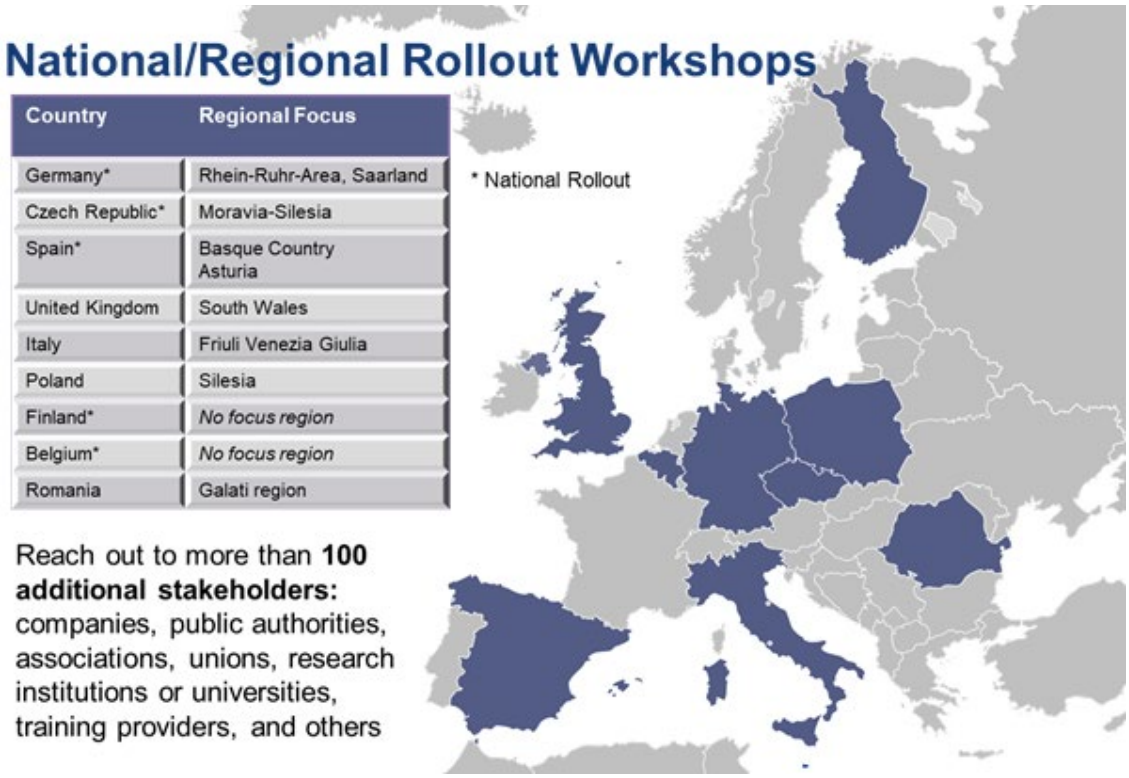


Figure 30: Overview of ESSA National/Regional Rollout Workshops

The main topics discussed in the workshops and round tables of the different National-Regional Training Ecosystems are as follows:

The **poor image of the steel industry** as a declining industry, polluting the environment and offering arduous manual labour causes low participation of young people in technical schools but also of recruitment problems. *Suggested solution approaches*: rebuilding a positive image of the steel industry in the minds of the public and decision-makers; coordinated campaigns to change the image and develop and disseminate new narrative; highlighting the steel industry's sustainability and transformation efforts while looking at the steel industry as a solution for climate change, attracting and asking (young) talents to take part in the transformation; creating new channels of access to this sector; showing more presence in schools and

universities; presenting the "new steel industry 4.0" changing the view of the general society (e.g. stable employment, good labour conditions, etc.).

As the steel sector is a male-dominated industry, initiatives for more **involvement of women** are already carried on (e.g., the “WomenOfSteel” podcast to attract female engineers). *Suggested solution approaches*: developing a communication strategy to involve current women to encourage other woman to work on steel; more incentive for the women involvement; valorising the female perspective; promoting the application of Industry 4.0 technologies that can help in gender equality.

A still outdated corporate culture of the steel companies with partly outdated hierarchical structures and **unattractive job profiles for young people** was also highlighted. *Suggested solution approaches*: more efforts to attract young applicants related to their demands for work (low hierarchies, new leadership, work-life balance, etc.); the adaptation of job profiles against the background of the digital and green transformation (industrial symbiosis, decarbonisation, circular economy).

To overcome the **shortage of skilled students** due to the low interest of young people in the steel industry and in Vocational Education and Training in general (academisation) as well as to the lack of proper career guidance, some measures were outlined in the rollout workshops. *Suggested solution approaches*: promoting the attractiveness of work in the steel industry and career opportunities; regular cooperation among companies, training administration and VET system; developing new job profiles related to green and digital technologies; modernising old job profiles against the background of transformations; promoting STEM-related courses of study; increasing targeted internships and hours dedicated to alternating school and work; improving the knowledge of parents/families about the attractiveness of the steel sector as an interesting and future-oriented workplace; increasing the integration of underrepresented and disadvantaged target groups (women, refugees, migrants, etc.).

The **disconnection between formal training and companies’ requirements,** due to the lack of communication between steel companies and vocational education and the lack of vocational teachers, was also highlighted. *Suggested solution approaches*: improving the VET system by networking among training institutions and academies of companies (e.g. in Italy); closer interactions between companies and high and VET schools; retraining apprentices onsite after college training, especially for manual and practical skills; consulting process by asking workers about their needs and concerns; workers participation in lifelong learning in companies, not only by and in the companies but with the support of social partners and policy.

The **poor relationship among companies, universities and public administration** and the need for public support was underlined. *Suggested solution approaches*: the need of a public support; improving cooperation between the steel industry and the education authorities to update curricula; fighting the stereotype that vocational schools are attended by weaker students; a more flexible training system, including programs, initiative, publics funding according with company’s needs, without enormous bureaucratic barriers; more interaction with policymakers; revision of the standard professional profiles at the regional level (e.g. in Italy); putting new contents into existing profiles by policymakers; support from Educational Public Administration (VET/Higher Education) and to carry it out on the national rollout (e.g. in Spain).; stronger government support to vocational training activities, technological education (e.g. in Czech Republic).

In addition to many commonalities, the rollout workshops also highlight major differences - not only between different states, but also within states, between individual regions as well as

between individual companies. For example, emigration is seen as a major challenge in some countries, while other countries benefit from immigration and thus gain new potential workers. At the same time, there are major differences within countries with regard to the challenges in rural regions compared to metropolitan regions. Labour shortages are particularly pronounced in rural regions, also because potential applicants and workers often emigrate to metropolitan regions. It is also evident that the challenges of small and medium-sized enterprises are very different from those of large corporations. Therefore, targeted measures for SMEs are also necessary.

Against the backdrop of these challenges, support and **help of ESSA and the usage of its steelHub** was highly appreciated. *Suggested solution approaches*: engaging the relevant stakeholders and to offer a platform to rethink the way education and training are intertwined with current economic and technological developments; connecting ESSA with regular national-regional workshops or meetings to exchange the necessities of training and to forward a competitive training to steel industry; the Online Training Ecosystem steelHub tool is an important part of the learning process in educating professionals for the steel sector; further information about opportunities to use steelHub online training services, and how to involve the national-regional steel industry and VET actors and existing and forthcoming regional steel training ecosystems.

Most of the big steel companies do have strong relationships with the regions they are placed in. Corporate Social Responsibility activities (a) show the responsible corporate conduct towards environment, employees and other stakeholders going beyond legal requirements; (b) lead to new business strategies, cross-sector cooperation, stakeholder integration and interaction; and (c) are the starting point for new problem solutions and approaches - within the company and in the local, regional environment. In this context, the regional cooperation within a Regional Training Ecosystem of all the willing stakeholders from different sectors (industry, policy, education and research, and civil society) will raise a win-win-situation improving r**egional development**.

The central results of the rollout workshops in the respective countries are presented in detail in Chapter 4.3 of Deliverable 6.2 “Piloting and Implementing the Blueprint”. It is focused on the general description of issues in the countries, the question of which stakeholder groups contributed and which challenges and approaches to solutions were discussed in the course of the workshops. Even though there are many overlaps with regard to the prioritised challenges in the individual countries and regions, the topics are differently handled, showing different priorities and approaches for solutions. Starting with the Tata Steel Ijmuiden in the Netherlands, as a kind of reference model for an already successful regional Ecosystem, the specific results of the workshops in Germany, Czech Republic, Spain, Wales, Italy, Poland, Finland, Belgium, and Romania are summarised.

European Community of Practice for National-Regional Skills and Training Ecosystems (ECoP Steel)

Due to successful national-regional processes, ESSA is setting up a **European-National-Regional Community of Practice (ECoP Steel)** for supporting the existing and establishing new National-Regional Training Ecosystems. Within this EU-wide network, national-regional ecosystems will share knowledge, tools, strategies and good practice, learn from each other, support each other, and conduct common research and development to improve the steel regions. In addition, the ESSA ECoP Steel will catalyse regional collaboration on the European level (within the Foresight Observatory) to develop the training solutions within the local context by connecting the steel regions and its regional stakeholders, using synergies to accelerate

the progress. This exploitation will be coordinated, supported and implemented by the ESSA Foresight Observatory in collaboration with the European steel associations and platforms, also involving the national steel associations and unions. Within the member states a focus on steel regions (steel industry clusters) is key. These clusters are the basis for different specific (depending on the main regional employment, education and training, and social demands) Regional Skills Ecosystems also connected with the steelHub (Online Training Ecosystem). The ECoP will inform the work of the European Foresight Observatory as a junction for improving skills adjustments proactively together, learning from each other, and pushing both technological innovation and qualification of the workforce forward in a common manner, to the benefit of each other.

Further developments of the ECoP were outlined during the ESSA Final General Assembly and the ESSA Final Conference. They are related to the structure, content and possibilities of such Community of Practice as well as the possible governance of the Community of Practice within ESTEP FG People and the steelHub online platform. The main objective of ECoP is to set up a **platform** for sharing best practice, common goals and information, connecting and coordinating the rollout of nations-regions to aligning and sharing their experience. It will include **strategies for skills development** and **strategies for networking**, and it is crucial to define the end-users of the contents clearly.

The combination of the regional and national level with the European Steel Skills Alliance and Agenda will lead to plan a cooperation within the ECoP of Steel Regions and how to connect the ECoP with the rollout regions. Finally, to manage the ECoP in a sustainable way its integration in the ESSA Foresight Observatory has to be checked as well as its related governance.

However, the ongoing exploitation of ESSA after the project lies in the hands of the ESTEP FG People, by an incorporation of the exploitation in the ESSA governance within existing steel sector structures (ESTEP FG People, EUROFER Social Affairs Committee, industriALL Sectoral Social Dialogue Committee on Steel) and in steel related European programs (Clean Steel Partnership, Pact for Skills and the Large Scale Partnership Energy Intensive Industries, Processes for Planet, Research Fund for Coal and Steel). This approach includes also an engagement in new European innovation activities (i.e. New Skills Agenda, Industry 5.0, and the New European Innovation Agenda (NEIA)).

The already existing background for the exploitation and sustainability of ESSA involves the European steel community, the related partnership, and the ongoing activities within the established ESSA governance (i.e. Foresight Observatory, and its Technology and Skills Foresight Radar, Online training platform steelHub, and National-Regional Training Ecosystems and the related European Community of Practice (ECoP Steel)).

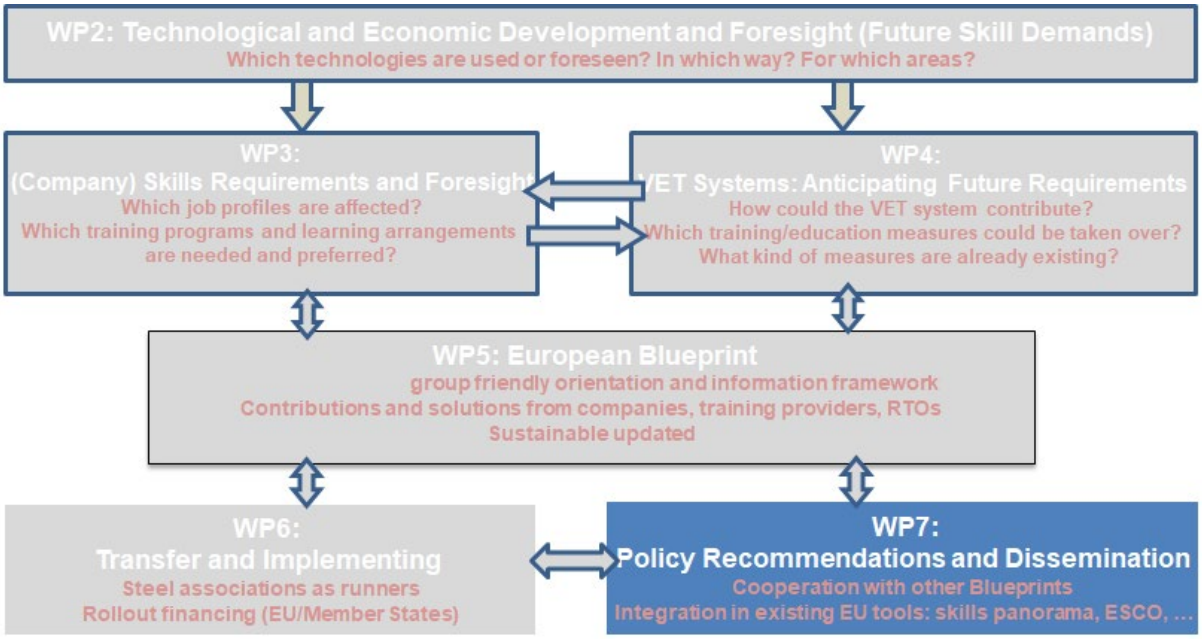
Integration in European Activities of ESSA

The national-regional rollout activities are coordinated via the European level. ESSA is already integrated in the main European and national steel industry activities related to skills. In addition, cooperating and informing European programs and concepts took and will take place further, especially related to the Pact for Skills and the European Year of Skills, skills for Industry 5.0, Skills Intelligence, ESCO, Processes for Planet, Clean Steel Partnership and RFCS. The ESSA Blueprint was also developed as a possible blueprint for other industry sector. In particular, discussions took and will take place for instance with DRIVES, SPIRE-SAIS, the new chemical Blueprint run by ECEG, ECoP Europe and H4C, Construction, Skillman.

The **Large Scale Partnership Energy Intensive Industries (LSP EII)** is a central element of the further exploitation of ESSA. It aims at integrating both the European Steel Skills Alliance and Agenda ESSA and the Skills Alliance for Industrial Symbiosis SPIRE-SAIS. This cross-sectoral Skills Alliance will address the challenges of European digital and green twin transition and complement it by the social transition of the SPIRE-SAIS and ESSA industry driven Skills Agenda, and Strategy for an ongoing and short-termed implementation of new skills demands in sectors. The LSP EII is built on a Blueprint strategy for human capital and skill development through a **Cross-Sector Skills Alliance of Process Industries,** already developed within a (social) innovation process of ESSA and SPIRE-SAIS. It involves a broad range of key stakeholders from the included sectors: companies, associations and social partners, education and research institutions, policy and civil society organizations. Based on this, both strands further under a common umbrella will be developed, by integrating new (non-Blueprint) members and addressing further skills demands and related training solutions.

7 Dissemination, Legislative Framework and Dissemination (WP7)

Policy recommendations and dissemination activities are informed by the results of all the former ESSA activities (work packages results) described so far. This includes besides the distribution and proceeding of results in the steel sector also the cooperation with policy makers, other sectoral Blueprints as well as the integration of ESSA results in the existing EU tools and platforms (such as Skills Panorama, CEDEFOP, ESCO, and others).



7.1 Objectives

Based on the ESSA results and activities a dissemination strategy was developed and related activities were and will be conducted and monitored during the whole project duration and beyond. Additionally, based on the impressions of the activities carried out in the different areas (work packages) and according to the Blueprint framework, policy recommendations were defined and structured basically in form of practical guidelines. Having this said, it becomes evident that there is a close **connection of dissemination and rollout strategies and activities**.

The ESSA approach includes the analysis and compliance of the recommendations with the different legislative frameworks at national and European level. This will allow to exactly identify the policy makers and stakeholders (which are not already part of the ESSA consortium) and to address the defined guidelines in an effective and targeted way.

Main objectives of this work package are:

- To spread and discuss the ESSA findings in a broader sense in the whole steel sector (including SMEs) but also within related industries and environments (e.g. within the SPIRE public-private partnership of energy intensive industries);
- To identify, implement, secure and promote necessary political support measures by mobilising and integrating stakeholders and policy makers of the EU and national level;
- To secure the roll-out of the Blueprint in the steel relevant member states;
- To improve the public image of steel industry as a modern, high-tech, digital, sustainable and green industry.

Concerning dissemination (and the rollout activities) we obtain to:

- Raise awareness;
- Extend the impact;
- Engage stakeholders and target groups;
- Share solutions and know how;
- Influence policy and practice;
- Develop new partnerships and alliances.

7.2 Methodology

Dissemination and policy recommendations are placed by the "Blueprint for a sustainable, steel industry driven and coordinated European steel skills agenda and strategy for an ongoing and short-termed implementation of new skills demands" as the main ESSA "branding". Dissemination and policy recommendations of the European Steel Skills Agenda and Alliance for the Steel Sector and EU institutions and national/regional policy makers was and will be defined and done (a) based on the main findings of the ESSA activities (described so far) and (b) considering the perspective of the targeted stakeholder groups. A set of recommendations and dissemination activities are and will be defined in order to enhance the cross-border approach involving relevant national, regional and local players, mobilising and integrating stakeholders toward Blueprint aims and objectives. Recommendations were defined to stress the cooperation among them, each one with its own peculiarity and mission.

- Key target groups – the main focus of **dissemination** activities - are:
  - Education and training institutions: align offered VET skills sets, reach mutual added value by cross-fertilisation of education and training programs, complementing curricula mutually with skill offers.
  - Learners / students: support teachers and other staff of education and training institutions in the above activities.
  - Companies: focus on job role-based certification and job role-based training.
  - Workers: support companies in the above activities.
  - Policy-makers: ensure there is no administrative, legal or any other barriers for the implementation of the strategy at national and regional levels.
  - Associations and social partners: encourage education and training providers, companies and their peers (e.g. social partners at lower level) to uptake the blueprint.
- Secondary target groups:
  - General public: showing the attractiveness of the steel sectors' future technical development; looking attractive to young people or those willing to change activity by upskilling engagement.
  - Press and media
  - Academics
  - Stakeholders of other sectors related to the steel industry

Political support will be essential to assure an effective adoption defined **policy recommendations** and for the rollout of ESSA to the steel regions. The strategy will is focused to involve the main European and national stakeholders according to their institutional mission or field of interest. Dedicated events (e.g. meetings or seminars) and publications were made to present the Blueprint results and to share the most suitable measures to give political and technical support to policy makers and stakeholders in the member states.

The impact of technological and economic developments (mainly dedicated to Industry 4.0 technologies and visions) aligned with respected skills demands and training support is also analysed in order to individuate the working positions more susceptible of intervention. The use of examples, taken from the reality of the Steel industry working conditions and case studies focused on the most representative situation are encouraged and the importance of actions to be taken for the benefit of the whole society are highlighted.

To accomplish the goals of the blueprint the political support is essential. This includes that the legislative context, both at European and at National level, must be considered with particular reference to the compliance of the policy recommendations with European and national legislative framework. The aim is to ensure that the main rights of the workers (i.e. health and safety at work, equal opportunities for women and men, protection against discrimination based on sex, race, religion, age, disability and sexual orientation, etc.) are respected.

Another important aspect covered is related to the working conditions contained in the labour laws (part-time work, fixed-term contracts, working hours, employment of young people, informing and consulting employees, etc.) and in the companies due to new working conditions (e.g. homeworking, work-life balance, remote working and learning. The items to be considered are then several from binding legal instruments (regulations, directives and decisions) to non-binding instruments (resolutions, opinions), company related programs, up to other instruments (EU institutions' internal regulations, EU action programmes, etc.).

However, policy recommendations will be realised in form of practical guidelines organized in a final version.

7.3 Results

7.3.1 Dissemination

"A good dissemination plan will share the concrete results of the project; not just inform people that the project has taken place" (Erasmusnet.org)

The dissemination started already shortly before the official project start and went on while the policy recommendations were developed based on relevant ESSA results, esp. the Blueprint Prototype. A dissemination strategy was developed and implemented early on to spread the project results. A suitable approach was also chosen to transfer the recommendations to policy makers, industry associations, social partners, and national Vocation Education and Training institutions (see see below, in the form of policy workshops).

The dissemination strategy comprises a mix of dissemination activities to achieve project visibility, the contents of which are geared towards the intended audience:

- The (public) ESSA website (www.estep.eu/essa) is part of the homepage of the European Steel Technology Platform (ESTEP) to ensure sustainable run after the project duration. The website reports the project's progress and results with news and newsletters, deliverables and event information (esp. list of current recruitment events).
- Project leaflet both in paper and in electronic form were published in English, Polish, French, Italian, Spanish, and Czech. Videos and simulations to illustrate main outcomes are considered for the final results. In the final part of the project life, before the final conference, a new project leaflet was published to provide updated information on the project background, main objectives, governance and sustainability structure, steelHub, rollout phase.

- ESSA approach and results were presented in more than 80 seminars, conference, and other events, due to the accessibility to them by the consortium (and associated partners) with a focus on involving stakeholders and policy makers (e.g. the Sectoral Social Dialogue Steel, the Social Affairs Committee of Eurofer, ESTEP Support and Working Groups, European Steel Day).
- After the intermediary (May 2021) a final conference (May 2023) has been organised in Duisburg; at thyssenkrupp Steel Europe plant presenting the results to the most important stakeholders at European level for the steel sectoral European Commission representatives. A final workshop has also been organized to present the final results obtained focused on the policy recommendations with inviting interlocutors belonging to the political, industrial, research and academia world.
- A specific focus on SMEs has been included in the policy recommendations, in order to overcome the barriers that this specific type of company faces in its day-to-day work with regard to access to training courses for the various professional figures in the company - often not significant in quantitative terms - and, more generally, to access to information on the vocational education and training system
- Scientific publications, contributions to conferences, publications in magazines has been developed. In particular, 32 articles on the ESSA concept and results have been published or are in the process of publication; more articles will, we are sure, disseminate the current and future results of ESSA.

The partnership includes a complementary mix of strategic partners, including all the relevant stakeholder groups of the European Steel Industry. Not only for dissemination but transfer and exploitation all partners collaborate in the dissemination activities according to the type of organisation (industry, academia, steel association, etc.) by taking advantage from the networks they are engaged in, coordinated by a communication officer also in charge of social media posts. Most of the main steel producing Member States are represented directly in the partnership, missing ones are directly involved by the global steel companies (esp. ArcelorMittal, Celsa Group), EUROFER (and IndustriALL as associated partner). Implementing a new Skills Alliance Strategy and Blueprint is the main driver of the ESSA consortium and dissemination and promotion measures.

Particular attention has been paid to the development of a dedicated section concerning the Recruitment Events, which is continuously updated at the ESSA website with upcoming (and past) events.

ESSA website (www.estep.eu/essa) has been set-up at the beginning of the project within the ESTEP homepage to ensure sustainability. It is and frequently updated with relevant project internal and external news, in order to create an interactive collaboration among the partners, stakeholders and policy makers. A specific section of the project website is devoted to the list of documents generated by the project, with a pdf version, including the ESSA newsletters. Digital newsletters (but also printable) have been published to disseminate the project results of the different deliverables.

There is also a “hidden” dissemination result concerning the wide knowledge that the project has achieved in Europe thanks to all the work done, considering the high amount of person, professionals, teachers, VET providers, national and regional public and private institution and stakeholders contacted at different level and interviewed along all the work done (and to do in the future).

Furthermore, the strictly cooperation with the “Steel Sector Careers” Blueprint has led to a wide dissemination with a multiplying effect on the ESSA project knowledge due also to the participation of partners and persons also cooperating in both projects.

A lot of dissemination activities spread the news about ESSA, but since spring 2020 the COVID-19 pandemic has completely blocked many dissemination events, meetings, workshops and other relevant occasions to spread the ESSA results and achievement. The dissemination strategy and the events already planned starting from the first months of 2020 have been reorganized as online events or postponed. ESSA partners obtained from other online events relevant inputs for the Blueprint (e.g. the Steel Sector Careers final conference, ESTEP seminars). However, the ESSA consortium has preferred to postpone some events (e.g. Intermediary Conference, ESTEP Workshop) considering the characteristics of the event; e.g. because of the need of alliance building, personal exchanges and commitments and the need to meet people in person to discuss in the most effective, creative, interactive and dynamic way the ESSA results and future activities.

ESSA's dissemination activities of all partners ensured the distribution of results to stakeholders, steel companies and potential institutional stakeholders through the usual measures such as web pages, brochures in different languages, thematic newsletters and social media activities that achieved very interesting results in terms of post views, especially for LinkedIn, but also collaboration with other Blueprints and industry sectors. The workshops and events, which in the pandemic years were mainly held remotely, but in the last year in a hybrid manner, were not only held to disseminate the ESSA results, but were used strategically to discuss the ESSA results and complement the current discussion on the demand for digital and green skills. The same rollout phase in which the project was presented in the different European target countries and in others not previously planned was the purpose and subject of the dissemination carried out before and during the meetings. With this in mind, the ESSA Final Conference, held in May 2023 in Duisburg at thyssenkrupp Steel Europe and in online mode, was not only a due achievement for the ESSA project, but also a very important final dissemination event (given the high number of participants and the quality of them) and, above all, an important moment of further growth and finalisation of the implementation of the ESSA Alliance, Strategy and governance structure, which will lead to an effective impact for the project in terms of its sustainability after its natural end date of 30 June 2023 and the effective integration of its results into the systems.

The used methodology led to:

- A pro-active, targeted and direct dissemination and exploitation strategy, aimed specifically at decision makers and HR stakeholders of the steel industry, but also aimed to connect the project related to affiliated sectors (e.g. Automotive, Construction, Advanced Manufacturing), are implemented.
- A common visual identity of the project (logo) and related branding and marketing strategy.
- Raising awareness in the steel sector and beyond (other industry sectors, employment agencies, VET and employment institutions, and others), sensitising and engaging key stakeholders.
- Engaging existing networks and platforms (e.g. SSDCS, ESTEP, European Steel Day, EUROFER, Sector Skills Councils, the national steel platforms, IndustriALL, etc.) for feedback, inputs, dissemination and exploitation in a continuous way. These platforms are the arena for maintaining the Blueprint profile and disseminating the message to all companies and sector stakeholders/decision-makers at the local, regional, national and European level.

- Continuing dialogue with policy makers to facilitate rollout of the blueprint.
- Influencing policy and extending impact: ESSA got already the award as a project with highest social impact from University of Deusto (see table below), The policy recommendations of the project (D7.1) are and will be tools of real influence in future policy choices concerning training in the steel sector but more generally of the VET system in the different levels at which they were developed (EU level, national and local) and will be able to ensure more and more a social impact of the project results through mechanisms of involvement of the different actors of the VET system and stakeholders with the aim to update and improve skills and competences of the steel workers, to provide the system with an increasing competitiveness to the overall European economy and to the people working in this sector so important for Europe.

The Label Deusto Research Social Impact recognises research projects that demonstrate a potential social impact through: • the transforming action and social impact for the people, entities, the environment and the society in general in alignment with the Sustainable Development Goals, the European policy priorities and/or the Basque Country RIS3 Strategy (or other relevant policies linked to the main project theme); • the involvement, at different levels, of non-academic agents; • the project's contribution to the knowledge field beyond the scientific impact, giving evidence of adoption, uptake and exploitation of the results by the relevant stakeholders, and of dissemination of project results to the target group(s)	

Table 7: DEUSTO Social Impact Award

7.3.2 Legislative Framework

The European Commission is aiming to shift to a human-centric orientation in the workplace. For this purpose, as mentioned above, the Commission has been actively building directives, frameworks, action plans, and communications to ensure the main rights of workers, such as health and safety at work and equal opportunities for women and men. The Commission aims to avoid discrimination based on sex, race, religion, age, disability, and sexual orientation and to improve the working conditions contained in labor laws, including part-time work, fixed-term contracts, working hours, and informing and consulting employees. In addition, member states support the EU-level directives created by enacting complementary national-level legislation (an overview of the relevant legislative framework could be found in Deliverable D5.3 Annex 4 (Schröder & Stroud, 2023).

European steel industry's aim/importance being human centric orientation

The aim and approach of the ESSA project are completely in line with the philosophy of the EU and national-level legislation. Therefore, the policy recommendations created by ESSA, which are presented in this deliverable, align with these directives.

The ESSA project asserts that the ongoing green and digital transformation of the European steel industry should be led by science, technology, and innovation. Moreover, it emphasizes that this current transformation should also be based on social consensus and a human-centric orientation.

The European steel industry aspires to be not only a sustainable and resilient industry but also to have a human-centric orientation. It aims to develop technology and organizational structures that prioritize people and enable the industry to address societal challenges.

ESSA and human centric policy

The ESSA project aims to enable evidence-based and long-term management of the European steel workforce and its skill needs. To implement a human-centric European steel industry, ESSA constantly emphasizes the importance of an inclusive working environment and an empowered workforce strategy. It underscores that building such a working environment is not possible without enabling policies and regulations on working conditions, health and safety, gender equality, and workers' rights.

ESSA underlines the importance of preserving and enhancing sector competitiveness, as well as avoiding skill shortages in the future, by attracting qualified and motivated future employees and preserving the current competitive workforce. First and foremost, it is essential to proactively respond to the needs and expectations of talented individuals (both professionally and personally) by developing suitable work-life balance models. A working environment that provides optimal working conditions, ensures the main rights of workers regarding health and safety, avoids discrimination based on sex, race, religion, age, disability, and sexual orientation, and guarantees secure employment with good economic opportunities, is a key factor in choosing an employer. ESSA emphasizes that highlighting the positive opportunities and career prospects in the European steel industry would be impossible without securing the rights of workers and enabling optimal working conditions for them.

ESSA also asserts that it is impossible to highlight the positive opportunities and career prospects in the European steel industry without securing the rights of workers and enabling optimal working conditions for them.

7.3.3 Policy Recommendations

The policy recommendations are presented as general recommendations. Secondly, we offer policy recommendations by levels: European, national and regional, in order to provide further contextualisation. Thirdly, we present some recommendations related to the specific support of small and medium-sized enterprises (SMEs). In particular, we recommend (see detailed recommendations in Deliverable D7.1 Policy Recommendations; ESSA, 2023aKlicken oder tippen Sie hier, um Text einzugeben.):

- **An Ecosystem Approach and Social Innovation Processes.**
  Skills Alliances should engage all the relevant and willing stakeholders
- **Sectoral specialisation through CVET.**
  Continuous Vocational Education and Training (CVET) provision to be made more relevant by tackling specific technical skills gaps
- **Encourage training modules focusing on or integrating transversal skills.**
  Transversal skills are of high importance to manage recent and upcoming challenges at the workplace and necessary to encourage national and local stakeholders to adopt and develop training

- **Promote the importance of informal and non-formal education, with a focus on mentorship. Encourage companies to facilitate knowledge transfer.**
  Knowledge transfer has been identified as a key challenge, with necessary know-how often acquired through on-the-job learning and mentoring
- **Implement new instruments for new skills in the green transition.**
  During the green transition it is necessary to preserve the high-quality jobs in the steel sector and secure the contractual conditions, by ensuring the viability and competitiveness of the steel industry
- **Recognising and Promoting Equality and Diversity.**
  A central challenge for the industry is to address questions relating to Equal Opportunity and Diversity
- **Give visibility to high-skilled positions, with task variety and modern career paths in the steel industry.**
  The requirements of digital skills necessitate this focus and growth opportunities are attractive to new talent
- **Nourish an innovation culture at all level.**
  Training offered to workers should go beyond responding to ad hoc needs and foster a culture of change and innovation
- **Integrate the industry with online training platforms (e.g. ESSA steelHub), combining online platforms with on the job training.**
  Integration with digital technologies should allow learners to take advantage of remote learning, interact with simulators, and practice with hands-on laboratories
- **Investments in Industry 5.0(2) activities can produce benefits both for workers and companies**.
  This approach could be implemented to empower workers and to evolve skills and training needs of employees
- **Emphasise the prominence of steel in every aspect of modern society and address the industry's image.**
  A multilevel and systematic image campaign is suggested by making a large use of mass-media and social media

At the European Level:

- **Establish a reliable governance structure to engage stakeholders within the Steel Alliance, and provide a platform for engaging further stakeholders.**
  A governance within existing European steel industry structures is crucial, including a Technology and Skills Foresight Radar (Foresight Observatory), an online training platform, and a European Community of Training Practice
- **Engage with European programmes, tools and activities.**
  It is recommended to take advantage for example of ECVET for mobility opportunities managed by external VET providers/schools or employer mobility schemes

At the National level:

- **Engage with national VET system institutions and national programmes**.
  Steel companies and sectoral representatives need to engage with the VET system stakeholders to integrate their immediate and future skills and qualification demands in the curricula directly and urgently. Adjusting sectoral qualifications and occupations in national catalogues is key to attract talented people

- **Encourage workers to make use of national schemes for validation of prior learning.**
  To follow CEDEFOP recommendations on recognition and validation of non-formal and informal learning
- **Align internal company provision with national/ European frameworks/benchmarks**.
  It is recommended that steel companies align their activities with national standards (e.g. sectoral qualifications and occupations in national catalogues)

At the Regional level:

- **Link steel companies and stakeholders at the regional level.**
  Steel companies and key stakeholders in the regional context must be active in the monitoring, identification and development of the skills needed in the steel sector. In addition, create tools and fora for dialogue with public and private institutions in the VET sector
- **Lobby among steel companies and stakeholders at the regional level.**
  Our comparative study of VET governance in the case study countries points to the regional level as the most appropriate level for companies to lobby at within an ecosystem approach

Finally, recommendations related to SME support are:

- **Human Resources and Training support.**
  The SME perspective should be integrated in the Foresight Observatory on labour market trends and skills prospects
- **Support SME capacity to access quality training.**
  Training in basic and advanced digital skills, cybersecurity and environmental regulation is necessary for SMEs
- **Specific training for SME managers**.
  Raise awareness of the opportunities of technological innovation, Industry 4.0 implementation, and new business strategies
- **Regional SMEs clusters to be identified.**
  The European Community of Training Practice (ECoP Steel) could offer steel SMEs an efficient networking platform

We conclude that transforming the steel sector requires a collaborative approach, a bottom-up process of social innovation, the identification of national and regional potential and the involvement of all relevant stakeholders in a governance process. We view the implementation of these recommendations as necessary for developing a resilient industry with modern skills that is attractive to highly skilled people.

In order to facilitate these policy recommendations, we allocated them to specific stakeholders to bring them into action (see Deliverable D7.1 Policy Recommendations; ESSA, 2023aKlicken oder tippen Sie hier, um Text einzugeben.).

8 Summary and Next Steps

Screening (technological) innovative projects and combining theoretical excellence with practical knowledge and experience has produced new insights for skills development: Company based job profiles and job families as well as a template to assess future skills demands against the background of job profiles and skills classification (based on T-shape skills) are combined with the occupational profiles of the ESCO database and its future development against transversal skills – aiming at a common skills understanding across the EU steel related Member States and aligned as much as possible with their VET systems.

There is a strong need to adjust especially digital and green skills demands, with the ESSA foresight showing that there is a clear shift towards Industry 4.0 and the transition to the green economy and decarbonisation. These trends affect the structure, tools and technologies and hierarchies in organisations, thus changing tasks and, in turn, influencing the type of skills that will be needed. In the short and medium term, these trends tend to create skills gaps and mismatches as there are lags between the introduction of an innovation and the creation of measures to up/re-skill the workforce in line with what the innovation requires, including within formal VET delivery.

Digitalisation, automation and decarbonisation are the main trends currently affecting the steel sector and leading to changes in skills needs, but also constitute opportunities to improve the image of the sector and showcase its modernisation achievements by becoming digitalised and green.

8.1 Summary of the Work Packages Results

Against this backdrop, ESSA focused on the examination of relevant technological and economic development (WP2), industry skills requirements (WP3) and related VET system conditions (WP4); serving the ground for the development of the Blueprint (WP5) and its testing, implementation and rollout (WP6) as well as related policy recommendations and dissemination activities (WP7).

Technological Foresight and Skills Requirements (WP2)

The steel industry is evolving towards industry 4.0 starting from a high level of automation. Regarding the evolution or incremental adjustment, the challenge of digitalization concerns the integration of all systems (sensors, automation, and IT systems) and all production units in different dimensions (horizontal, vertical and transversal). In this context, the steel industry's expectations from digitalization focus on quality, flexibility and productivity through the optimization and the interactions of the individual production units. Economic aspects include not only the reduction operational costs, i.e. energy/row materials consumption reduction, but also the introduction of new business models and organizational structures.

The impact on the workforce mainly concerns the requirement of horizontal, transversal soft-skills, such as collaboration, communication and autonomy, as well as the need of continuous learning in an interdisciplinary perspective (and environment). The concrete impact of digitalization on the low skilled workers and the effect on employment remains open to further discussion.

Company Skills Requirements (WP3)

In close relation to the technological development and VET system requirements company related skills needs (current and future) and redefinition of professional profiles which are

directly related to steel production, including maintenance, led to an approach and strategy of mainly incremental up- and re-skilling of existing job profiles. However, displacement and deskilling of some jobs should remain under observation. Starting not with formal and static occupational profiles but with an overview of existing job profiles oriented at functions and tasks in the production areas, company-based job profiles and job families and a template to assess future skills demands against the background of existing and occupational profiles (focused on T-shape skills) were elaborated in close relation with the ESCO database and its future development against transversal skills.

A European Steel Sector Profile Family Tree was generated (representing a valid view of the steel job profiles which can be used to facilitate navigation and demonstrate relationships between them). Finally, 26 main families (Level 1) and (in total more than 200) professional role profiles (Level 2) were listed. To reduce complexity a first set of nine representative job profiles / occupations were selected for a detailed (current and future) skills assessment: (1) Metallurgical Managers, (2) Process Engineers, (3) Maintenance and Repair Engineers, (4) Process Engineering Technicians/Supervisors, (5) Production Supervisors, (6) Industrial Electricians, (7) Metal Processing Plant Operators (including Continuous Casting Operator selected for a pilot online training tool), (8) Metal Working Machine Tool Setters and Operators, (9) Factory Hands. Additionally, the train the trainer relevance lead to (10) Corporate Trainer, (11) Vocational Teacher, and the (12) Manufacturing Manager profile integration.

These profiles are differently affected by Industry 4.0 and digitalisation, representing matching company job profiles with existing ESCO occupations, representatively covering all major ISCO groups as well as taking the importance for the steel production and maintenance, most in-demand jobs and potential added value for other sectoral (industry) Blueprints into account.

The European Steel Sector Professional Role Profiles aimed at the construction of a common standardised Skills Assessment Checklist. Thus, the template for assessing technical and transversal skills in comparison of the “Steel Professional Role Profiles” comparing its current status and future demands was developed taking ESCO as a reference and considering European ICT Professional Role Profiles. A general set of skills (technical, digital, green, individual/personal, social, and methodological) was defined based on the T-shaped skills approach for the “steel professional role profile assessment” template.

An excel-based automated database of professional profiles related to steel sector is integrating ESCO occupations. In close collaboration with ESCO it will be continuously upgraded.

VET System Requirements (WP4)

Data on national VET systems’ organization and functioning was collected in close alignment with the ESSA results concerning the steel industry’s technological and industry requirements. Agreement was reached to focus on formal qualifications (mainly IVET) related with production and maintenance occupational profiles. As a background for the Blueprint implementation and rollout, regulation and provision of VET systems in five case study countries (UK (market orientated), Germany (dual system), Spain (company orientated), Italy (regional) and Poland (centralised)) and about the main European frameworks and tools related to VET were analysed. Results of surveys and interviews combined insights from the research literature with practical experiences.

The comparative analysis of the VET systems of the five case study countries generated insights on the overall functioning of national VET systems and the main vocational and technical programmes that currently provide skilled workers to the industry (e.g. in line with the

nine selected steel professional profiles). Detail is reported on national VET regulatory frameworks and their relationship to the steel industry (see Deliverable D4.1; Antonazzo, Weinel, Stroud, et al., 2022)), describing the functioning of the different national systems, their recent reforms (patterns of divergence and convergence) and the steel industry-related programmes currently available, as well as potential scope for improvements (in terms of skills gaps or learning arrangements). Additionally, the most relevant cross-European frameworks and standards for sector skills recognition (see Deliverable D4.2; Antonazzo, Weinel, & Stroud, 2022) at the EU level and the state of adoption of these across the five case study countries show how an optimal implementation and combination of such frameworks and tools could support the industry in terms of favouring cross-national skills recognition, skills and qualifications mapping and benchmarking, as well as talent mobility.

A Sector Skills Matrix (SSM) has been developed with a framework of occupational qualification programmes (OQPs) for four case study countries (Germany, Italy, Poland and Spain). The fifth case study country, the UK, was dropped from the Matrix because the UK's fragmented VET system made it impossible to fit coherently within the – or any – SSM design. The SSM from a VET system perspective was designed to connect the steel industry professional profiles, those related to Maintenance, Production (Melt Shop and Rolling Mills), Logistics and Quality Control, with relevant formal initial vocational training (IVET) and continuing vocational training (CVET) provision available in four case study countries. The SSM is the outcome of an attempt to systematically identify, evaluate and compare steel-sector relevant OQPs in these four European countries. The Matrix's intended three main function are 1) to identify steel sector relevant occupational qualification programmes in four (initially five case study) countries; 2) to provide a range of standardised and thus comparable formal information about each identified qualification programme and 3) to provide an assessment of each occupational qualification programme in terms of adequacy of current and future transversal skills provision.

Overall, in summary, the essential features of the case study country VET systems have been categorised and the identification of the vocational and technical programmes relevant to the steel industry has been conducted. On the former, we note a clear convergence in VET practices, but national differences remain significant and relevant. This presents key challenges and criticalities that need to be addressed – with companies embedded in national contexts, any new training arrangements and ESSA proposals need to account of the specificity of the national VET system, particularly in relation to patterns of technological innovation (particularly for Industry 4.0) and 'greening'.

The company representatives that were interviewed argue for a more holistic approach to training, requiring workers to possess wider and more adaptable skillsets. The need is for enhanced transversal skills, which goes along with a demand for stronger and more advanced technical or professional skills. This supports a T-shaped approach to skills provision, particularly with social skills and digital skills, based on strong foundational and methodological skills, stated to be of high importance. Further, in the leveraging of EU frameworks and guidelines, clear benefits for the steel industry would flow from the effective implementation of the range of tools and frameworks available, particularly for enhancing flexibility of workers and VET systems.

European Blueprint Framework (WP5)

The final Blueprint is based on the background of the ESSA and the implementation and testing of the Blueprint prototype. The Blueprint is reflecting the structure and main elements of ESSA integrating developed tools and approaches with a focus on (a) incremental adjustment of skills

in production and maintenance, (b) job profile description and assessment from an industry perspective, (c) in relation to existing VET systems and their possible support.

The **holistic and industry driven approach** of the Blueprint comprises (1) technological and economic demands and skills requirements, (2) industry driven skills adjustment, (3) strategies and measures, (4) alliances and leadership, and finally (5) implementation and rollout (see Figure below).

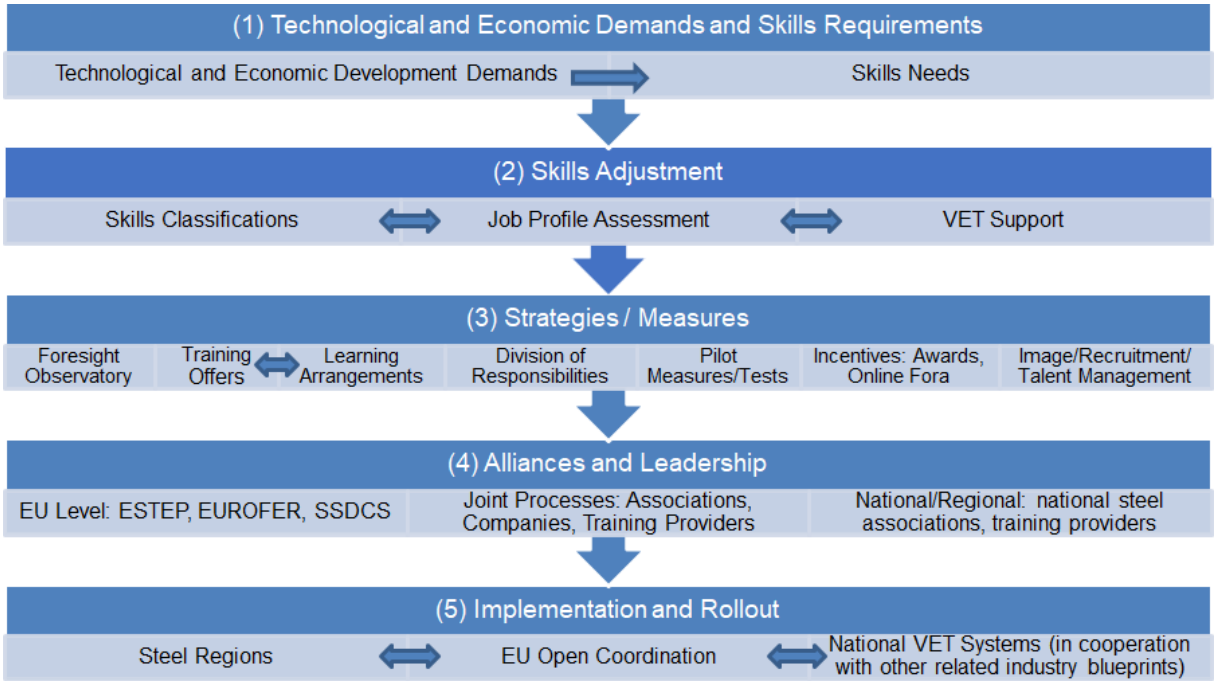


Figure 31: General Blueprint outline

Core of the Blueprint are (1) the European Foresight Observatory and the **E**uropean Steel **T**echnology and Skills Foresight **P**anel (**ESSA ETP**) (demand side), (2) the European Online Training Ecosystem **steelHub** as well as (3) National-**R**egional Skills and **T**raining Eco**s**ystems (**ESSA RTS**) combined in a **European Community of Practice (ECoP Steel)** (supply side).

These elements do also form the **ESSA governance structure**, already implemented sustainably in the European Steel Technology Platform (ESTEP), supported by EUROFER and industriALL Europe.

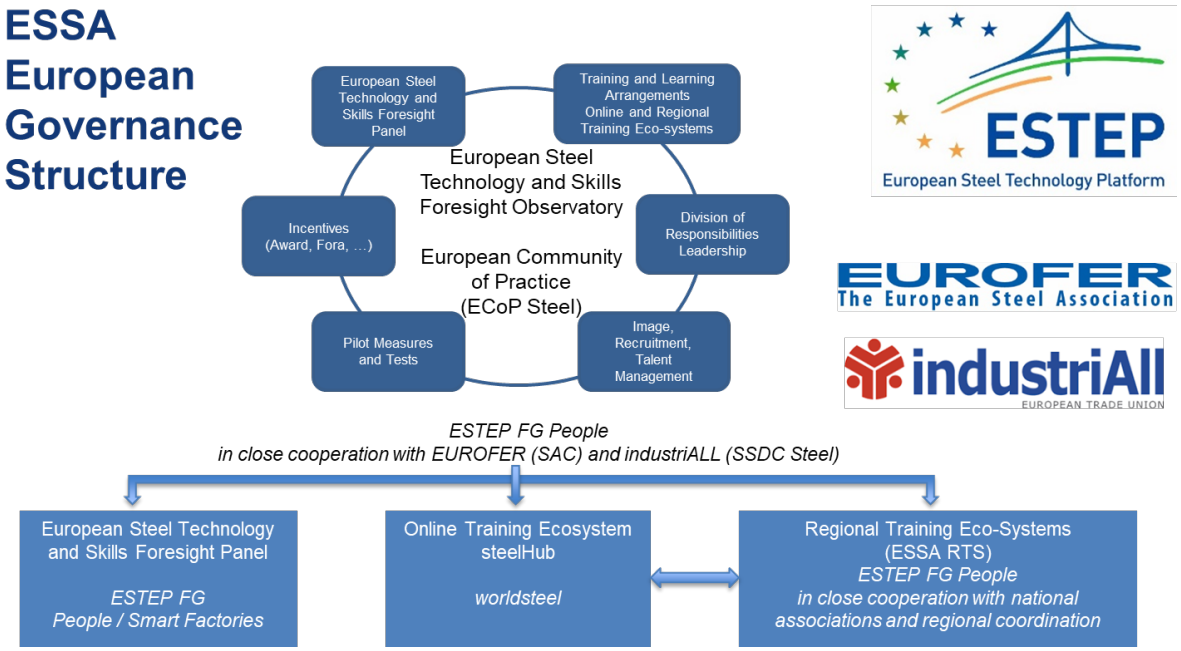


Figure 32: ESSA Governance within the European Steel Industry Authorities

The European Steel Technology and Skills Foresight Observatory is the central coordination unit, integrated in the ESTEP Focus Group People. The observatory bundles all the necessary activities to (a) **monitor and evaluate** regularly technological and economic developments and related industry skills requirements and (b) to ensure the alignment and support of the Online Training Platform steelHub and (c) the National-Regional Training Ecosystems coordinated by the ECoP Steel. Fundamental part of the ESSA Foresight Observatory is a regular annual **foresight survey**: ESSA European Steel Technology and Skills Foresight Panel (ESSA ETP). Additional tasks comprise pilot measures and tests, incentives (such as Awards, Online Fora), dividing responsibilities and leadership, formulate policy recommendation and reclaiming policy support, and not at least launching and conducting campaigns concerning esp. image, recruitment, and talent management.

The online training platform **steelHub** is integrating inputs and exchange (a) of associations, companies, individual learners and training providers, (b) (current and future) industry skill requirements, (c) EU tools and institutions (such as ESCO, EUROPASS, Skills Panorama, CEDEFOP), (d) VET system institutions and anticipating future VET system requirements, (e) other sectoral Blueprints, and last but not least (f) individual informal and non-formal learning. Central elements of the steelHub are the Learning Solution Directory, Skill Directory, Capability Assessor, and the Integration in different learning paths.

The European Community of Practice of Steel Regions (ECoP Steel) is comprising now nine steel related **European national-regional skills and training ecosystems** (ESSA RTS), integrating more than 100 additional stakeholders in the ESSA Alliance on the national-regional level, esp. public authorities and unions, VET and labour agencies (see the next paragraph).

Transfer and Implementation of the Blueprint (WP6)

The Blueprint implementation and testing led to an interrelated and connected European - National - Regional rollout by setting up specific National-Regional Training Ecosystems (ESSA RTS). In order to provide an overview on EU level about the national outreach, a list of steel member states as well as a list of the steel associations for each country has been

provided. Based on a template for describing the national steel companies, training providers, and research institution active in the steel sector, ESSA selected nine steel regions establishing National-Regional Training and Skills Ecosystems. In particular, the rollout processes started on the:

- national level in Finland (because there is no specific conglomerated steel region)
- national-regional level in Czech Republic, Germany and Spain (combining national and regional perspectives)
- regional level in UK (Wales), Italy, Poland, Romania, and the Netherlands (concentrated steel regions).

All the nine ecosystem developments were different, depending on the composition of the actors, the defined priorities and processes, and the specific regional demands. Specific national-regional/local workshops and round tables were launched, reaching more than 100 additional external stakeholders for our Skills Alliance. The main national-regional challenges were recruitment and image challenges, the need to attract female and new talent, the shortage of skilled students and the disconnection between formal training and companies' requirements.

Due to successful national-regional processes, ESSA is setting up a **European-National-Regional Community of Practice (ECoP Steel)** for supporting the existing and establishing new National-Regional Training Ecosystems. Within this EU-wide network, national-regional ecosystems will share knowledge, tools, strategies and good practice, learn from each other, support each other, and conduct common research and development to improve the steel regions.

Regulatory Framework and Policy Recommendations (WP7)

Within its new concept of Industry 5.0 the European Commission is aiming to shift to a human-centric orientation in the workplace (Breque et al., 2021). For this purpose, the **Commission** has been actively building **directives, frameworks, action plans, and communications** to ensure the main rights of workers, such as health and safety at work and equal opportunities for women and men. The Commission aims to avoid discrimination based on sex, race, religion, age, disability, and sexual orientation and to improve the working conditions contained in labor laws, including part-time work, fixed-term contracts, working hours, and informing and consulting employees. In addition, member states support the EU-level directives created by enacting complementary national-level legislation and there are similar commitments introduced at sector level. The aim and approach of ESSA are completely in line with the philosophy of the EU and national-level legislation. Therefore, the policy recommendations created by ESSA align with these directives.

The **policy recommendations** (see in detail Deliverable D7.1; ESSA, 2023a) target various levels, including the European, national, regional, and company levels. These recommendations are formulated based on input from the steel industry and research conducted throughout the ESSA project timeline. They are somewhat abstract and take the form of general advice rather than specific instructions. It is ultimately up to stakeholders in the steel industry to adopt and implement the recommendations as they see fit. In order to facilitate these policy recommendations, we allocated them to specific stakeholders to bring them into action.

ESSA **dissemination** activities of all the partners ensured and will ensure the distribution of results to the stakeholders and companies of the steel sector (via the usual measures, such as inputs in regular meetings, webpage, leaflets in different languages, thematic newsletters,

and social media activities). The collaboration with other Blueprints and sectors (esp. SPIRE-SAIS where steel is one of the comprised energy intensive sectors) is key, not only for dissemination of ESSA results but a strategic incorporation of the ESSA Blueprint and Alliance in ongoing activities. Regular meetings of the sector associations (mainly of ESTEP, EUROFER, industriALL and the Sectoral Social Dialogue Committee Steel), conferences, workshops and events are not only practised for spreading the ESSA results but strategically used to discuss ESSA results and integrate the current discussions on digital and green skills demands. Publications in scientific journals and the ESSA based book (Stroud et al., forthcoming) will spread the ESSA results beyond the steel industry.

8.2 Steps Ahead

The ESSA mission is still a continuous and **proactive adjustment of the future skills demands by the steel industry and for the steel industry**.

Figure 33: Mission and main objectives of ESSA

Against this backdrop, the ESSA Roadmap for the coming years is still comprising the five central elements for the permanent implementation and running of the Skills Alliance ESSA: Foresight Observatory and Panel, steelHub, and the European Community of Practice (ECoP Steel), coordinating the national-regional rollout activities.

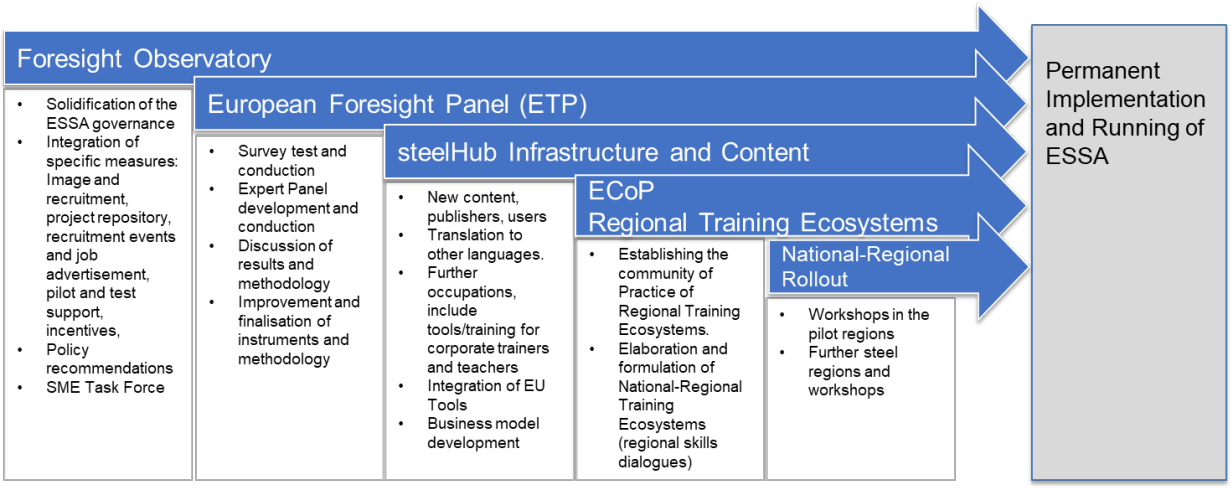


Figure 34: ESSA Roadmap

The European Foresight Observatory as the central coordination unit will bundle all the necessary activities to (a) **monitor and evaluate** regularly technological and economic developments and related industry skills requirements and (b) to ensure the alignment and support of the Online and Regional Training Ecosystems. Central part of the ESSA Foresight Observatory will be a regular annual **foresight survey**: ESSA European Steel Technology and Skills Foresight Panel (ESSA ETP). Based on the results of this survey a **Technology and Skills Foresight Index** will be established, showing also the trends over the time. An Expert Panel Workshop will discuss these quantitative results more in-depth and qualitatively.

The ESSA Foresight Observatory will operationalise the roadmap (see Figure 34), to ensure monitoring and adjustment of skills (demand side) and to organise education and training for them (supply side).

- **Monitor and anticipate** new skills demands of the EU steel industry via the observatory (ESSA ETF)
- Provide and promote training in **T-shaped skills** of the main job profiles concerned
- Support the further extension of the **Online (steelHub) and Regional Training Ecosystems (ESSA ECoP Steel)**
  - Promote new learning arrangements
  - Expand and promote relevant **digital** and **on-the-job training**
  - Communicate on the importance of lifelong learning
  - Promote **(reverse) mentorship** as a way of knowledge transfer
- Improve the **image** of the sector and careers
  - Initiate EU-wide communication campaigns
  - Advertise and promote job opportunities in the sector to candidates of varied disciplines (incl. a new diversity by women, migrants, etc.)
  - Advertise good working conditions in the sector
  - Promote the steel sector in primary and secondary schools (pre-VET)
  - Conduct skills awareness-raising campaigns
  - Include underrepresented groups, such as women and migrants
  - Document and award best practices (of skills adjustments)
- **Pilot measures and tests** using existing funding tools on the European (RFCS, Horizon Europe, Erasmus+, ESTEP tasks, and others), national and regional level (ESF, EFRE) (initiated and coordinated by the Foresight Observatory)

- **Incentives** by generating good or best practice awards, online forum(s), best practice exchange and others (e.g. as part or integrated in the activities of the Foresight Observatory)
- Division of responsibilities for ensuring the update of learning lifelong between companies/industry/social partners - VET systems - the individual worker.

As the European Steel Skills Alliance ESSA is already established with its European-National-Regional Governance, the main activities foreseen are related to the three ESSA coordination units:

Foresight Observatory:

- Establishing a yearly regular technology and skills foresight survey leading to a Steel Technology and Skills Index
- Yearly validation of recent results and forthcoming technology and skills demands by an expert workshop
- Project repository
- Image and recruitment repository of events, materials etc.,
  comprising the topics:
  (1) EU Recruitment Events, (2) Materials, (3) Job Advertising, (4) Talent Management.

steelHub:

- New content, publishers, users
- Translation of training modules
- Integration of ESSA tools
- Further job profiles, occupations
- Train the trainer, teacher measures

ECoP Steel:

- Yearly Roadmap
- National-regional platforms integrated in the steelHub
- Integration of further regions, member states
- Yearly workshops

We will do these activities in divided leadership but by nominating a coordinator for the central elements.

More training modules and offers from the steel companies and training providers will be collected and integrated in the **steelHub**. Steel industry relevant training measures of other (mainly Erasmus and Leonardo) projects will be checked for an integration in the Online and Regional Training Systems. On the job, on-site training in companies and VET schools are mainly part of the Regional Training Ecosystems (ESSA RTS) to be combined with online training if possible.

The Observatory, steelHub, and the European Community of Practice are part of the European Steel Community, connected with present European platforms and tools beyond the steel sector, ensuring exchange with the broader European process industry: mainly by being part of the **Large Scale Partnership Energy Intensive Industries** under the Pact for Skills, within the Process for Planet programme of A.SPIRE and via the Skills Alliance for Industrial Symbiosis (SPIRE-SAIS), where steel is part of. The governance structure of ESSA is built on a division of responsibilities, clarified and checked with the European Steel Associations and

social partners ESTEP, EUROFER, and industriALL. Connections with European platforms beyond the steel sector (e.g. CEDEFOP Skills Intelligence, Pact for Skills, Centres of Vocational Excellence) and tools (e.g. ESCO, Europass, ECVET) are part of the ESSA strategy, measures and training (esp. in the steelHub and the Regional Training Ecosystems). ESSA will have a closer look at other regional approaches (such as Smart Specialisation, Cluster Platforms, Centres of VET Excellence and others) as well. To ensure a stronger integration of Small and Medium Sized Enterprises (SME), an "ESSA Task Force SME" was founded, ensuring and integrating the SMEs perspective.

Concerning the **cooperation with other sectoral Blueprints,** a close cooperation with the **SPIRE-SAIS** Blueprint has to be mentioned - not only because steel is one of the ten energy intensive industry sectors embedded, but more importantly because of its focus on green skills: new skills for industrial symbiosis and energy efficiency.

ESSA is the main founder of the **Large Scale Partnership Energy Intensive Industries** under the Pact for Skills, integrating the European Steel Skills Alliance and Agenda ESSA and the Skills Alliance for Industrial Symbiosis SPIRE-SAIS. Based on a Memorandum of Understanding the two Blueprints will merge under a common umbrella with two specific foci:

- SAIS = industrial symbiosis skills specific blueprint **across different process industries**
- ESSA = example of a specific sector (steel) related blueprint including an incremental upskilling of representative job profiles (t-shaped skills: technical and transversal skills (green, digital, social, individual, and methodological)).

Within the LSP EII the engagement of other European tools, such as ECQA (European Certification and Qualification Association), the Skills Panorama, to exchange our results with the broader VET and industry community, and Europass, to collect learning outcomes for the individual learner will be stronger recognised.

We will also take up the concept of **Industry 5.0** (Breque et al., 2021) and operationalise it to a **Steel Industry 5.0**. The paradigm Industry 5.0, to which the European Commission recently dedicated a conceptual report, focuses besides a sustainable industry also on a human-centric and resilient industry. Human-centric by using technology primarily for the benefit of people, sustainable by not harming the environment, and resilient by contributing to the security of supply and reliable supply chains (Breque et al., 2021, pp. 14–16). A first step in the direction of a Steel Industry 5.0 discussion and operationalisation is the article of Schröder et al. (forthcoming) discussing the transformation from Industry 4.0 to Industry 5.0 by emphasizing the **triple** transition: digital, green, and **social**.

However, it has to be mentioned that skills are not always a top priority for top management of the industry. For instance, the **pandemic and the energy crises** led and may lead to a delay of strategic investments and, consequently, there was a delay in investing in skills improvements and adjustments. However, it should not be forgotten that **people and their skills have to facilitate the digital and green transformation of the steel industry**. The Covid-19 crisis showed first of all the evident relevance of digital skills and new learning and communication arrangements for everyone. Some technologies, which were used in the COVID-19 situation should be established more often: remote coordination or remote team working, E-Learning, smart working. More teamwork and greater awareness for digital and green development related skills is necessary. New digital ways of learning and delivering training are of growing relevance: digital skills for communication, self-learning tools, online-

training, self-learning and others. ESSA is delivering with its governance structure, the Foresight Observatory, the steelHub and the European Community of Practice of National-Regional-Ecosystems a sound ground for keeping skills high on the agenda and serving solutions of the industry for the skills adjustment in the steel industry.

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List of abbreviations

AI	**Artificial Intelligence**
BAT	Best Available Techniques
BF	Blast Furnace
BTEC	Business and Technology Education Council
CAD	Computer Aided Design
CCU	Carbon Capture, Storage and Usage
CDA	Carbon Direct Avoidance
CEDEFOP	European Centre for the Development of Vocational Training
COCOP	Coordinating Optimisation of COmplex Industrial Processes
COSME	Competitiveness of Enterprises and Small and Medium-sized Enterprises
CPS	Cyber-physical system
CSP	Clean Steel Partnership
CV	Curriculum Vitae
CVET	Continuing vocational education and training
DB	Database
DG	Directorate-General
DigComp	Digital Competence Framework
DRIVES	Development and Research on Innovation Vocational Education Skills
e-CF	European e-Competence Framework
EACEA	Education, Audiovisual and Culture Executive Agency
EAF	Electric Arc Furnace
EASME	Executive Agency for Small and Medium-sized Enterprises
EC	European Commission
ECoP	European Community of Practice
ECQA	European Certification and Qualification Association
ECTS	European Credit Transfer System
ECVET	European Credit System for Vocational Education and Training
EFRE	European Regional Development Fund
EFSI	European fund for strategic investments
EGAF	European Global Adjustment Fund
eLLa4.0	excellent Leadership and Labour 4.0
EQAVET	European Quality Assurance in Vocational Education and Training
EQF	European Qualifications Framework
ESCO	European Skills, Competences, Qualifications and Occupations
ESF	European Social Fund
ESIF	European structural and investment funds
ESSA	European Steel Skills Agenda
ESSA ETF	European Steel Technology and Skills Foresight Observatory
ESSA OTS	Online Training Ecosystem
ESSA RTS	Regional Training Ecosystem
ESSC	European Sectoral Skills Council
ESTEP	European Steel Technology Platform
EU	European Union
EUROFER	European Steel Association

Facts4Workers	FACTorieS for WORKERS
FG People	Focus Group People
FoF	Factories of the Future
FSN	Future skill needs
GT-VET	Greening Technical-Vocational Education and Training
HNC	Higher National Certificate
HND	Higher National Diploma
HR	Human Resources
I2M	Intelligent Integrated Manufacturing
ICT	Information and communications technology
ILO	International Labour Organization
IoS	Internet-of-Services
IoT	Internet-of-Things
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
IT	Information Technology
IVET	Initial Vocational Education and Training
KET	Key Enabling Technology
KPI	Key Performance Indicator
LOs	Learning outcomes
LSP EII	Large Scale Partnership Energy Intensive Industries
MES	Manufacturing Execution System
ML	Machine learning
NVQ	National Vocational Qualification
OPEX	Operational expenditures
OQPs	Occupational Qualification Programmes
PBL	Problem-based Learning
PDM	Product Data Management
PjBL	Project-based Learning
pre-VET	pre Vocational Education and Training
R&D	Research & Development
RFCS	Research Fund for Coal and Steel
ROBOHARSH	Robotic workstation in harsh environmental conditions to improve safety in the steel industry
RTO	Research and Technology Organisations
S4TCLF	Skills4Smart Textile, Clothing, Leather, and Footwear
SAC	Social Affairs Committee
SCORM	Sharable Content Object Reference Model
SME	Small and medium-sized enterprises
SPIRE	Sustainable Process Industry through Resource and Energy Efficiency
SPIRE-SAIS	Skills Alliance for Industrial Symbiosis – Cross-sectoral Blueprint for a Sustainable Process Industry
SRA	Strategic Research Agenda
SRIA	Strategic Research and Innovation Agenda
SSC	Steel Sector Careers
SSDCS	Sectoral Social Dialogue Committee on Steel
SSM	Sector Skills Matrix

STEM	Science, technology, engineering, and mathematics
SVQ	Scalable Vector Graphics
TCLF	Textile, Clothing, Leather, and Footwear
TVET	Technical and Vocational Education and Training
UNIFE	Union des Industries Ferroviaires Européennes
VET	Vocational Education and Training
WG	Working group
WP	Work package

Skills Classification and Definitions

Job profiles

Metallurgical managers coordinate and implement short and medium term metallurgical or steel-making production schedules, and coordinate the development, support and improvement of steel-making processes, and the reliability efforts of the maintenance and engineering departments. They also partner with ongoing remediation initiatives.

Process engineers apply engineering concepts in order to improve all kinds of production and manufacturing processes in terms of efficiency and productivity. They evaluate the variables and constraints present in given processes and present engineering solutions to optimise them.

Maintenance and repair engineers focus on the optimization of equipment, procedures, machineries and infrastructure. They ensure their maximum availability at minimum costs.

Process engineering technicians/ supervisors work closely with engineers to evaluate the existing processes and configure manufacturing systems to reduce cost, improve sustainability and develop best practices within the production process.

Production supervisors coordinate, plan and direct manufacturing and production processes. They are responsible for reviewing production schedules or orders as well as dealing with staff in these production areas.

Industrial electricians install and maintain electricity cables and other electrical infrastructure in large industrial buildings. They perform inspections and repair defective parts of electrical systems to ensure efficiency.

Metal processing plant operators monitor, operate, adjust and maintain single-function process machinery and equipment to process and convert mineral ores and refine, harden, roll and extrude metals.

Factory hands assist machine operators and product assemblers. They clean the machines and the working areas. Factory hands make sure supplies and materials are replenished.

Metal working machine tool setters and operators set and/or operate various machine tools, working to fine tolerances.

Skill categories

Technical skills: use and manipulate materials, tools, equipment, and artefacts as well as manage operations and functions in order to achieve particular outcomes.

> **Physical and manual skills:** use physical tools, operations and functions, work with hands.

Transversal skills: high transferability across different jobs and sectors, relevant to a broad range of occupations and economic sectors, often referred as core skills, basic skills or soft skills.

> **Digital skills:** use digital devices, communication applications, and networks to access and manage information; be critical and reflective towards the information available and its responsible use.

Green skills: adapt products, services and processes to climate change and the related environmental requirements and regulations (such as low carbon emission regulation), improve living in, develop and support a sustainable and resource-efficient society.

Social skills: enable people to cultivate their relationships and work with others to achieve goals together, facilitate interaction and communication with others both verbally and non-verbally, through gestures, body language and our personal appearance.

I**ndividual-personal skills:** inner abilities or skills of an individual, soft skills which are not easy to teach (although not impossible), possessed by a person deemed to be their strengths or weaknesses.

Methodological skills: process, interpret and evaluate different types of data (including documentary and other qualitative sources as well as statistical data) procedurally, explain the respective roles and interaction between evidence and explanations, identify and critically assess causal claims, and analyse the problems using various perspectives.

Physical and manual skills:

General equipment operation: handle and operate heavy or medium equipment, knowledge of production procedures, physical stamina and strength, ability to read blueprints, schematics and manuals, and others.

General equipment repair and mechanical skills: repairing and maintaining function and/or cleanliness of equipment and machinery including preventive maintenance, installation, reading comprehension (for manuals and blueprints), suitable equipment selection, operation monitoring.

Craft and technician skills: understanding and assimilating the total technology of a craft and its application in any craft situation so as to produce effective and satisfying results - directly related to specific pieces of practical knowledge (techniques of working, jointing, fixing and finishing materials, both traditional and modern, use of tools and appliances in working, jointing, fixing and finishing, resourcefulness etc.).

Gross motor skills and strength: mobilise one's capacities and complete whole-body movements, including physical strength, muscular flexibility and stamina.

Inspecting and monitoring skills: observe and record the production or management activities regularly through gathering information on all aspects in order to check everything is correct or legal.

Digital skills:

Basic digital skills: Skills in a day-to-day professional or personal context: (1) digital foundation skills, such as using a browser, connecting to the internet, (2) communicating, collaborating through email/social media and sharing contents, (3) finding, handling and storing digital information and content securely, (4) managing transactions online to purchase goods and services, (5) finding solutions to problems using digital tools and online services, (6) data storage/sharing, updating and keeping passwords secure, and taking precautions against viruses.

Advanced data analysis and mathematical skills: apply statistical and/or logical techniques systematically in order to describe and illustrate, condense and recap, and

evaluate data. Advanced data analysis can be carried out using advanced excel skills (PivotTable, VBA program development), Structured Query Language (SQL) queries, data visualization, statistical programming languages, Artificial Intelligence.

Cybersecurity: protect and defend IT systems, network, digital information, and every asset that form part of an IT infrastructure in an organization. Some of the abilities used for cybersecurity are IT fundamentals, understanding architecture, administration and operating systems, database knowledge, Coding skills—C, C++, Java, Python, Ruby, Perl, PHP.

Use of complex digital communication tools: manage any piece of software or platform that is used to facilitate internal and external communication (e.g. workflow, project management, instant messaging, social intranet & internal communication, video conferencing software).

Advanced IT skills & Programming: using Internet and email, computers, word processing, graphics, analytics and multimedia, and spreadsheets and databases and ability to program/code.

Green skills:

Environmental awareness: understand how behaviour impacts environment, including environmental concerns alongside others (such performance and safety) in taking decisions, including in the choice of processes and technologies.

Energy efficiency: perform a more efficient, conservative use of energy in the production plant, including understanding of energy use, attaining goals of energy efficiency assessments, identification of potential energy efficiency opportunities, installing appropriate monitoring equipment and developing analysis systems.

Water conservation: perform a more efficient, conservative use of water in the production plant, including monitoring sites, negotiating with regulatory authorities and professionals in this area, advising about possible water conservation solutions, keeping up to date with changes in legislation/EU directives.

Waste reduction and waste management: use less material and energy to minimize waste generation and preserve natural resources, preventing materials from ending up as waste before they reach the recycling stage. Skills required to collect, transport, dispose or recycle and monitor waste.

Resource reuse/recycling: reprocess discarded waste materials for reuse, which involves collection, sorting, processing, and conversion into raw materials which can be used in the production of new products; maintaining inventory of recyclable materials, planning and managing the separation of recyclable materials for storage and shipment, recovering recyclable materials and inspecting and disposing of unrecyclable materials etc.

Social skills:

Advanced communication and negotiation skills: guide communication between oneself and another or a group to achieve goals and outcomes. This includes confidence, using and reading body language and nonverbal cues (eye contact, facial expressions, hand, arm gestures, posture), verbal and presentation skills, teamwork skills, persuasion skills, enthusiasm, patience, improvisation. Qualities that allow two or more parties to reach a compromise or an agreement avoiding any kind of argument

and dispute. Possessing communication, persuasion, planning, strategizing and cooperating skills is the first step to becoming a strong negotiator.

Interpersonal skills and empathy: behaviours and tactics a person uses to interact with others effectively in daily life, including a wide range of skills such as communication skills (such as active listening, effective speaking), emotional skills (the ability to control and manage your emotions), negotiation and persuasion skills, collaboration, conflict resolution, ability to recognize emotions in others, and to understand other people's perspectives on a situation.

Leadership and managing others: guiding initiatives and organizing other people toward the achievement of a shared goal, managing others.

Entrepreneurship and initiative taking: turn ideas into action, support individuals in the workplace, being aware of the context of work, being creative, being able to seize innovation and opportunities, take risks and plan and manage projects in order to achieve objectives.

Adaptability and continuous learning: being able to quickly respond to changing trends, innovation, destabilization, industry shifts, and so forth; expanding skills and skill-sets on an on-going basis in response to a changing environment and new developments through increasing knowledge.

Teaching and training others: help to develop other person's subject knowledge and maybe even their mind and personality.

I**ndividual-personal skills:**

Critical thinking & decision making: analyse information objectively, use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems, make a reasoned judgment/logical decision.

Personal experience: The level of experience gained by an employee throughout her/his career by carrying out the same or similar tasks to those required by their current position.

Adapt to change: quality of being able to change or be changed in order to deal successfully with new situations, changing trends, innovation, destabilization, industry shifts, and so forth.

Work autonomously: achieve results with no supervision or with limited supervision, ability to work both independently and as a member of a team, to make independent decisions and solve problems on your own. It also demands self-motivation, confidence and time management.

Active listening: giving full attention to a speaker, taking time to understand their message, comprehend the information and respond thoughtfully (asking questions as appropriate, and not interrupting at inappropriate times).

Methodological skills:

Basic numeracy and communication: manage simple arithmetic (even if using a calculator) and have a good understanding of some basic mathematical concepts such as percentages, fractions, measurements, decimals etc.; express ideas and views clearly, confidently and concisely in speech, writing and body language - involving listening, speaking, writing, observing and empathising

Basic data input and processing: enter the collected data into an input device in order to convert it into a machine-readable form and to get the input data transformed into a more meaningful form (information) in the CPU (central processing unit).

Advanced literacy: understand and comprehend things that are read and similarly to be able to be understood by others using the written word in increasingly diverse ways and facing with increasingly diverse audiences.

Quantitative and statistical skills: handle data and use numerical evidence systematically, understand and interpret data and findings related to budgeting, mathematics, statistical analysis, probability, software applications, operations management and other areas of business strategy and management.

Complex information processing and interpretation: get complex raw data transformed into a meaningful form (information) in the CPU (central processing unit) and evaluate the output.

Process analysis: carry out a systematic review of all steps and procedures followed to perform a given activity, understanding how processes operate, and to determine potential targets for process improvement and increase efficiency.

Creativity: think about a task or a problem in a new or different way, use imagination to generate new ideas, look at things from a unique perspective, solve complex problems or find interesting ways to approach tasks.

Complex problem solving: handle difficult or unexpected situations in the workplace as well as complex business challenges, determine the source of a novel, ill-defined problem and finding an effective solution in complex, real-world settings.

ESSA Skills Assessment (Survey)

This questionnaire is designed to identify the **current and future skills needs** in steel jobs and to define their importance for the European steel sector. The role of technologies and training measures is also explored.

Your participation in this survey is **voluntary**. The duration of your participation depends on the selected job profiles. Each job profile section is expected to last **10 minutes**. Your data will be treated confidentially and evaluated anonymously.

Thank you very much for your valuable time and contribution.

This survey was developed as a part of the sectoral blueprint **European Steel Skills Agenda (ESSA)** (project number: 600886-EPP-1-2018-1-DE-EPPKA2-SSA-B, project website). Please contact Antonius Schröder (antonius.schroeder@tu-dortmund.de) for further information about the project or the survey.

Section A: Technology

First, we want to better understand which **technologies** are used in your company.

A1. Which technologies are already being used in your company today?

Please choose **all** that apply:

Virtual / Augmented Reality
Cybersecurity
Cloud Computing
Internet-of-Things (IoT) & Industrial Internet of things (IIoT)
Internet-of-Services
Cyber-Physical systems / Digital Twins
Advanced Human- Machine interfaces
Big Data and Analytics
Artificial Intelligence (incl. Machine Learning & Deep learning)
Predictive Maintenance
Advanced Process Monitoring & Control / Tracking & Tracing
New generation of sensors
Additive Manufacturing
Mechatronics and Advanced Robotics (incl. Drones)
Asset Management & Smart Product Inventory
Digital Platforms for Circular Economy
Energy & Resource Management, Monitoring and Control
Other: _____

A2. Which technologies do you expect to be introduced or expanded in your company within the next 3 years?

Please choose **all** that apply:

Virtual / Augmented Reality
Cybersecurity
Cloud Computing
Internet-of-Things (IoT) & Industrial Internet of things (IIoT)
Internet-of-Services
Cyber-Physical systems / Digital Twins
Advanced Human- Machine interfaces
Big Data and Analytics
Artificial Intelligence (incl. Machine Learning & Deep learning)
Predictive Maintenance
Advanced Process Monitoring & Control / Tracking & Tracing
New generation of sensors
Additive Manufacturing
Mechatronics and Advanced Robotics (incl. Drones)
Asset Management & Smart Product Inventory
Digital Platforms for Circular Economy
Energy & Resource Management, Monitoring and Control
Other: _____

A3. From your point of view: Which are the main expected benefits from the adoption of new technologies in your company?

Please choose **all** that apply:

Production costs reduction
Increase of production volumes
Increased flexibility
Load balancing & stock reduction
Improvement of logistics
Product quality improvement
Reduction of resources consumption
Emissions reduction, i.e. CO2
Reduction of waste
Improvement of workforce conditions
Increase of workplace safety
Improvement of customer services
Increase of the competitiveness/sustainability
Other: _____

Section B: Job profiles general questions

B1. We want to find out what kind of jobs you have experiences with and knowledge of.

Please take a look at the generic job profiles listed below.

Do you know jobs from your daily work which fit to these profiles and for which you have specific knowledge regarding skill requirements and skill development?

Please click on the green question marks if you do not know the meaning of a job profile name.

	Yes, I have knowledge.	**No, I do not have knowledge.**
Metallurgical manager		
Process engineer		
Maintenance and repair engineer		
Process engineering supervisor		
Production supervisor		
Industrial electrician		
Metal processing plant operator		
Factory Hand		
Metal working machine tool setters and operators		

B2. In view of recent and emerging challenges in your company, what do you expect in terms of the development of job profiles within the next five years?

Please choose the appropriate response for each item:

	Strongly disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly agree**
I expect that new job profiles will be necessary					
I expect that the existing job profiles will remain					

B3. Which job profiles do you expect to be created?

B4. What job profiles do you expect to disappear in your company?

Section D: Job profile related skills development

Considering the technological and organisational changes within the job profile: With regard to the following skills categories (technical, digital, green, social, individual personal and methodological), please evaluate the currently required skill levels (0 = Novice, 1 = Awareness/Basic Actor, 2 = Practitioner, 3 = Expert, 4 = Master) and how these are expected to change in the foreseeable future (within 3 years).

D1. Technical, subject-related skills

	Current skill level					**Future skill level (3 years)**				
	0	1	2	3	4	0	1	2	3	4
General equipment operation										
General equipment repair and mechanical skills										
Craft and technician skills										
Gross motor skills and strength										
Inspecting and monitoring skills										

0 = Novice, 1 = Awareness/Basic Actor, 2= Practioner, 3 = Expert, 4 = Master

D2. Digital skills

	Current skill level					**Future skill level (3 years)**				
	0	1	2	3	4	0	1	2	3	4
Basic digital skills										
Advanced data analysis and mathematical skills										
Cybersecurity										
Use of complex digital communication tools										
Advanced IT skills & Programming										

0 = Novice, 1 = Awareness/Basic Actor, 2= Practioner, 3 = Expert, 4 = Master

D3. Green skills

	Current skill level					Future skill level (3 years)				
	0	1	2	3	4	0	1	2	3	4
Environmental awareness										
Energy efficiency										
Water conversation										
Waste reduction and waste management										
Resource reuse/recycling										

0 = Novice, 1 = Awareness/Basic Actor, 2= Practioner, 3 = Expert, 4 = Master

D4. Social skills

	Current skill level					Future skill level (3 years)				
	0	1	2	3	4	0	1	2	3	4
Advanced communication and negotiation skills										
Interpersonal skills and empathy										
Leadership and managing others										
Entrepreneurship and initiative taking										
Adaptability and continuous learning										
Teaching and training others										

0 = Novice, 1 = Awareness/Basic Actor, 2= Practioner, 3 = Expert, 4 = Master

D5. Individual personal skills

	Current skill level					Future skill level (3 years)				
	0	1	2	3	4	0	1	2	3	4
Critical thinking and decision making										
Personal experience										
Adapt to change										
Work autonomously										
Active listening										

0 = Novice, 1 = Awareness/Basic Actor, 2= Practioner, 3 = Expert, 4 = Master

D6. If you think about the expected development of the _____ job profile over the next three years: How challenging do you think it will be to close possible skill gaps by that time?

	Not challenging	Moderately challenging	Very challenging
Technical, subject-related skills			
Digital skills			
Green skills			
Social skills			
Methodological skills			
Individual personal skills			

D7. Can you describe in more detail, what skill gaps you do expect for the different categories of skills within the Metal working machine tool setters and operators job profile?

Section E: Training Measures

E1. How relevant are the following strategies for closing skill gaps in your company?

	Not relevant	Somewhat relevant	Quite relevant	Highly relevant
On-the-job training (existing staff)				
Dedicated training programmes (existing staff)				
Recruiting young professional				
Recruiting experienced workers				
Use of external services				

E2. How relevant are the following technologies and methods for training your company employees?

	Not relevant	Somewhat relevant	Quite relevant	Highly relevant
Online training and simulation				
On the job training				
Integration of general or specific modules in company training schemes				
Reverse mentorship as a two-way process between older and young employees				
Webinars				
Training paths for individuals				
Self-learning modules and models				
Experiential learning / game-based learning				
Blended learning				
Project-based, challenge-based and integrative learning				
Social and collaborative learning				
New forms of assessment and validation (e.g. ePortfolios)				
Virtual reality environments				

Section F: Type of organisation

F1. In which country is your regular workplace?

Austria
Belgium
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Malta
Netherlands
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden
United Kingdom
Other: _____

F2. Which department do you work for in your company?

Technical department
Machine operation
Management
Human resources / training
Other: _____

F3. How many employees are working in your company?

1-50
51-250
251-1000
More than 100

F4. What kind of production route does your company use?

Blast Furnace (BF)
Electric Arc Furnace (EAF)
Processing Industry

Section G: Evaluation

This survey is a pilot and aims to detect skill demands within the steel industry. Please help us to improve the tool by answering the following questions.

G1. Please evaluate whether you agree with the following statements.

	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
I have understood which jobs were specifically meant by the job profile names.					
I have understood what technologies were meant by the technology names.					
I have understood what the different skill categories meant.					
I have understood what the different skill levels meant.					
I had no problems evaluating the current skill levels in the various job profiles.					
I had no problems evaluating the future skill levels in the various job profiles.					

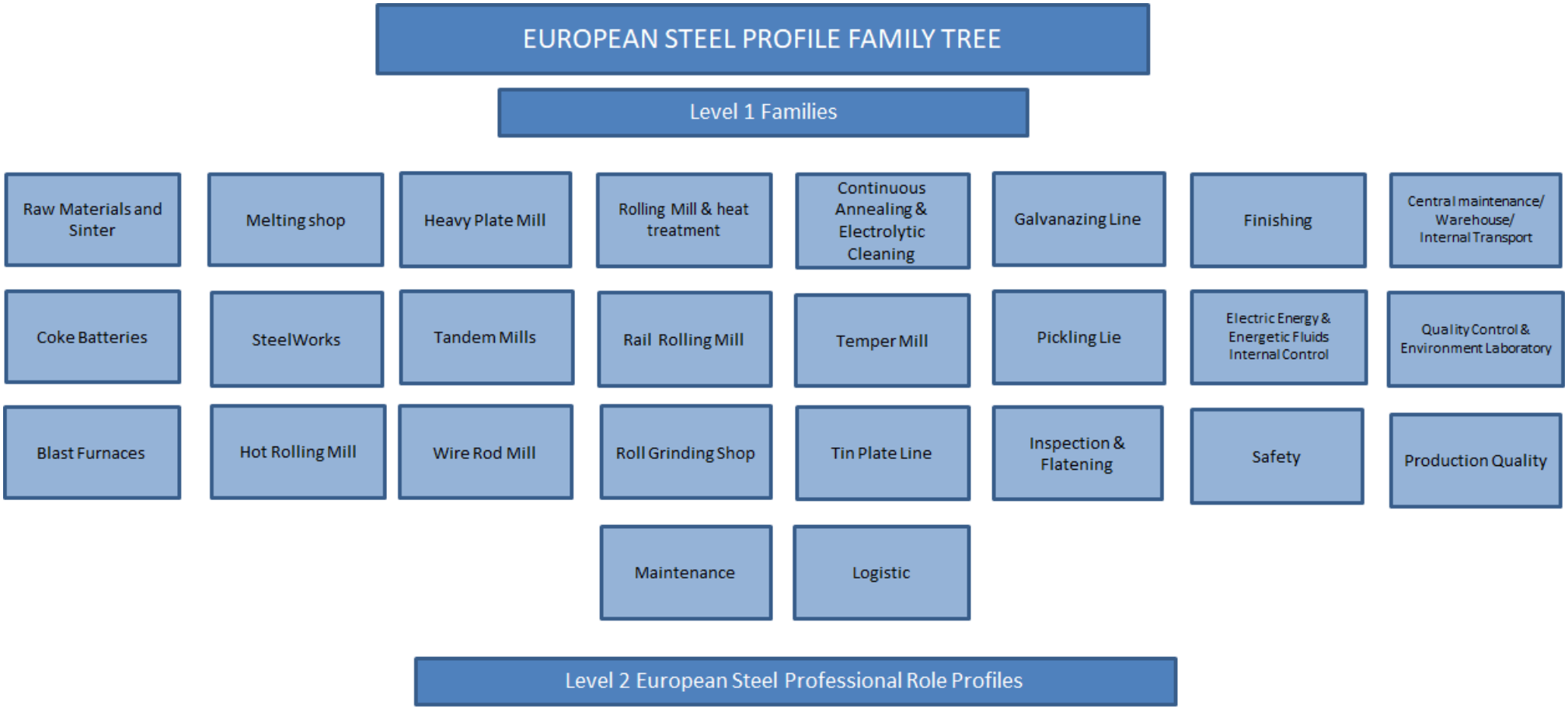
G2. How useful is this questionnaire for …

	not at all useful	**slightly useful**	**moderately useful**	**very useful**	**extremely useful**
... for raising awareness of needs within my companies.					
... to identify sector-wide trends.					

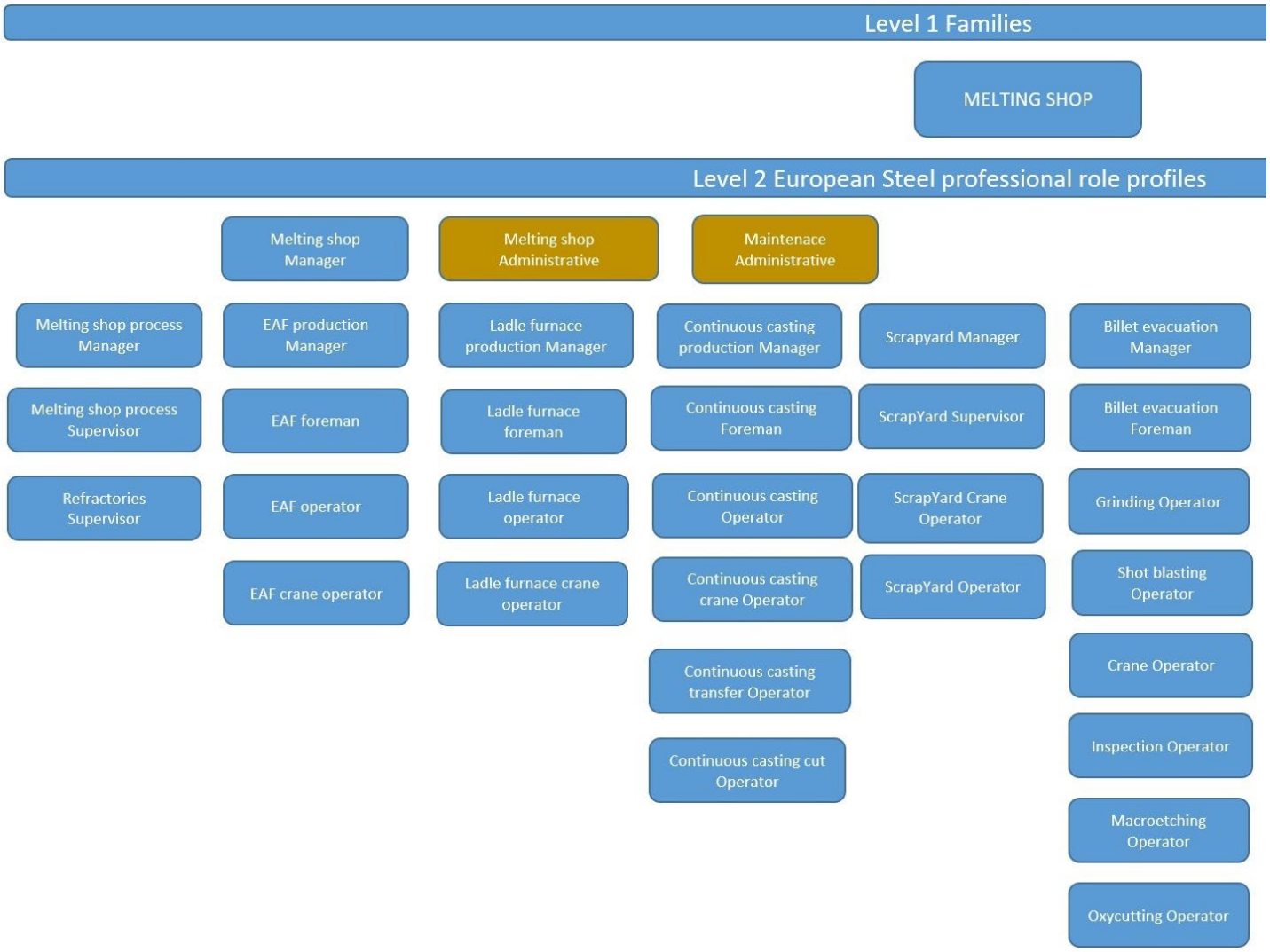
G3. Do you have any further comments and suggestions about this tool? How could it be improved?

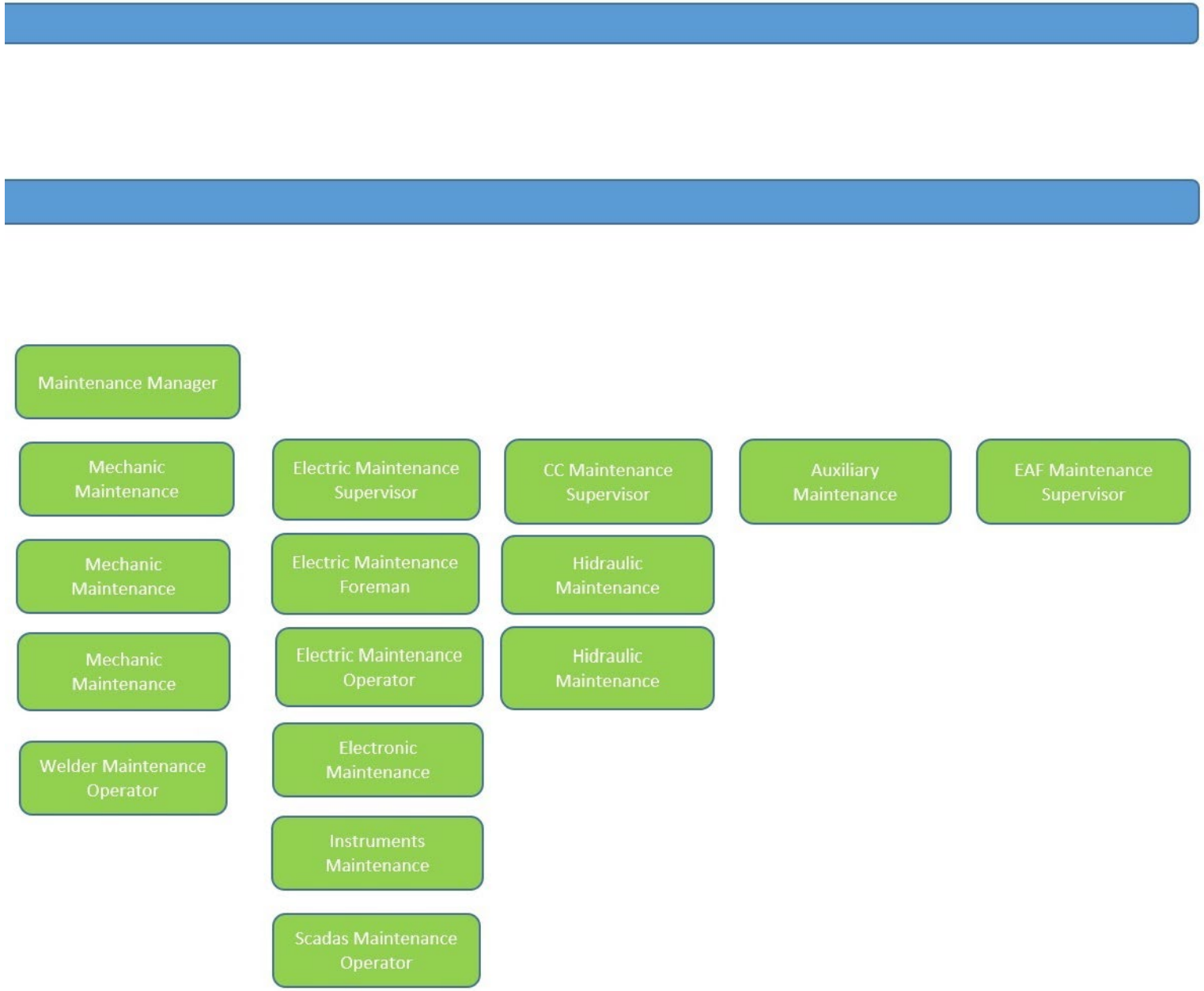
European Steel Sector Family Trees and Profiles

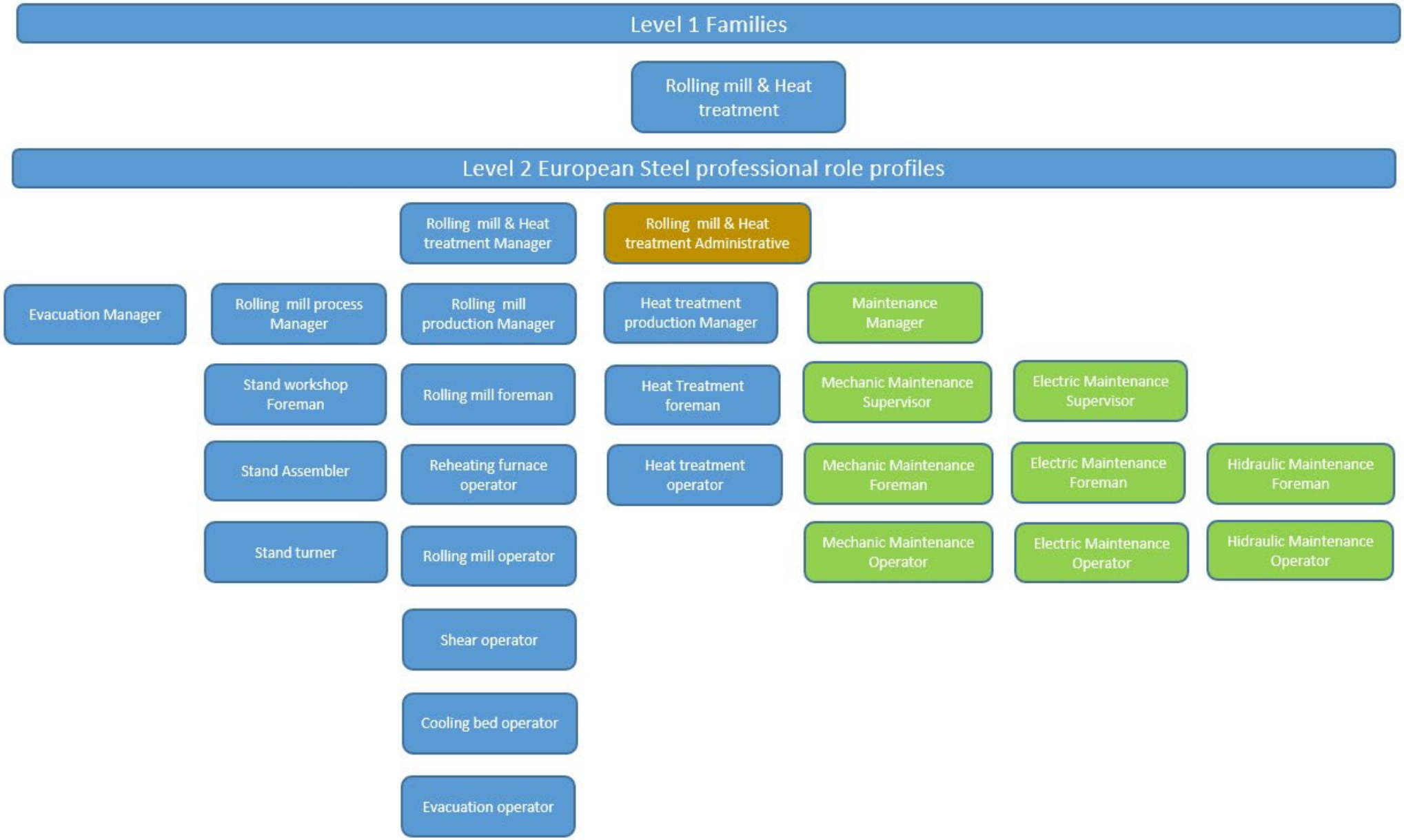
Level 1 "Families"

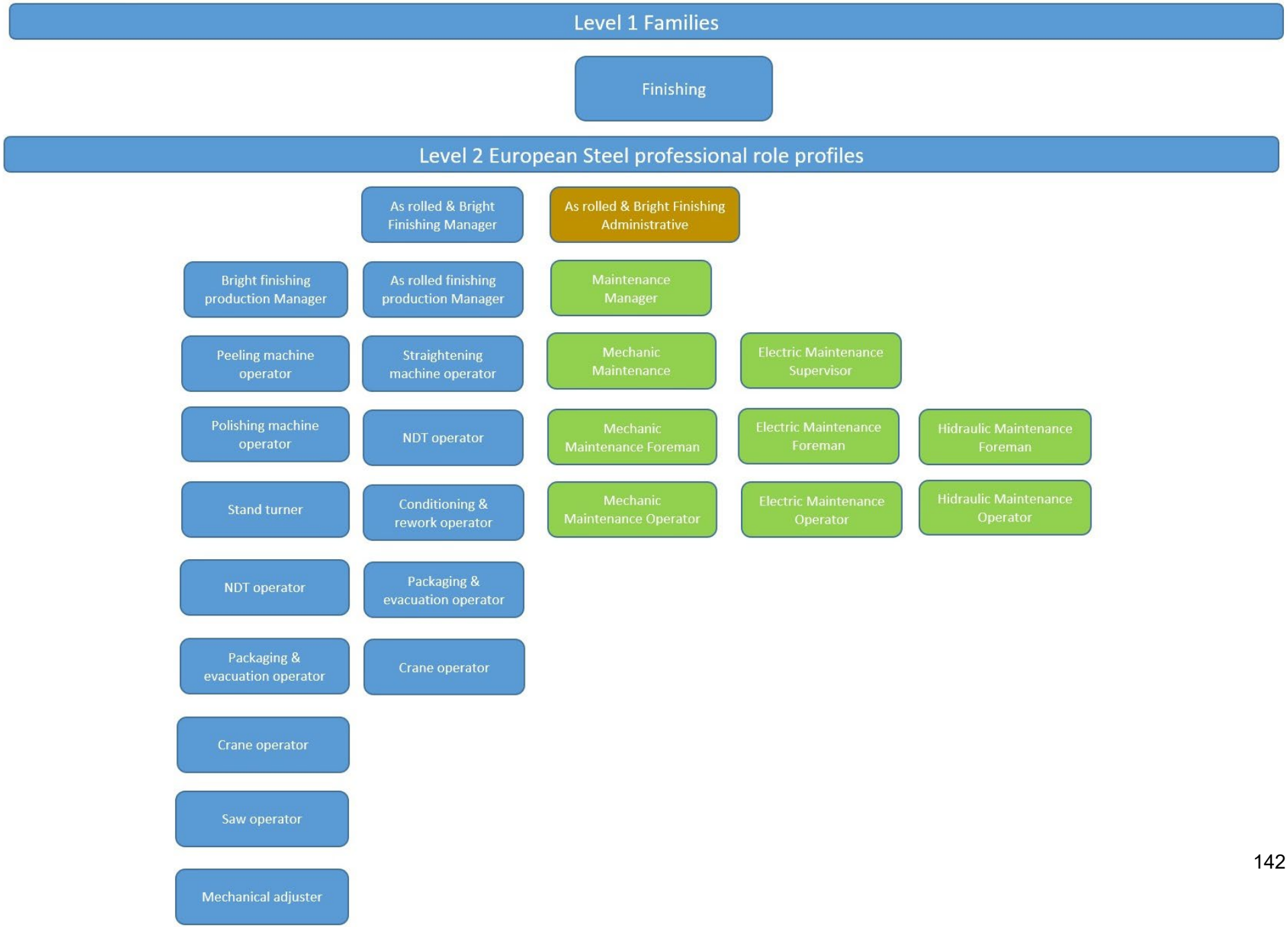


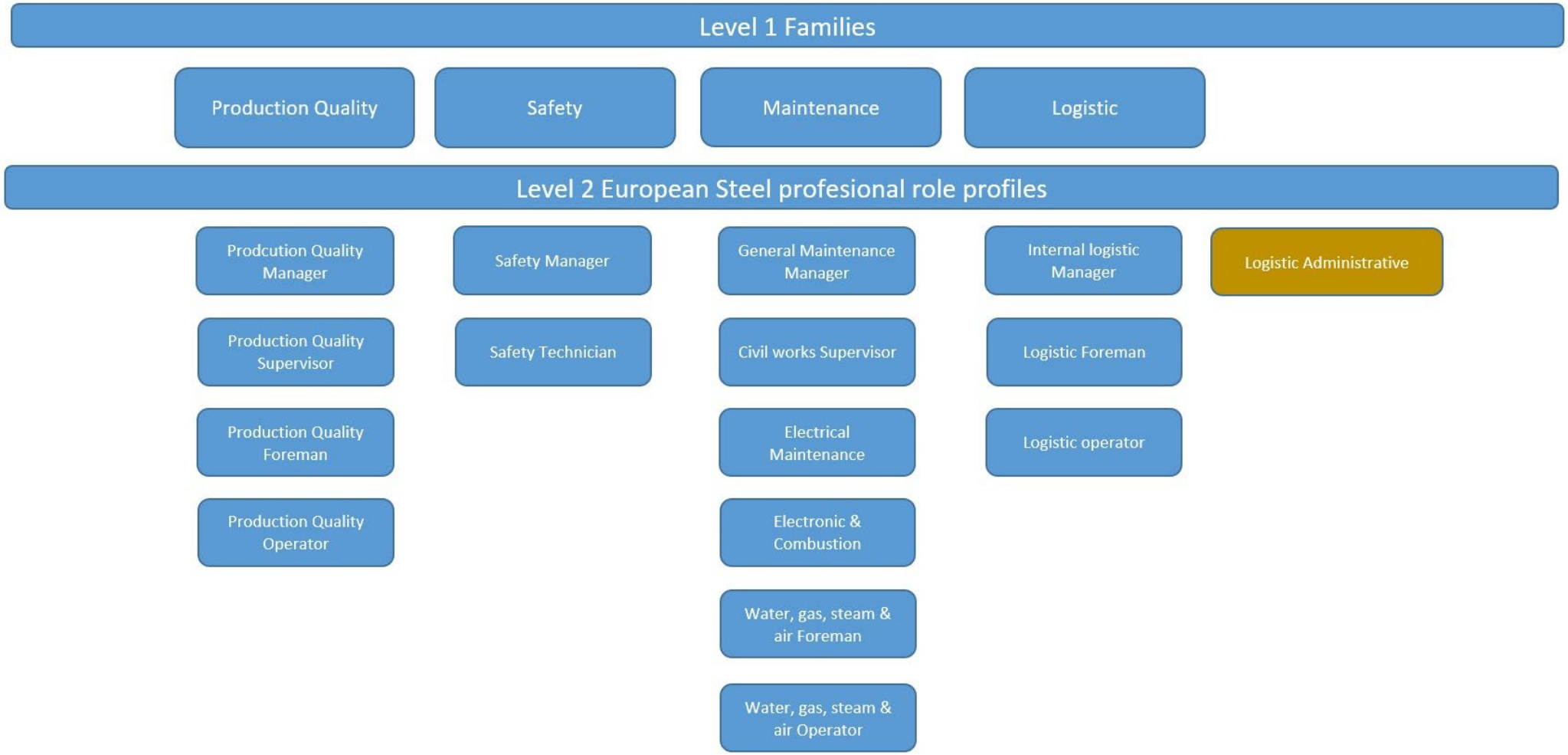
Level 2 "Professional Role Profiles" (blue: production, orange: administration, green: maintenance)

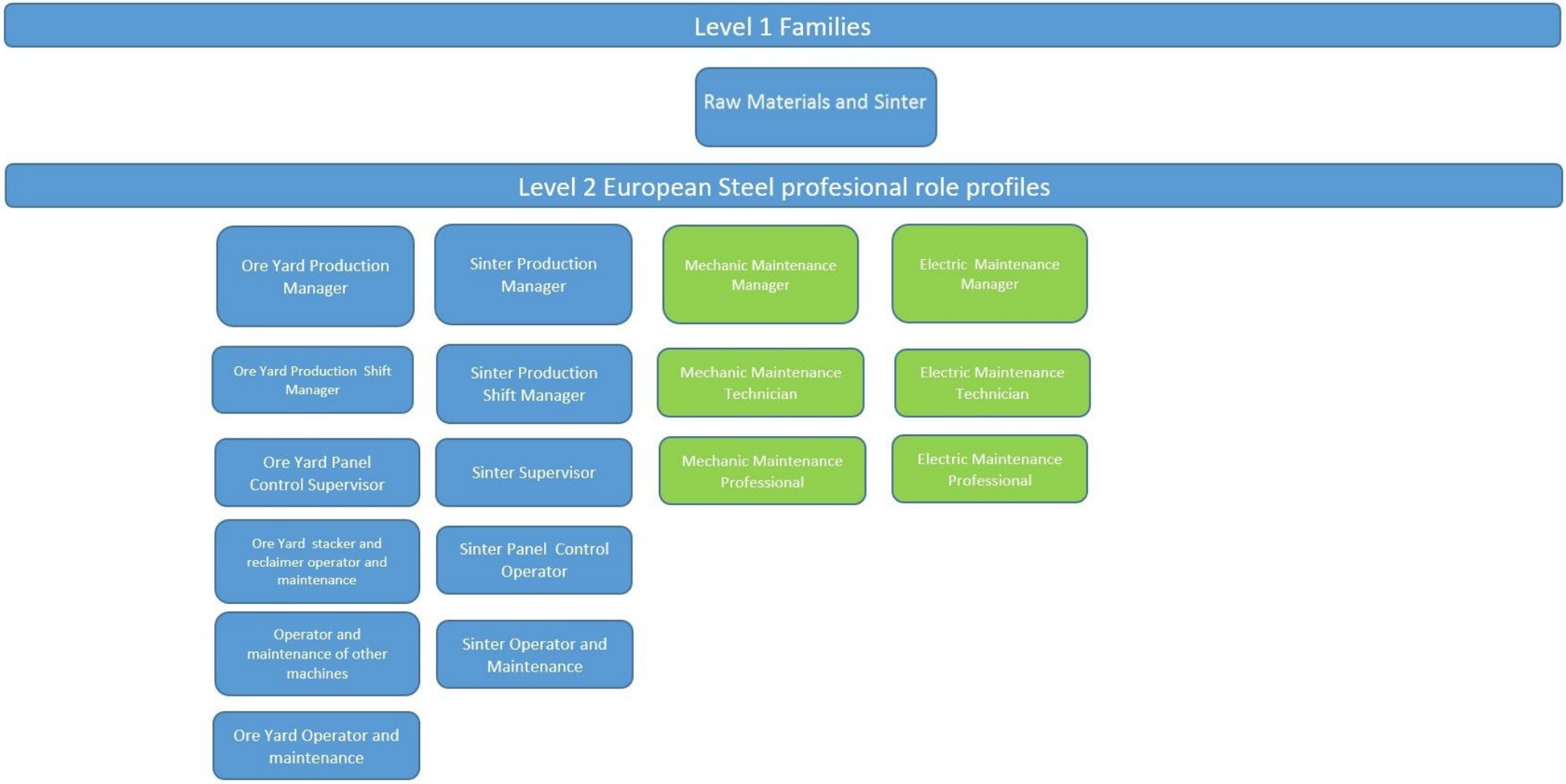


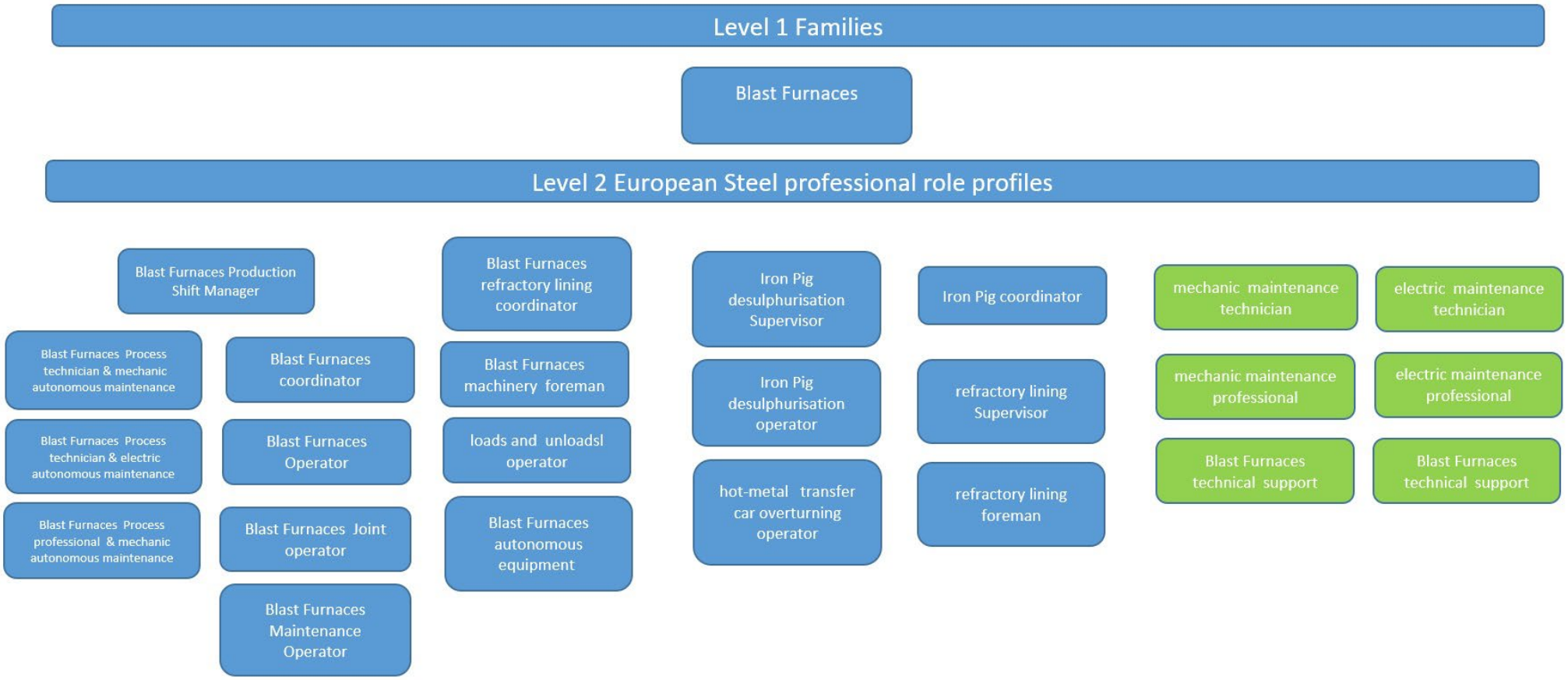

Maintenance Manager
Mechanic Maintenance
Mechanic Maintenance
Mechanic Maintenance
Welder Maintenance Operator
Electric Maintenance Supervisor
Electric Maintenance Foreman
Electric Maintenance Operator
Electronic Maintenance
Instruments Maintenance
Scadas Maintenance Operator
CC Maintenance Supervisor
Hidraulic Maintenance
Hidraulic Maintenance
Auxiliary Maintenance
EAF Maintenance Supervisor

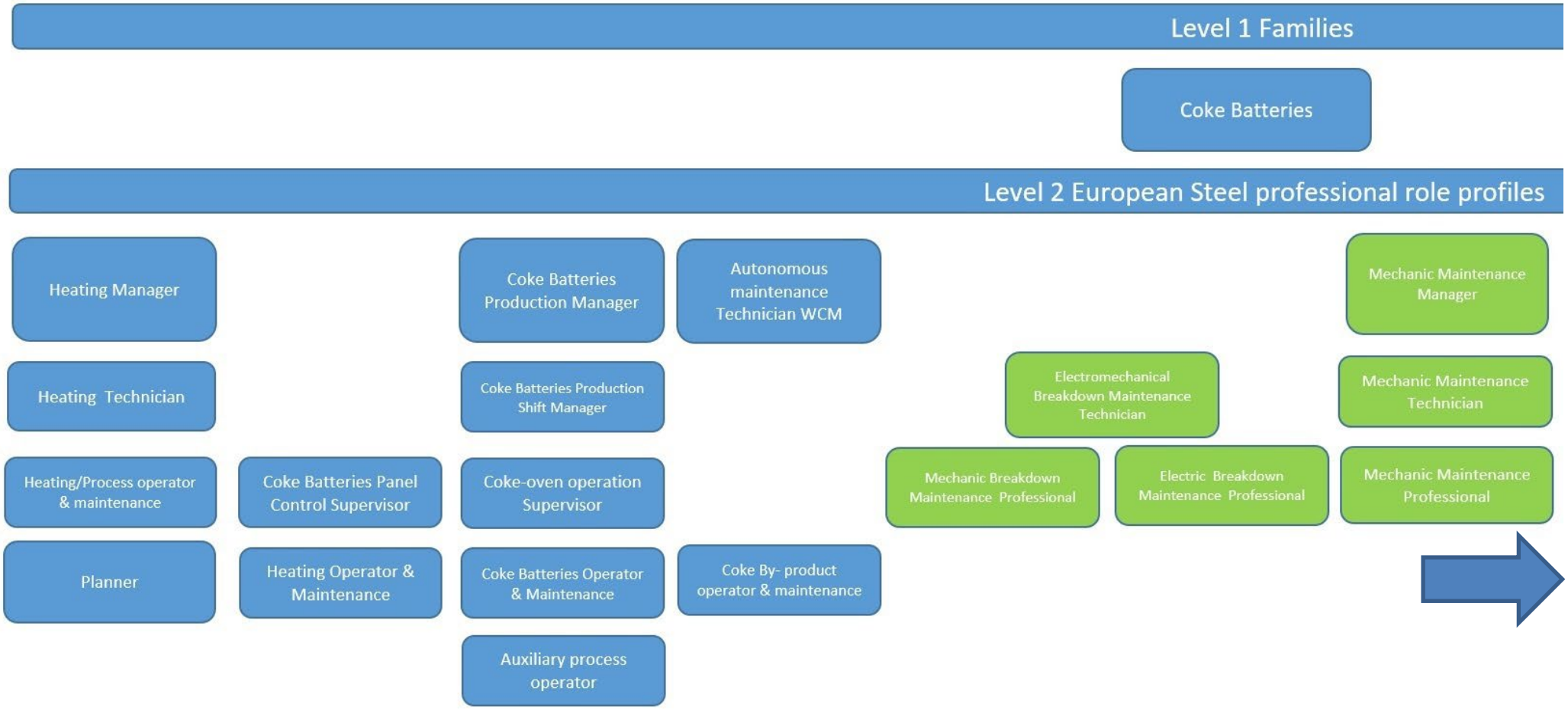

Level 1 Families
Rolling mill & Heat treatment
Level 2 European Steel professional role profiles
Rolling mill & Heat treatment Manager
Rolling mill & Heat treatment Administrative
Evacuation Manager
Rolling mill process Manager
Rolling mill production Manager
Heat treatment production Manager
Maintenance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

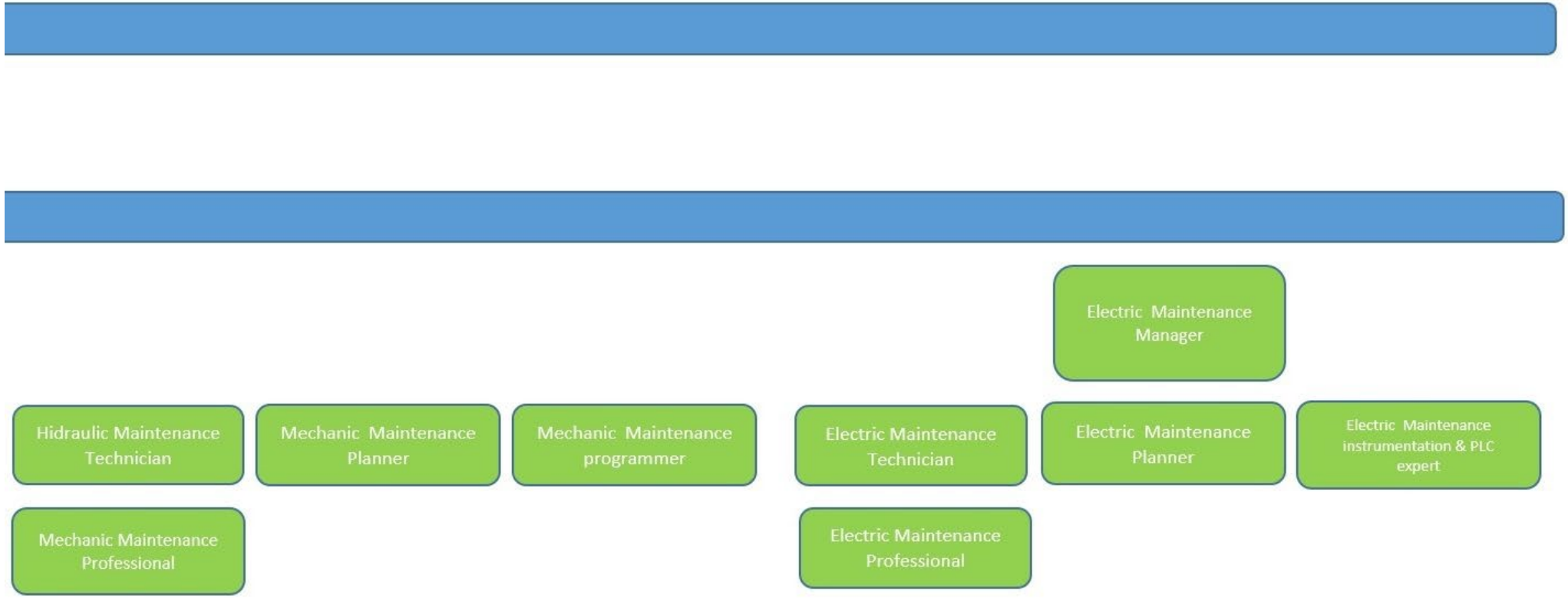

Level 1 Families
Finishing
Level 2 European Steel professional role profiles
As rolled & Bright Finishing Manager
As rolled & Bright Finishing Administrative
Bright finishing production Manager
As rolled finishing production Manager
Maintenance Manager
Peeling machine operator
Straightening machine operator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

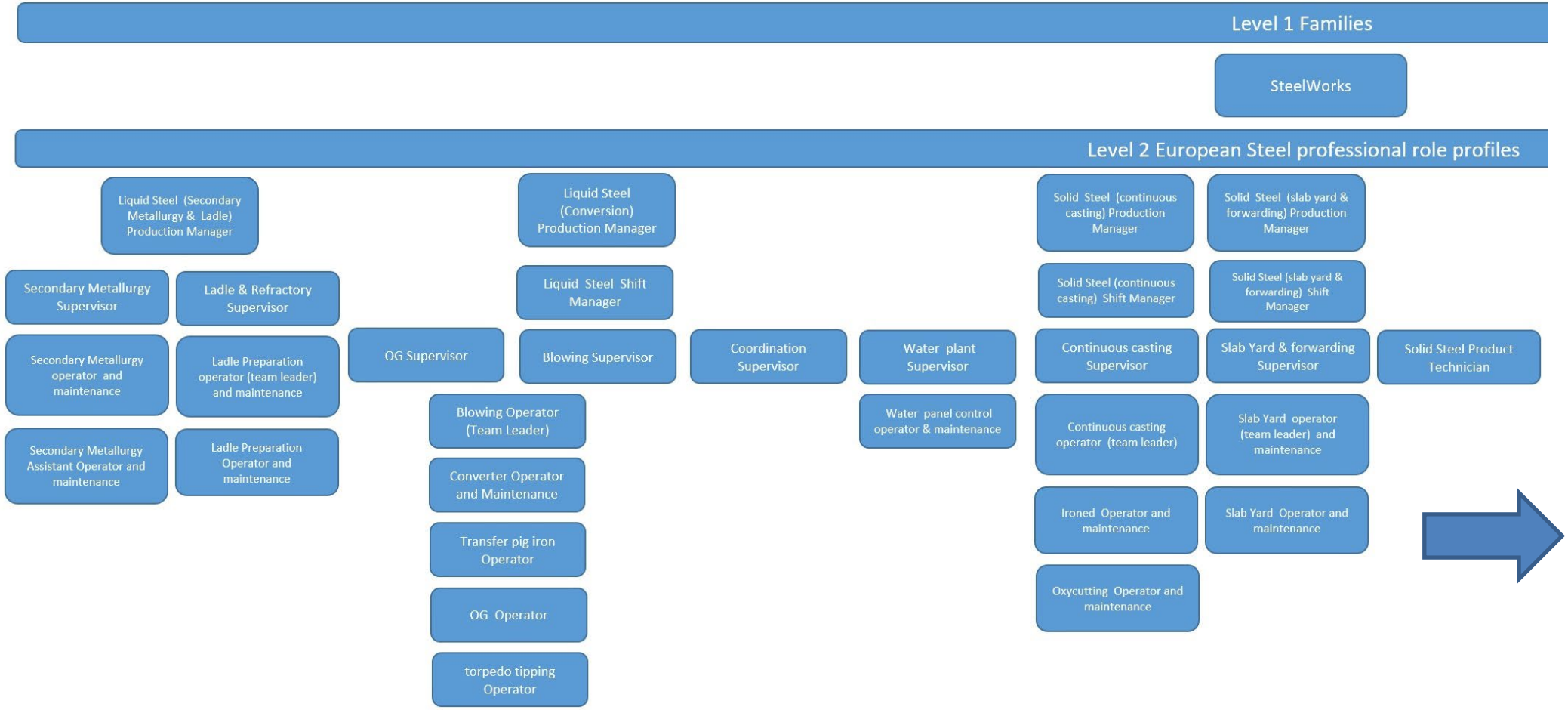

Level 1 Families
Production Quality
Safety
Maintenance
Logistic
Level 2 European Steel profesional role profiles
Prodcution Quality Manager
Production Quality Supervisor
Production Quality Foreman
Production Quality Operator
Safety Manager
Safety Technician
General Maintenance Manager
Civil works Supervisor
Electrical Maintenance
Electronic & Combustion
Water, gas, steam & air Foreman
Water, gas, steam & air Operator
Internal logistic Manager
Logistic Foreman
Logistic operator
Logistic Administrative

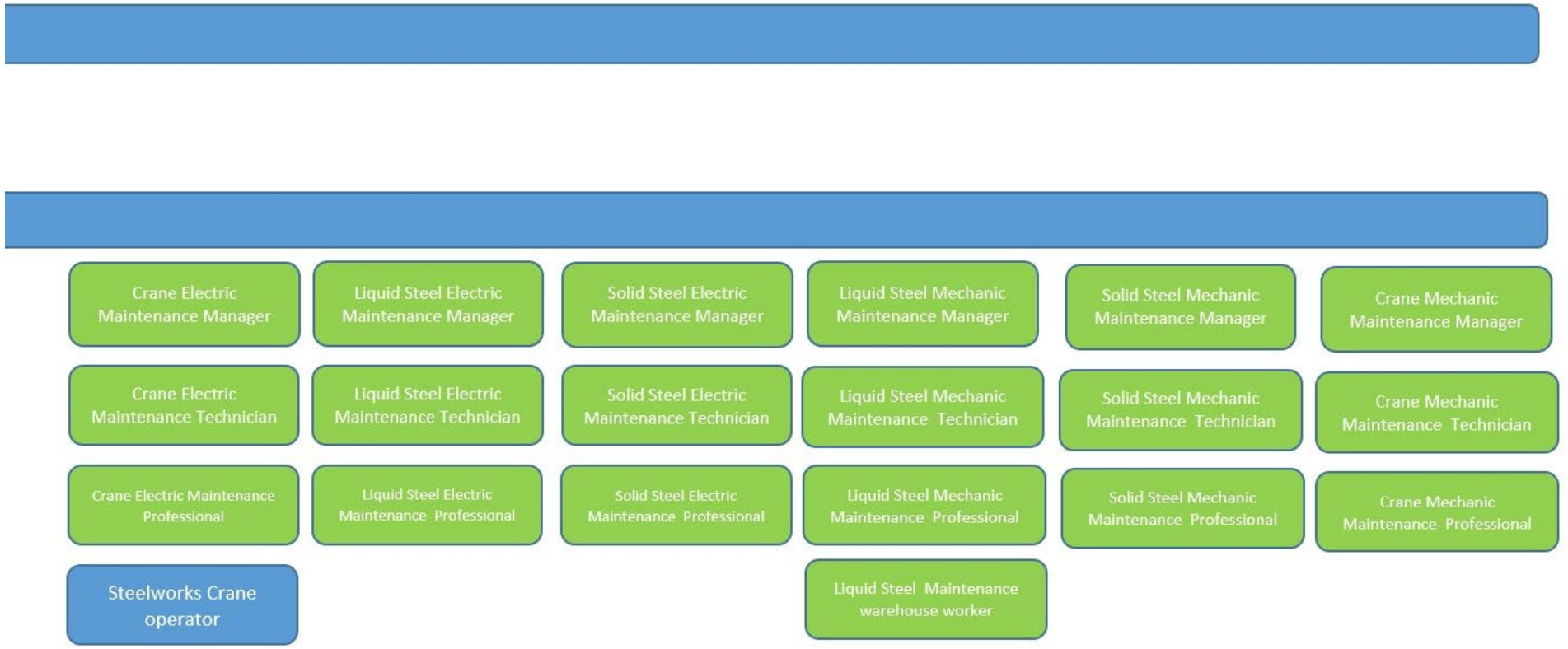

Level 1 Families
Raw Materials and Sinter
Level 2 European Steel profesional role profiles
Ore Yard Production Manager
Sinter Production Manager
Mechanic Maintenance Manager
Electric Maintenance Manager
Ore Yard Production Shift Manager
Sinter Production Shift Manager
Mechanic Maintenance Technician
Electric Maintenance Technician
Ore Yard Panel Control Supervisor
Sinter Supervisor
Mechanic Maintenance Professional
Electric Maintenance Professional
Ore Yard stacker and reclaimer operator and maintenance
Sinter Panel Control Operator
Operator and maintenance of other machines
Sinter Operator and Maintenance
Ore Yard Operator and maintenance

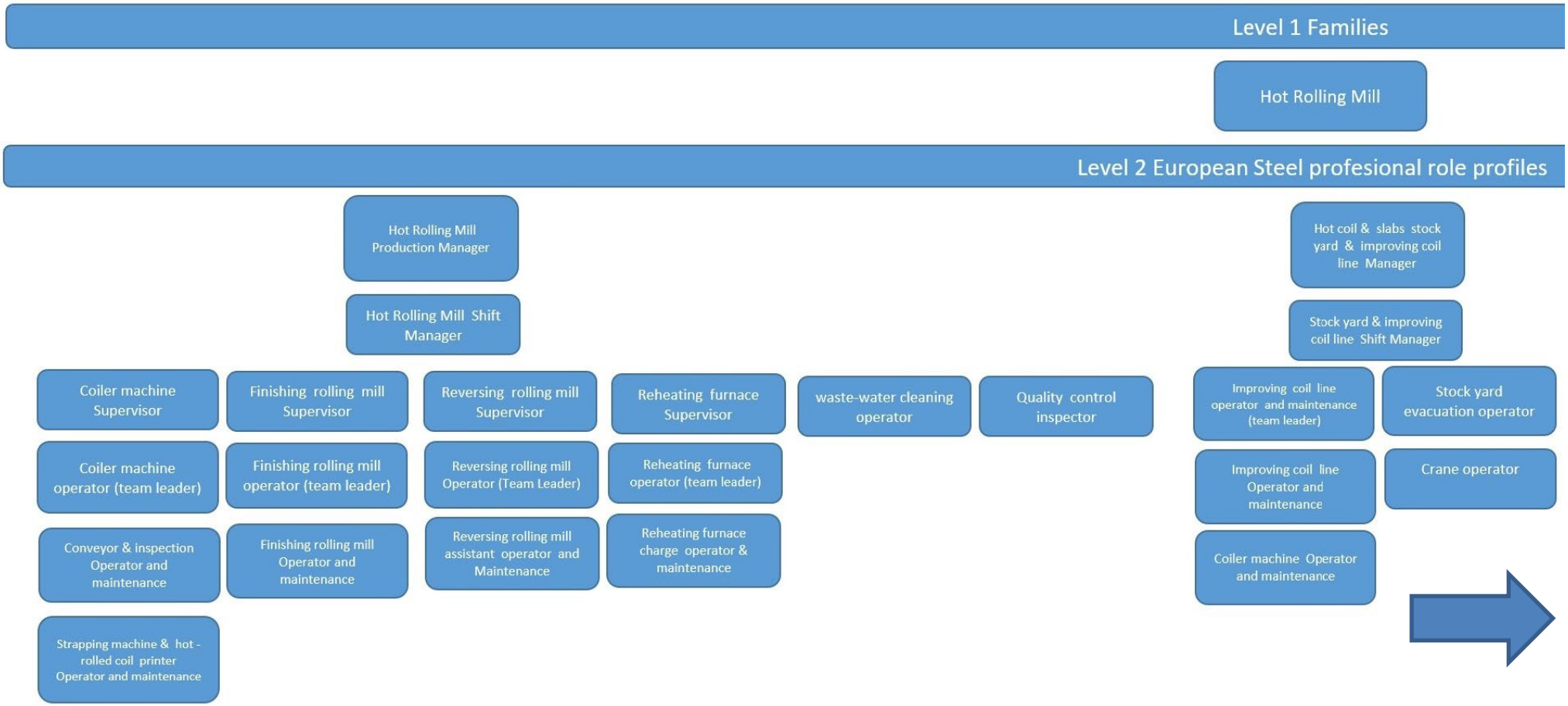

Level 1 Families
Blast Furnaces
Level 2 European Steel professional role profiles
Blast Furnaces Production Shift Manager
Blast Furnaces Process technician & mechanic autonomous maintenance
Blast Furnaces Process technician & electric autonomous maintenance
Blast Furnaces Process professional & mechanic autonomous maintenance
Blast Furnaces coordinator
Blast Furnaces Operator
Blast Furnaces Joint operator
Blast Furnaces Maintenance Operator
Blast Furnaces refractory lining coordinator
Blast Furnaces machinery foreman
loads and unloadsl operator
Blast Furnaces autonomous equipment
Iron Pig desulphurisation Supervisor
Iron Pig desulphurisation operator
hot-metal transfer car overturning operator
Iron Pig coordinator
refractory lining Supervisor
refractory lining foreman
mechanic maintenance technician
mechanic maintenance professional
Blast Furnaces technical support
electric maintenance technician
electric maintenance professional
Blast Furnaces technical support

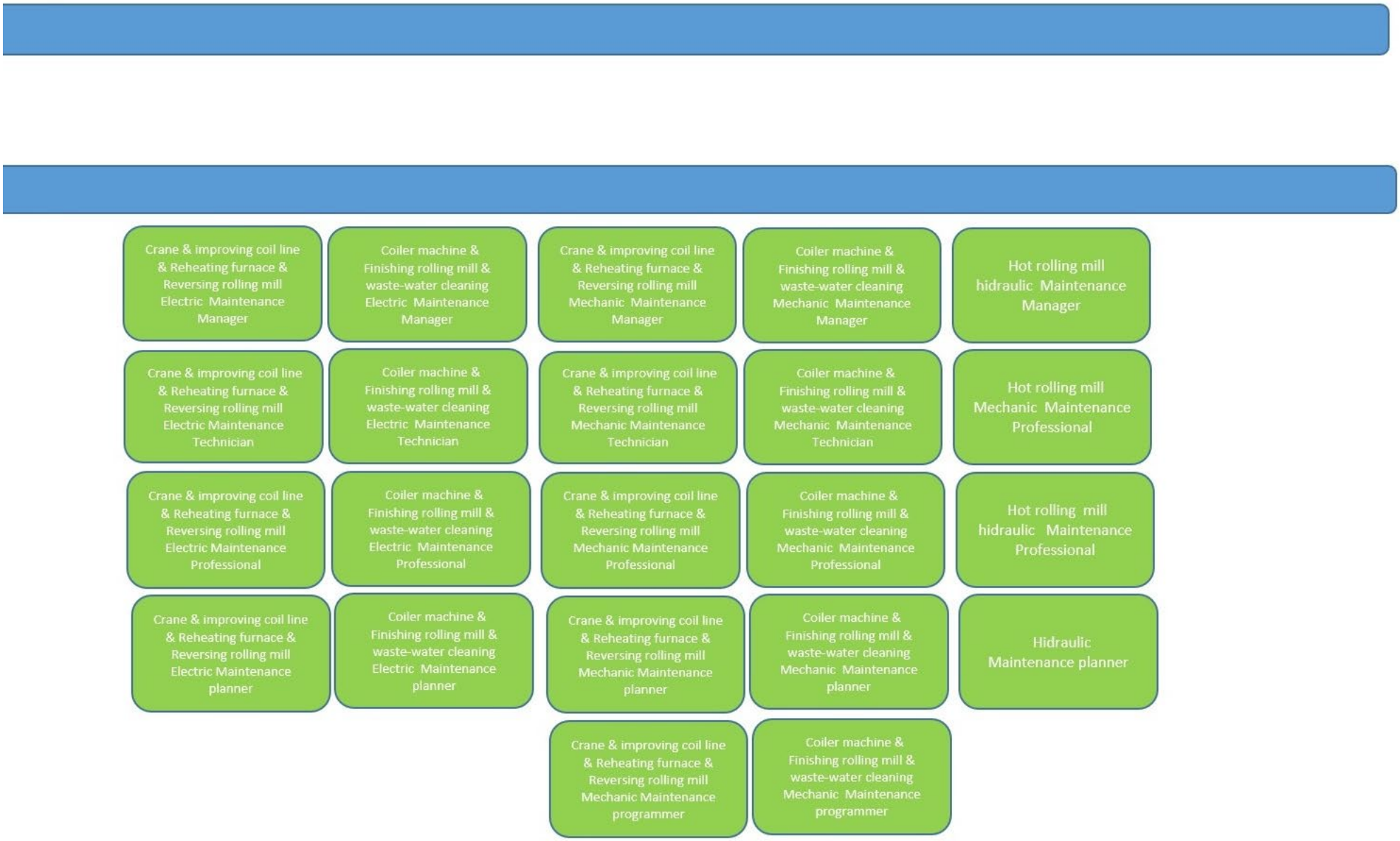

Level 1 Families
Coke Batteries
Level 2 European Steel professional role profiles
Heating Manager
Heating Technician
Heating/Process operator & maintenance
Planner
Coke Batteries Panel Control Supervisor
Heating Operator & Maintenance
Coke Batteries Production Manager
Coke Batteries Production Shift Manager
Coke-oven operation Supervisor
Coke Batteries Operator & Maintenance
Auxiliary process operator
Autonomous maintenance Technician WCM
Coke By- product operator & maintenance
Electromechanical Breakdown Maintenance Technician
Mechanic Breakdown Maintenance Professional
Electric Breakdown Maintenance Professional
Mechanic Maintenance Manager
Mechanic Maintenance Technician
Mechanic Maintenance Professional


Electric Maintenance Manager
Hidraulic Maintenance Technician
Mechanic Maintenance Planner
Mechanic Maintenance programmer
Electric Maintenance Technician
Electric Maintenance Planner
Electric Maintenance instrumentation & PLC expert
Mechanic Maintenance Professional
Electric Maintenance Professional

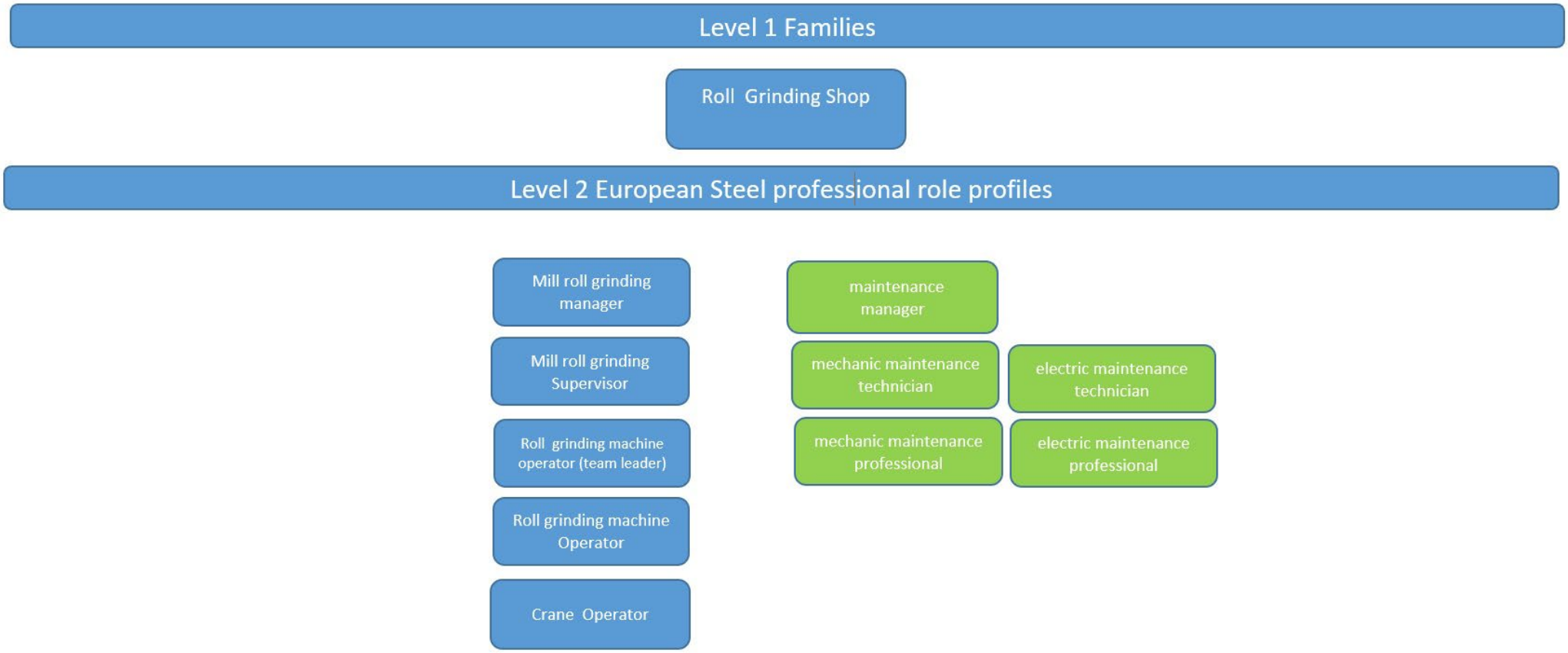

Level 1 Families
SteelWorks
Level 2 European Steel professional role profiles
Liquid Steel (Secondary Metallurgy & Ladle) Production Manager
Secondary Metallurgy Supervisor
Ladle & Refractory Supervisor
Secondary Metallurgy operator and maintenance
Ladle Preparation operator (team leader) and maintenance
Secondary Metallurgy Assistant Operator and maintenance
Ladle Preparation Operator and maintenance
Liquid Steel (Conversion) Production Manager
Liquid Steel Shift Manager
OG Supervisor
Blowing Supervisor
Blowing Operator (Team Leader)
Converter Operator and Maintenance
Transfer pig iron Operator
OG Operator
torpedo tipping Operator
Coordination Supervisor
Water plant Supervisor
Water panel control operator & maintenance
Solid Steel (continuous casting) Production Manager
Solid Steel (continuous casting) Shift Manager
Continuous casting Supervisor
Continuous casting operator (team leader)
Ironed Operator and maintenance
Oxycutting Operator and maintenance
Solid Steel (slab yard & forwarding) Production Manager
Solid Steel (slab yard & forwarding) Shift Manager
Slab Yard & forwarding Supervisor
Slab Yard operator (team leader) and maintenance
Slab Yard Operator and maintenance
Solid Steel Product Technician

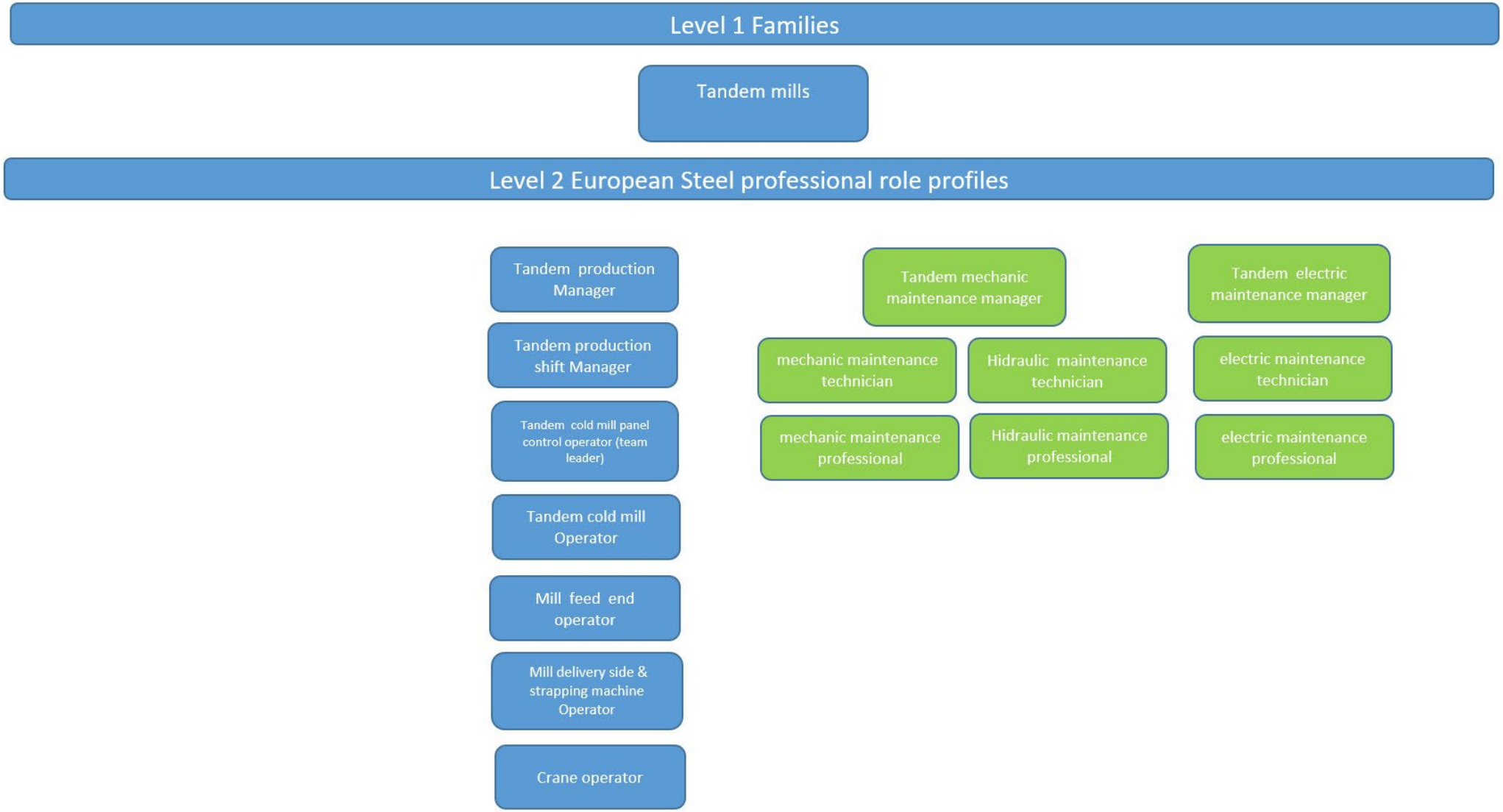

Crane Electric Maintenance Manager
Liquid Steel Electric Maintenance Manager
Solid Steel Electric Maintenance Manager
Liquid Steel Mechanic Maintenance Manager
Solid Steel Mechanic Maintenance Manager
Crane Mechanic Maintenance Manager
Crane Electric Maintenance Technician
Liquid Steel Electric Maintenance Technician
Solid Steel Electric Maintenance Technician
Liquid Steel Mechanic Maintenance Technician
Solid Steel Mechanic Maintenance Technician
Crane Mechanic Maintenance Technician
Crane Electric Maintenance Professional
Liquid Steel Electric Maintenance Professional
Solid Steel Electric Maintenance Professional
Liquid Steel Mechanic Maintenance Professional
Solid Steel Mechanic Maintenance Professional
Crane Mechanic Maintenance Professional
Steelworks Crane operator
Liquid Steel Maintenance warehouse worker

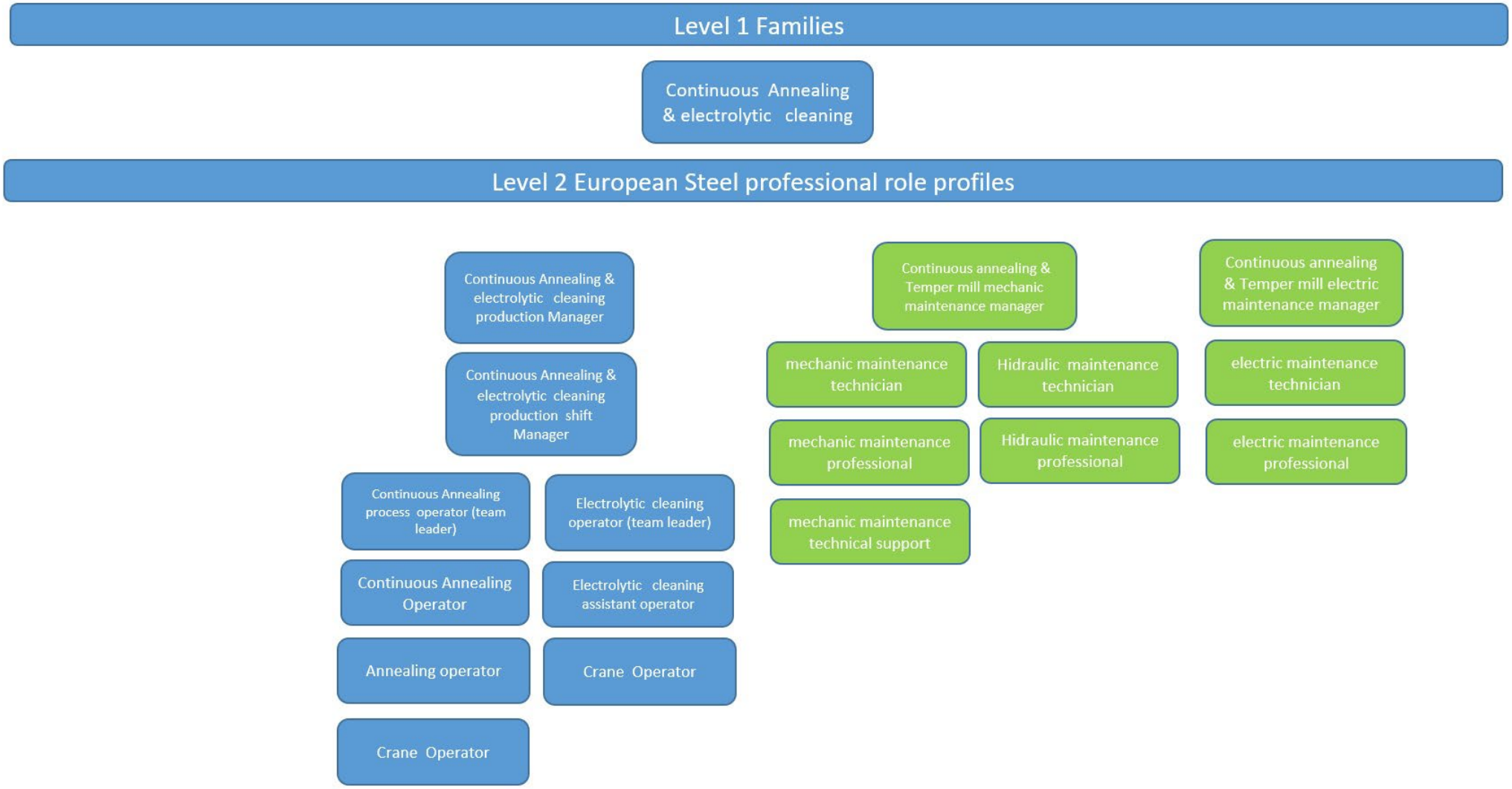

Level 1 Families
Hot Rolling Mill
Level 2 European Steel profesional role profiles
Hot Rolling Mill Production Manager
Hot Rolling Mill Shift Manager
Coiler machine Supervisor
Finishing rolling mill Supervisor
Reversing rolling mill Supervisor
Reheating furnace Supervisor
waste-water cleaning operator
Quality control inspector
Coiler machine operator (team leader)
Finishing rolling mill operator (team leader)
Reversing rolling mill Operator (Team Leader)
Reheating furnace operator (team leader)
Conveyor & inspection Operator and maintenance
Finishing rolling mill Operator and maintenance
Reversing rolling mill assistant operator and Maintenance
Reheating furnace charge operator & maintenance
Strapping machine & hot - rolled coil printer Operator and maintenance
Hot coil & slabs stock yard & improving coil line Manager
Stock yard & improving coil line Shift Manager
Improving coil line operator and maintenance (team leader)
Stock yard evacuation operator
Improving coil line Operator and maintenance
Crane operator
Coiler machine Operator and maintenance


Crane & improving coil line & Reheating furnace & Reversing rolling mill Electric Maintenance Manager
Coiler machine & Finishing rolling mill & waste-water cleaning Electric Maintenance Manager
Crane & improving coil line & Reheating furnace & Reversing rolling mill Mechanic Maintenance Manager
Coiler machine & Finishing rolling mill & waste-water cleaning Mechanic Maintenance Manager
Hot rolling mill hidraulic Maintenance Manager
Crane & improving coil line & Reheating furnace & Reversing rolling mill Electric Maintenance Technician
Coiler machine & Finishing rolling mill & waste-water cleaning Electric Maintenance Technician
Crane & improving coil line & Reheating furnace & Reversing rolling mill Mechanic Maintenance Technician
Coiler machine & Finishing rolling mill & waste-water cleaning Mechanic Maintenance Technician
Hot rolling mill Mechanic Maintenance Professional
Crane & improving coil line & Reheating furnace & Reversing rolling mill Electric Maintenance Professional
Coiler machine & Finishing rolling mill & waste-water cleaning Electric Maintenance Professional
Crane & improving coil line & Reheating furnace & Reversing rolling mill Mechanic Maintenance Professional
Coiler machine & Finishing rolling mill & waste-water cleaning Mechanic Maintenance Professional
Hot rolling mill hidraulic Maintenance Professional
Crane & improving coil line & Reheating furnace & Reversing rolling mill Electric Maintenance planner
Coiler machine & Finishing rolling mill & waste-water cleaning Electric Maintenance planner
Crane & improving coil line & Reheating furnace & Reversing rolling mill Mechanic Maintenance planner
Coiler machine & Finishing rolling mill & waste-water cleaning Mechanic Maintenance planner
Hidraulic Maintenance planner
Crane & improving coil line & Reheating furnace & Reversing rolling mill Mechanic Maintenance programmer
Coiler machine & Finishing rolling mill & waste-water cleaning Mechanic Maintenance programmer


Level 1 Families
Pickling line
Level 2 European Steel professional role profiles
Pickling production Manager
Pickling production shift Manager
Edge trimmer operator (team leader)
Pickling process Operator
Pickling operator
Uncolier Operator
Crane Operator
HCL plant & accesory equipment Manager
HCL plant & water treating plant Supervisor
HCL & accesory equipment operator
HCL & accesory equipment assistant Operator
Pickling line & HCL plant & accesory equipment mechanic maintenance manager
mechanic maintenance technician
mechanic maintenance professional
Pickling line & HCL plant & accesory equipment electric maintenance manager
electric maintenance technician
electric maintenance professional


Level 1 Families
Roll Grinding Shop
Level 2 European Steel professional role profiles
Mill roll grinding manager
Mill roll grinding Supervisor
Roll grinding machine operator (team leader)
Roll grinding machine Operator
Crane Operator
maintenance manager
mechanic maintenance technician
electric maintenance technician
mechanic maintenance professional
electric maintenance professional

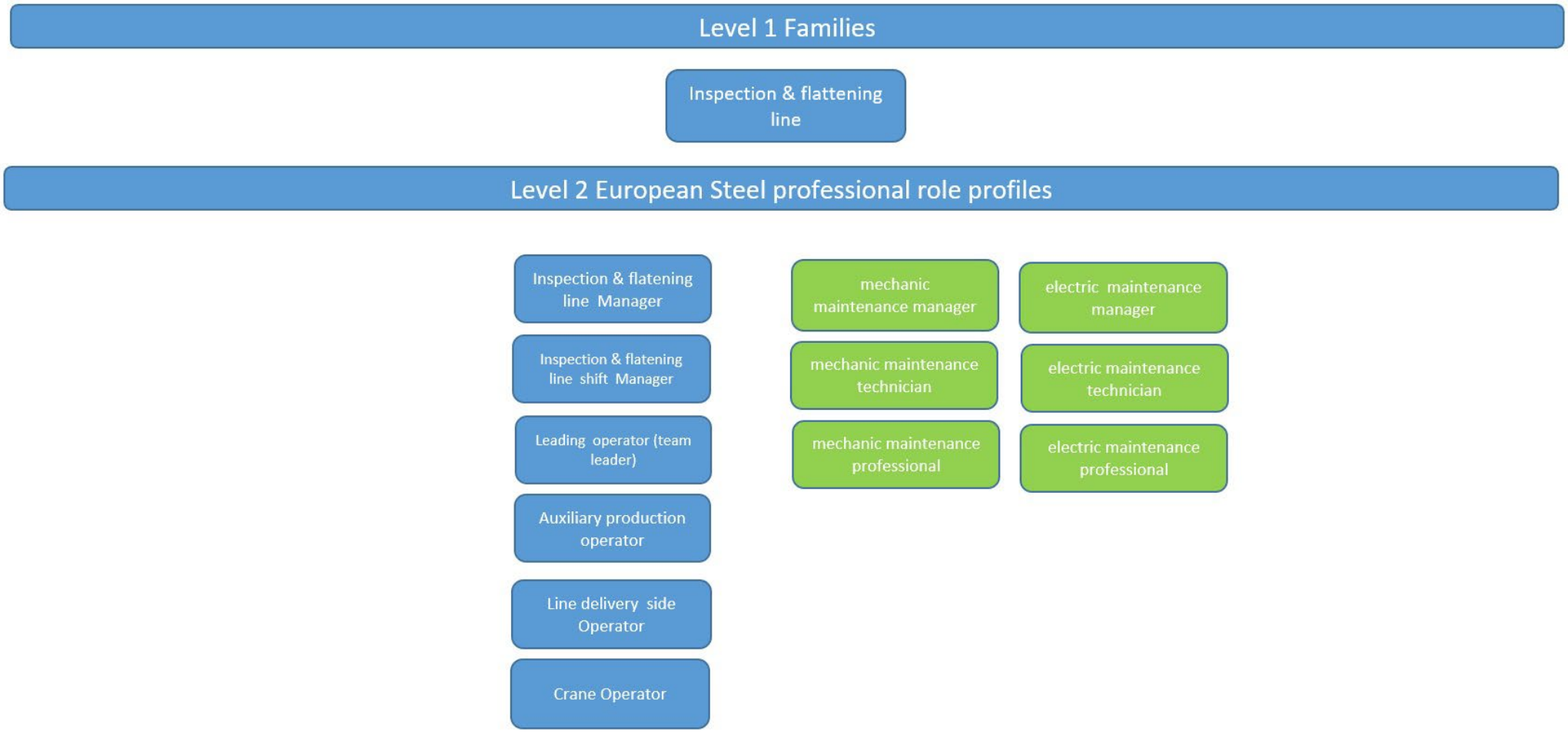

Level 1 Families
Tandem mills
Level 2 European Steel professional role profiles
Tandem production Manager
Tandem production shift Manager
Tandem cold mill panel control operator (team leader)
Tandem cold mill Operator
Mill feed end operator
Mill delivery side & strapping machine Operator
Crane operator
Tandem mechanic maintenance manager
mechanic maintenance technician
Hidraulic maintenance technician
mechanic maintenance professional
Hidraulic maintenance professional
Tandem electric maintenance manager
electric maintenance technician
electric maintenance professional

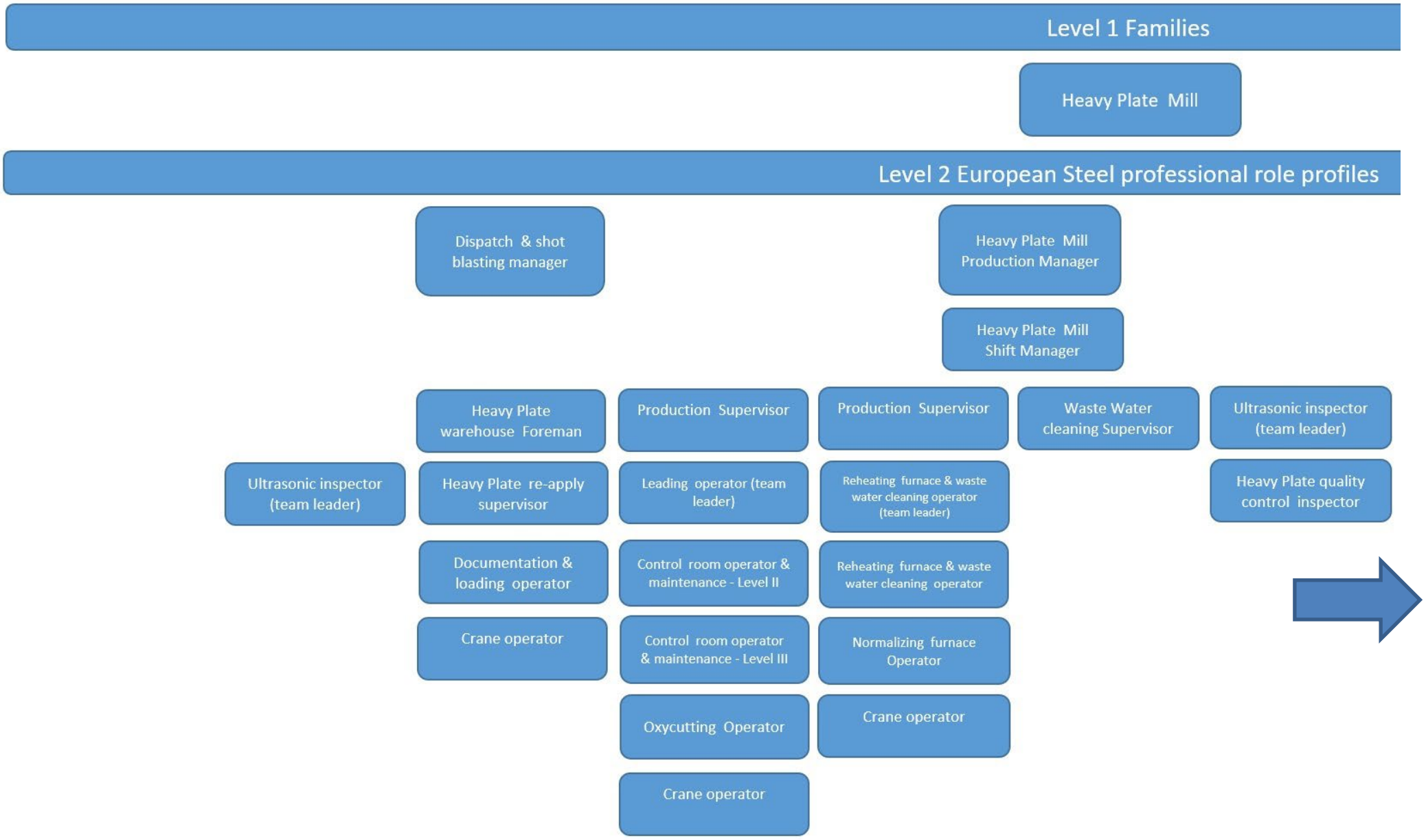

Level 1 Families
Continuous Annealing & electrolytic cleaning
Level 2 European Steel professional role profiles
Continuous Annealing & electrolytic cleaning production Manager
Continuous Annealing & electrolytic cleaning production shift Manager
Continuous Annealing process operator (team leader)
Electrolytic cleaning operator (team leader)
Continuous Annealing Operator
Electrolytic cleaning assistant operator
Annealing operator
Crane Operator
Crane Operator
Continuous annealing & Temper mill mechanic maintenance manager
Continuous annealing & Temper mill electric maintenance manager
mechanic maintenance technician
Hidraulic maintenance technician
electric maintenance technician
mechanic maintenance professional
Hidraulic maintenance professional
electric maintenance professional
mechanic maintenance technical support

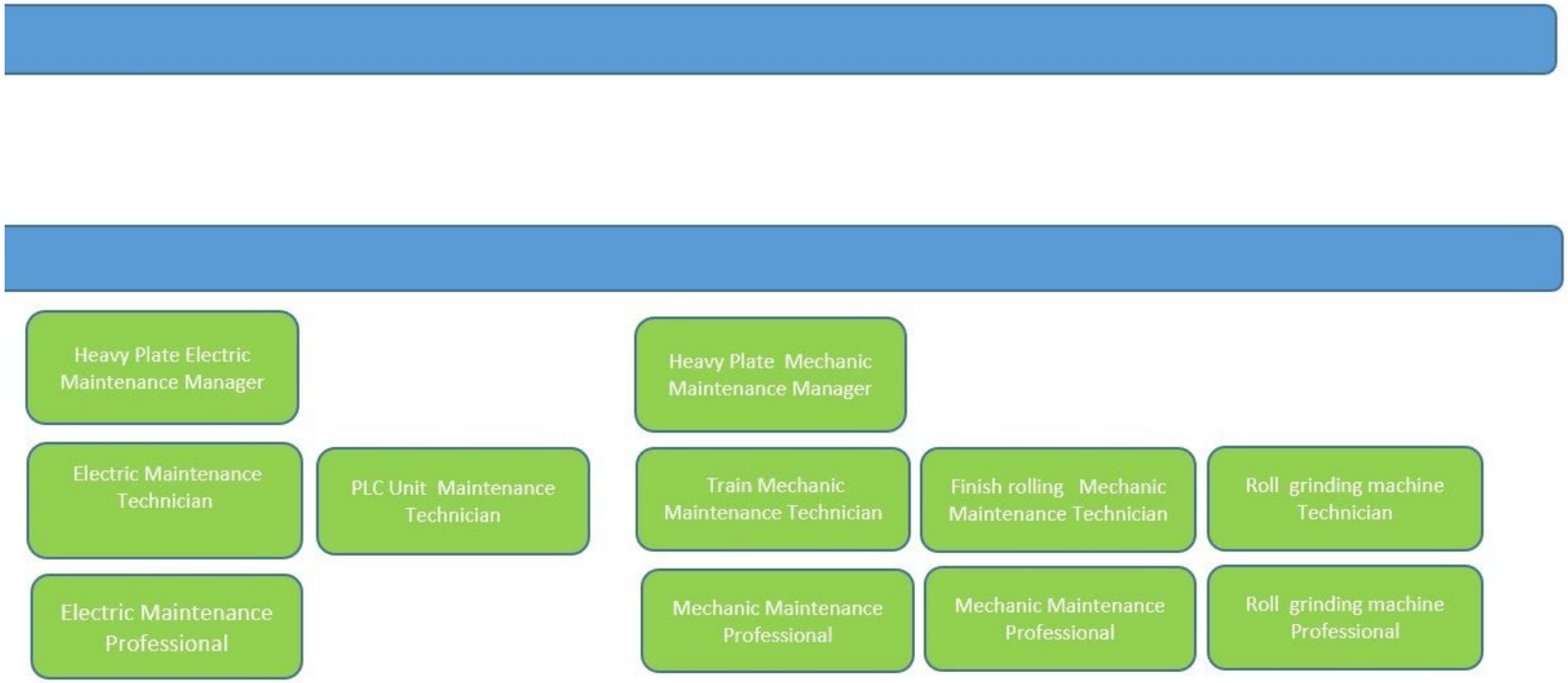

Level 1 Families
Temper mill
Level 2 European Steel professional role profiles
Temper mill production Manager
Temper mill production shift Manager
Tempering operator (team leader)
Tempering Operator
Crane operator

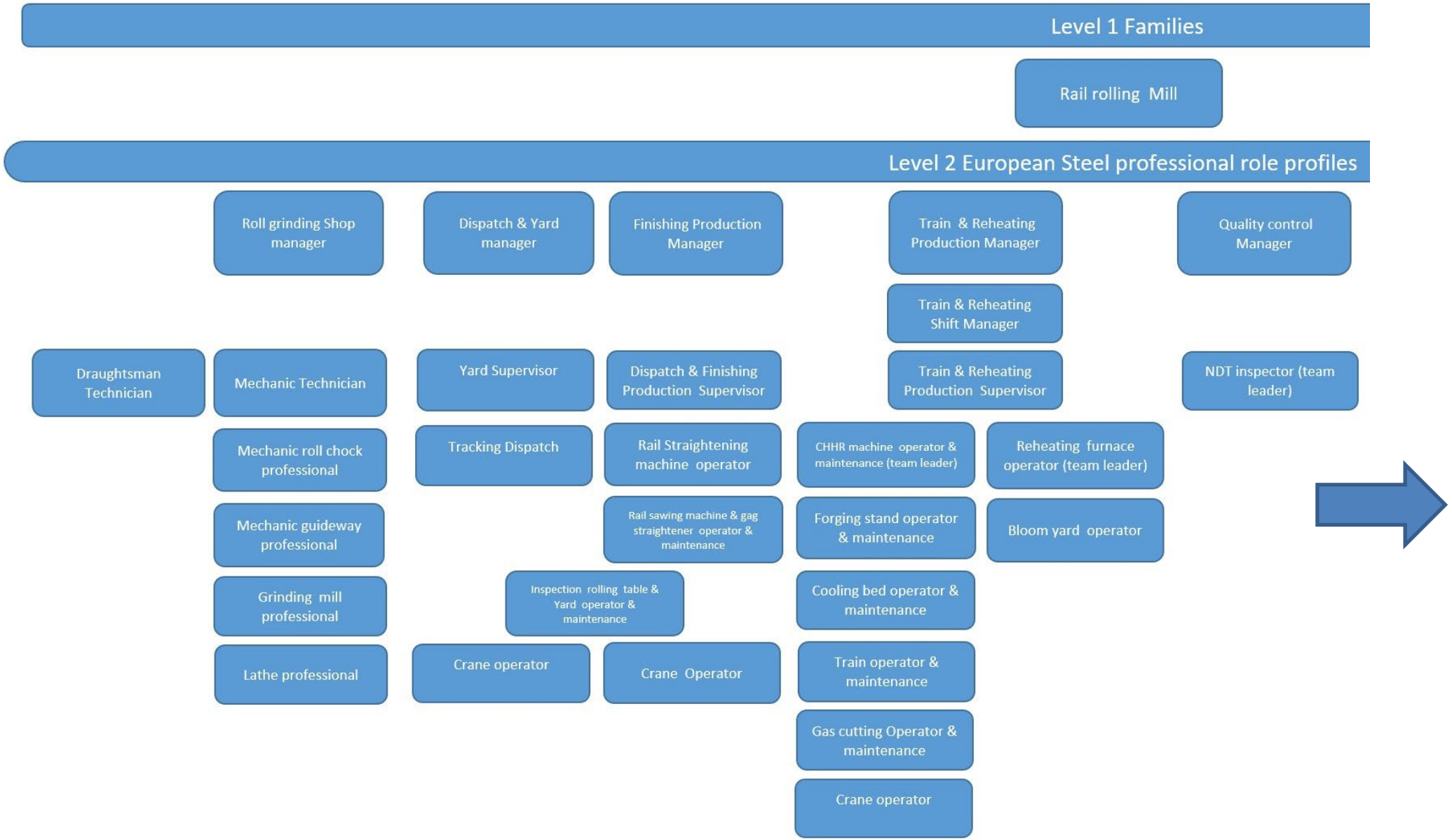

Level 1 Families
Tin Plate Line
Level 2 European Steel professional role profiles
Tin Plate production Manager
Tin Plate production shift Manager
Tin Plate process operator (team leader)
Tin plate process Operator
Tin Plate operator
Inspection line Operator
Crane Operator
Tin Plate mechanic maintenance manager
mechanic maintenance technician
mechanic maintenance professional
Tin Plate electric maintenance manager
electric maintenance technician
electric maintenance professional

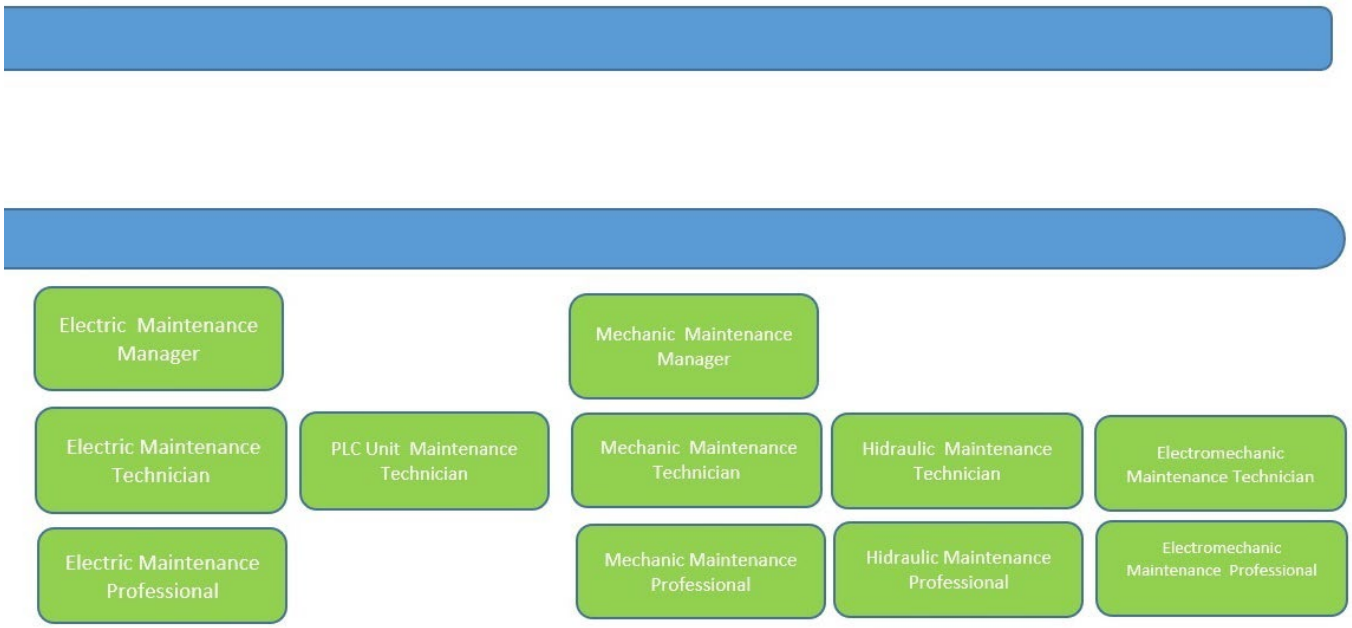

Level 1 Families
Galvanizing line
Level 2 European Steel professional role profiles
Galvanizing production Manager
Galvanizing production shift Manager
Leading operator (team leader)
Assistant leading operator
Inspection operator
Line feed end Operator
Line delivery side Operator
Welding machine Operator
Crane Operator
mechanic maintenance manager
mechanic maintenance technician
mechanic maintenance professional
hidraulic maintenance professional
electric maintenance manager
electric maintenance technician
electric maintenance professional

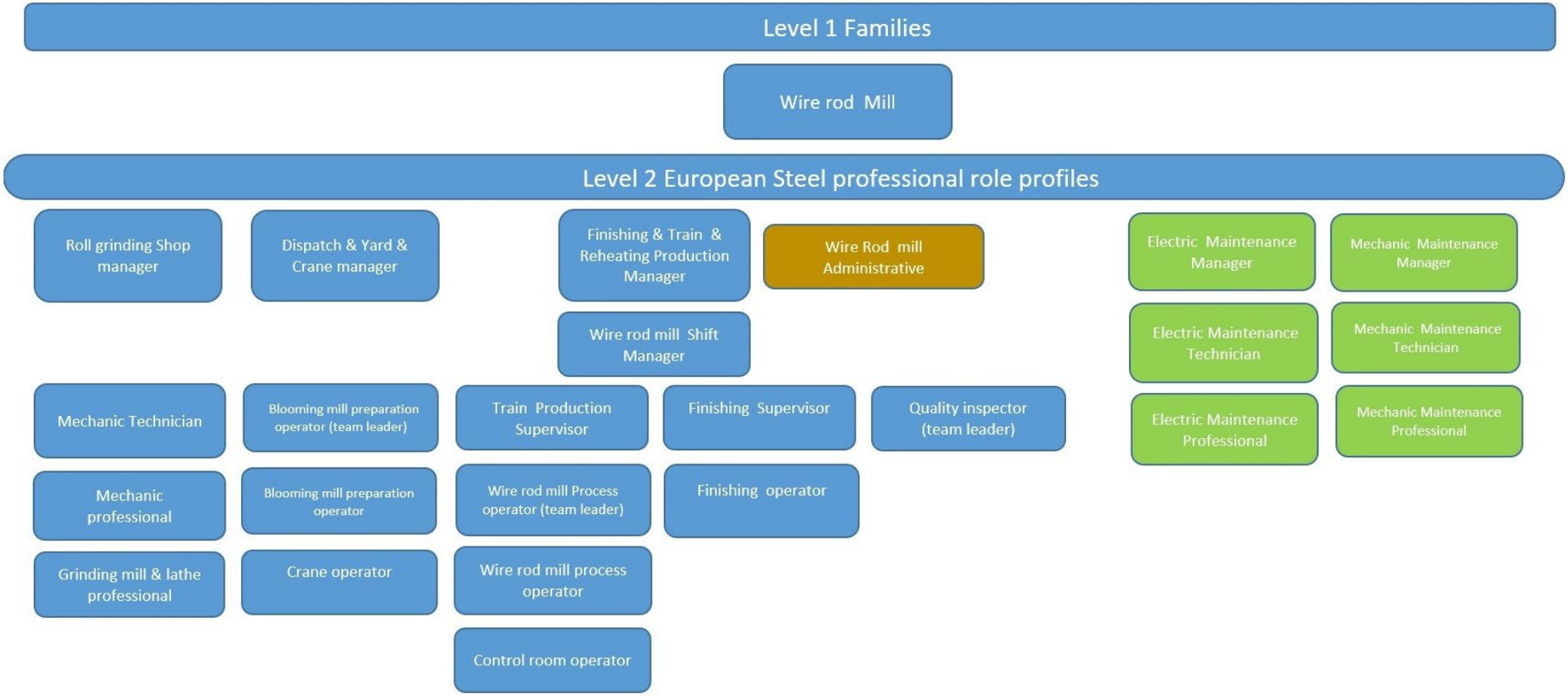

Level 1 Families
Inspection & flattening line
Level 2 European Steel professional role profiles
Inspection & flatening line Manager
Inspection & flatening line shift Manager
Leading operator (team leader)
Auxiliary production operator
Line delivery side Operator
Crane Operator
mechanic maintenance manager
mechanic maintenance technician
mechanic maintenance professional
electric maintenance manager
electric maintenance technician
electric maintenance professional

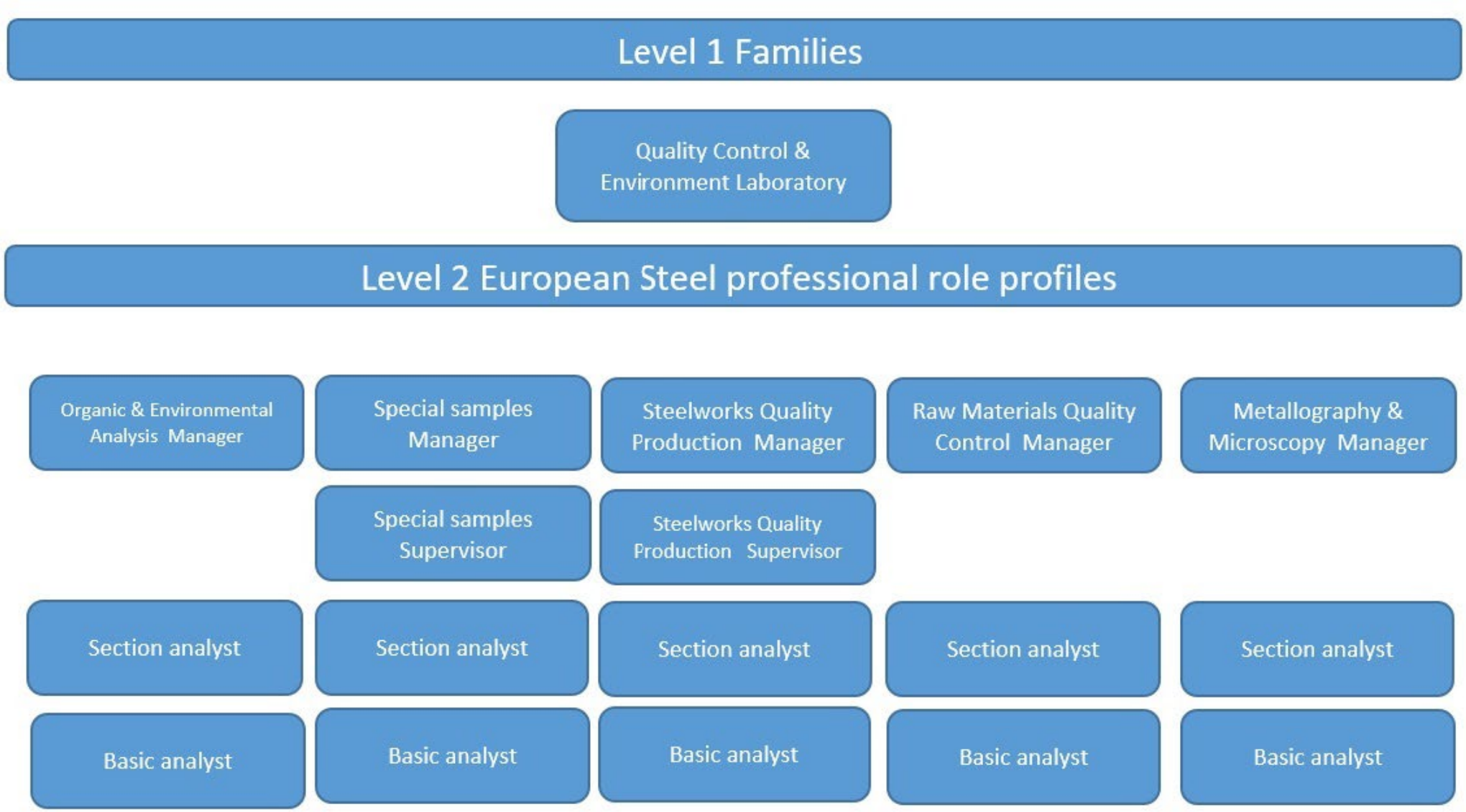

Level 1 Families
Heavy Plate Mill
Level 2 European Steel professional role profiles
Dispatch & shot blasting manager
Heavy Plate Mill Production Manager
Heavy Plate Mill Shift Manager
Heavy Plate warehouse Foreman
Production Supervisor
Production Supervisor
Waste Water cleaning Supervisor
Ultrasonic inspector (team leader)
Ultrasonic inspector (team leader)
Heavy Plate re-apply supervisor
Leading operator (team leader)
Reheating furnace & waste water cleaning operator (team leader)
Heavy Plate quality control inspector
Documentation & loading operator
Control room operator & maintenance - Level II
Reheating furnace & waste water cleaning operator
Crane operator
Control room operator & maintenance - Level III
Normalizing furnace Operator
Oxycutting Operator
Crane operator
Crane operator

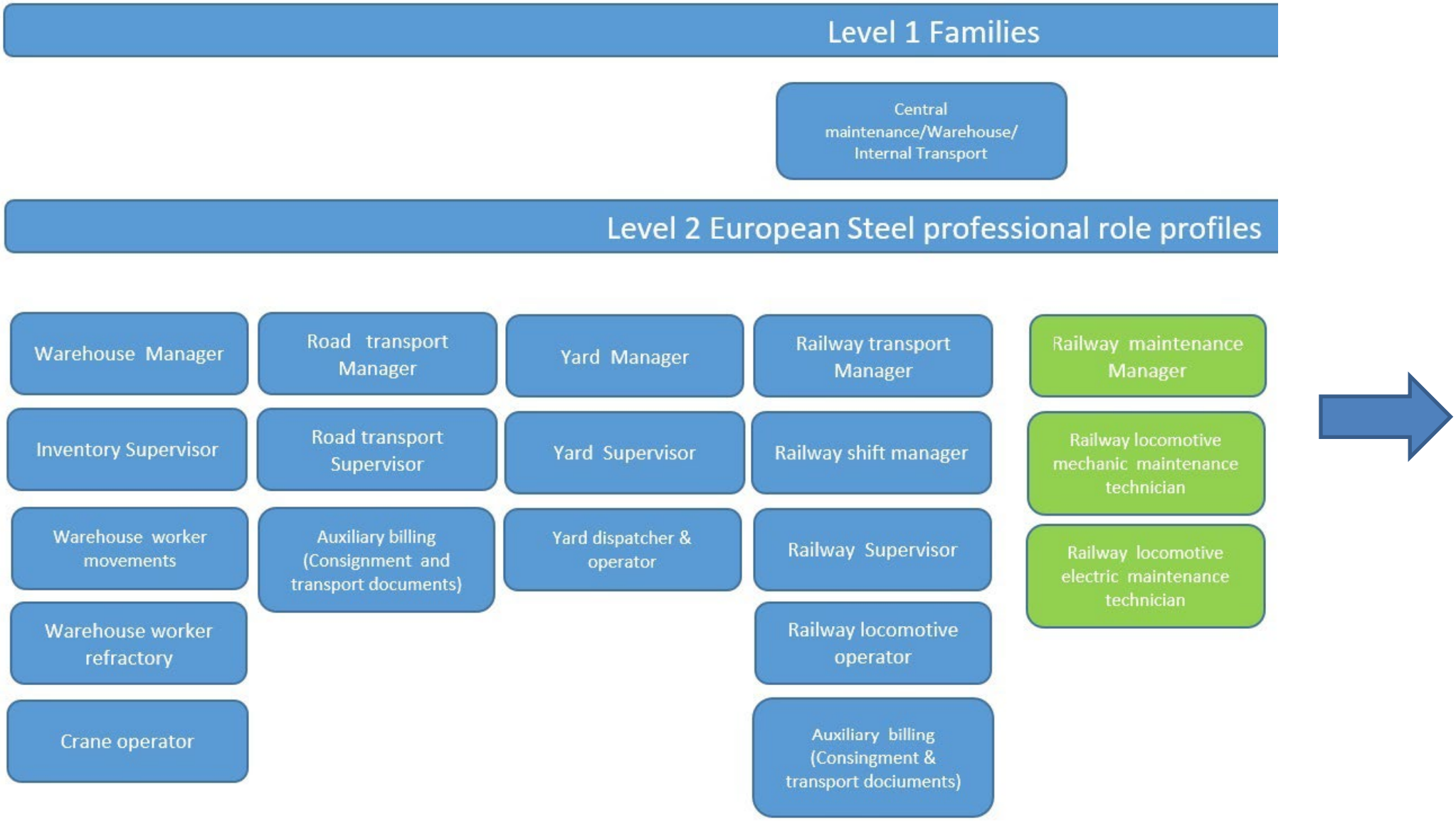

Heavy Plate Electric Maintenance Manager
Electric Maintenance Technician
PLC Unit Maintenance Technician
Electric Maintenance Professional
Heavy Plate Mechanic Maintenance Manager
Train Mechanic Maintenance Technician
Finish rolling Mechanic Maintenance Technician
Roll grinding machine Technician
Mechanic Maintenance Professional
Mechanic Maintenance Professional
Roll grinding machine Professional

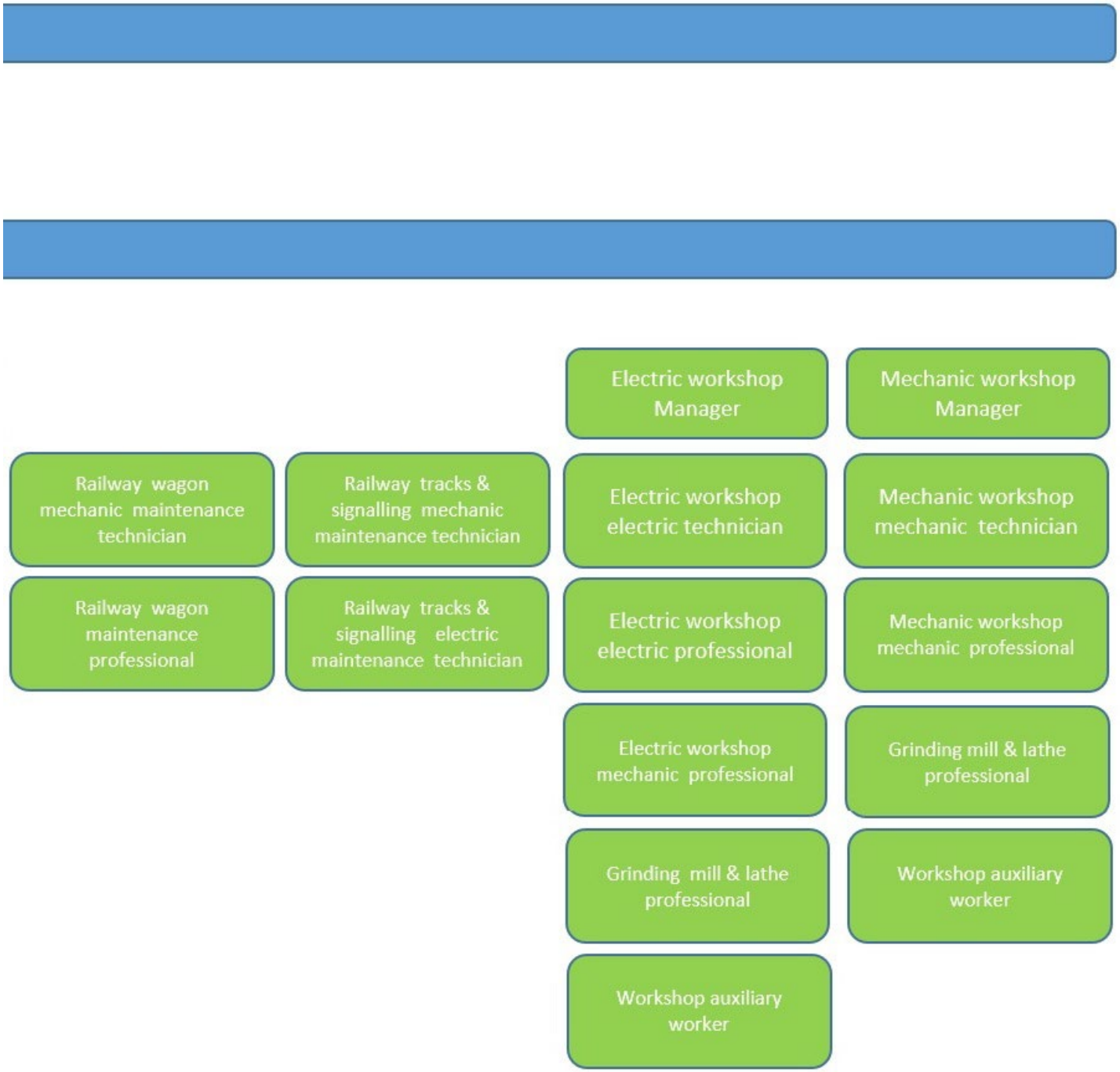

Level 1 Families
Rail rolling Mill
Level 2 European Steel professional role profiles
Roll grinding Shop manager
Dispatch & Yard manager
Finishing Production Manager
Train & Reheating Production Manager
Quality control Manager
Train & Reheating Shift Manager
Draughtsman Technician
Mechanic Technician
Yard Supervisor
Dispatch & Finishing Production Supervisor
Train & Reheating Production Supervisor
NDT inspector (team leader)
Mechanic roll chock professional
Tracking Dispatch
Rail Straightening machine operator
CHHR machine operator & maintenance (team leader)
Reheating furnace operator (team leader)
Mechanic guideway professional
Rail sawing machine & gag straightener operator & maintenance
Forging stand operator & maintenance
Bloom yard operator
Grinding mill professional
Inspection rolling table & Yard operator & maintenance
Cooling bed operator & maintenance
Lathe professional
Crane operator
Crane Operator
Train operator & maintenance
Gas cutting Operator & maintenance
Crane operator

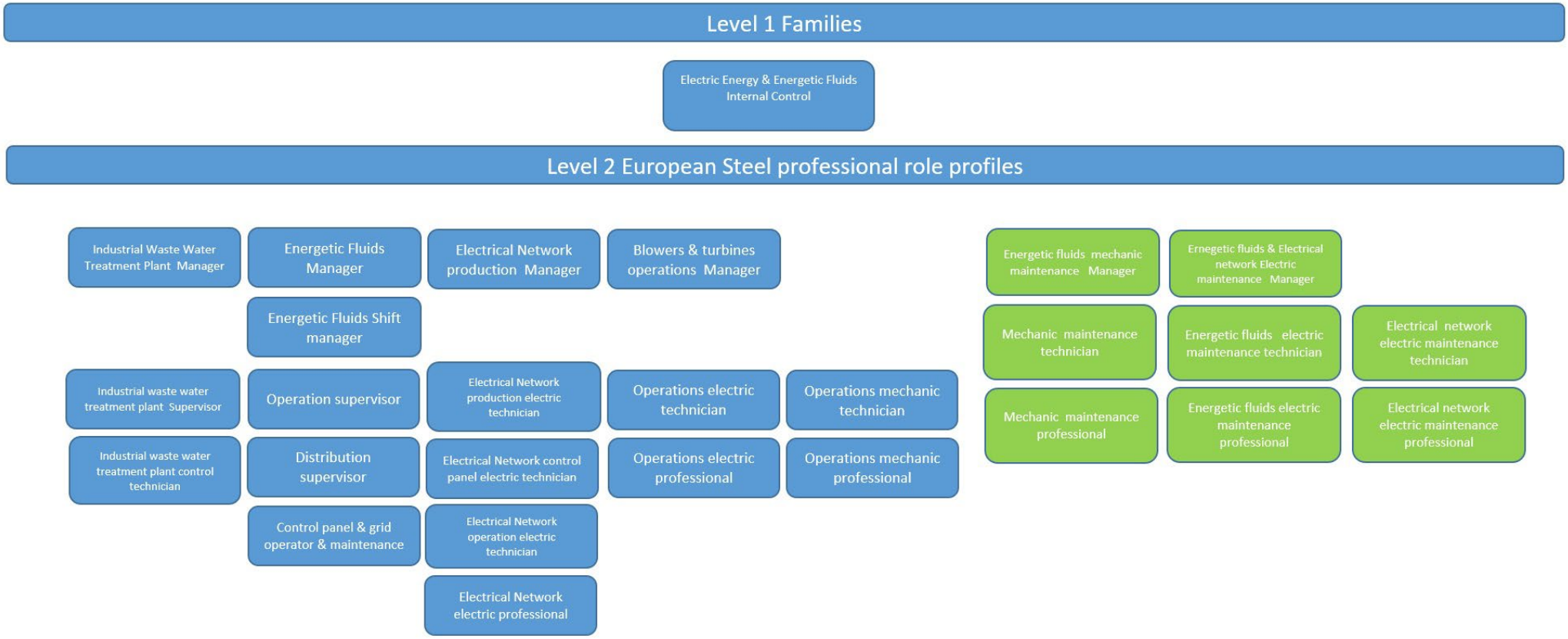

Electric Maintenance Manager
Mechanic Maintenance Manager
Electric Maintenance Technician
PLC Unit Maintenance Technician
Mechanic Maintenance Technician
Hidraulic Maintenance Technician
Electromechanic Maintenance Technician
Electric Maintenance Professional
Mechanic Maintenance Professional
Hidraulic Maintenance Professional
Electromechanic Maintenance Professional


Level 1 Families
Wire rod Mill
Level 2 European Steel professional role profiles
Roll grinding Shop manager
Dispatch & Yard & Crane manager
Finishing & Train & Reheating Production Manager
Wire Rod mill Administrative
Wire rod mill Shift Manager
Electric Maintenance Manager
Mechanic Maintenance Manager
Electric Maintenance Technician
Mechanic Maintenance Technician
Electric Maintenance Professional
Mechanic Maintenance Professional
Mechanic Technician
Blooming mill preparation operator (team leader)
Train Production Supervisor
Finishing Supervisor
Quality inspector (team leader)
Mechanic professional
Blooming mill preparation operator
Wire rod mill Process operator (team leader)
Finishing operator
Grinding mill & lathe professional
Crane operator
Wire rod mill process operator
Control room operator


Level 1 Families
Quality Control & Environment Laboratory
Level 2 European Steel professional role profiles
Organic & Environmental Analysis Manager
Special samples Manager
Steelworks Quality Production Manager
Raw Materials Quality Control Manager
Metallography & Microscopy Manager
Special samples Supervisor
Steelworks Quality Production Supervisor
Section analyst
Section analyst
Section analyst
Section analyst
Section analyst
Basic analyst
Basic analyst
Basic analyst
Basic analyst
Basic analyst


Level 1 Families
Central maintenance/Warehouse/ Internal Transport
Level 2 European Steel professional role profiles
Warehouse Manager
Inventory Supervisor
Warehouse worker movements
Warehouse worker refractory
Crane operator
Road transport Manager
Road transport Supervisor
Auxiliary billing (Consignment and transport documents)
Yard Manager
Yard Supervisor
Yard dispatcher & operator
Railway transport Manager
Railway shift manager
Railway Supervisor
Railway locomotive operator
Auxiliary billing (Consingment & transport dociuments)
Railway maintenance Manager
Railway locomotive mechanic maintenance technician
Railway locomotive electric maintenance technician


Electric workshop Manager
Mechanic workshop Manager
Railway wagon mechanic maintenance technician
Railway tracks & signalling mechanic maintenance technician
Electric workshop electric technician
Mechanic workshop mechanic technician
Railway wagon maintenance professional
Railway tracks & signalling electric maintenance technician
Electric workshop electric professional
Mechanic workshop mechanic professional
Electric workshop mechanic professional
Grinding mill & lathe professional
Grinding mill & lathe professional
Workshop auxiliary worker
Workshop auxiliary worker


Level 1 Families
Electric Energy & Energetic Fluids Internal Control
Level 2 European Steel professional role profiles
Industrial Waste Water Treatment Plant Manager
Energetic Fluids Manager
Electrical Network production Manager
Blowers & turbines operations Manager
Energetic Fluids Shift manager
Industrial waste water treatment plant Supervisor
Operation supervisor
Electrical Network production electric technician
Operations electric technician
Operations mechanic technician
Industrial waste water treatment plant control technician
Distribution supervisor
Electrical Network control panel electric technician
Operations electric professional
Operations mechanic professional
Control panel & grid operator & maintenance
Electrical Network operation electric technician
Electrical Network electric professional
Energetic fluids mechanic maintenance Manager
Ernegetic fluids & Electrical network Electric maintenance Manager
Mechanic maintenance technician
Energetic fluids electric maintenance technician
Electrical network electric maintenance technician
Mechanic maintenance professional
Energetic fluids electric maintenance professional
Electrical network electric maintenance professional