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

Blueprint New Skills Agenda Steel

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Executive Summary

The final Blueprint is outlining a strategic agenda to proactively adjust skills demanded by the steel industry for the steel industry. Based on the recent and future technological and economic developments, skills demand and supply of training measures are outlined, related strands and structures figured out, already tested and checked with the stakeholders in the implementation and test phase. 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) adaption related to existing VET systems and their possible support. Core elements of the Blueprint are three:

(1) the European Foresight Observatory and its Steel Technology and Skills Foresight Panel (ESSA ETP) (demand side), and
(2) the European Online Training Ecosystem steelHub, as well as
(3) the rollout to Regional Skills and Training Ecosystems (ESSA RTS) coordinated by the European Community of National-Regional Training Ecosystems (ECoP Steel) (supply side).

The European Steel Technology and Skills Foresight Observatory is the central coordination unit of the running ESSA Alliance beyond the project funding, integrated in existing European Steel Sector structures (mainly as part of the ESTEP Focus Group People). The Observatory 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 National-Regional Training Ecosystems. Central part of the ESSA Foresight Observatory will be a regular **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 recommendations and reclaiming policy support, and not at least launching and conducting campaigns concerning esp. image, recruitment, and Talent Management.

Based on the ESSA approach and partnership (integrating stakeholders from companies, associations and social partners, training providers, research and development organisations) the Online Training Eco-System conceptualised as an exchange platform "**steelHub**"[1] (https://hub.steeluniversity.org/). This exchange platform is implementing and transferring human resources and training relevant contents and issues from and to all the relevant stakeholders: associations, industry, other blueprints, VET systems, individuals, and EU Tools.

The Online Training Ecosystem steelHub sets the infrastructure for a European/worldwide exchange of training content, integrating inputs from and serving offers to steel associations and companies, VET systems, research centres, other Blueprints, European tools, and the non-formal and informal learning of individuals. The steelHub is also serving the National-Regional Training Eco-Systems, linking European and regional training, and online and work-based learning.

steelHub is an open online system. Based on a business model (agreements between the training publishers and the runner of the platform worldsteel) every training provider,

[1] A short video explaining the steelHub could be found here: https://cdn.hub.steeluniversity.org/assets/videos/play.html?id=MRK0010

could offer training which could be used by every interested company, VET institution, association and individual learner. The main components of the steelHub are (1) a Learning Solution Directory, (2) a Skills Directory, (3) a Capability Assessor, and (4) the Integration in different learning and training paths.

The **Online** Training Eco-System steelHub is complemented by a **National-Regional** Training Eco-System (ESSA RTS) approach lightning 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, public authorities, research and science, and civil society activities within an ecosystem considering the responsibility, competences and activities for VET within a region.

Against the Dutch reference ecosystem model already running in Ijmuiden eight representative steel regions were selected for setting up combined national-regional skills and training ecosystems. Up to four round tables and workshops in a country or region took place 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, Italy, Poland, and Romania (concentrated steel regions).

Because of the successful national-regional processes ESSA is setting up of a European-national-regional European Community of Practice (ECoP Steel) for supporting National-Regional Training Ecosystems, exchanging good practice and mutually learning from each other. Follow-up activities of the National-Regional Ecosystems will focus on (taken up and prioritised differently by the countries and its regions):

- Image and Recruiting: New Narrative of the Steel Industry
- Digital and Green Transformation: Hydrogen Usage and Impact on Skills
- steelHub Interlinks to the Regions, including how to combine online and on-the-job, work-based learning
- Specific SME Regions and Specific Skills Needs and Adjustment Strategies
- Human Resources Demands in Rural Steel Areas.

Beside the already running cooperation with ESCO for exchanging job profiles and related skills demand, the Blueprint engages with other European tools: such as ECQA (European Certification and Qualification Association) for certification of steel related skills and training modules with in the steelHub and the RTS ecosystems, the Skills Intelligence of CEDEFOP (see more here: Cedefop, 2019a) to exchange our results with the broader VET and industry community, and Europass to collect learning outcomes for the individual learner.

The European Commission is aiming to shift to a human-centric orientation in the workplace. 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. 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 the ESSA are completely in line with the philosophy of the EU and national-level legislation. The policy recommendations created by ESSA align with these directives. ESSA policy recommendations are outlined as general and level related policy recommendations: European, national and

regional, in order to provide further contextualisation. Finally, we present some recommendations related to the specific support of small and medium-sized enterprises (SMEs).

ESSA together with the Blueprint Skills Alliance for Industrial Symbiosis (SPIRE-SAIS) is now part of the Large Scale Partnership Energy Intensive Industries (LSP EII) under the Pact for Skills. With this pact we are looking for a **sustainable development** of ESSA under a **common, different process industries comprising framework** with two specific foci as a starting point:

- SPIRE-SAIS = **cross-sectoral** and **industrial symbiosis skills** specific blueprint
- ESSA = **specific sector** related blueprint including an incremental upskilling of representative job profiles (t-shaped skills: technical and transversal skills (green, digital, social, individual, and methodological))

Background

The main objective of the project is to develop and run a Blueprint for an ongoing, *steel industry driven* European Steel Skills Alliance and Agenda (ESSA), which is a strategy for the continuing and short-termed implementation of new skills demands to improve sustainability and resilience of the Steel Industry. The agenda was piloted by the development of related scenarios, strategies, frameworks, training modules and tools, 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 to meet the future requirements of the industry. This Blueprint sets the ground for the European Steel Skills Agenda and Alliance (ESSA) based on the results of a four and a half years project co-funded by the Erasmus+ Program of the European Union.

With its clearly defined mission "**Industry driven proactive adjustment of future skills with the industry and for the industry**" the main European strategies of the alliance are reflected in the Observatory objectives:

- **Adjusting the workforce proactively**, to deploy and implement new technologies aimed at optimisation of the production process
- **Monitoring and shortening the implementation of industry relevant qualifications and training**
- **Gaining political support** measures by mobilising and integrating stakeholders and policy makers of the European and national level
- Developing and sharing successful sector-wide **upskilling schemes** and efficient management of knowledge
- Improving the **attractiveness of the steel (and process) industry** and steel sector careers for talented people (**recruitment and retention**).

As it is industry driven the Blueprint is strongly based on the company related skills requirements (WP3) which derived from the technological and economic development and foresight (WP2) complemented by the anticipation of future requirements by the Vocational Education and Training (VET) Systems (of selected member states representing different VET systems) (WP4).

The Blueprint is designed as a practical and user-friendly orientation and information framework delivering contributions and solutions from the steel industry for the steel industry, incorporating all the stakeholder groups (companies, training providers, research institutions, and associations / social partners). All the activities and the Blueprint outlines have been informed by the results of the Steel Sector Careers project (https://op.europa.eu/s/n6SH). The strong network of the steel sector ensured and will further ensure a synergetic exchange with other sectors (e.g. the energy intensive sectors via the SPIRE-SAIS project (www.spire2050.eu/sais) in regard to successful up-skilling approaches.

The Blueprint is also based on the results of the implementation and transfer phase and the policy recommendations and dissemination activities (WP6 and 7).

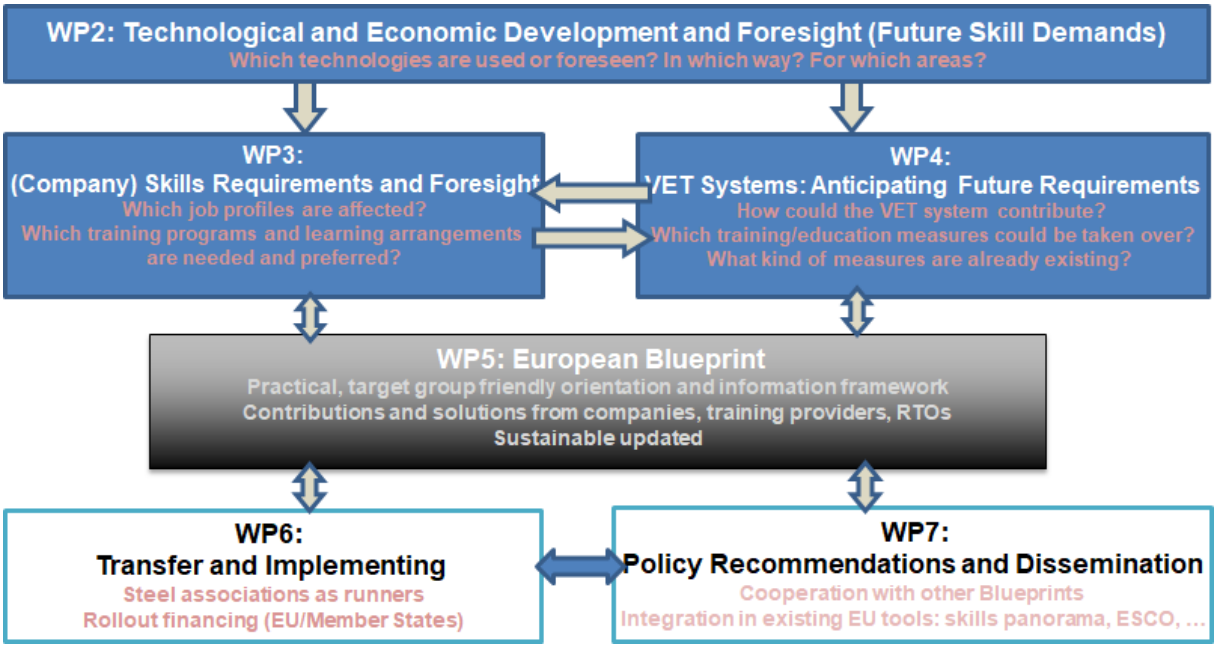


Figure 1: Structure and work programme of ESSA

The Blueprint is also based on the results of the implementation and transfer phase and the policy recommendations and dissemination activities (WP6 and 7).

In a nutshell the Blueprint is composed of:

- Strategies for the implementation of measures to meet defined skill needs, based on the sector skills framework and the improvement of sector occupations and job profiles
- Identification of relevant tools and upskilling schemes
- Development of training courses, tools and activities for integration within VET, company and association training programmes, including:
  - training courses for up- and reskilling existing profiles,
  - update of occupational profiles or parts of it
  - train the trainer, improvements of training providers
  - new training methods and arrangements, considering new possibilities of digital learning and support and workers participation (e.g. workplace innovation, but also by using digital tools like tablets, smart phones, laptops, etc.)

- Development of a strategy to overcome central human resources challenges of the steel industry: 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 as well as strategies increasing the workforce mobility and diversity (e.g. increasing the attractiveness of the steel industry for women).

The Blueprint development and implementation was done in six phases:

Phase 1 and 2 (2019): Requirements / Reflection
Phase 3 (2020): Prototype
Phase 4 (2021/22): Improvement / Implementation and Rollout
Phase 5 (2023): Optimisation/Finalisation
Phase 6 (from July 2023): Sustainable Establishment as part of ESTEP FG People.

Key challenges of the Blueprint relate to the priorities of companies and the resources that will be allocated to skills development on top of other issues the industry is currently dealing with. Skills are important for the steel industry as these contribute to productivity and creating high-value products. Yet the industry faces global issues and market issues that push back skills development and space for engagement with skills issues (such as overcapacities and global competitive distortion, COVID-19 and energy crisis). Bringing together industry stakeholders is crucial to increase the efforts towards skills development. How the industry is supported to recover is also an important factor that affects where skills stand in the priority list of the steel industry.

The ESSA Blueprint is grounded on a holistic and transformative orientation system with new alliances and changing social practices. Based on the work package structure of ESSA (see Figure 2), five topics and their interrelation shape the Blueprint strategies, activities, measures, and tools (outlined in the next chapter and summarised in Figure 3):

1. Technological and Economic Demands and Skills Requirements
2. Skills Adjustment
3. Strategies / Measures
4. Alliances and Leadership
5. Rollout.

Programmatic Orientation and Blueprint Outline

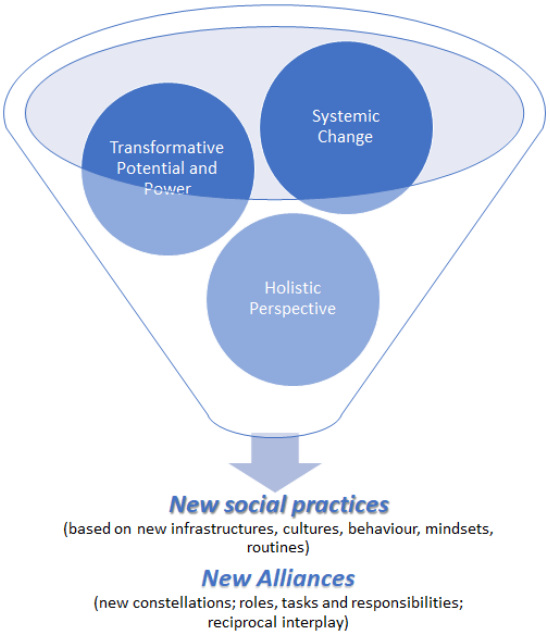


Figure 2: ESSA approach – new social practices and alliances

The development of the Blueprint was a bottom-up *social innovation process* (see Figure 5), integrating all the relevant stakeholder groups (companies, training providers, research institutions, associations and social partners) right from the beginning. This includes also the integration of managers, workers and trainers from different departments, combining a company with the training providers perspective - on a European and a national and regional level. Taking up this holistic approach ESSA looked for the transformative potential and power of technological and social (people related) change in a systemic way → developing an accepted orientation framework for adjusting skills proactively leading to new social practices (for new infrastructures, working conditions, behaviour and mindsets) to improve existing routines (see Figure 2). To move things forward in this directive new alliances with new constellations, roles, tasks and responsibilities in a reciprocal interplay have been established.

The structure and work programme of ESSA (see Figure 1) is reflected in the general Blueprint outline:

(1) Current and future technological and economic developments and related new skills demands are reflected (chapter 1)
(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 (chapter 2)
(3) Strategies and measures are generated to ensure a continuous and sustainable skills assessment and adjustment by the steel industry for the steel industry (iterative, feedback-loop approach) (chapter 3):
    - Foresight Observatory: coordination of the technological foresight and skills needs on a regular monitoring tool: ESSA European Steel Technology and Skills Foresight Panel (ESSA ETP)
    - steelHub: Training offers and learning arrangements available via a common European Online Training Eco-System Platform
    - National-regional Training Eco-Systems (ESSA RTS) bundled in a European Community of Practice (ECoP Steel)
(4) To sustainably run the Blueprint new alliances and governance structures have been integrated in existing sector structures, assigning leadership for the 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 (chapter 4)

(5) European Open Coordination will roll-out the Blueprint concentrating on steel regions, including VET system support of the member states, and in a common action with other energy intensive industries in the Pact for Skills (chapter 5).

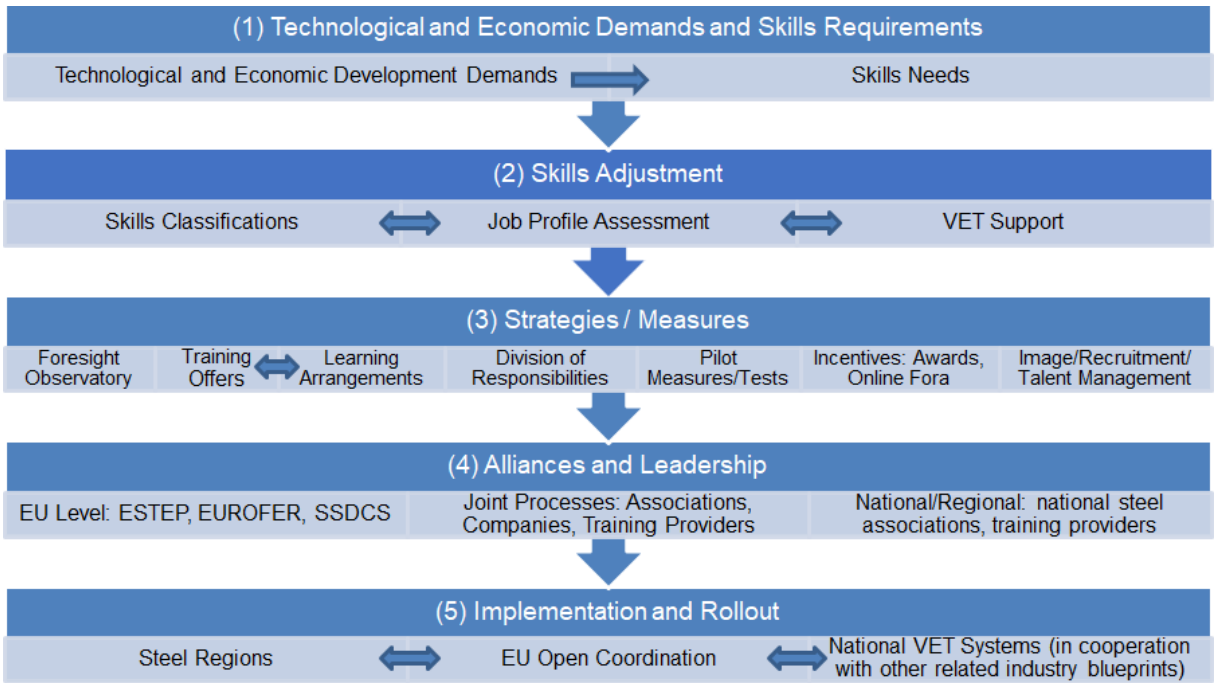


Figure 3: General Blueprint outline

The holistic and industry driven approach of the Blueprint for a **Technology and Economy Driven Skills Adjustment** shown in the following flow chart (Figure 4) is listing the main topics from a skills perspective, which are combined with related strategies, activities, and tools. A (demand) cluster sets technology (and economy) as the genuine driver of new applications (implemented with specific company objectives) leading to organisational implications. The triangle of **technology - organisation - human** is the frame for defining the new skills needs. A second cluster is dedicated to supplying 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 (private) training offers and VET system support (via curricula of initial and continuous VET, aiming to identify gaps in the provision of certain skills categories). 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).

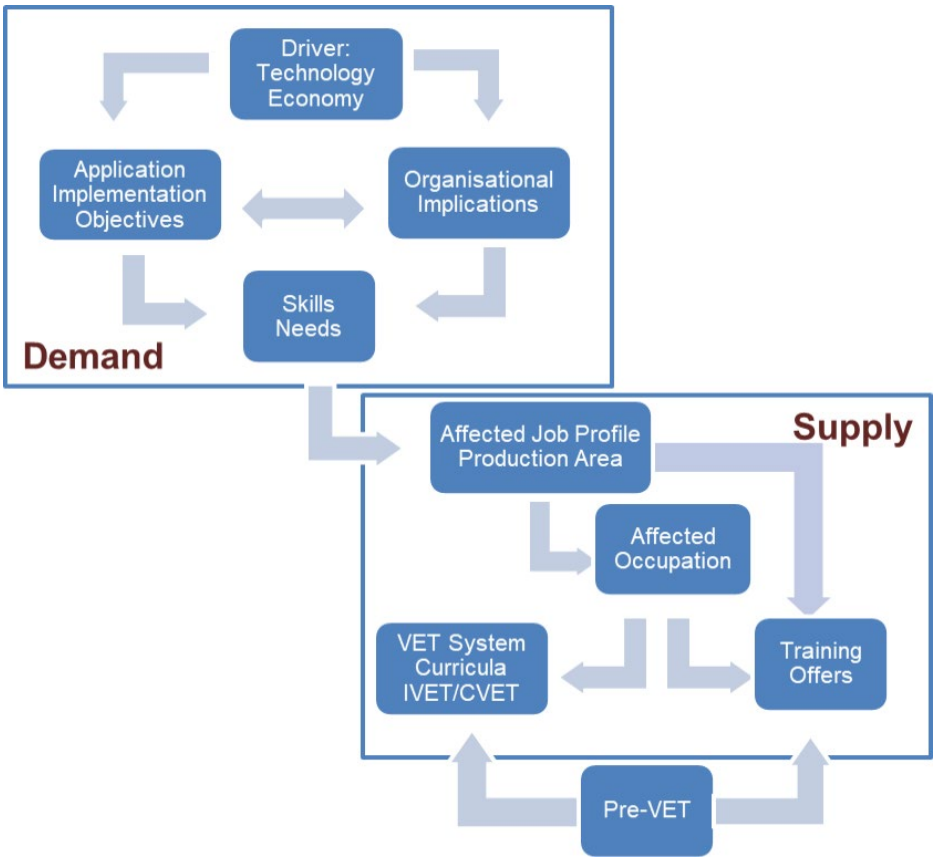


Figure 4: Industry and technology driven skills adjustment

However, beside the industry driven perspective ESSA also focuses on a worker- or human-centric approach of technological development (as outlined in the **Industry 5.0** concept):

> *"Against the backdrop of the implementation of the broad range of Industry 4.0 technology the workers are confronted with changing roles and increased reliance on complex technologies. Upskilling of the workforce includes therefore also workers empowerment, challenging their traditional education life cycle of training, work and retirement. Technological development has to be complemented with the cognitive, experience and practical based skills of the workers, already in the technological innovation development phase - leading to more responsibility for and increased supervision of the production process, advanced "collaboration" between humans and robots."*
>
> *"Rather than asking the industry worker to adapt his or her skills to the needs of rapidly evolving technology, we want to use technology to adapt the production process to the needs of the worker, e.g. to guide and train him/her."*
>
> *(Breque et al., 2021, p. 14)*

Additionally, the process of developing and further running of the ESSA Blueprint is organised as a **social innovation process**, integrating relevant and intrinsic motivated stakeholders of different areas and proveniences right from the beginning in the consortium (including associated partners, willing to participate on their own costs). Starting with the **challenge** of adjusting skills needs because of new technological and economic development, the **idea** of a sectoral Blueprint of the Erasmus+ program was taken up, leading to the **intervention** of setting up a European Steel Skills Agenda and Alliance 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. Already in the planning of the project **iterative and cyclical feedback loops** are planned, ensuring upgrading of the interventions and implementation of the Blueprint.

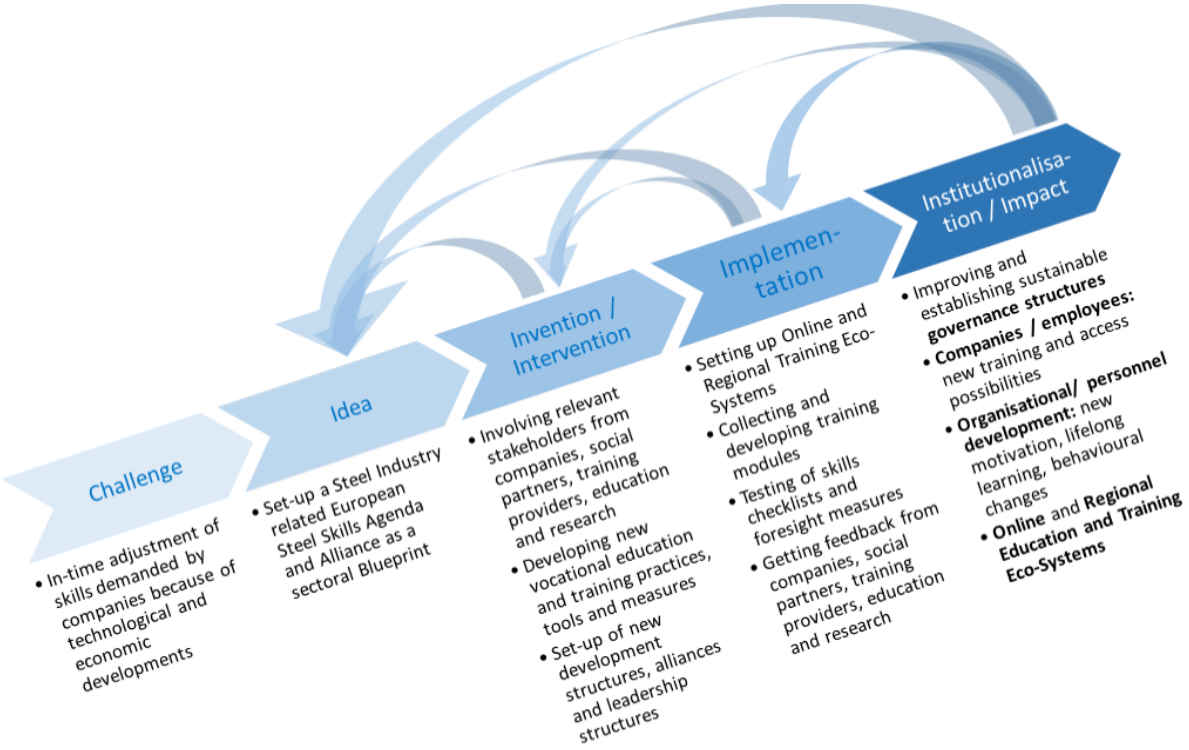


Figure 5: Blueprint development as a social innovation process

This process is still ongoing after the project duration within the integration of ESSA in European-national-regional governance structures of the Steel Industry. Therefore, the Final Conference of ESSA (in May, 2023) was called by the participating stakeholders much more a "transition conference" from a project to an **established** and further running European Steel Skills Agenda and Alliance (ESSA).

1 Technological and Economic Demands and Skills Requirements – The Demand Side

The starting point and background of the Blueprint are the technological and economic developments as far as they can be foreseen. In general, changes in the European Steel Industry are not only due to technical change but also due to pressure of globalisation and non-EU import of steel products because of global overcapacities (state subsidies distort the world steel market and the steel trade flows). To adjust the skills proactively the current and future implementation of new technologies have to be considered with respect to their implementation and related organisational changes. Defining the demand side an intensive desk research and analysis of European current innovation projects in the steel sector (more than 90 projects covering the last 10 years mainly of RFCS, Horizon 2020, Horizon Europe and other EU framework) took place, reflecting the existing innovation streams within the steel sector including Best Available Technologies, technologies for low-carbon steel and Additive Manufacturing. The desk research was also complemented by a survey of steel companies (see in detail Deliverable D2.1 (Murri et al., 2023) and D3.2 (Bayón et al., 2023)) conducted at the beginning and at the end of the ESSA project. A wider backdrop was provided also by the aforementioned Steel Sector Careers Blueprint.

The determination of skills demands is based on this inspection of the technological and economic drivers, their application, implementation and objectives and their organisational implications. Here it has to be kept in mind, that companies are mainly following the production logic, and human resources and skills are often left behind (because they are often not appointed to production necessities). ESSA ensured that both are combined: improved skills will improve production and products as well as competitiveness. Therefore, a systematic connection between intra-personal skills and the adjustment of production logic and chain was established.

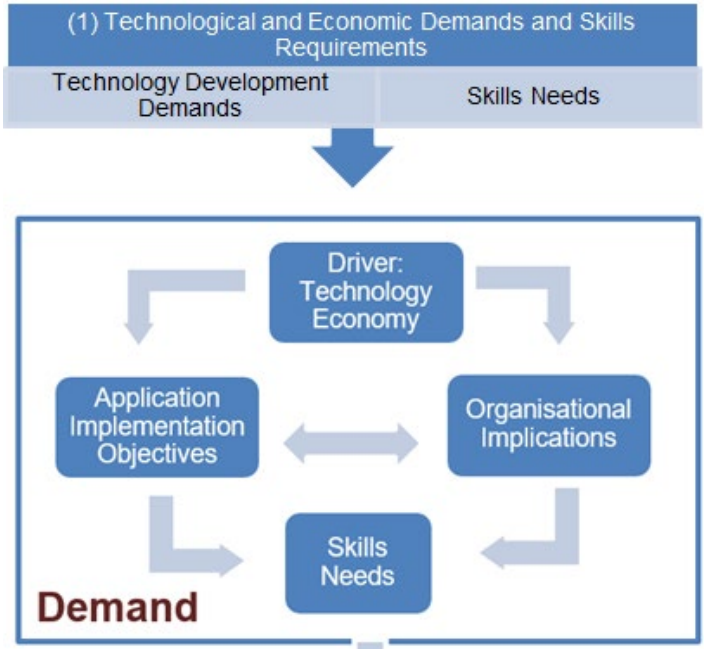


Figure 6:
Technological demand and skills requirements

Looking at the demand side of the technology and industry driven skills needs the drivers identified are covering a broad range of technologies, implementation areas, organisational implications, involving different production areas and products. As a result of the forecast analysis based on recent innovation projects most of recent Industry 4.0 technologies are in place, including Key Enabling Technologies (KETs) in the area of advanced manufacturing and processing: 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, Virtual/Augmented

Reality and Predictive Maintenance. Table 1 shows the technologies that are generally implemented in different applications in order to achieve the expected objectives.

Technologies in place	Applications	Objectives
• New generation of sensors • Big Data and Analytics • 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 • Virtual/Augmented Reality	• Online / Offline Assistance and Support Tools • Additive Manufacturing (new alloys for powders and 3D printing) • Robotic applications for the replacement of (manual/human) activities • Supply chain management • Virtual testing • Inspection and defects detection system • Tracing • Product tracking • Real-time production control and monitoring systems • Process Simulation/Optimisation • Knowledge Management tools	• Processes optimization from an economic perspective: – Energy efficiency – Efficiency of raw material consumption – Lower Operating Expense (OPEX) • Reduction of losses as well increase of product qualities and productivity • Increase of health and safety in the workplace • Valorisation and enhancement of the Company knowledge

Table 1: Technologies, applications and objectives

The desk research analyses were underlined by survey answers (see Figure 7): A broad range of technologies is already implemented and used (mainly for Cyber Security, Predictive Maintenance, Process Monitoring, Cloud Computing, Energy and Resource Management) while planned investments in the next few years cover also most of all the technologies, but mainly Data Analysis, Digital Platforms for Circular Economy, Artificial Intelligence, and Virtual/Augmented Reality.

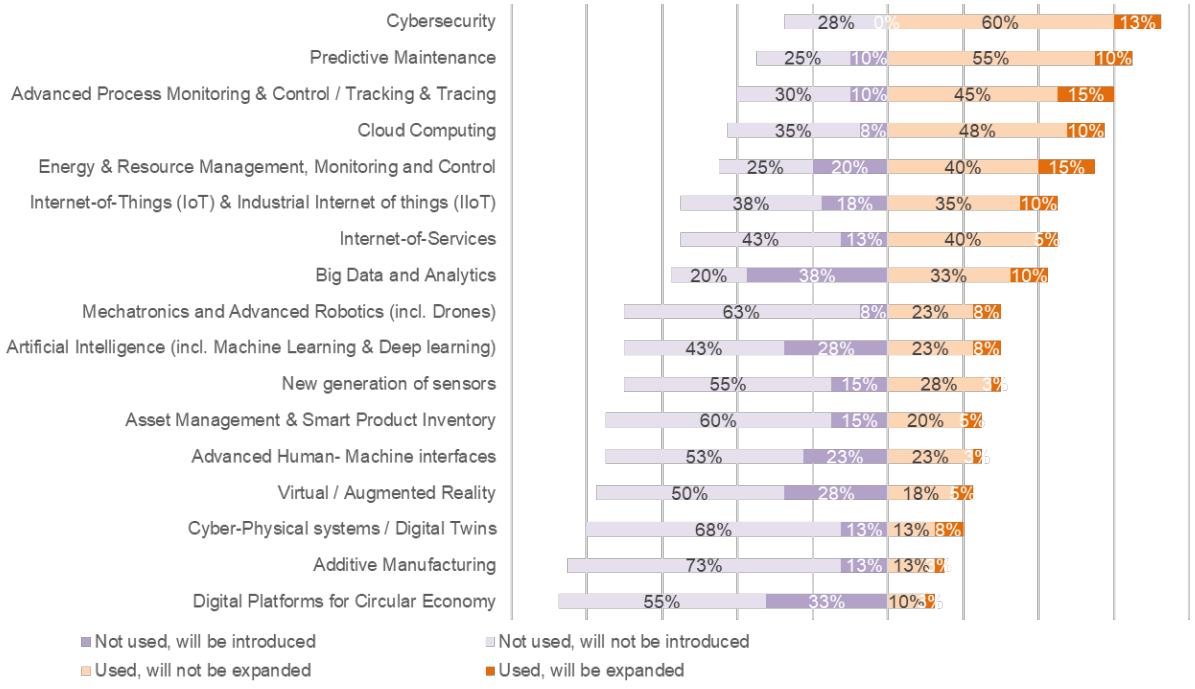


Figure 7: Technologies in use and planned (ESSA survey results 2023, percentage of participants)

These technologies affect also most of the company areas (with production, administration and quality control on top) (see Figure 8), and conduct a lot of different benefits (see Figure 9):

- cost, resources and consumption reduction
- increase of competitiveness, sustainability, health and safety, and production volumes
- improving workforce conditions, customer services, product quality, logistics, and reduction of emissions and waste.

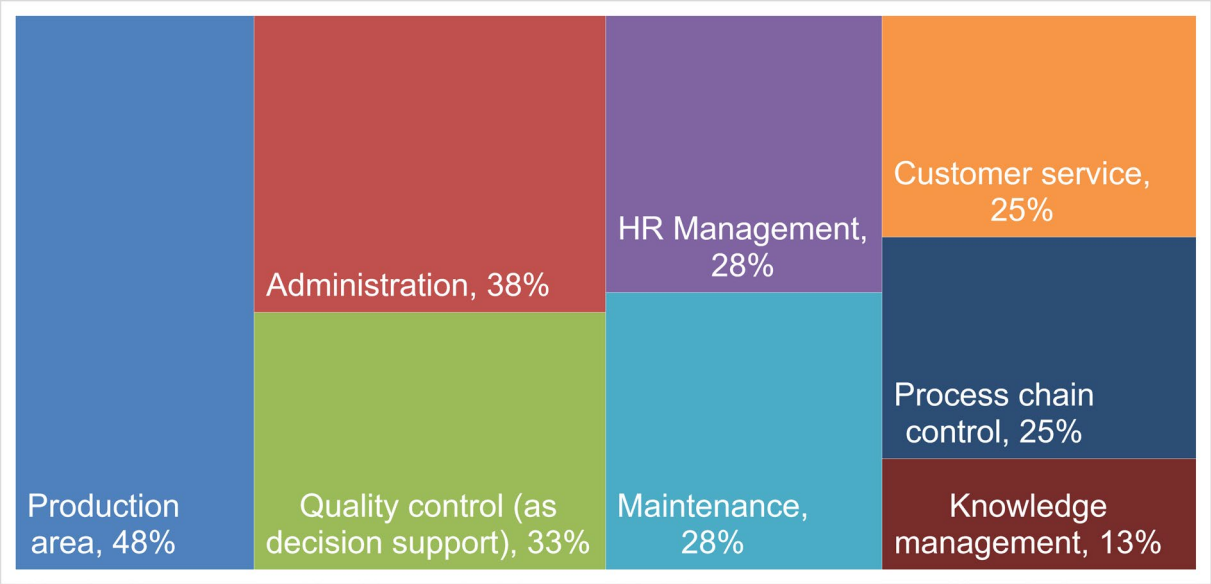


Figure 8: Most digitised company areas (Top 3) (ESSA survey results 2023, percentage of participants)

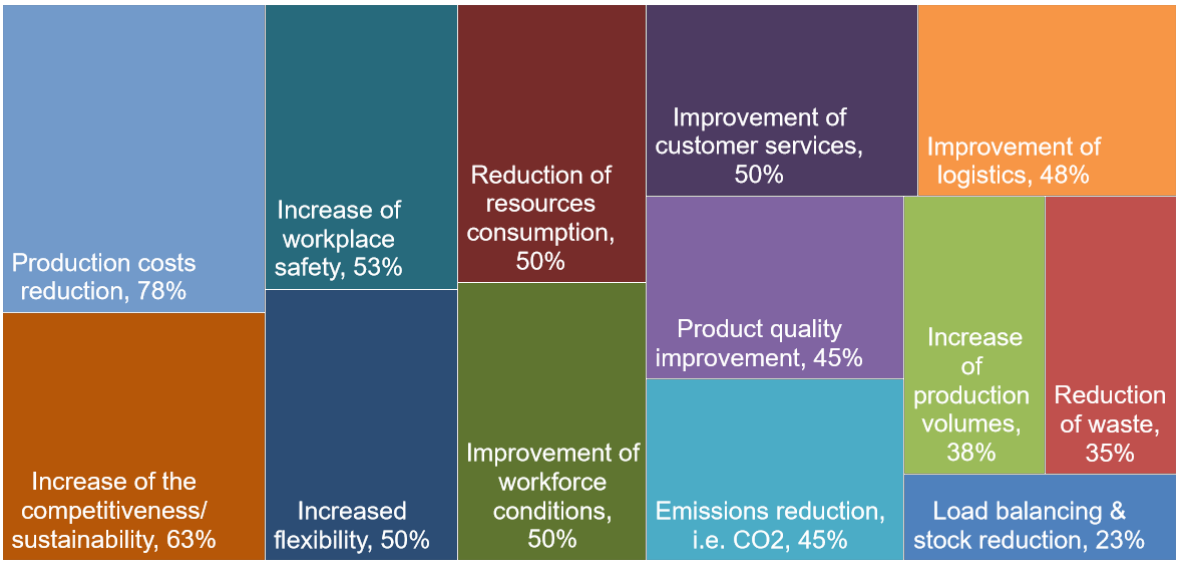


Figure 9: Expected benefits of new technologies (ESSA survey results 2023, percentage of participants)

From a technological forecast point ESSA is and will be cooperating with ESTEP Focus Group Smart Factories. In their forthcoming position paper Internet of Thing IOT, Cloud Computing, and Artificial Intelligence (AI) and Machine Learning (ML) are the main digital technologies up to 2023 measured by investment rates (see Figure 10).

n°	Digital Technology	Forecast Period	CAGR (*) Compound Annual Growth Rate	Global Market Size Expenditures billion US$	Year of forecast
1	IoT	2022-2030	21.4%	$1.057,55	2030
2	Cloud Computing	2022 -2030	15,70%	$1.554,94	2030
3	AI and ML	2022-2030	38,10%	$ 1.597,1	2030
4	Big Data & Business Analytics	2020-2030	13,50%	$ 684,12	2030
5	Data Centres	2021-2030	5,00%	$ 343,6	2030
6	Cybersecurity	2021-2030	9,50%	$478.68	2030
7	Industrial Business Intelligence	2022-2030	13,10%	$ 73,57	2030
8	Industrial Automation (**)	2022-2030	8,59%	$ 412,8	2030
9	Industrial Robotics	2022-2030	12,30%	$ 120,31	2030
10	Industrial Logistics	2022-2030	11,00%	$ 109,31	2030
11	Edge computing	2021-2030	38,90%	$ 157,91	2030
12	Modelling and Simulation in Industry	2022-2030	11,83%	$ 40,5	2030
13	VR & AR	2022-2030	38,50%	$ 451,5	2030
14	Digital Twin	2023-2030	37,50%	$ 155,83	2030
15	Platform Economy	2022-2030	18,00%	$ 6,73	2030

(*) Base represented by the firts year of the observation period.
(**) 4 is part of 2.
(***) This market segment includes connectivity proptcols (5G), robotics, artificial intelligence, ICT architectures, I4.0 applications, industrial automation and control systems prevalently for improving productivity and reducing labour costs.

Figure 10: Technological Foresight
(Source: FG Smart Factories Position Paper 2023, forthcoming)

Furthermore, the ESTEP Focus Group Smart Factories combined 18 research, development, and innovation areas related to the steel industry into five technological clusters of which one especially is putting human empowerment and human-in-the-loop on top (see Figure 11). This more detailed list of current research activities from a smart steel factory perspective indicates the main application areas:

- Improvement of production processes
- Autonomous operations
- Improvement of green steel production
- Augmented support of workers and management, including new skills acquisition and learning arrangements
- Expanding information and communication technologies.

	R&D&I Areas	Technological Clusters
1	New sensors, soft sensors and plug-in objects	Automation, Process Setup, Process Control & Supervision
2	Big Data & Analytics - Artificial Intelligence, Machine Learning, Deep Learning	
3	Modelling: First Order Modelling, Multi-scale & Multi-Physical Modelling, Data Driven Modelling	
4	Digital Twins, Virtual & Augmented Reality	
5	Remote Operations, Robots, Drones	Autonoumous Operations, Remotization
6	Cyber Physical Systems and Autonomous Systems	
7	Productivity, Efficiency, Interoperability, Scalability, Flexibility	Digital Technology for Sustainability
8	Asset Inventory & Monitoring, Predictive Maintenance & Asset Management	
9	Energy Management, Emission and Pollution Monitoring & Control, Circular Economy Platforms.	
10	Intelligent Logistics & Logistic Management	
11	Tracking & tracing of products and product Quality; Smart Product Inventory	
12	Integrated Manufacturing Chain & Supply Chain Optimization and Management	
13	Augmented Reality, Smart Pulpits, Wearable Systems, Business Intelligence	Empowering Humans, Human-in-the-Loop
14	Cognitive HMI; H2M; M2M techniques & technologies	
15	New Skills, AR & VR for Training, Continuous Learning,	
16	Super-Internet; IoT & IIoT; Smart Networks	Digital Technology for IT&OT Landscape
17	Flexible and Data-driven ICT Architectures, Cloud, Standardization	
18	Cybersecurity	

Figure 11: Technological clusters in the steel industry
(Source: FG Smart Factories Position Paper 2023, forthcoming)

Against this backdrop, it becomes evident that the steel industry is on track and in line with the "**twin transformation: digital and green**" announced by the European Commission (e.g. within the Clean Steel Partnership, in which a part of the budget is allocated to people and digitalisation).

At the European level, strategies have been implemented to promote sustainable material and resource management, as well as rational waste management and recycling practices, according to the Circular Economy approach. The European strategy "Europe 2020" focused on smart growth through knowledge and innovation, sustainable growth by improving resource efficiency and fostering a greener and more competitive economy, and inclusive growth with a high-employment economy and social cohesion. The development of low-carbon technologies and the adoption of renewable energy are crucial for reducing greenhouse gas emissions and combating global warming, leading to increased energy sustainability and economic development. The International Energy Agency has introduced the Energy Technology Perspective model to achieve a low-carbon future perspective. 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. The Green Deal aims at improving process industries performances and make Europe the world's first climate-neutral continent. In the steel sector, research, development, and innovation activities are ongoing, focusing on breakthrough technologies such as Carbon Direct Avoidance, Smart Carbon Usage, and carbon capture and storage. The Clean Steel Partnership (CSP) will demonstrate

these technologies supported by the Horizon Europe framework (part of its budget is allocated to people and digitalisation).

In detail, digital and green transition in the steel Industry comprises:

- Integration of all systems (sensors, automation, and IT systems) and productions units in different dimensions:
  - Vertical: systems across the classic automation levels from the sensor to the enterprise resources planning system
  - Horizontal: integration of systems along the entire production chain
  - Transversal: based on the decisions taken during the steel production chain, considering technological, economic and environmental aspects at the same time (automation and optimization technologies and their combination in an integrated way)
  - Life-cycle: integration along the entire lifecycle of a plant from basic engineering to decommissioning
- Digitalisation trends are: adaptive online control, optimization, synchronization of data, zero-defect manufacturing, traceability, intelligent and integrated manufacturing
- Knowledge Management (big data and human expertise) is a key factor for new developments.

Objectives and expected benefits are deriving from optimisation, automation, interconnection of production processes:

- Improvement of quality, flexibility and productivity through the optimization and interactions of the individual production units
- Adaptive online control, through-process optimization, through-process synchronization of data, zero-defect manufacturing, traceability, intelligent and integrated manufacturing
- Improved Knowledge (Data and Human expertise) Management
- Enhanced environmental process performance by combining digital and CO2 mitigation technologies
- Increased health and safety.

Main economic factors:

- Reduction of energy and raw material consumption, lower operational expenditure (OPEX), reduction of losses, increased product quality and productivity, improved flexibility and the reliability of processes, customer orientation (quality and specificity)
- New business models & organizational structure: stronger networking between business processes, creation of efficient interfaces, integrated data exchange and management

The transition from Industry 4.0 to Industry 5.0, focusing on human-machine integration, 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. The steel sector faces significant challenges and opportunities in adopting AI and ML applications, requiring investments in equipment, upskilling, and attracting young talent. Skills intelligence, a

concept based on data analysis, is being developed in the steel industry to address skill imbalances and improve decision-making processes. Increasing environmental awareness, interest in green products, the sharing economy, and the circular economy will drive the development of Industry 5.0. Future research will focus on understanding the impact of Industry 5.0 on the manufacturing landscape, with data crawling techniques providing valuable insights.

Nevertheless, the potential of the technological solutions (reflected in the analysed innovation projects) seems to a high degree unused and unfolded because of missing systematic digitalisation and investment strategies and priorities. Although there is a high innovation *research* engagement (reflected and evidenced by a huge number of projects related to Technology Readiness Levels TRL 6/7/8), there is still an **implementation lag** of existing technologies (TRL 9) because of high investments needed, high risks, and the recent economic situation (on the global market, the current corona pandemic). Investment perspectives are needed to develop an advanced digital and green steel industry to ensure the transition from pilot projects to implementation and institutionalisation. This is not only due to the European steel industry, as a paper on "Industry 5.0" states: "Despite claims of digital technology developing exponentially and becoming ever more disruptive in nature, the adoption of digitalisation in European industry seems to be of a more gradual nature. Although specific new technologies may allow for new, disruptive approaches, the large infrastructural investments required for some types of industry and the fragmentation into a multitude of smaller players (lacking digital skills or investment capacity) in other areas, result in the current uptake of digital technologies in European industry being linear rather than exponential, and gradual rather than disruptive." (Breque et al., 2021, p. 11).

On the other hand, digital innovation has a great potential for enabling and supporting the social innovation process, facilitating knowledge sharing and cooperative work. In this context, digital technologies are promising tools that can support the collaboration, the knowledge sharing and the networking of various stakeholders, leading not only to emerging skills but also to promote, in particular, the upskilling process.

However, whilst technological development and insertion is shown to be largely gradual and phased there remains a significant disjuncture between technological innovation and skills provision - in the perspective of the industry *VET systems lag behind technological innovation*.

Within the context of ESSA new technology implementation is affecting the workers and the workplace in a more incremental way. Innovative applications in this way are mainly implemented for supporting workers and work with and for the given but optimised infrastructure. This approach was emerged as perspective during the workshop activities with the companies involved in the digital transformation (see Table 2).

The practice perspective of a company (workshop results with representatives from different company areas and hierarchies)
Specialisation is growing, mass production is declining, data exchange is growing (of the upstream and downstream production processes, new links between shifts, information from shift do shift, plant-wide process optimisation, error search and guided trouble shooting), quality control is increasing because of new technologies, every plant and company is working different, former orientation of maintenance is changing from current malfunctions to continuous data, knowledge and condition based lean and foresight maintenance Leading to a growing importance of individual experiences and competences, interdisciplinary teams, broad range of qualifications, long company internal training and familiarisation periods (2-3 years) (for new positions and after VET / HE graduation) Improving integration and use of new media (monitors, tablets, boards, smartphones, ...), new sensors and measurement technology in the production and maintenance processes for transparent and foresight-oriented knowledge, activities, and knowledge-based monitoring and decision making.

Table 2: Technological development (workshop results with company representatives)

Concerning digital skills, 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 (World Manufacturing Foundation, 2019).

Against this background the skills demand analysis for steel sector led to three main complementing strategies:

- Incremental up-skilling of existing job profiles with a main focus on transversal skills and up-skilling of the existing workforce
- Buy-in of digital competences from external experts, consultants outside the company that could not be imparted by upskilling of the existing workforce
- Recruiting and retaining talented people with digital skills.

Whilst specific, technical skills are still needed (see also Steel Sector Careers Project) and to be updated and upgraded, transversal or soft skills are more and more in focus because of the new digital applications. Transversal skills across different job profiles are important to enhance the workforce and companies' resilience against different types of turns by improving adaptability of workers and so potentially a better capacity to deal with organisational changes where and when needed.

Both types of skills (technical and transversal) could be related as company and/or steel sector specific as well as process industry overarching. Therefore, also transferable (mainly transversal or soft) skills from sector to sector or to different VET systems of the member states were considered to take advantage of possible synergies (e.g. as part of the ESSA online training platform steelHub and SKILLS4Planet (SPIRE-SAIS Blueprint). The ongoing technological and organisational improvements desire continuous learning, more and more also in an interdisciplinary perspective (e.g. by adding green and digital applications to the steel production, integrating customer requirements).

Based on these results and assumptions the main challenges are the broad range of

- Relevant new technologies
- Concerned job profiles
- Affected production areas (including particularly maintenance).

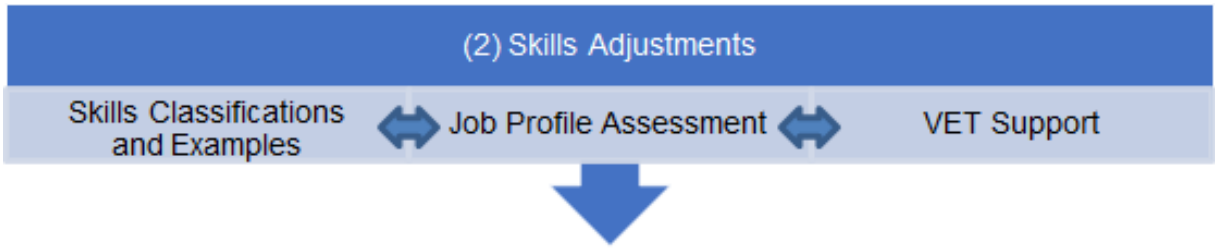
The main challenge is how to serve the whole range of professions and how to select and prioritise affected job profiles. To close the digital skills gap esp. upskilling of low and middle skilled workers as well as recruiting and retaining talented people with digital skills (because of the still existing negative perception of the steel sector and its recent economic situation) (see Steel Sector Careers Project) are key. The question of job losses through further automation and replacement of routines by new technologies seems recently not to be expected in a relevant way. This might be due to the already done atomisation of production years ago with a loss of about 40.000 jobs. As global restructuring is still also an issue for the EU industry seeking competitive advantages, besides competition on cost the focus is much more on quality nowadays. But, if Europe will continue to have a quality-oriented steel industry not only investment in research and innovation, new products and technology, and regulatory protections is required but also in skills. The trend to specialise creates at the same time a high need for outstanding communication skills. Only if a specialist is able to efficiently communicate with specialists of other domains, the complex challenges of today and tomorrow can be mastered in a competitive way.

Nevertheless, there are different scenarios hypotheses concerning jobs and skills: substitution, polarisation (more low and more high skilled workers with reduction of the middle level), and upskilling. Based on our ESSA results we assume a somewhat uniform and consistent penetration of the key Industry 4.0 technologies across the sector and that the Blueprint tools and strategies are outlined on the basis of this ideal-typical Industry 5.0 scenario (which may apply to some countries or companies, but not necessarily to others), showed by current evidence.

However, in further observation and discussion beyond the project duration, ESSA will continuously check the still remaining potential for appearing totally new job profiles and negative implications and job losses

2 Skills Adjustment Approach

Based on the technological and economic implications a strategy for adjusting skills in a proactive way was piloted leading to a steel sector specific **skills classification** (grounded on existing classification schemes, such as the European Qualification Framework EQF, the ESCO Database, and the European e-Competence Framework) and an overarching **job profile assessment** (oriented at the functions within the production areas, including maintenance).



Based on the results of the technological developments (in chapter 1) Industry 4.0 is expected to affect 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 existing occupational descriptions, roles and functions. Besides, there will be a moderate upskilling of a lot of existing job profiles and occupations (digitalisation of unchanged occupations) (see Figure 12)

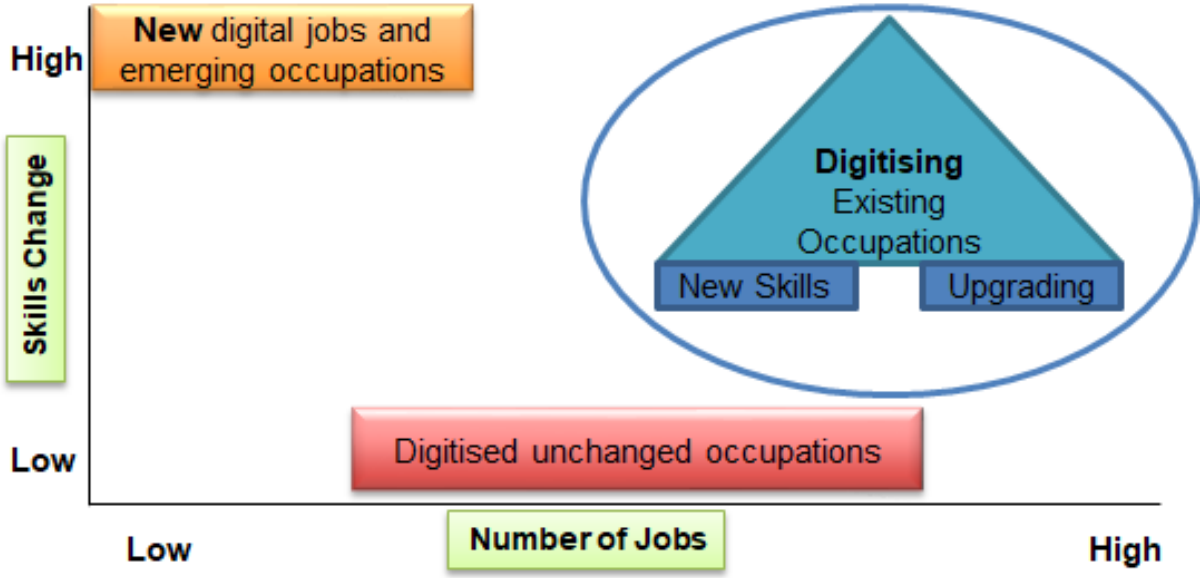


Figure 12: Number and skills degree of affected jobs (based on Schmid, CEDEFOP, World Congress on TVET, 13-16 May 2012)

Although ESSA is focusing on the *incremental* technological change in production (e.g. as it was done in the COCOP project (Kohlgrüber et al., 2021)) it is relevant to keep an eye also on still happening *disruptive* technological change (mainly based on automation and taking place in maintenance (see ROBOHARSH project; Colla et al., 2017). It is important to differentiate between *incremental* (COCOP: adding a control system to existing production systems) and *disruptive* technological changes (ROBOHARSH: replacing manual work in a substantial way via robotic assistance with a new control and monitoring system). While in COCOP new skills are dedicated to gather additional information from a plant-wide perspective for the production process, in ROBOHARSH completely new digital skills are replacing manual dexterity. Both processes have different needs and ways to integrate operators and workplace experience as well as a different impact on skills and training. But again, the main company strategy nowadays is to buy-in digital know-how externally that cannot be trained to or covered by the existing workforce.

2.1 Sectoral upskilling schemes

Before being able to identify successful **sectoral upskilling schemes** in the steel industry, there is the need to define the digital changes and the impact and requirements at the workplace and for the job profiles and roles, predominantly for its production and maintenance departments. As the ESSA analysis and the further results of workshops with steel companies showed, digital changes affect more or less and in different ways the complete steel making process, meeting different groups of recipients with varying *access*, *abilities* and *willingness* to digitalization. The steel industry is on its way of transformation, but also (partly) trapped in old structures of education plans/content, training methods and imparting of knowledge. Innovative forms of learning concepts and skills development have more or less lighthouse character. Facing shorter cycles and more dynamics including a tremendous growth in media diversity make digital changes obvious: Opportunities for remote diagnosis rise (also meeting the employees will to work e.g. in a home office), machine learning could enable smarter production and maintenance processes, but still, skills are needed to cope with big data complexity in order to unfold the digital possibilities steel companies could profit from. This high-speed logic implies that the steel making infrastructure needs to address *high speed training and qualification demands*, since the whole steelmaking process is potentially affected by digital changes.

To meet production and maintenance needs, VET and company **training curricula in general should address complexity and the dynamics of change**, i.e. being open for modification in order to meet the ability and the willingness as well as motivation of employees to participate successfully in digital changes and its impact on-site production. For that reason, the sector has defined beneficial factors for successful steel specific education and training, such as target-group orientation, open minded attitude, user orientation, attractiveness of methods, try and error possibilities, cooperation orientation and on/near-the-job imparting of knowledge. Deriving from practical experience, hence industry driven, basic agreements on fundamental contents face consensus, but still, steel industry uses mostly traditional training methods, especially from a blue-collar worker perspective. Instead, project related training with precise scheduling could enhance the promotion (partly transformation) from operators (physical/repetitive work) to supervisory or managerial level. Also, on-site training arrangements that meet the precise skill need of a special working situation should be more common, and focused on in the future (i.e. micro learning arrangements).

The steel sector is fully aware, that compliance restrictions prevent from intense intra-sectoral exchange since the rules of competition law are of utmost importance. But undoubtedly, training methods must meet the needs of companies and must be attractive and target group oriented for those who shall apply knowledge, no matter in what company of the steel sector they are working. Therefore, ESSA is promoting a **European joint alliance and strategy for upskilling** the workforce fundamentally and serving a platform for innovative learning arrangements and contents, accessible for the whole sector. Increasing the attractiveness of training and imparting of knowledge by innovative methods is one of the success factors of upskilling schemes, facilitates the adaption to shorter cycles mentioned above and adds value to the sector, e.g. by addressing problem-solving competencies of the workforce. The transformation from classical trainings to target group specific digital ways (e.g. by using Virtual Reality or simulators) and micro-learning modules promise to be success factors in upskilling schemes since they could be provided just in time when needed.

Education and training programs are suitable for the steel sector in at least two ways:

1. They should meet the shop floor needs and they should comply with (changing) formal job profiles. A promising approach for production/maintenance is to provide (vocational) training modules with micro learning on-site, informal learning and traditional training but also remotely, in order to meet the mobility needs of today´s workforce. This way of imparting knowledge by different media or tools is key to increase attractiveness of trainings and also allows their "on-site" applicability in many areas. This game changing way of upskilling has implications for the leadership culture: Since employees not necessarily have to be on-site to do their jobs, remote leadership will gain in importance and trust will replace attendance-culture. Furthermore, todays leaders have to stay up to date regarding their own IT skills.
2. Concerning formal job profiles, parts of the vocational or commercial training curricula should be if possible modularized as short education and training units (as part of Initial and Continuous VET). The formal requirements and somehow "statics" of traditional occupations in the steel industry are not able to withstand the dynamics mentioned above. Apprentices have to catch up with the speed of development, therefore, overall competences become more and more important. Thus, the question must be raised, if it is still appropriate to let young people aged 16 decide upon their definite occupation without having the possibility of (digital) specialization when running through the curricula. This question will become more and more relevant since automation and digitalization skills will be more and more demanded by the industry to cope with technological development. Basically, all occupational profiles will have to transform: more IT, more process-competence, more problem-solving and social competencies while meeting personal demands of the steel workforce 4.0 at the same time.

Having described digital changes, preconditions for successful sectoral upskilling schemes and the necessity of their suitability, it is important to circumscribe the idea of the future development of education and training programs. The workforce will work independently in complex topics with digital media, being individually responsible regarding its own training when closing knowledge gaps. There is no doubt, that guidance is needed to foster the idea of self-responsibility. Leaders need to differentiate between employees´ "pull factors" (such as training schemes for personal career progression) and "push factors" (fundamental training to be successful in the current position). But in times of ongoing digitalization, which can potentially lead to rationalization, it becomes more and more key to learn "on your own".

Employee self-responsibility can only work in cooperation with focused and empathically leadership guidance. Executives must operate as mentors and motivators. They need to address employees´ confidence, since it is not an easy step to admit a lack of skills. Thus, if the future development of training shall be successful, it must be accompanied by an open feedback culture between employee and superior. Precondition for a successful development from the executives´ perspective is to prove their confidence in their employees. Leadership is not an easy task which needs time to put cultural change, hence conditions for self-learning, into operation. Leaders have to be "role models" when identifying new ways of learning in order not to be driven by development but to drive change and to demand new ways of training and education. It will become more crucial to demand performance in the future. Therefore, skill gaps must be closed fast by flexible programs.

This is underlined by required managerial and leadership competencies and qualities stressed by the talent survey results of ESTEP (Echterhoff & Schröder, 2015, p. 28): "The ability to motivate employees was seen as the most important behavioural competence. Top ranking behaviour included also willingness to share success, openness to change and new information, and ability to make well-informed, effective and timely decisions. Also treating others with courtesy, sensitivity, and respect was seen as an important leadership behaviour." Therefore, an appropriate working environment is needed to unfold these issues.

Management needs to anticipate further developments of skills. Therefore, it must be aware of its *proactive* role when addressing skill needs. Due to further rationalization, complexity and transformation, the *leadership span* will extend. Executives must promptly identify significant future changes and control the demand for training of their workforce in time. To facilitate the imminent developments leaders must take responsibility for coaching and provide orientation. The understanding of the whole steel making process is important. The development of skills depends on various factors that have to be considered. As ecological changes and challenges might set path for further technological breakthroughs, human factors in total must not be neglected, such as skills.

Furthermore, a tightening of the labour market with regard to skills supply to the industry (quantity and quality) threatens to impede the pace of sector development. It is important that employers develop strategies to recruit and retain the best talents and build connections with education and training institutions e.g. VET schools, universities, as well as policy makers and other related stakeholders. For the industry to address its needs, it must remain politically relevant. Efforts in this direction require the building and maintaining of stakeholder relationships, and establishing firm patterns of collaboration and engagement at all levels. See the section below on National-Regional Training Ecosystems (chapter 3.4.2).

In this context, management has to define, which occupational profiles will survive and to take up a position, if modular training units (short and timely) are the future means of choice. Such modular (online) training has to consider the role of people in learning contexts like the shop floor (reality versus expectations) and be aware of what limits exist in a continuous process like steelmaking. Here, administrative support must act beneficial to foster digital education efforts; this can be done if e.g. people with a higher level of education and teaching/training qualification are temporarily deployed as trainers or coaches to close the knowledge gaps where they occur.

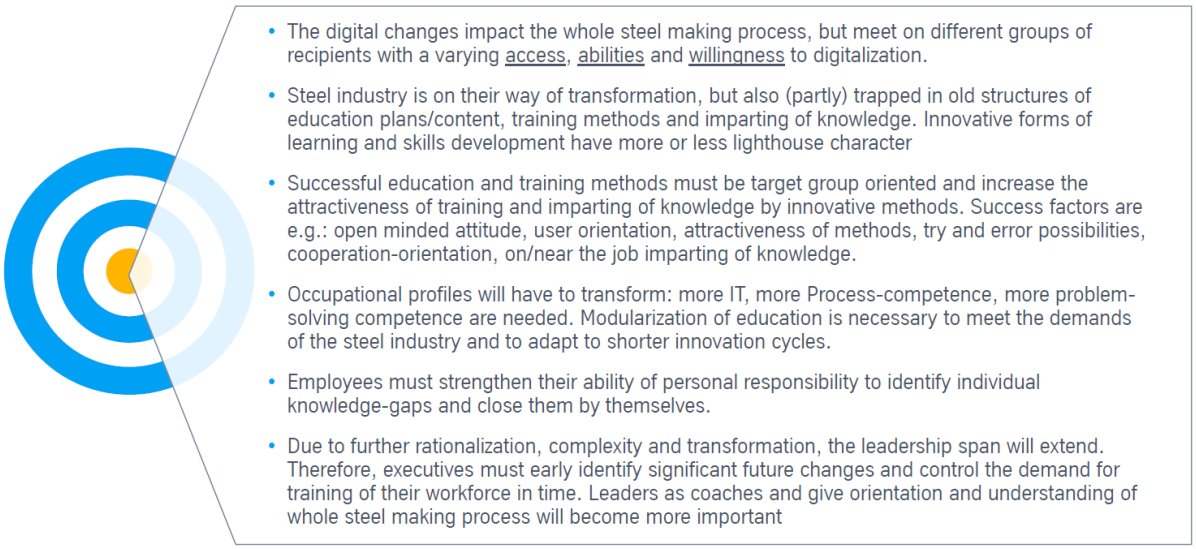


Figure 13: Upskilling schemes for the steel industry (summary of an ESSA company workshop)

2.2 Skills Classification and Demands

2.2.1 Skills Classification

Due to the broad range of the affected production areas, a repository and overview of all the professional role profiles was created in ESSA. Then, the profiles were grouped in so-called **family trees** for all the production and maintenance functions in steel companies. The "Family tree" approach was used as a valid view to facilitate navigation and demonstrate relationships between job profiles. Ending up in **26 different family trees** ((or production areas) (level 1, see **Fehler! Verweisquelle konnte nicht gefunden werden.**) covering all in all more than 200 job profiles (level 2, example Melting Shop in **Fehler! Verweisquelle konnte nicht gefunden werden.**) demonstrate the high complexity structured from two different production processes (“Blast Furnace” and “Electric Arc Furnace”), different products and applications. The final version of this family tree aimed to be used as reference for the whole steel sector beyond the focus of skills adjustments (see complete list in the Annex).

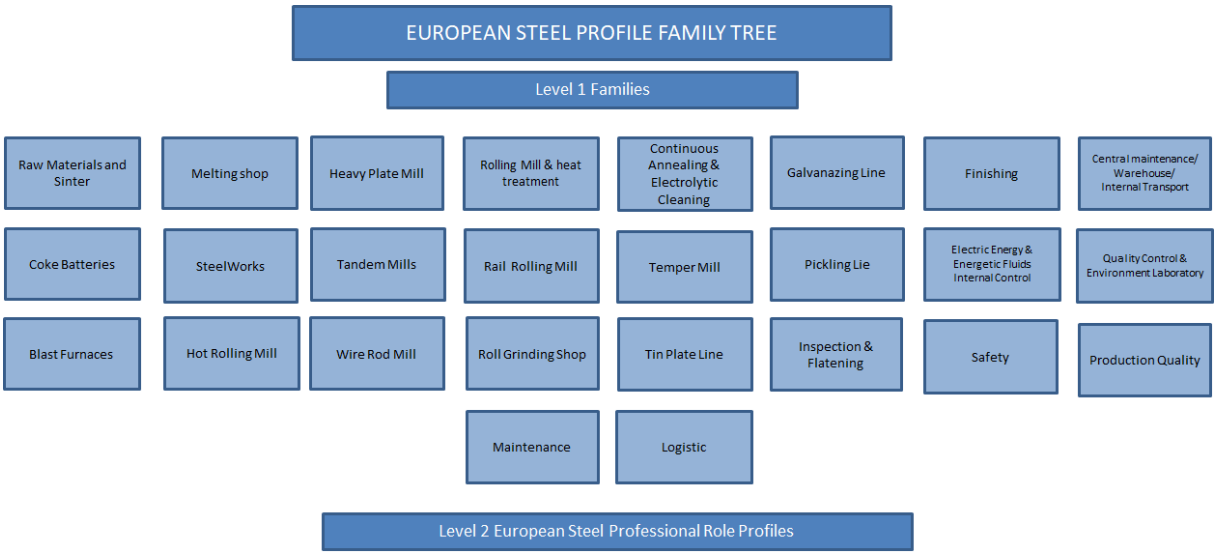


Figure 14: European steel sector professional role profiles: 26 families at the top of the European steel sector profile family tree (level 1)

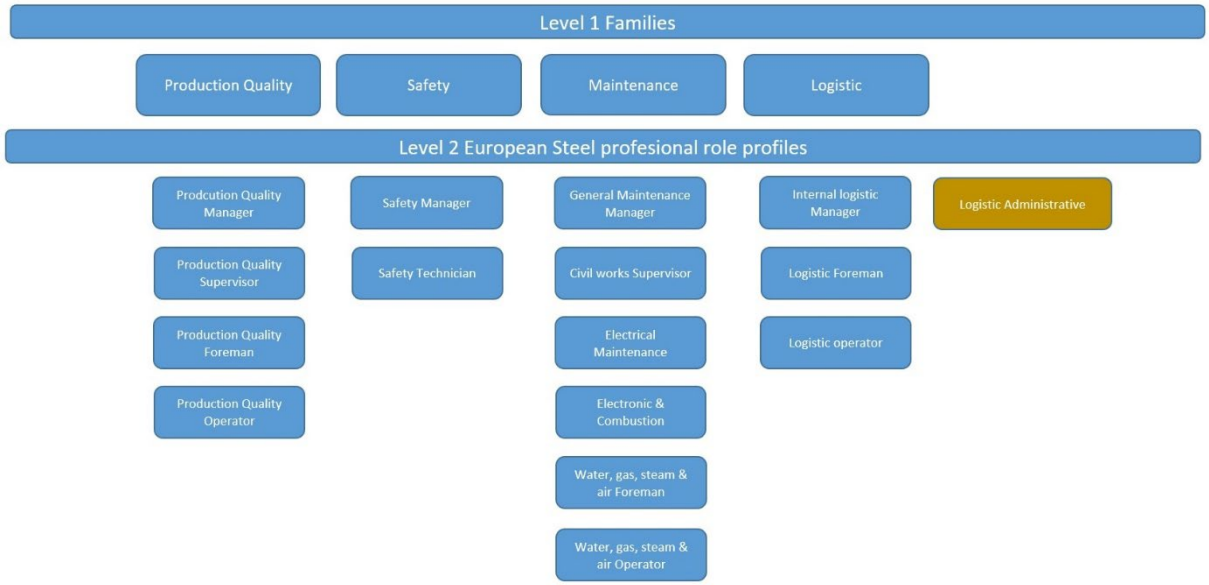


Figure 15: Job profiles (level 2) example melting shop family
(blue: production, orange: administration)

This job function and profile classification shows a huge range of different job titles across the Steel Sector professions and they are created for a variety of purposes including attracting new recruits and providing recognition for organisation loyalty through the promotion and construction of enhanced job titles. Jobs are unique but a similar title can be used to describe widely different jobs, conversely similar jobs 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. 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 a

selection of representative pilot job profiles and the alignment of steel sector job profiles with the relevant *occupations in ESCO database*.

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 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 ISCO major 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.

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 as a first online training program based on ESSA results, see chapter (3)) 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.

Two additional Job Profiles were added for **train the trainers/teachers** (see chapter 3.2.1).

The potential equivalence between ESCO and the profile titles in the Steel Sector enable us to take the ESCO description of occupations as the basis for a full description of the **Steel Sector Professional Role Profiles** and the steel job profile skills assessments. The European Steel Professional Role Profiles and the related steel job profile skills assessments were constructed consistently to provide a common template, since a *standard template* makes

it easier for end-users to compare different profiles and present a fast start for developing new profiles or contributing to designing new job descriptions. The template was evolved towards the industrial needs incorporating sections for job description, mission, tasks etc, (from ESCO) and creating new sections for new skills categories, equivalent steel job profiles and skills levels.

Although, the family tree approach is highly useful from a sectorial-organizational point of view, it is unnecessarily complicated for VET framework providers to generate training programs. In order to reduce complexity and achieve an effective match of occupations and skills profiles, ESSA tried to generate a common ground combining the Steel Industry and VET (system) perspective. The European Steel Sector Professional Role Profiles and Job Profile Skills Assessments may also be used to implement an effective competence assessment process. Defining and implementing an internal competence assessment process enables verification of an organisation's existing roles and aids identification of competence gaps. The result of the assessment can be used to improve accuracy of different processes:

- In training, the competence gap analysis can be used to design accurate training paths that can, for example, develop the proficiency levels required to meet organisation requirements.
- In the development of an organization the result of the assessment can be used to guide the design of the organization itself, allocating resources optimally and identifying the competence shortcomings to inform the recruitment process.
- In career development, recruitment and talent management, the outcome of individual assessments can be used to identify optimal career development paths of the Steel Sector professional, benefiting the employee and the organisation.

To make an assessment process accurate and effective a **skills checklist** was developed focusing on the specific job profiles and their related skills. This checklist is following the T-shape approach combining specific specialised skills with transversal skills (see Figure 1). This approach (add a source here) was taken because beneath essential and optional production related technical skills new technologies of Industry 4.0 ask especially for an improvement of digital, green, social, personal and methodological skills (Skills4Industry Report 2019; Probst et al., 2019). These skills might be generic steel specific or transferable skills also relevant for other (industry sectors).

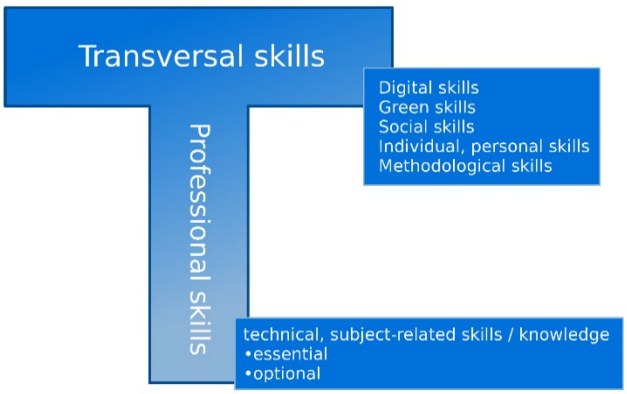


Figure 16: T-shaped Skills Approach

Against this backdrop a **Job Profile Skills Assessment Template** was elaborated compromising a description of the profile, integrating the main tasks description from the ESCO database (if possible) and assessing the different skills categories by the current and future proficiency levels[2].

[2] 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

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 3: ESSA skills classification and definitions (overview)

Five skill proficiency levels are defined in order to evaluate these current and future skills from an industrial perspective:

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. 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

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 Labour 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.

Can perform required activities with high level of knowledge and skills, without any guidance, assistance or direct supervision; can monitor, mentor, advise 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

Based on these skills categories, levels and definitions a **job profile skills assessment template /professional role profile (description) template** was developed to define job profiles, evaluate their current and future skills levels and identify their skills demands. This template was tested for the nine job profiles described above within two surveys (translated in different languages and explaining all the categories in a short definition) (see chapter 1 and the detailed results in Deliverable D3.2; Bayón et al., 2023).

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 4: Job profile skills assessment template

The aforementioned equivalence between ESCO occupations and steel sector job profiles also opened the door to the automatization of the **European Steel Sector Professional Role Profiles** and **Job Profile Skills Assessments** through using ESCO database. Therefore, within ESSA an excel-based software was developed that allows partly automating the description of the different steel-related job profiles. Our future plan is to be able to introduce the current/future skills and the current/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 will also be checked if it could feed the ESCO database, enriching it with new occupations and descriptions (steel sector related and beyond).

2.2.2 Skills Demands

The T-shaped skills classification was checked for its recent and future relevance by two rounds of a survey send to company related experts of the nine job profiles (40 experts analysed 144 job profiles in the second survey conducted 2022/23). The participants were 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*). (see also chapter 2.2 of Deliverable D3.2; Bayón et al., 2023). All in all, the results of the second survey did not show major differences compared with the first one in 2019/20.

Technical skills

Regarding technical skills it has to be noted that *Gross motor skills and strength* will only grow in relevance to a minor degree (see Figure 17). This could indicate that, due to technology, more manual activities could be automated or facilitated. All other skill categories will rise more distinctly in relevance. If interpreted metrically[3], the absolute relevance of technical skills will rise by 0.3 points on the scale (from 2.1 to 2.4) on average.

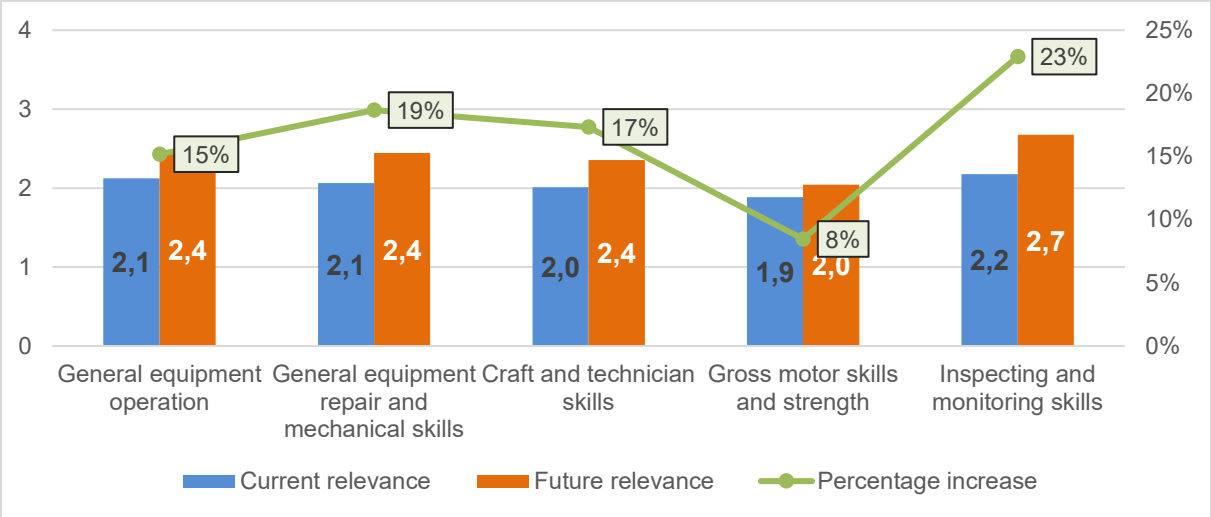


Figure 17: Technical skills (across all nine job profiles)

Digital skills

Compared to technical skills, digital skills will experience a stronger increase in importance. *Figure 18* shows that all subcategories will require a much higher skill level in the future.

[3] For this statistic the used scale was transformed into numbers ranging from 0 (Novice) to 4 (Master).

However, there are also substantial differences between the subskills: Basic digital skills are transversal in a sense, as only in 2 percent of the assessments it was stated that there is no need for these basic digital skills in the future; whereas with regard to *Advanced IT skills and Programming* it was the case in 20 percent of the assessments. Similarly, only in 18 percent of the assessments it was assessed that not any *cybersecurity* skills will be needed within the respective job profile in the future. On the opposite, the needed Cybersecurity skills levels are the ones that had the strongest increase of all digital skills (plus 65 percent). Overall, the digital skills needs will rise from 1.5 to 2.2 points.

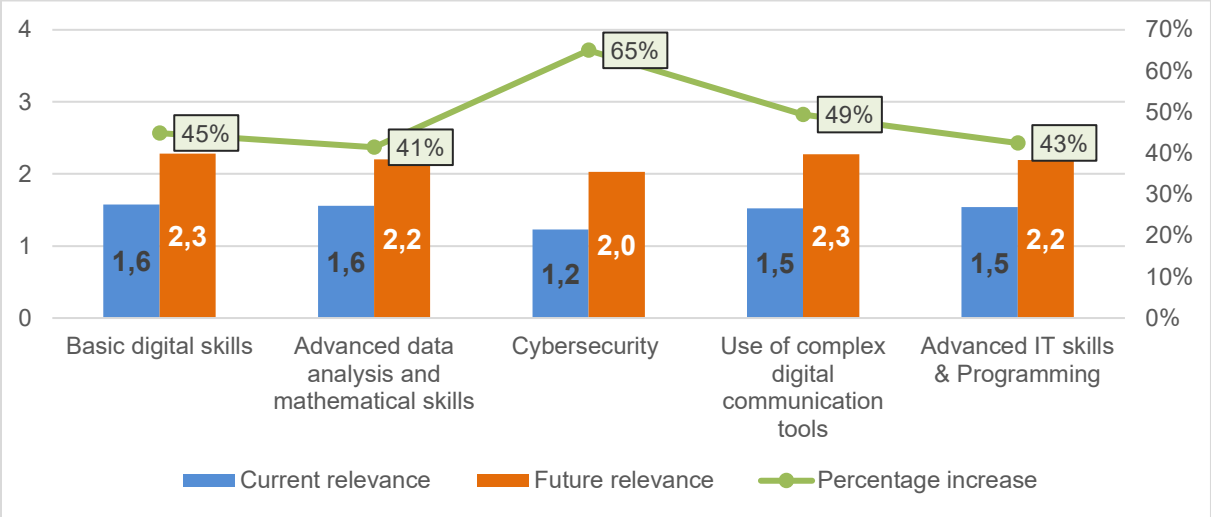


Figure 18: Digital skills (across all nine job profiles)

Green skills

Similar to digital skills, green skills also become increasingly important. As Figure 19 shows this applies to all five green skills subcategories. The differences between the different categories are rather small. Within each sub-category, an increase in the required skill level by at least one level was noted in more than half of the cases. However, rather strong increases of needed skill levels were detected at each subcategory, with mean values increasing by 43 to 48 percent. Overall, the needed skill level across all job profiles will rise from 1.6 to 2.4 points.

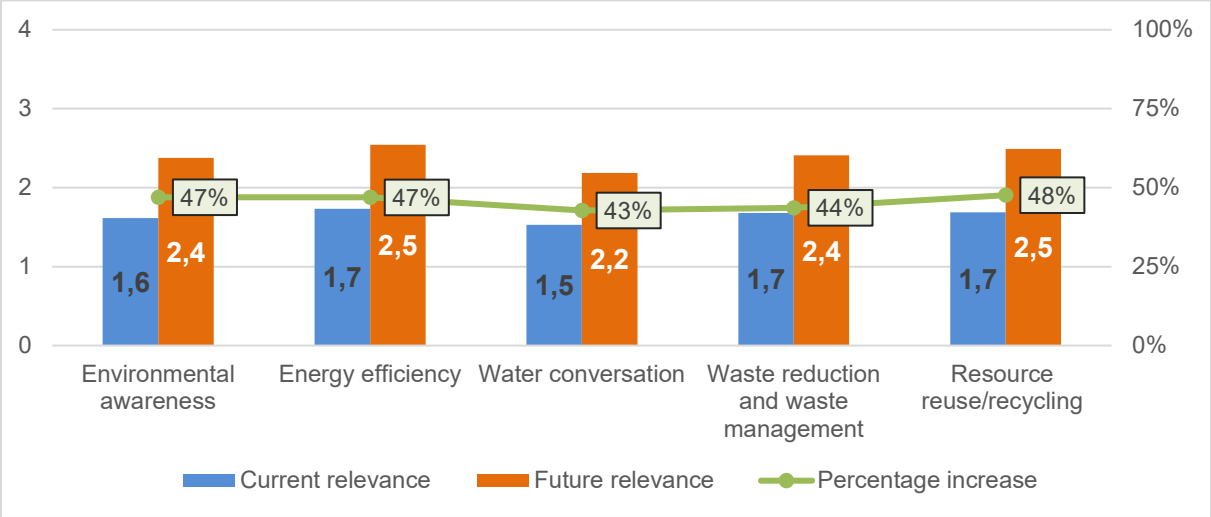


Figure 19: Green skills (across all nine job profiles)

Social skills

Social skills are already very important in the present and will not strongly gain in importance (see Figure 20). The changes in the single categories range from 29 % (*Entrepreneurship and initiative taking*) to 38 % (*Advanced communication and negotiation skills*). Overall, the needed level of social skills will grow from 1.8 to 2.4.

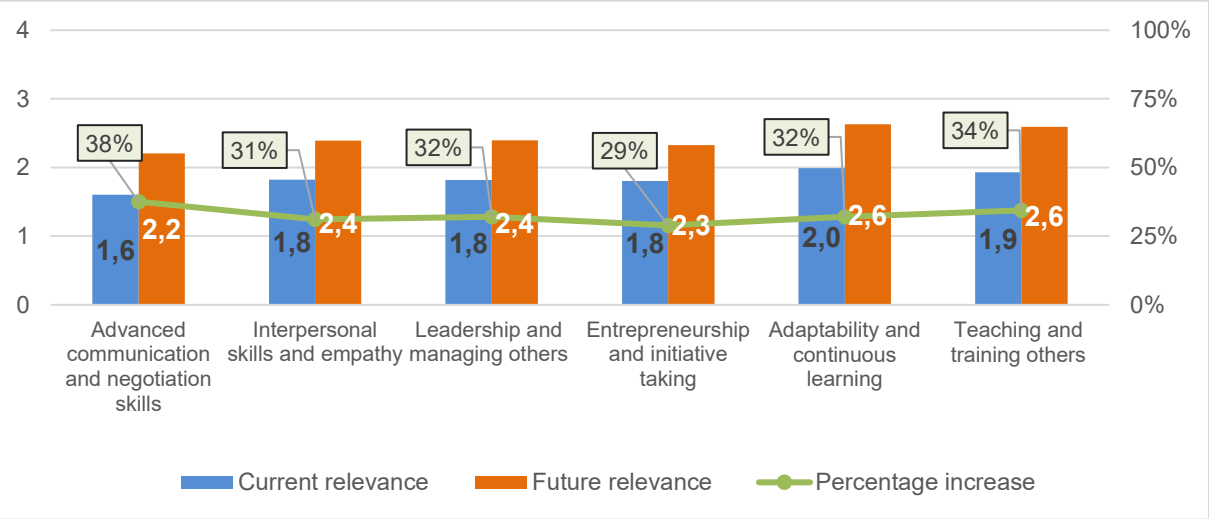


Figure 20: Social skills (across all nine job profiles)

Personal skills

Like social skills, personal skills are partly already in place (see Figure 21); especially personal experience and Work autonomously will obtain importance in the future with increase rates of 15 respectively 16 percent. Only in about one in three assessment (33 to 38 percent), an increase of relevance was expected. The other skills will clearly increase in importance, which specifically applies to *adapt to change*, where 6 of 10 assessments predict required Master or Expert skill levels in the future. 54 percent of the assessments included an increase by one point, 6 percent an increase by two or more points. The overall level of needed personal skills will grow from 2.1 to 2.6.

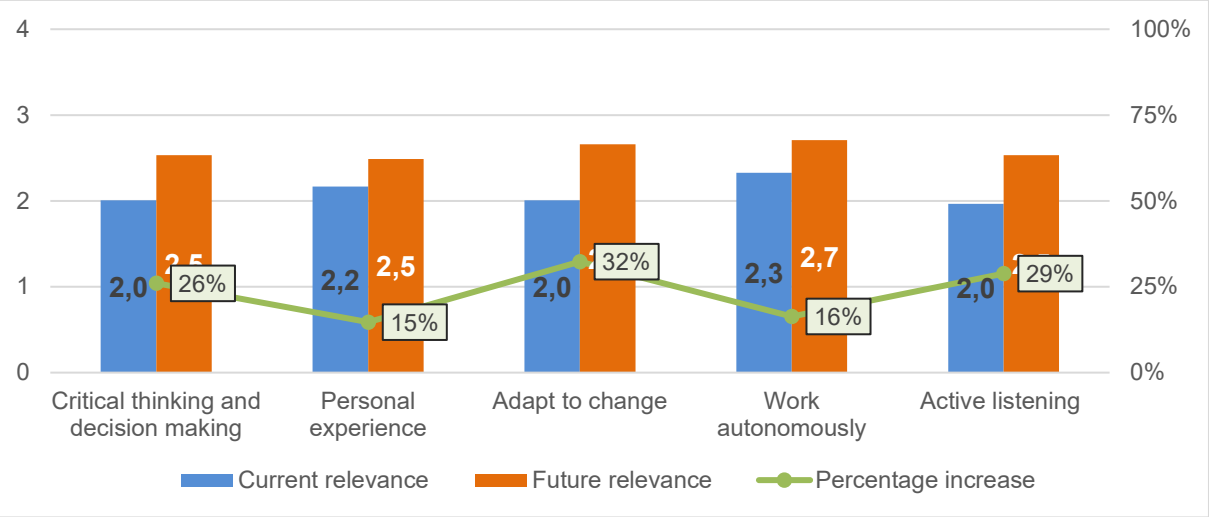


Figure 21: Personal skills (across all nine job profiles)

Methodological skills

As with social and personal skills, it can be said that many methodological skills are already quite important today but their relevance will further increase in the future (see Figure 22).

Smaller increases were detected for e.g. *Basic numeracy and communication* (+ 24 percent) as well as *Advanced literacy* (+19 percent).

However, skills related to processing information will receive a major up boost: *Quantitative and statistical skills*, but also *complex information processing and interpretation* as well as *basic data input and processing* will be more important in the future. The overall importance of methodological skills will rise from 1.8 to 2.3.

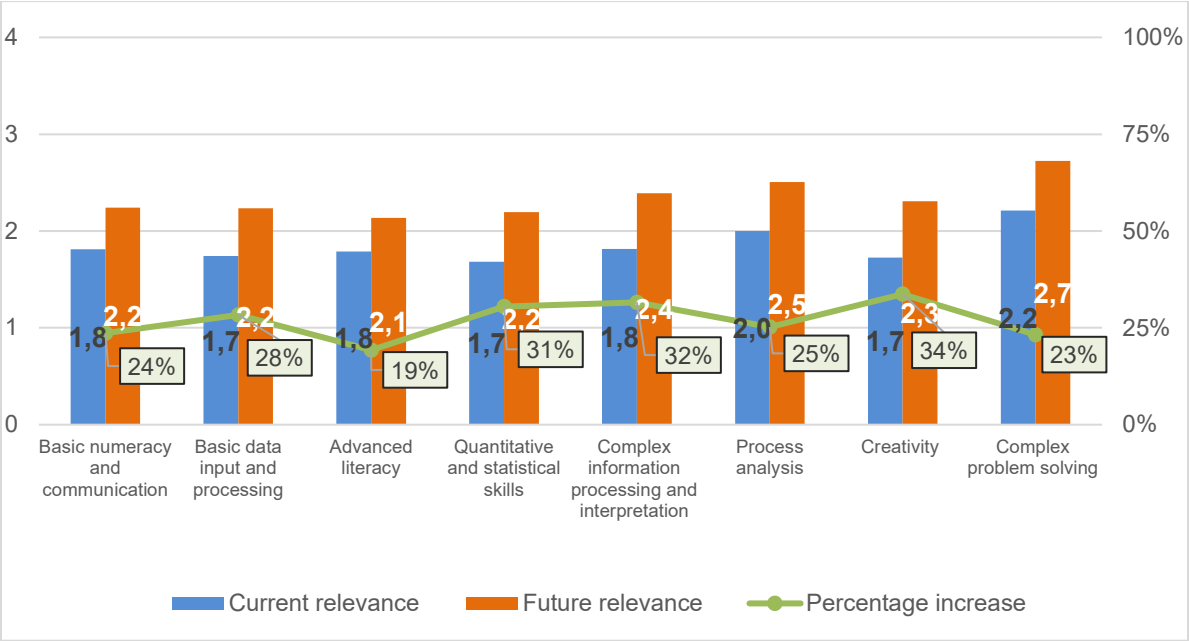


Figure 22: Methodological skills (across all nine job profiles)

Skills demands related to the different job profiles

Looking at the importance of these six skill categories for the nine selected job profiles (see Figure 23) it has to be stated that in general a higher level of proficiency (upskilling) is needed for all of them in the next three years. However, 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 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 the operator profiles (*metal processing plant operator, metal working tool setters and operators*), the *industrial electrician* and (particularly) the *factory hand* profile requiring a lower overall level of skills. Much speaks in favor to call the latter group the **technical oriented job profiles** and the first group the **managerial 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 (no other skills categories have a higher relevance within these profiles), these skills play subordinated roles within the more managerial oriented job profiles.

There are few further more characteristic differences between the job profiles: Within the managerial-oriented jobs the social and methodological skills seem to play a more important role. Other skills as personal skills are more transversal and required within all job profiles to a more similar extent. Compared to these skills categories, digital and green skills mostly play a more or less subordinated to moderate role *within* the job profiles today compared with other skills.

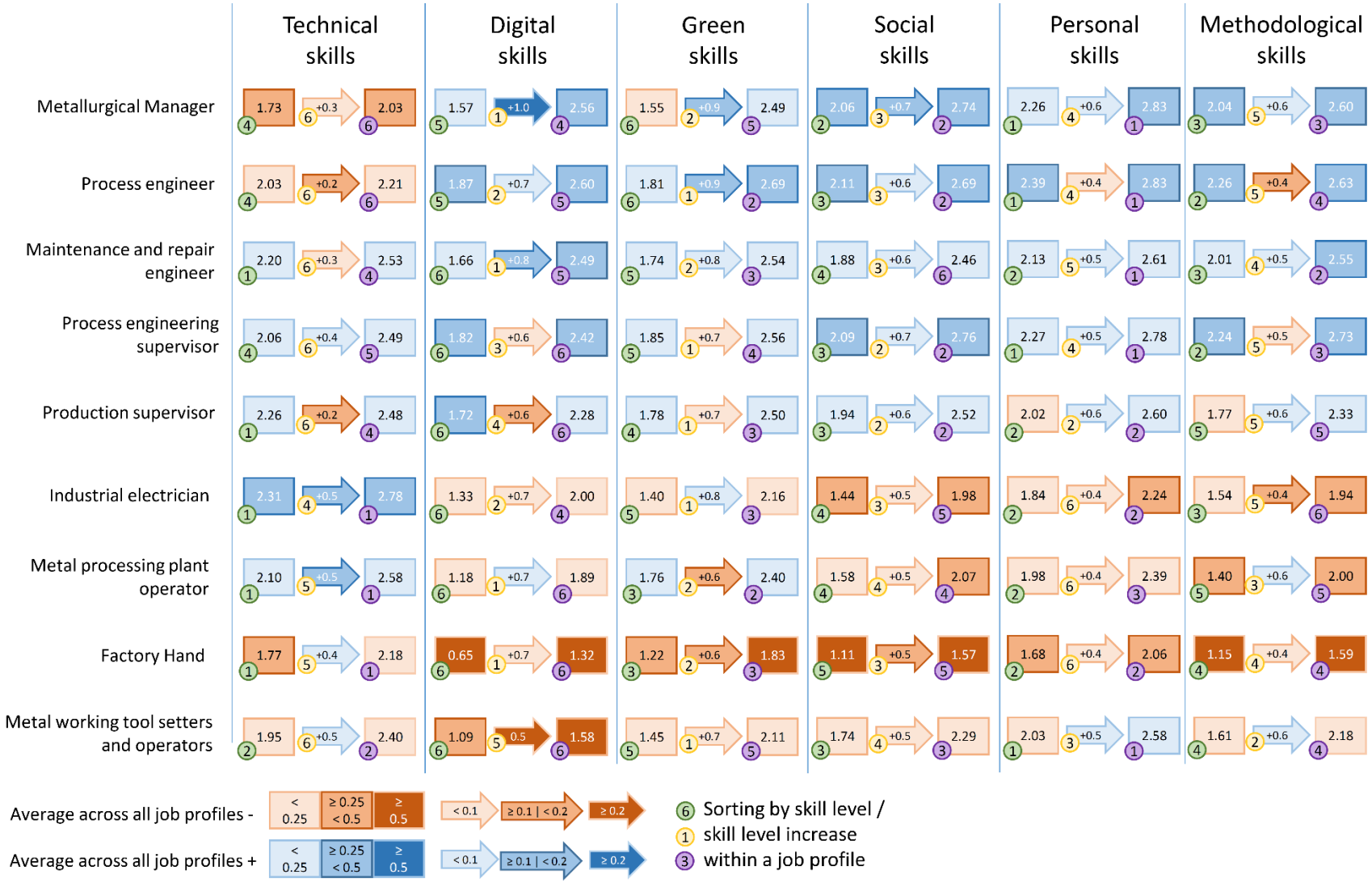


Figure 23: Skills needs of the job profiles and skill categories

The number in the circle indicate the rank of the respective skill level or increase of needed skill level within one job profile. Rank 1 represents the strongest skill level increase / skill level within this job profile

With regards to future developments the increase of skills levels 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 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 job profiles.

In general, 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 with lower degrees. This seem to entail the danger of a growing gap between high and low skills job profiles and also impeding the upskilling of certain kind of occupations.

Strategies to close skills gaps

The survey depicted also the most important company strategies to close existing skill gaps (see Figure 24). In general, all the listed measures are of relevance. About 80% of the companies are using recruitment of young professionals and experience workers as well as dedicated training programs and on-the-job training for the existing staff. The use of external services has a lower relevance for adjusting the skills of the workforce.

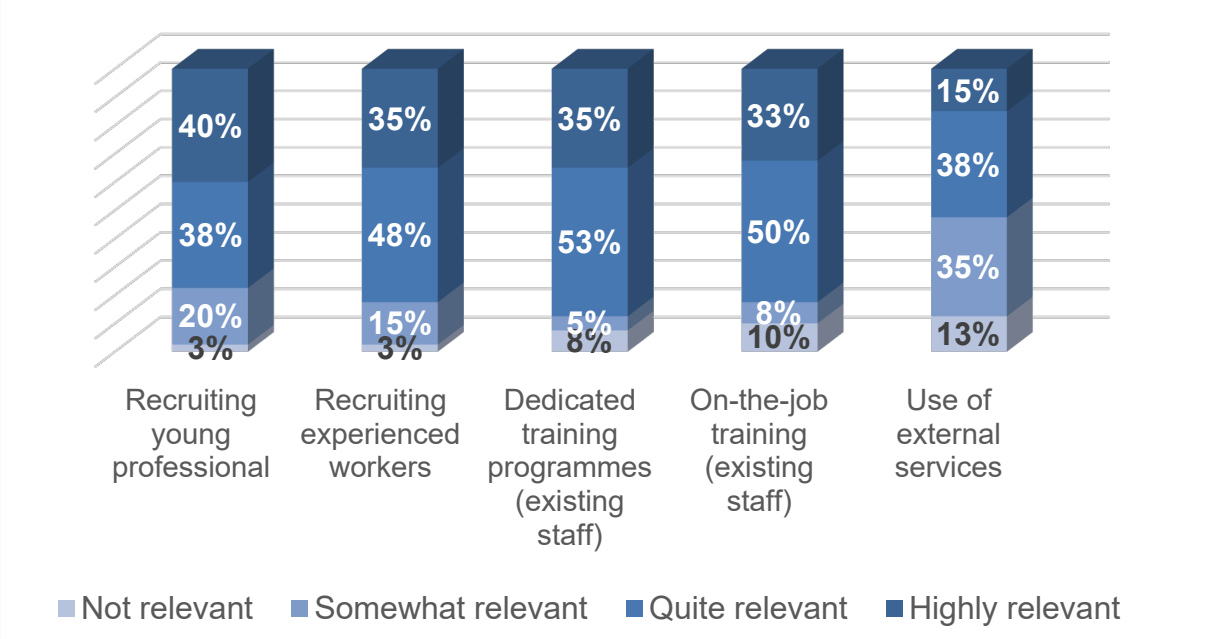


Figure 24: Relevance of approaches to close skill gaps in companies
(ESSA Survey 2023, N = 40).

However, ESSA looks for the need of upskilling based on the results of the survey, but also consider specific steel industry related *new job profiles* in the future. Especially if there is the need of a new occupation delivered by the VET systems such as the *process technologist in the metal industry* (developed by the BIBB, 2018). The ESSA technology and skills assessment survey of 2023 showed also that 83% of the participating human resources experts of steel companies expect that new job profiles will be necessary: green and data related profiles as well as IT and Cybersecurity and process related profiles (see Figure 25).

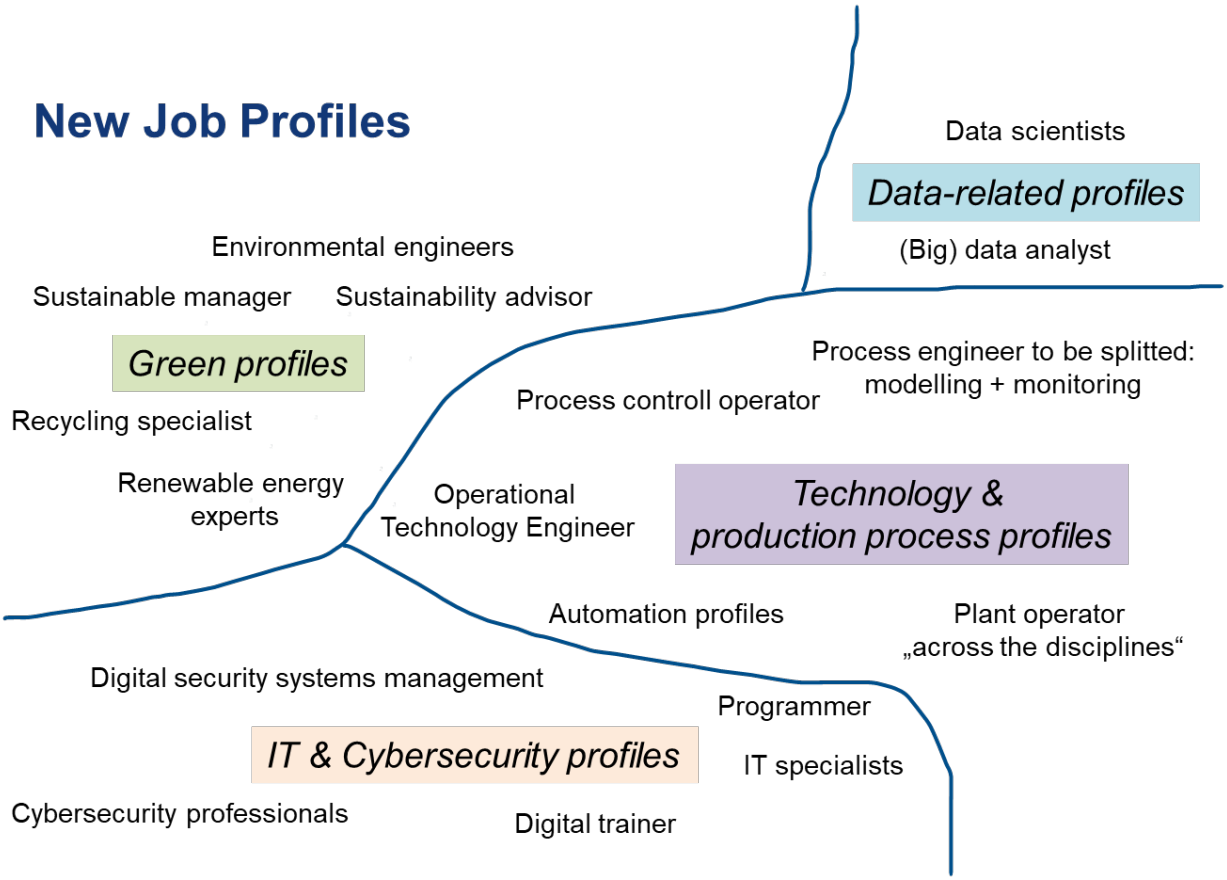


Figure 25: Expected new job profiles (ESSA survey results 2023)

But which profiles will disappear? We see a broad range of highly qualified employees (as mathematicians or physicians), lower skilled occupations as operators or workers, and administrative specialists named by the participants of the ESSA survey 2023:

- Greaser
- Operators
- Highly qualified maintenance personnel
- Crane operator
- Metal workers
- System engineers
- Finishing product operator
- Simple / manual profiles
- Pure electrical profiles *(in favour of profiles combining electrical, electronic and programming knowledge)*
- Physicians
- Mathematicians
- Administrative specialist

The ongoing skills alliance ESSA will take up these results as a starting point for further integration of job profiles and trainings.

2.3 VET System Framework and Provision

As already mentioned one of the main challenges of ESSA is to combine the industry driven classification of job profiles with the existing VET provision for occupations. As ESSA is

industry driven, the steel company and sector requirements are prior to the VET systems perspective and function. ESSA aligned industry skills requirements and adjustment measures as much as possible with the European and national VET system frameworks, tools and support mechanisms:

- On the European level with the ESCO (and ISCO) database, EQF, Europass, ECQA, and EQAVET creating a comprehensive recognition umbrella
- On the national level by exploring the link and support of different VET systems (central, regional, dual, industry related) to the skills demands of the Steel Industry.

On the **European level** the ESSA skills classification is integrating the steel sector relevant ISCO and ESCO occupations, concerning the description of tasks and specific skills (e.g. for the pilot job profiles listed above, except the Factory Hands). This is done by an automatic integration of the ISCO/ESCO database descriptions in the ESSA skills classification system. Starting with the specific skills (which are not only steel but more process industry related) an integration of transversal skills was provided during the course of the project. Up to now these skills are not bundled in the way of the ESSA classification but more or less widespread in the ISCO/ESCO database. In the table below the listed ISCO/ESCO occupation examples are interpreted and related to the Electric Arc Furnace and Blast Furnace Job Profiles in the steel industry.

ISCO Group	ESCO Occupation	Electric Arc Furnace	Blast Furnace
1219	Department Manager	Melting Shop Manager	Blast Furnace Manager
2141	Process Engineer	Melting Shop Process Manager	Blast Furnaces Process Technician
3119	Process Engineering Supervisor	Melting Shop Process Supervisor	Blast Furnaces Process Professional
1321	Industrial Production Manager	EAF production Manager	Blast Furnaces Production Manager
3122	Machine Operator Supervisor	EAF Foreman	Blast Furnaces Foreman
3135	Blast Furnace Operator	EAF Operator	Blast Furnaces Operator
	Machine Operator		Blast Furnaces Joint Operator
8343	Production Plant crane Operator	EAF crane Operator	Loads and Unloads Operator
	Refractories Coordinator		Blast Furnaces Refractory Lining Coordinator
	Refractories Supervisor	Refractories Supervisor	Blast Furnaces Refractory Lining Supervisor
	Refractories Operator		Blast Furnaces Refractory Lining Foreman

Table 5: ISCO and ESCO related steel job profiles for Electric Arc and Blast Furnace steel making (examples)

The **national VET system analysis** of five different VET systems (Germany, Italy, Poland, Spain, and UK) (see Deliverable D4.1) shows that they are active in reforming formal

occupations, curricula, and measures due to the digitalisation of manufacturing i.e. Industry 4.0. These reforms are very much in line with the ESSA approach. Integration of national VET system players took place mainly during the rollout of in ESSA (see chapter 5) to the member states, focusing on the steel regions where most of the European steel companies are placed. The support of national VET institutions is integrated as well but focussing on the skills demands of the companies and the steel region. Although we know, that potential impact on national/regional VET systems by ESSA is limited we will align our efforts with other sectoral industry blueprints by addressing common recommendations and trying to engage with key players (esp. under the recently established Large Scale Partnership Energy Intensive Industries[4] under the European Pact for Skills).

It is not intended (or within our power as these are nationally institutionalised systems) to change VET systems in general but we aim to enrich public vocational education and training curricula and teaching where possible by providing concrete Blueprint measures and tools for the steel industry (esp. integrating the regions in the ESSA European Community of Practice and the Online Training Ecosystem by setting up and connecting specific Regional Training Ecosystems). This will help to serve different centralised and decentralised VET systems, combining national and local needs, overcoming fragmented systems and policy structures. It is addressed by adopting steel related modular approaches (maybe also relevant for the process industry in general), supporting dual VET by collaboration of schools and companies, integrating possibilities of recognition of informal and non-formal learning via the VET system, and supported by social partnership. This might also lead to a re-balancing VET offers by extending it to the post-secondary and tertiary level, including better connecting VET with higher education. All in all, we intend to find new mechanisms to incorporate informal and non-formal learning in the VET system (recognition and validation of prior learning) and to improve the permeability of VET systems.

The European proactive mechanisms of skills forecast and systematic reviews of qualifications of ESSA were, and will be, transferred to the regional level, combining practical on-the-job training with wider theoretical knowledge and an enhancement of (technical and) transversal skills (T-shape approach):

- Enhancing vertical and horizontal mobility within the steel industry as well as between different process industries
- Enhancing workers' and companies' resilience in rapidly changing (technological and economic) environments
- Improving connection and transition between VET and Higher Education.

In the context of qualification development and VET system curricula design, the European Steel Sector Professional Job Profiles can be used as

- A communication tool between employers and educators which improves consultation process and outcomes
- A starting point for more detailed job profiles and curricula design in specialised fields (e.g. CyberSecurity, Data and Big Data)
- Reference profiles within VET system curricula.

[4] https://pact-for-skills.ec.europa.eu/about/industrial-ecosystems-and-partnerships/energy-intensive-industries_en

One of the key challenges of effective curricula design is managing how different stakeholders communicate and cooperate to design curricula that meet both educational and employer objectives. The skills assessment of the job profiles can provide a useful shared language and starting point so that discussions between these stakeholders are quickly focused on useful content rather than constantly re-explaining the foundations of the debate. Different stakeholders have different perspectives, terminologies and ways of thinking about steel sector related knowledge, skills and competence. It is important to take these differing points of view, into account, and understand the different ways of thinking and the different priorities of the stakeholders to better comprehend where there is the need for reform and change in the steel sector and VET systems. Bridging the gap between company and VET system perspective is an important and declared objective of ESSA. The European Steel Sector Professional Job Profiles have been kept in line, as much as possible, with the ESCO terminology and the resulting descriptions can be used to provide a bridge or communication tool to facilitate this process. Professional Role Profiles add a crucial step by providing informative examples of which skills are needed for which tasks. This means that the employer can easily start with the tasks that need to be done and work back towards what skills can be included in the curricula by educators. This will significantly speed up agreements on curricula design between employers and educators. In terms of updating curricula for new or changed activities in the workplace a structure is in place to inform that debate. For example, when analysing the educational needs of a specific job, the aligned European Professional Job Profile of the steel sector may be adopted to form a common vision of the role and its associated educational requirements. The competences within a profile provide guidance on skills and knowledge units that can be developed to inform VET system curricula design and desired learning outcomes.

In comparatively assessing the functioning of the VET systems of five European countries, in relation to the industry requirements arising from intense digitalisation and technological transformation, two levels have to be considered:

- macro-level which concerns the overall functioning of the national VET systems, and
- programme level, which focuses on the main vocational and technical programmes running in the countries that provide skilled workers to the industry (connected with the identification and assessment of job profiles).

All the five case study countries reviewed in ESSA have recently undergone **VET reforms** (or are currently undergoing reform and will continue to do so as dynamic systems) that were devised by the responsible authorities to cope with the current industrial and labour market challenges (in the direction of the ESSA objective of an industry driven adjustment). Most commonly, but to different degrees, reforms aim to:

- activate dual training arrangements
- relaunch and strengthen apprenticeship schemes
- extend VET at the post-secondary level (EQF 4-6)
- increase flexibility:
  - allowing 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
- 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.

Table 6 below offers an overview of the five case study countries in a multi-level analytical perspective. On a macro-level, the economic model of a country influences the type of skills that are more likely to be delivered within a system. Coordinated Market Economies, such as Germany, for instance, are usually associated with specific skills (a technically and theoretically informed workforce), while Liberal Market Economies tend to show higher preferences towards general education. The type of skills formation system operating in a country highlights the respective involvement of states and companies in the organisation of skills provision. The level of standardisation refers to the meso-level of analysis and points at the degree to which VET meets the same standards nationwide. The final level of analysis (micro) offers some relevant information on the most adopted type of learning arrangements and some essential characteristics of the different systems. Overall, the table shows that national VET systems are undergoing similar patterns (see below), although national differences still remain relevant. As companies are embedded in local contexts, new training arrangements and upskilling/reskilling proposals should consider the still present national differences in VET systems in order to complement them in the most appropriate way.

Country	Economic model	Skills formation system	Standardisation Level	Learning arrangements
Germany	Coordinated Market Economy	Collective	High	Mainly apprenticeship-based
Essential characteristics	Solid dual system Consensus based regulation Incremental adaptation Occupation-based system Holistic approach to occupational competencies Technology neutral provision Referenced to EQF			
Italy	Mediterranean Capitalism	Statist → (Collective)	High	Mainly school-based
Essential characteristics	National and Regional VET provision Recently introduced dual VET arrangements Post-secondary level more connected with companies Integrated route from secondary to tertiary VET Based on learning outcomes Qualification-based system Referenced to EQF			
Poland	Dependent Market Economy	Statist → (Collective)	High	Mainly school-based
Essential characteristics	System undergoing deep reforms (technical & vocational schools/dual model) until 2022 Distinction between programme and qualification Recently introduced dual VET arrangements Mechanisms in place for the recognition of prior learning Based on learning outcomes Qualification-based system Referenced to EQF			
Spain	Mediterranean Capitalism	Statist → (Collective)	High	Mainly school-based
Essential characteristics	Double VET route (in education or employment) Recently introduced dual VET arrangements Mechanisms in place for the recognition of prior learning Modularity Based on learning outcomes Qualification-based system No EQF referencing			
United Kingdom	Liberal Market Economy	Liberal	Low	Mixed
Essential characteristics	Complex governance Plurality of providers VET taken mostly at secondary level Raising demand in apprenticeships Becoming more employer-led Distinguishing role of awarding bodies Modularity Referenced to EQF			

Table 6: VET systems main characteristics in the five case study countries.

In line with the ESSA approach all the countries, except for Germany in which this was already established, aimed for better integration of employers in the qualification design process and the training provision. Cooperation between industry (including social partners) and academia is key in the creation of dual education programmes: One of the most effective methods to provide the future workforce with the needed competencies and know-how, while at the same time making them familiar with the industry. Dual education is not well established in all Member States, but combining VET with company performance and skills was stressed as important by companies and stakeholders during the course of the project (also recommended by the Steel Sector Careers Blueprint). This might be a way to a more *collective and industry driven type* of skills formation within the VET systems. Additionally, overcoming frequent VET funding cuts through companies' engagement (especially relevant for high-tech occupations) has to be part of the agenda.

The ***German*** case shows a lesser degree of change, compared to the other countries: initiatives have been undertaken to face the problem of skills mismatches through "occupations screenings" with the aim to understand the impact of technological innovation on some industrial key sectors, including metalworking. This resulted in the introduction of **additional learning modules** on digitalization and 4.0 enabling technologies (e.g. the module "Digitalisation of work, data protection and information security" [*Digitalisierung der Arbeit, Datenschutz und Informationssicherheit*]).

Poland, instead, is undergoing the deepest structural changes. A series of reforms have been initiated in 2016 and are changing the landscape of general and vocational programmes, the outcomes of which will become visible in the coming years. As regards the ***United Kingdom***, the extent of VET reforms depends on the different countries and devolved administrations. While England seem to tend more towards structural reforms such as the replacement of former apprenticeship frameworks with new employer-led standards and the introduction of new technical programmes (e.g. T Levels), other countries such as Wales are adopting a more cautious approach aimed at reviewing the current offer against the needs of employers and learners. In ***Italy*** and ***Spain*** recent reforms have mostly aimed at introducing dual arrangements (although this option is not much adopted yet), reviewing the national standards for the occupational profiles and strengthening the links between secondary and post-secondary VET.

A preliminary screening of the programmes indicates that IVET qualifications designers in the different countries are paying - in line with the ESSA approach - more attention to soft and digital skills and to combine cross-sectoral and occupation-specific skills to meet both the needs of employers and learners (see table below). This includes the establishment and better combination of VET regulation and qualification at technology and work organisation level. The table below show the various programmes in the five different VET systems that offer qualifications relevant to the industry. While this table is just an overview of the main programmes, it should help us to identify amongst these the programmes and qualifications that link with the nine selected job profiles (described earlier in this report).

	Germany	Italy	Poland	Spain	United Kingdom
Secondary level (EQF2-4)	Vocational schools (*Berufsfachschule*) Apprenticeship (*Ausbildungsberufe*)	Technical schools Vocational schools Strictly VET programme (*Istruzione e Formazione Professionale - IeFP*) Apprenticeship	Sectoral programmes (*Szkoły branżowe I stopni*) Technical programmes (*Technika*)	Basic VET (*Formación Profesional básica*) Intermediate VET (*Formación Profesional de grado medio*) Apprenticeship	College-based VET (e.g. National Vocational Qualifications - NVQ; Business and Technology Education Council - BTEC etc.) Technical programmes (T Levels) Apprenticeship
Post-secondary level (EQF4-6)	Technical schools (*Fachschule*) Advanced vocational training (*Meister*) Apprenticeship (*Fortbildungsberufe*)	Higher Technical Education and Training (*Istruzione e Formazione Tecnica Superiore - IFTS*) Higher Technical Institutes (*Istituti Tecnici Superiori - ITS*) Apprenticeship	Vocational schools (*Szkoły policealne*)	Higher VET (*Formación Profesional de grado superior*) Apprenticeship	College-based higher VET (BTEC, NVQ etc.) Higher apprenticeship

Table 7: VET programmes in the five case study countries delivering qualifications relevant to the industry

Challenges/Criticalities: Rapidly changing industrial landscapes and labour markets require *not just timely but coherent responses*. Our comparative analysis of VET systems shows a latent tension between fast responses and mid- to long-term incremental adaptation. This is exemplified by the cases of the United Kingdom, in the case of the former responses, and Germany, in the case of the latter forms of adaptation. Experts' interviews point out that while fast responses might lack coherence and do not point to a long-term strategy, too rigid 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 leads to a proliferation of narrow-defined occupational standards. This might undermine the capacity of the system to deliver what ESCO defines as skills with a higher degree of *reusability*, so limiting workers as well as businesses' resilience. The German concept of "vocational action competence" (*Handlungskompetenz*), instead, seems to point towards a more holistic vision of the occupation and its associated competencies.

From this point of view, a crucial challenge for future VET would be *defining the optimal balance between soft, digital, cross-sectoral and occupation-specific skills*.

Another criticality concerns the degree of *fragmentation* of a VET system. Where governance is complex, the consistency of the whole system and its capacity to align with a national strategy might be undermined. A complex regulatory framework might also discourage the engagement of both social partners and learners. A challenge for all European countries

would be to guarantee high-quality and internationally-transparent VET qualifications, at the same time rationalising the overall system functioning.

The ESSA Blueprint could help to release the tension between different approaches (short-termism flexibility vs. long-term planning; fragmentation vs. centralisation) providing an overview of the shortcomings and gaps in VET provision in different systems and delivering a set of VET-related recommendations with the aim to support a long-term sectoral skills development strategy that also considers the need for more flexible approaches. At the same time, through the online training ecosystem steelHub (see next chapter), ESSA could complement national systems with additional guidance for learners, micro-credentials and tailored training, in so enriching and adding more flexible provision.

However, the ESSA overview of the skills adjustment approaches and frameworks indicates a broad range of topics to be considered. This is underlined and broadened by the relevant areas for VET conducted by Andrew McCoshan (McCoshan, 2019, Centres of Vocational Excellence CoVE). In the latter assessment, teaching and learning have to change but also governance, funding and leadership need to be embedded in new cooperation and partnerships. Looking at this and considering our overview of ESSA, we can assess that ESSA is on the right track in aiming to establish training and skills ecosystems via the Foresight Observatory and Regional and Online Training Eco-systems (see next chapter).

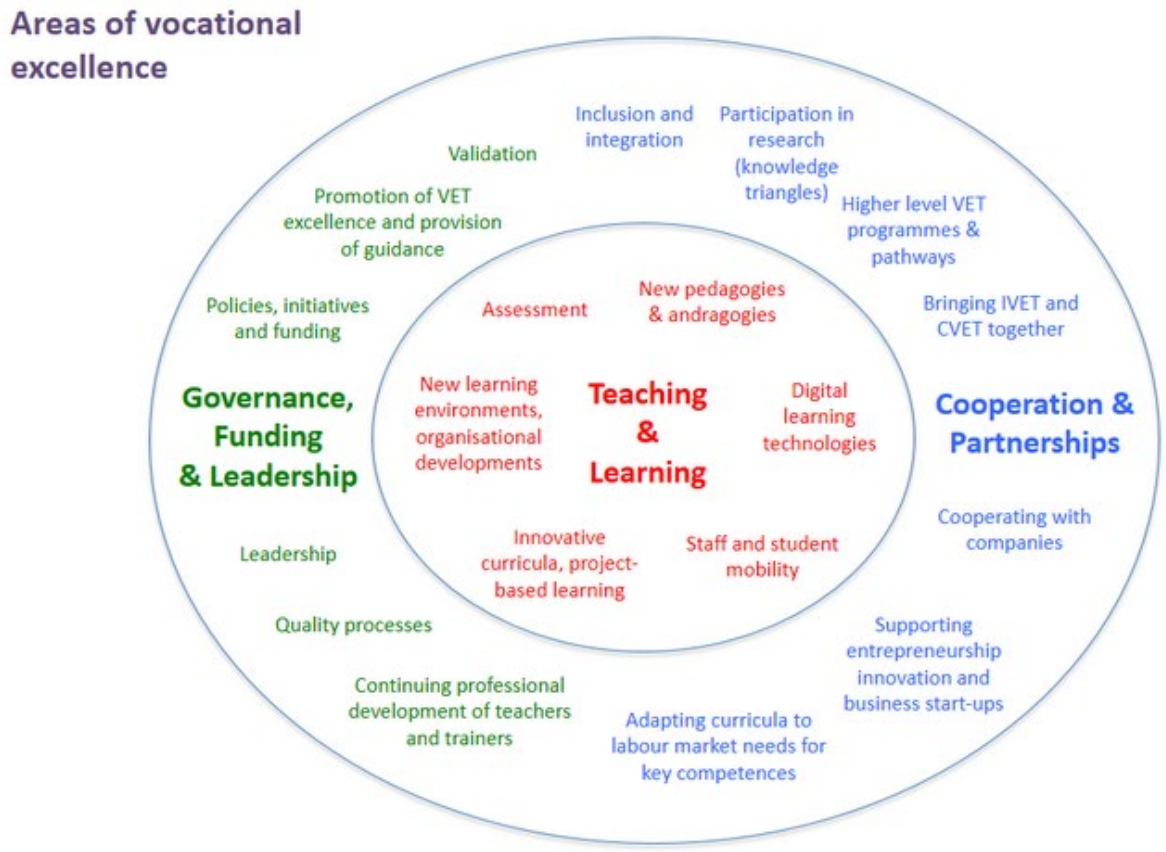


Figure 26: Areas of excellence in VET
(taken from McCoshan (2019)

To align the selected job profiles (see chapter 2.2) with comparable information about steel-relevant I-VET qualification programmes a Sector Skills Matrix (see Figure 27, and in detail Deliverable D4.4; ESSA, 2021) was elaborated including the five European pilot countries of ESSA: Germany, Italy, Poland, Spain and UK. The main focus of the Matrix is on the depth

and breadth of transversal skills provision at the level of learning outcomes offered formally through the VET qualification programmes.

In particular, the matrix is designed to capture the following information:

1. the most relevant steel-production IVET and CVET programmes related to Maintenance, Melt Shop, Rolling Mills, Logistics and Quality Control in each of the five case study countries
2. Learning Outcomes concerning transversal skills
3. Information related to national VET systems: national labels, classification numbers, links to curricula and regulations (if available).
4. Assessment/Evaluation in each of the five case study countries in the form of a *RAG (red – amber - green) grading* of:
   - current transversal skills provisions compared to *current need* of the steel industry to establish *current* transversal skills gap
   - current transversal skills provision compared to *expected future (2030)* need of the steel industry to establish *future* transversal skills gap

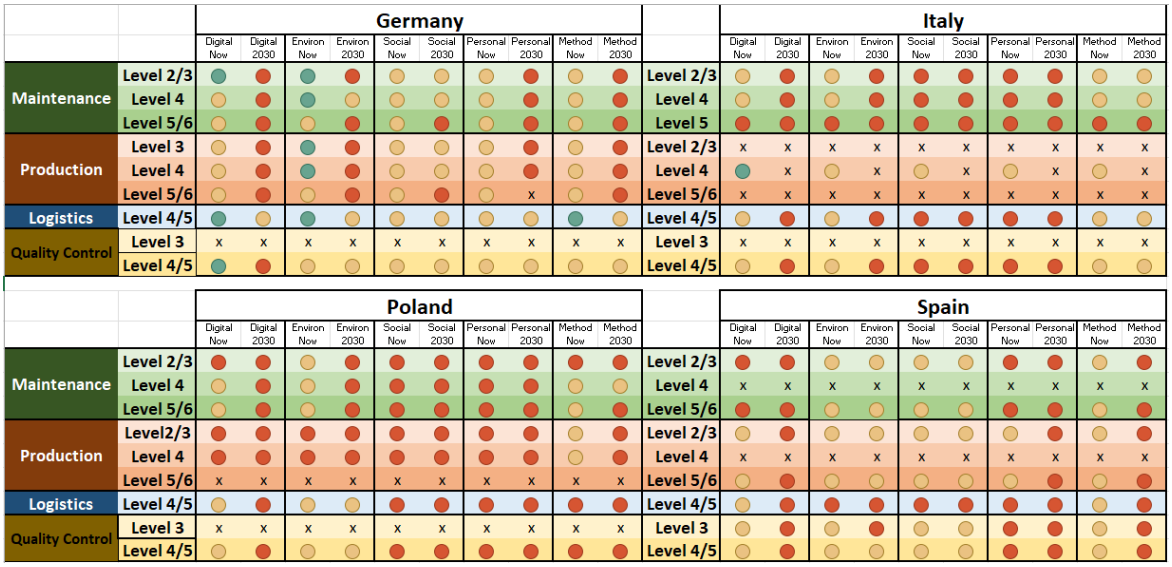


Figure 27: Global layer of VET System Matrix
RAG (red – amber- green) - grading of match between transversal skills provisions of (occupational) qualification programmes and current and future steel industry requirements in four case study countries

The Matrix opens up a range of angles for comparing national vocational programmes and VET provisions with the industry requirements. Beyond the confines of the ESSA project, there is potential usefulness of the sector skills matrix for a range of actors operating at three different levels.

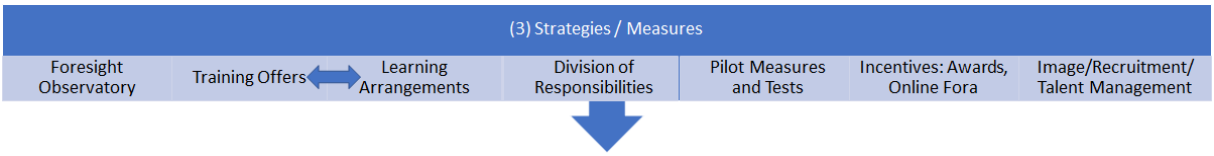
At the European level, the Matrix might prove useful to EU institutions such as the Commission but also EU-funded research projects as well as European-level institutions representing social partners. The matrix can inform EU-level steel-sector focused strategic decision-making related to policies, research programmes and development and/or adjustment of European VET tools. EU-level industry bodies and trade unions can use the information provided by the Matrix in similar ways or to use it to inform campaigning or lobbying efforts.

Industry bodies and trade unions operating at the national level could use the Matrix to try and influence the direction of national VET systems or to develop additional training programmes in response to identified skills gaps. The Matrix can also serve as useful feedback mechanisms to national VET institutions, which in turn might adjust decisions and activities to close identified skills gaps. The Matrix might also prove to be of value to a range of training providers as identified skills gaps offer opportunities to those with the capacity of closing them through the development of training offers.

Finally, at a regional level, the Matrix might prove useful to regional economic development initiatives such as the South Wales Industrial Cluster (SWIC) in the UK or the *Initiative Ruhrkreis* in the West of Germany. Given the industry- and sector-transcending nature of transversal skills, the matrix might inform broader regional and local initiatives for cross-sectoral transversal skills development. Given also the fact that steel companies are often concentrated within particular regions and localities, VET institutions operating at this level might also find the Matrix useful to inform their approaches to training provisions or to underpin wider skills development campaigns.

Regarding the relationship to other ESSA outputs, the VET system analysis in general and the Matrix in particular focus on steel-industry relevant aspects of national VET systems. The main analytic unit of the Matrix is '(occupational) qualification' and the aim is to come to an assessment whether available initial or continuous VET qualifications provide workers with the currently required capacity to perform particular steel jobs including working with new technologies.

3 Strategies / Measures – The Supply Side



Strategies and measures based on ESSA results 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 Panel (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 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

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 Eco-systems). EUROFER is supporting ESSA via its Social Affairs Committee (SAC) and industriALL via the Sectoral Social Dialogue Committee on Steel (SSDCS).

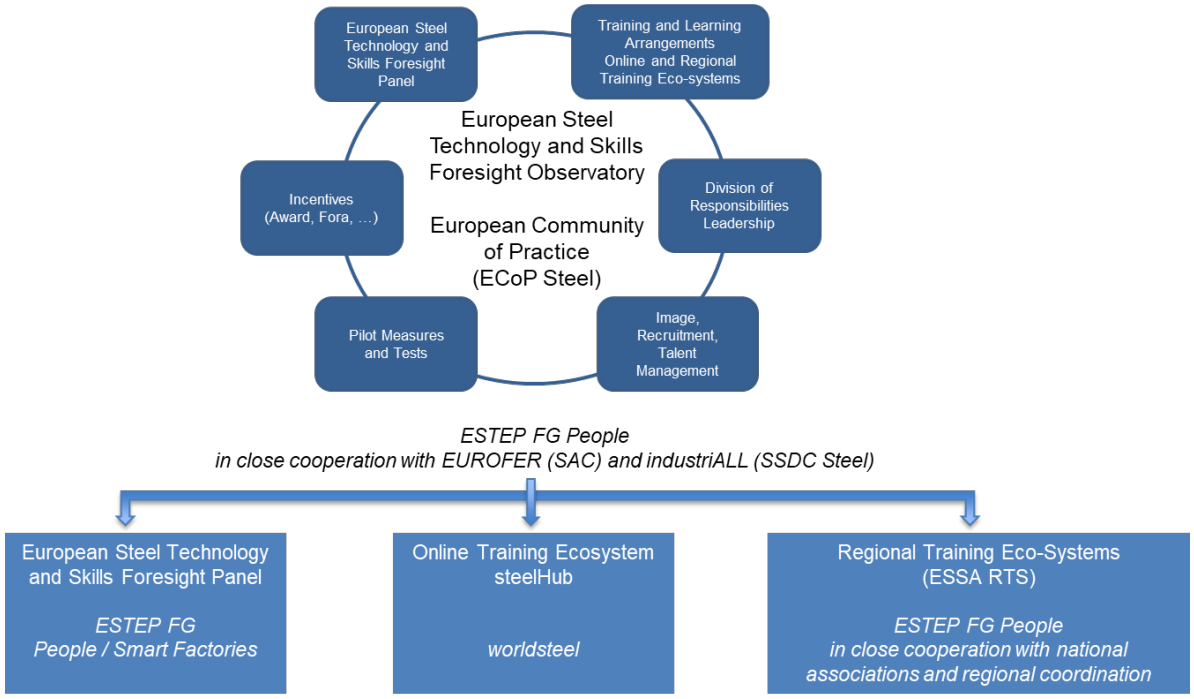


Figure 28: ESSA Governance Structure

3.1 European Foresight Observatory

As 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 Anticipation and Support of Future Skills.

Central part of the ESSA **Foresight Observatory** will be a regular **European Steel Technology and Skills Foresight Panel** (**ESSA ETP**). The survey will be developed further based on the results and methodology assessment of the two already conducted surveys during the implementation and test phase of ESSA (see Deliverable D3.2; Bayón et al., 2023) into regular monitoring and assessment instrument. It is planned to shorten the existing survey to the key questions (not to overload the participants with too much time for responding). The results are summarised in a Steel Technology and Skills Foresight Index, to be discussed further in a yearly workshop of selected experts focussing on necessary implications for the steel industry concerning the main results of the survey.

The Blueprint implementation, operation and monitoring on the European Level within the ESSA Observatory will comprise:

- Communication and involvement strategies for skills adjustments (e.g. new skills demand and development and upload of training measures in the steelHub)

- Rollout of information, tools, measures to the steel regions and vice versa integrating best practices and tools of the steel regions in the European activities
- Implementation and transfer by engaging the national steel associations and unions
- Setup of ad-hoc or regular sub-committees for hot topics – mainly incorporated in existing committees
- Organising joint processes of associations, companies, training providers to optimise skills adjustment strategies and VET strategies, tools, curricula across:
  - Associations: linking European and national, regional VET cooperation
  - Companies: joint training programmes, integration of training offers in the steelHub
  - Training Providers: exchanging best practices, advertising the steelHub.

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 Eco-systems, 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 Erasmus+, Clean Steel Partnership, Horizon Europe) and steel sector specific programmes (such as RFCS) or platform activities (such as ESTEP, SSDCS with support of the social partners EUROFER and industriALL).

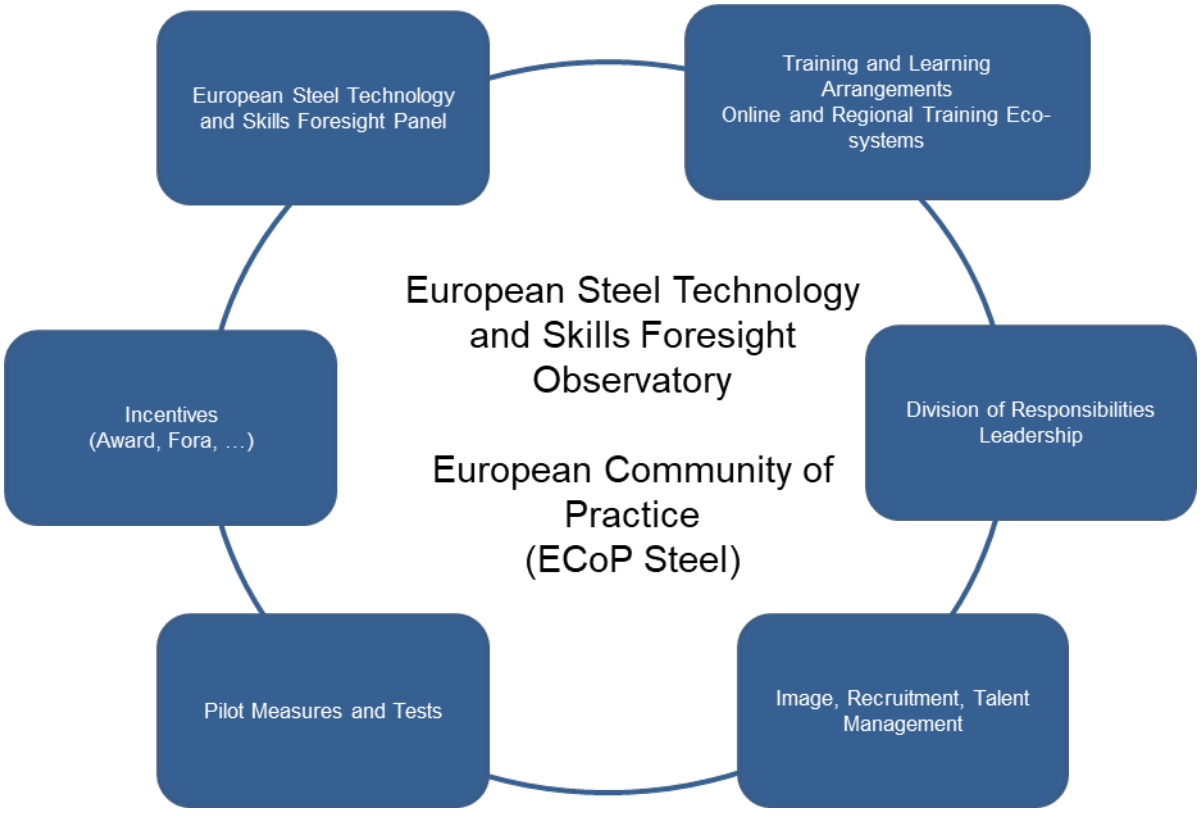


Figure 29: Elements of the Foresight Observatory

3.2 Training Offers and Learning Arrangements

Training Ecosystems will form the supply side as information and exchange platforms for training development and offers by integrating (updated or new) training courses and learning arrangements. Within the supply side skills demands have to be aligned to affected job profiles of different production areas of the steel companies. The impact or improvement of related formal occupations of the VET systems have to be identified and checked according to potential and necessary changes in the curricula and training offers for these occupations. Underscoring the formal patterns of change within VET systems, it is necessary to find ways to incorporate new skill demands related to job profiles within company training provision in more immediate ways to meet pressing needs. However, the change of the VET systems to support industry needs in a short-term effective way remains significant, esp. when it comes to higher basic skills of the new generations (including pre-VET education) and increasing the attraction for process industries like steel.

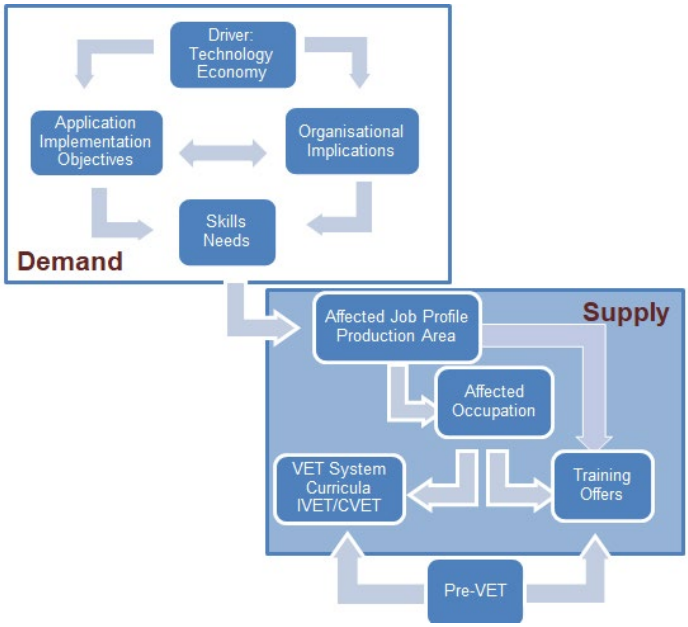


Figure 30: Vocational Education and Training as an answer to skill needs - the supply side

(New) training offers should reflect **(new) learning arrangements**. Digital transformation is not only focusing on re- and upskilling of the workers but also relevant for new learning and teaching arrangements. Digitalisation will also improve and increase new learning possibilities and arrangements (quantitatively and qualitatively): Training providers, companies, workers and apprentices have to improve their digital skills for both **learning and operating** at the workplace. Not only the Corona pandemic but also the speed of (technological and continuous) changes show the importance of more and new (digital) online learning and training possibilities. Digitalisation of learning modules, improved digital skills, flexible and agile trainers and learners are relevant elements of new digital learning strategies and alliances. New formats are needed articulating new developments in time comprising different possibilities such:

- Online training and simulation
- On the job training (combined with digital training modules)
- Integration of general or specific (online) modules in company training schemes

- Reverse mentorship as a two-way process between older and younger employees (as suggested by the Steel Sector Careers Blueprint SSC)
- Webinars
- Individual and specific groups training paths (in-company, across companies, individual)
- Self-learning modules and models (with real time feedback for iterative corrections)
- Vocational guidance and counselling
- Experiential learning (e.g. production process assessment concerning energy efficiency)
- Blended learning, combining classroom and workplace, linking VET schools and workplace, improved coordination of knowledge acquisition and practical learning)
- Project-based, challenge-based and integrative learning, game-based learning
- Social and collaborative learning
- New forms of assessment and validation: ePortfolios, learning challenges, feedback to learners, new links between assessors and learners
- Virtual Reality
- and others.

To illustrate the new learning possibilities a few new formats are listed below. A big part is to know, what the needed skills will be without having the technology yet and to set up some **play and test fields**, using new digital possibilities:

- labs where people can be trained at new digital solutions (see training laboratories below)
- simulations (digital twins), helpful for emergency practice - people can really train all the different accidents, which can happen, which could not be done at the normal installation.
- virtual reality / augmented reality (often used in labs)
- digital assistance which can support the workers in his activities but also to improve his knowledge concerning the work (digital knowledge management), trouble-shooting at the job-place.

Other formats are focusing on **exchange of digital knowledge** in a kind of reverse mentoring illustrate such new formats a few examples will be described.

steelTalks (Steel University) (https://steeluniversity.org/learn/steeltalks/) is a short webinar focusing on current hot topics of the steel industry

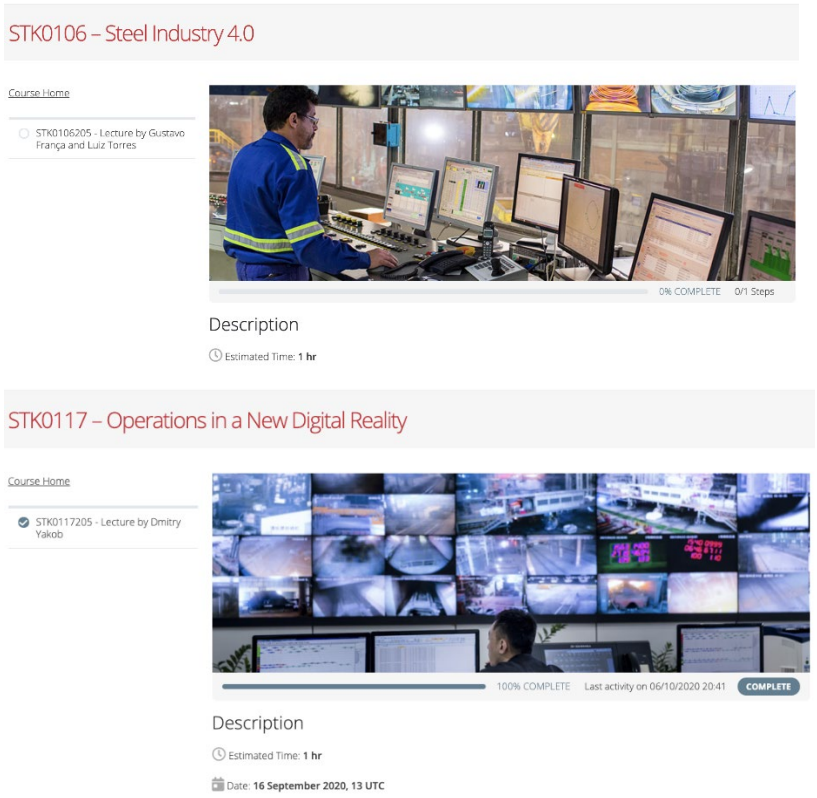


Figure 31: steelTalks of the Steel University

Digiscouts® (apprentices, SMEs) **(**https://www.digiscouts.de/) is a program to utilise the interest of apprentices and to attract the dual VET young trainees are looking for unfolded potential of digitalisation in the companies by using a discovering tool and a digital exchange platform, accompanied by a coach of the company.

(Reverse) Mentoring: Promote (reverse) mentorship as a way of knowledge transfer between older and younger workers – Large amounts of workers being on the brink of retirement is one of the urgent challenges the steel industry is facing (e.g. with the pro Zukunft (Future) program from thyssenkrupp). Mentorship appears to be a particularly viable method of ensuring that valuable knowledge is not lost in the process and is appropriately transferred to younger generations of workers. On the other hand, young people bring in valuable skills in their own right that they can share with their more senior colleagues, particularly in terms of digital skills. Solidifying and further expanding mentorship programmes, whenever possible in the form of reverse mentoring, therefore must be a crucial part of any forward-looking education and training strategy." (Steel Sector Careers Blueprint, Final Report; White Research et al., 2020, p. 10).

Training Laboratories: Training is specific developed laboratories (field labs, living labs), learning how to use new technologies, with the lab tests skill gaps are appearing, anticipating and getting ready, before new technologies will enter the company.

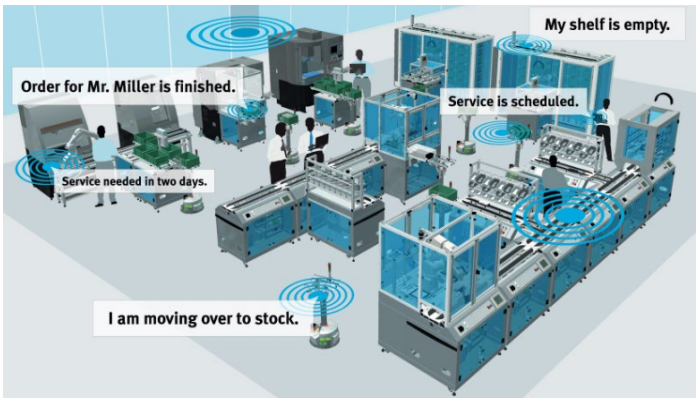


Figure 32: Learning Labs (Danieli Automation SpA, DIGI&MET) / Festo Lernfabrik 4.0
(Festo Didactic, n. d.)

Skilling and Training in Times of Covid-19

The Covid-19 crisis is a good example that digital skills are catalysed by economic and societal demands and necessities. As most of the steel companies reduced and stopped production during the pandemic crisis 2020, education of apprentices and training of the workforce could have been a measure to use the time given. There were already digital training courses available for online courses on different topics (including digital skills), e.g. at the steel university and the ESSA steelHub, within the big companies, and national training providers. Some training providers have already learning labs (incl. relevant machines), used for online learning and training possibilities. Some companies offered new education and learning remotely. For instance, 60 trainers of thyssenkrupp Steel Europe were teaching about 660 apprentices in their home offices, focusing on specific topics like health and safety, compliance, and maintenance.

3.2.1 Train the trainers/teachers

The important role of teaching professionals and trainers for transformation processes in the steel sector is beyond question and is also expressed in a high demand for training personnel (cf. e.g. Cedefop's skills forecast[5]). The transformations of decarbonisation and digitalisation, which are crucial for the steel industry, increase the importance of

[5] According to data from the 2023 edition, 8.3 million job openings for teaching professionals are expected from 2021 to 2035, the second most demanded occupation. Cf. https://www.cedefop.europa.eu/en/tools/skills-forecast

appropriate training for the relevant skilled workers. Because no education and training system is better than its teachers and trainers, ESSA recognises this by integrating train the trainer programmes as part of its Online Training Eco-System **steelHub**, and by considering the topic in the National-Regional Training Eco-Systems (ESSA RTS) (both described in the next chapter 3.3). 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). Now, in the final stage of the project, concrete offers have been developed in the steelHub, which were refined, adapted and enriched with the help of the rollout workshops (ESSA RTS).

The concrete ESSA approach to train the trainer will be described in this sub-chapter. Roughly summarised, the work was 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 (see chapter 2.2.1), 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 are 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, 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.

In concrete terms, trainer skills are implemented in the online platform steelHub (see chapter 3.4.1) 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, currently train the trainer modules and courses are 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 National-Regional Training Eco-System (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.

ESSA's broad approach to Train the Trainer over the duration of the project is as follows:

1. **Requirements / demands / good practice** could be extracted from the project work:
   - What kind of train the trainer measures are needed because of the technological, economic development (WP2)?
   - What does the industry require and have in place (WP3)?
   - What kind of approaches are shown by the VET systems (WP4)?
   - New strategies and guidelines and new skills (related to teaching activity) (WP5)
     i. *Resulting in the identification of three trainer profiles ('Corporate Trainer', 'Vocational Teacher', 'Manufacturing Manager') and corresponding trainer skills for each of these trainer profiles*

2. **(New) Training arrangements** for train the trainer:
    - **Hybrid teachers**: external but also internal (workplace but also schools/courses)
    - New allocation of **on the job learning and learning support of digital information tools**, e.g. tablets, apps.
    - **Peer training and learning:** trained workers (e.g. by the software developers of new digital solutions) train their colleagues on the job
    - **New leadership**: shift managers, managers getting the role of trainer/mentor/coach/facilitator, esp. for improving and distribution of transversal skills
    - **Online training**: e.g. gamification
    - **Case Study and simulation:** Learning by doing methodology.
        i. *Skills that enable trainers to conduct such training arrangements are represented in the functional skills of the three trainer profiles*
3. Integration of **training for trainers** already in place (examples for train the trainer → as part of the Online and Regional Training Eco-System)
        i. *As is done within the steelHub, where trainers can find training courses according to their needs and individual skills*
4. The train the trainer **methodology** (company internal and external) is constantly updated:
    - company job shadowing for trainers (VET teachers)
    - use of mentors within the company for on the job training (informal training)
    - enable professionals in the companies to teach and share their knowledge
    - module development
    - training database (viability, input of data, related to requirement of potential users → steelHub)
    - operating instructions (internal, external), use of tablets (new equipment) (→ facts4workers project https://facts4workers.eu/)

By embedding the trainer profiles and the corresponding modules and courses in the Online Training Ecosystem steelHub platform, 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.

3.3 Training Ecosystems

The results of ESSA stress both virtual and on-the-job learning, in the best way combined with each other. Therefore, the European perspective of ESSA intends to focus on the European level by an **Online Training Ecosystem Platform** (**steelHub)** and on the level of steel regions by specific **National-Regional Training Ecosystem** (national-regional cooperation). Both systems are complementary and are combined by adding specific advantages to each other (such as combining online and regional on-site analogue training modules that could be integrated in a broader training program of the companies and VET providers):

- virtual / online: independence of time and space, integration of relevant modules in company and individual learning paths, and others (see success factors of bitkom Position Paper June 2020 in Table 1 below)

- on-site / workplace related: real working experience, interactive learning, practicing new skills, and others.

Concerning VET system integration complementarity could be seen as follows:

1. Regional/national ecosystems could address recommendation to the states where gaps emerge and provide relevant and up-to-date information on sectoral trends and skills gaps on the basis of which the key actors can act to change the system from within (e.g. improve curricula, considering different learning arrangements); also, providing policy-makers with models and examples of effective regional VET-business configurations (e.g. see the one of Tata Steel Ijmuiden described as a reference model in Deliverable D6.2 (Schröder et al., 2023)).
2. Online ecosystem could provide guidance on how to better navigate and make use of national VET (especially CVET and recognition of non-formal and informal learning procedures) and EU frameworks; also, the online ecosystem can build micro-credentials on top of VET systems to fill gaps and complement them with more customised training (e.g. the continuous casting simulation described below).

Success Factors for Digital Learning
1. New work and new learning will grow together in an interrelated way: flexible self-regulated learning independent of space and time, coached and monitored by new leadership, digital learning responsible needed to check relevant offers 2. Cultural change and new leadership: decentralisation of decisions and work, participation of workers, monitoring and coaching instead of controlling, ... 3. New individual and pragmatic solutions, focusing on internal solutions 4. Strategic learning concept is relevant (contents, methodological-didactical approach, learning strategy, ...) 5. Stakeholder integration (IT, management, unions, ...) 6. Diverse digital learning arrangements to be used: webinars, web-based trainings, videos and podcasts, mobile and social learning 7. Internal and external solutions could be combined 8. Digital learning as investment in the future, improving recruiting and retaining of workers **9.** Qualification for digital learning as success factor

Table 8: Success factors for digital learning according to Bitkom (2020). Own translation / summary.

3.4.1 Online Training Eco-System (steelHub)

Based on the ESSA approach and partnership (integrating stakeholders from companies, associations and social partners, training providers, research and development organisations) the Online Training Ecosystem conceptualised as "**steelHub**"[6] (https://hub.steeluniversity.org/) is implementing and transferring human resources and training relevant contents and issues from and to all the relevant stakeholders: associations, industry, other blueprints, VET Systems, individuals, and EU Tools.

To ensure a highly qualified, specialised and multi-skilled workforce the steelHub and the National-regional Training Ecosystems (ESSA RTS) (see chapter 3.4.2) were composed as

[6] A short video explaining the steelHub could be found here: https://cdn.hub.steeluniversity.org/assets/videos/play.html?id=MRK0010

platforms to facilitate coordination, communication and collaborative partnership between all the relevant stakeholder groups of the ecosystem: research centres, associations and social partners, equipment and service providers, companies, training providers, and public authorities to be interlocked (see Figure 33).

Figure 33: Training and Development Ecosystem (steelHub and ESSA RTS)

The Online Training Ecosystem steelHub sets the infrastructure for a European/worldwide exchange of training content, integrating inputs from and serving offers to steel associations and companies, VET systems, research centres, other Blueprints, European tools, and the non-formal and informal learning of individuals. The steelHub is also serving the Regional Training Eco-Systems, linking European and regional training, and online and work-based learning.

steelHub is an open online system. Based on a business model (agreements between the training publishers and the runner of the platform worldsteel, see in detail Deliverable D6.2 (Schröder et al., 2023)) every kind of training provider could offer training which could be used by every interested company, VET institution, association and individual learner.

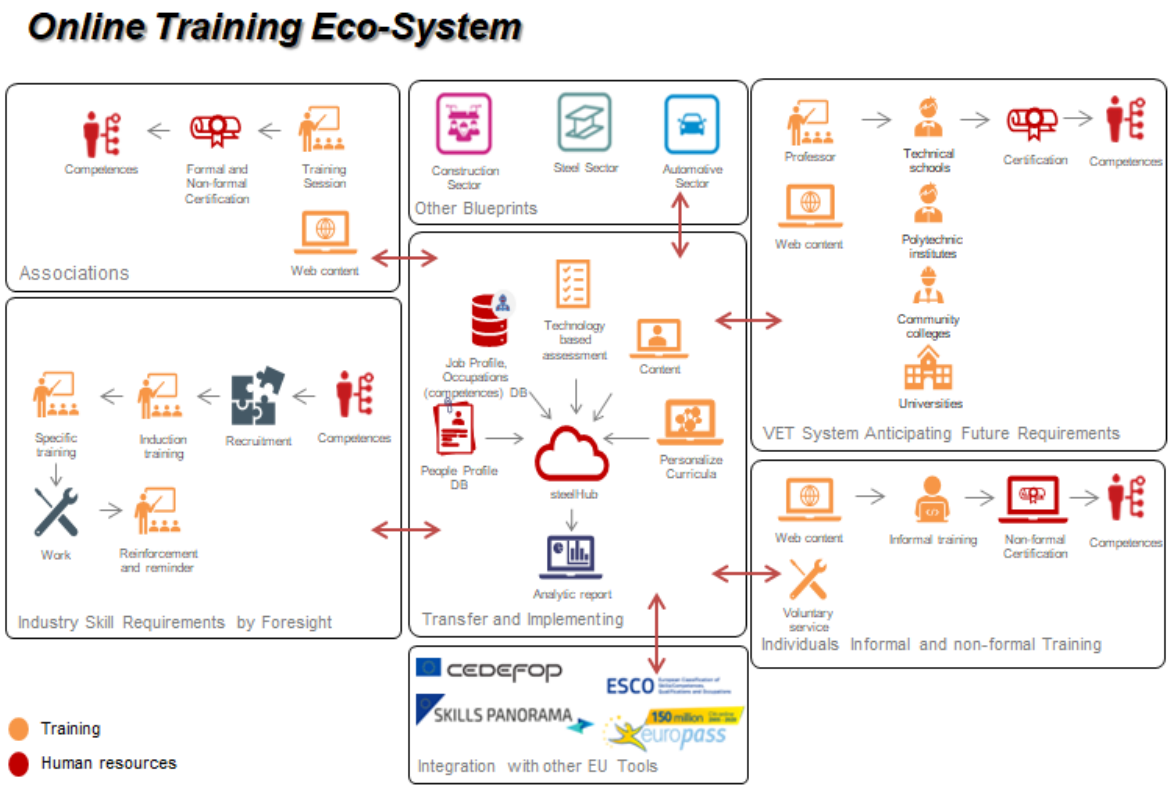


Figure 34: Connecting the Online Training Ecosystem steelHub

The steelHub as centre of the online ecosystem is engaging all the relevant and willing stakeholders and continuously integrating and updating job profiles and competences as well as a people profile database (human resources databases). Technology based assessment, different contents and personalised curricula feed the steelHub and give a basis for analytical reports. The systematisation considers the topics, the expected skills level of the audience and the linguistic problem (translation is important esp. relevant for lower skills levels). Courses are described in a comparable way and customer-oriented. General training courses but also modules for specific technology demands are in place.

The web-based steelHub is part of the already in place training program of worldsteel. It is a database and analytics system hosted in the cloud which can generate files to be shared with companies and education providers. The system is built in a flexible way to allow organisations that do not have an own learning management system to still use it. Through the system and based on a standard database of competencies, one can gain a rapid overview of the strengths and weakness at the individual level, but also compare where a company stands among other companies and how people's competences are distributed within a company. Furthermore, individual learners can see which skills are needed for a specific position and see how their own level compares to the job requirements and to the industry standards. Based on this gap analysis, they can choose individually and company tailored specific training to build the needed competences due to the contents and evaluations are curated by means of the standard database of competences. Besides, the creation of an automatic and customize training path (personalize curricula) to close the gap for each individual is also possible.

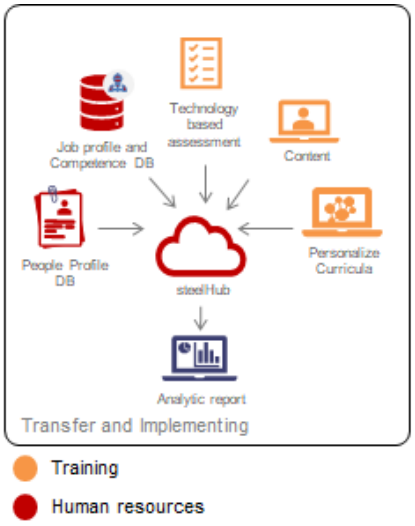


Figure 35: steelHub elements

The **steelHub** is an exchange platform for training offers (input and output). It is a continuously updated inventory of training offers and modules curated with standard competences data base. The development of training activities and modules, **including for training the trainers**, will be done by the different companies and training providers, coordinated by worldsteel as a platform coordinator. As an open platform, the steelHub training offers could be used by individuals, companies, VET providers (including VET institutions like vocational schools). Training could be integrated into VET provisions at company, national and sector level (incl. interrelation to existing EU tools like EQF, ECVET, ESCO, etc.). This central Blueprint platform 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, (e) improvement of measures and offers of training providers by ESSA results, (f) new training methods and arrangements. As an online platform steelHub is considering new possibilities of digital learning and support (social media, Moodle, virtual labs, online learning, simulations, digital twins, and others) and workers participation and empowerment (e.g. workplace innovation, but also by using digital tools like tablets, smart phones, laptops, etc.).

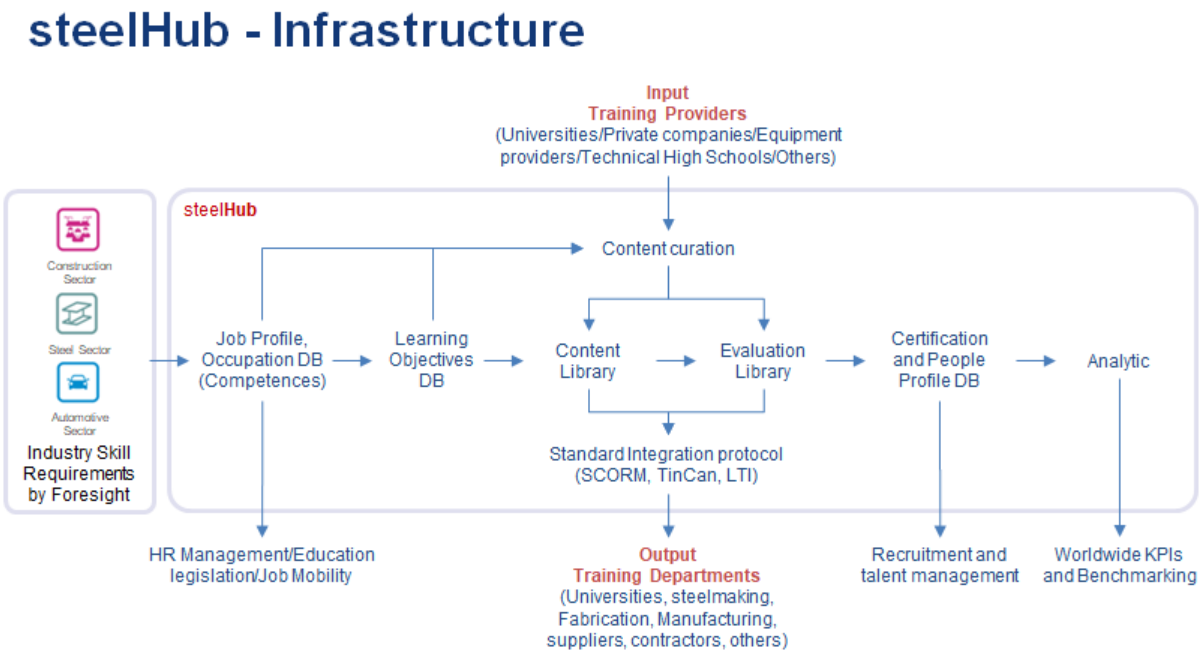


Figure 36: steelHub infrastructure

As a central element of the strategic Blueprint and being an ecosystem as well, ESSA developed the steelHub, a centralized digital platform to facilitate communication, collaboration, and coordination. steelHub sets the infrastructure for a worldwide exchange of content to create a Learning Solution Directory for the steel sector. This directory is a

collection of learning solutions delivered by Publishers into the framework of a marketplace business model.

One important component of this platform 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 needed 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 training 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 37: Modules of Digital Platform - steelHub

Each of these pillars involve task that have been developed during piloting and implementation phase, but need to continue executing to assure good service and quality. A description of the task for each pillar are.

1. **Learning Solution Directory,** which is a collection of learning solutions for up- and re-skilling current and future workforce.
    a. Identify and analyse learning solutions available.
    b. Develop and implement learning solutions.
    c. Identify and implement new training method using possibilities of digital learning and support (social media, virtual labs, online learning, among others).

   d. Identify and implement new training method to improve engagement of workers (e.g. workplace innovation, but also by using digital tools like tablets, augmented reality, virtual reality, among other).
   e. Innovative learning solutions for Train the trainer.
   f. New Leadership and Work 4.0.
   g. Develop and maintain Quality Assurance System to collect feedback from learners.
   h. Collect information and data for monitoring and reporting.
   i. Translation of learning solutions mainly for lower skills levels workforce.
2. **Skill Directory**, a centralize repository of skills and knowledge that represent the current and future training need of the steel sector.
   a. Develop and maintain a flexible IT infrastructure to upload, update and distribute skill Data Base.
   b. Curate Learning Solution Directory with skills and knowledge.
   c. Collect information and data for monitoring and reporting.
3. **Capability Assessor**, solutions to deliver capability assessments to organizations and individuals for Self-Directed Learning, to support individuals take primary responsibility for planning, organizing, and executing their own learning process.
   d. Develop and maintain a **Self-assessment** tool based on Skill Directory and Learning Solution Directory.
   e. Develop and implement technology-based assessment using **Evidence-Centered-Design (ECD)** methodology based on Skill and Learning Solution Directory.
   f. Collect information and data for monitoring and reporting.
4. **Integration,** steelHub is a flexible IT infrastructure that assure several integration options to meet the unique needs of organizations of different sizes and types as well as individuals. This includes the development, implementation, and maintenance of integration solutions for the following cases.
   g. Small and medium enterprises.
   h. Universities and Schools.
   i. Regional and national associations.
   j. Large organization.
   k. Individuals.
   l. EU Tools.

   Besides, this pillar includes the development and maintenance of a Dashboard with the data collected from the interaction of the learners with these pillars to support the Expert Panel in the identification of emerging skills and training needs.

To assure the continuation of the steelHub a non-for-profit business model was put in place to assure a self-sufficient economical model (see annex of Deliverable D6.2 (Schröder et al., 2023)). steelHub and the business model have been successfully integrated in 28 industries, 8 associations, 2 equipment providers, 1 Education and training provider and 10 R&D institutes and Universities. A total of 13,406 activate learners used learning solutions available in steelHub.

The solutions of steelHub can be integrated at different stages of the particular framework that companies use. To have a common ground to identify key steps to improve communication and integration of steelHub solutions, ESSA selected and implemented *ADDIE Model* (elmlearning, n. d.; van Vulpen, n. d.) adapted to skills-based development program.

The ADDIE model is a widely used instructional design framework that provides a systematic approach to developing effective training programs.

ADDIE model describes a flexible, systematic process to develop training programs for adult learners. The cyclical model has five stages: Analyze, Design, Develop, Implement, and Evaluate. Each stage has a deliverable that feeds into the next stage and includes opportunities to gather feedback that informs training development. The following diagram shows how the different modules of steelHub are integrated in this Framework, to ensure that training is well-planned, aligned with objectives, and continuously improved based on feedback and evaluation.

Figure 38: ADDIE Model adapted to skill-based development programs

Starting with the analysis of skills gaps and related objectives and training needs, the subsequent phases are designing and developing, implementation and evaluation of the trainings (a detailed description is given in D5.1 Training Framework (Muract & Schröder, 2023)).

Training offers should reflect (new) **learning arrangements**. Digital transformation is not only focusing on re- and upskilling of the workers but also relevant for new learning and teaching arrangement. Digitalisation will also improve and increase new learning possibilities and arrangements (quantitatively and qualitatively): Training providers, companies, workers and apprentices have to improve their digital skills for both **learning and operating** at the workplace. Not only the Covid-19 pandemic but also the speed of (technological and continuous) changes show the importance of more and new (digital) online learning and training possibilities. Digitalisation of learning modules, improved digital skills, flexible and agile trainers and learners are relevant elements of new digital learning strategies and alliances.

Hundreds of digital education tools have been created with the purpose of giving autonomy to the learner, improving the administration of training processes, encouraging collaboration, and facilitating communication between teachers/trainers and learners. The following image summarizes the digital resources and interaction that can be part of a training program at the level of the online and regional ecosystem.

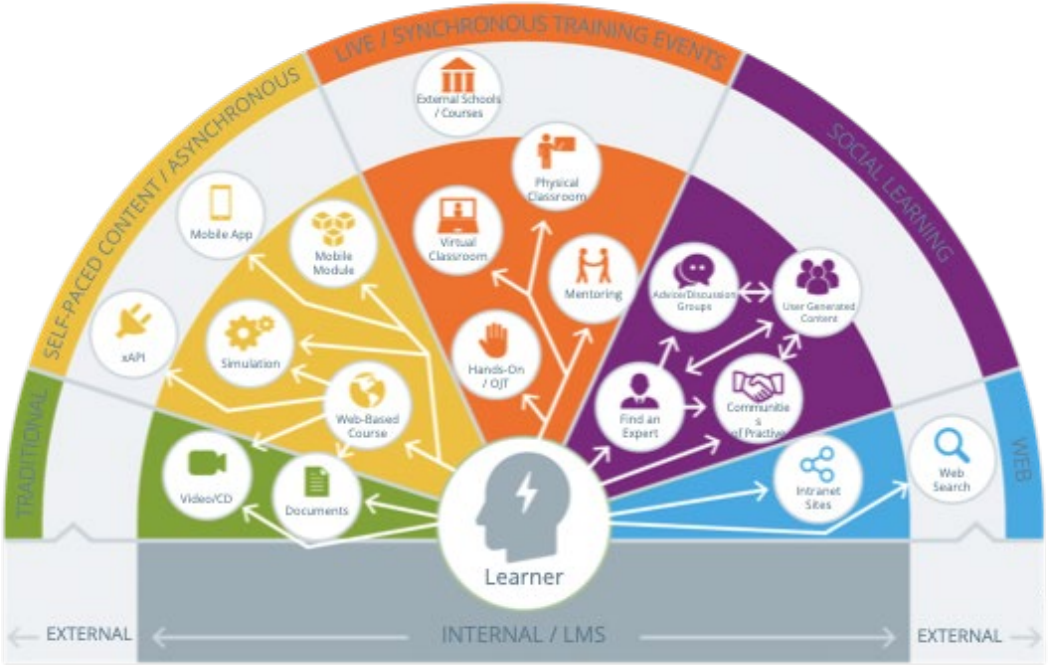


Figure 39: The learning ecosystem (adapted from Gipple (n. d.))

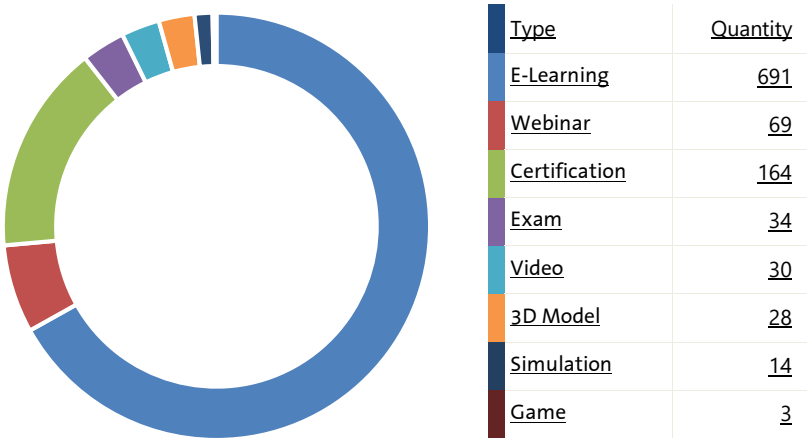
To organize the Learning Solutions provided by Publishers in steelHub, ESSA defined a categorization of the solution as follow.

- **E-Learning**: educational content and training through digital platforms and technologies. It involves the use of the internet, computers, and various digital learning modules (3D Models, Videos, Interactive HTML5 exercise, among others) to facilitate and enhance the learning process.
- **Webinar**: web-based seminar or presentation conducted over the internet. It is a live, interactive online event that allows participants to join remotely and engage in real-time learning and discussion. Webinars are could be recorded and delivered asynchronous over a digital platform.
- **Certification**: It is a formal document that serves as evidence or proof of accomplishment, completion, or achievement in a specific area of study or training, for example, after completion of an Exam, Simulation or Games.
- **Cognitive Assessment or Exam**: It is a standardized evaluation that assesses an individual's cognitive abilities and mental functioning. It measures various aspects of cognitive processes, including attention, memory, language, problem-solving, reasoning, and perception.
- **Videos:** They offers several benefits, including visual engagement, increased retention, accessibility, and the ability to cater to different learning styles. There are several formats, like i) Educational Tutorials, ii) Animated Educational Videos, iii) Virtual Lab Demonstrations, iv) subject explainers, v) Science Experiments and demonstrations, among others.
- **3D Interactive Models:** These models provide a highly engaging and immersive learning experience that enables learners to visualize and interact with complex concepts and objects.
- **Simulations:** They are a powerful educational tool that involves creating realistic, interactive environments or scenarios to replicate real-life experiences and

situations. It allows learners to actively engage, experiment, and apply knowledge and skills in a safe and controlled setting.

- **Game:** the use of games for education offers a unique and effective approach to engage learners, promote active learning, develop skills, and bridge the gap between theory and practice. By making learning enjoyable and meaningful, games have the potential to transform the educational experience and improve learning outcomes.

The community of publisher collaborate to create a Learning Solution Directory of 1896 innovative digital learning modules in different languages. The following table represent the distribution of those learning solutions.



Type	Quantity
E-Learning	691
Webinar	69
Certification	164
Exam	34
Video	30
3D Model	28
Simulation	14
Game	3

There are more information and description about learning solutions in Deliverable 5.1, Training Framework (Muract & Schröder, 2023).

3.4.2 National-Regional Training Eco-Systems (ESSA RTS)

The **Online** Training Eco-System steelHub is complemented by a **National-Regional** Training Eco-System (ESSA RTS) approach. 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, ESSA focused in its rollout phase on European Steel Regions by establishing workshops as a starting point and giving an input to already existing and to be extended networking for new skills, recruitment and image of the steel industry in the region.

The national-regional roll-out activities of ESSA based on the eco-system approach and the selection of pilot steel regions included not only activities focused on spreading the Blueprint, primary it was for starting and implementing specific national-regional processes: based, initiated and fostered by the ESSA Blueprint and its elements.

Due to the rapid transformation of the steel sector by digital and green technologies, ESSA is delivering a deeper collaboration among the different actors as crucial to expand existing synergies among steel regions in order to implement large-scale upskilling and reskilling strategies. In this regard, the continuous cooperation among companies, universities and VET providers at regional level can also affect new job orientations. On the other hand, incentives can extend across the breadth and variety of training offers available to employees. Moreover, also incentives for e-learning and remote learning tools can encourage

the professional upskilling in a sustainable way for companies. Furthermore, EU, national and regional efforts can pay a special attention to targeting hidden and young talents, which in the past have received less support.

A successful partnership in a region to strengthen and develop a regional ecosystem should involve different partners:

- Education and training providers, which deliver expertise in education, help with educational programs and attract new talents to the sector.
- Regional small and large business, which are important for competitiveness and future prospects, aiming at retaining talents at regional level. In addition, collaboration between businesses can improve innovation.
- Governments and public authorities, involved in a partnership, put a strong and viable labour market and well-trained human capital on the political and economic agenda. In addition, governments can stimulate potential partners to join and can help with subsidies to enable regions to start and expand partnership and to develop activities.
- Civil society should be also integrated as much as possible, in particular at the regional level, where people live and work, in order to ensure, with the other stakeholders, a continuous social innovation process to establish and improve new social practices in skills adjustments.

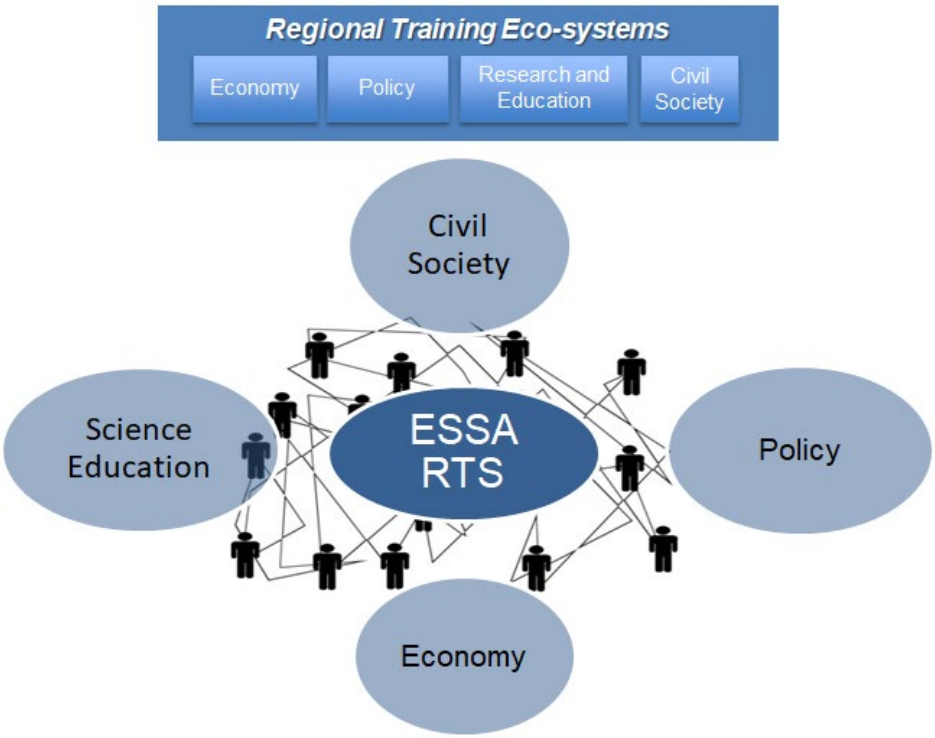


Figure 40: Regional Eco-system

In the implementation of the national and regional ecosystems, national associations, steel companies, unions and training providers play a key role. Through the close collaboration with (public) national and regional VET institutions a national/regional ecosystem was grounded and established in some pilot regions (namely in the Czech Republic, Germany, Italy, Poland, Spain, and Wales). On this subject, the European Steel Countries and Regions

developed specific comprehensive territorial skills strategies, in line with economic, industrial, smart specialisation and innovation strategies, affecting the areas involved.

During the rollout phase (see chapter 5) round tables and workshops with stakeholder groups (companies, trade unions, training institutions, research institutes, policy and civil society) in the selected regions aimed at gathering information, verifying the interest and the willingness to participate. Via these activities a social innovation process in the selected regions integrating all the relevant and willing stakeholders started, followed by the review of experiences, development and events. Finally, the activities developed and implemented can be transferred to and integrated in other regions, considering the results of the ESSA rollout implementation and testing phase in pilot the regions.

Based on the experience of Schröder (2012) for implementing new regional structures for Lifelong Learning, the National-Regional Training Ecosystems

- indicate new learning opportunities and support structures responding to the increasing and fast changing demands of work, education/training for companies, VET systems, and the individual learner
- integrate steel (and the wider) industry demands as a structural principal of the regional education and training system, including the improvement, reconstruction and partly new construction of traditional structures
- orientate on learning outcomes and the recognition of competences adopted on other ways than formal learning
- emphasize the growing demand and challenge for every single person to deal actively and self-confident with constant changes in the world of labour and society and - at the same time - challenge public responsibility to support individuals who are not able to maintain active learning
- improve quantitative and qualitative participation of lifelong learning of the workers and inhabitants of a region, giving access and support where people work and live.

Figure 41: Regional Training Ecosystem Approach

ESSA does not serve a one-size-fits all solution but a European orientation and support framework with a set of guidelines for adapting, modifying, complementing and further developing the Blueprint on the national-regional level, step-by-step within a social

innovation process. Therefore, the implementation process of the National-Regional Training Ecosystems is characterised by

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

To facilitate integrational developments, the relevant stakeholders and institutions (maybe still working strictly separated) at the national-regional level will be 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:

- 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.

This will lead to specific and different steel regions profiles under the umbrella of the European Steel Skills Alliance, focusing on specific regional demands, necessities and possibilities.

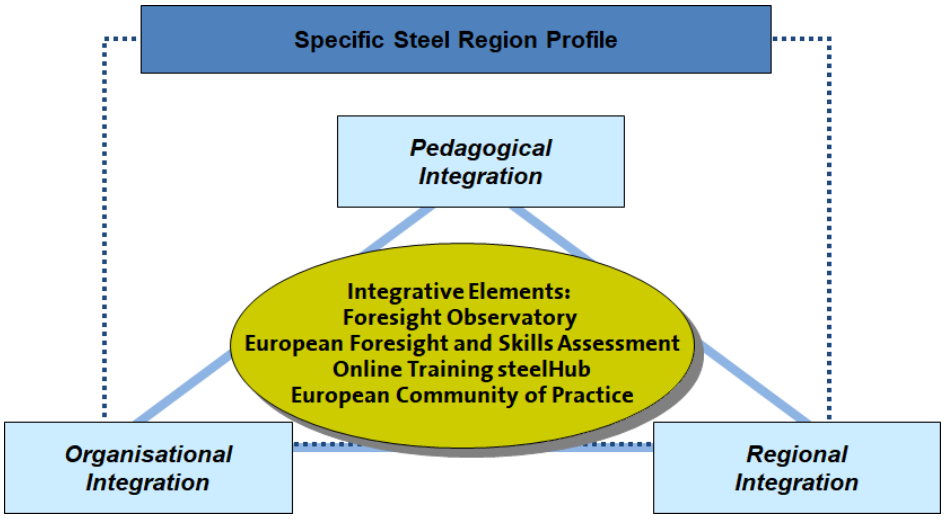


Figure 42: Pedagogical, organisational, and regional integration

By combining the regional (and national) level with the European Steel Skills Alliance and Strategy an integrative and binding cooperation going beyond pure networking is advised: extending complementary, subsidiary or supporting cooperation with setting up a new structural framework (common orientations, objectives and their practical implementation). In the sense of Social Innovation (Howaldt & Schwarz, 2010) we are aiming at developing new social practices, putting industry demands and the learner in the centre (changing from

an institutional to a strict learner's and learning process perspective). This includes different, heterogeneous innovation processes at the local level (depending on the recent demands and framework of the regions) within a common framework and overarching support structure and some common product developments.

The local context for companies is also informed by type of production and meeting the skill needs of EAF and BOF are different (meaning different skill needs), and the plants will be at different stages of technological development (especially concerning the implementation of a hydrogen route and Direct Reduced Iron DRI) and require different training provision, and VET provision has a local dimension also depending on the existing cooperation and infrastructures.

Nine representative steel regions were selected for a first rollout to the member states and steel regions (see Deliverable D6.2, Schröder et al. (2023, pp. 28–39)). The planned focus on the solely regional perspective was replaced by a combined national-regional approach, 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). Against this backdrop up to four round tables and workshops in a country or region took place 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, Italy, Poland, Romania, and the Netherlands[7] (concentrated steel regions).

[7] Because the Ijmuiden regional ecosystem was already in place and ongoing, no specific ESSA workshops were necessary and conducted there.

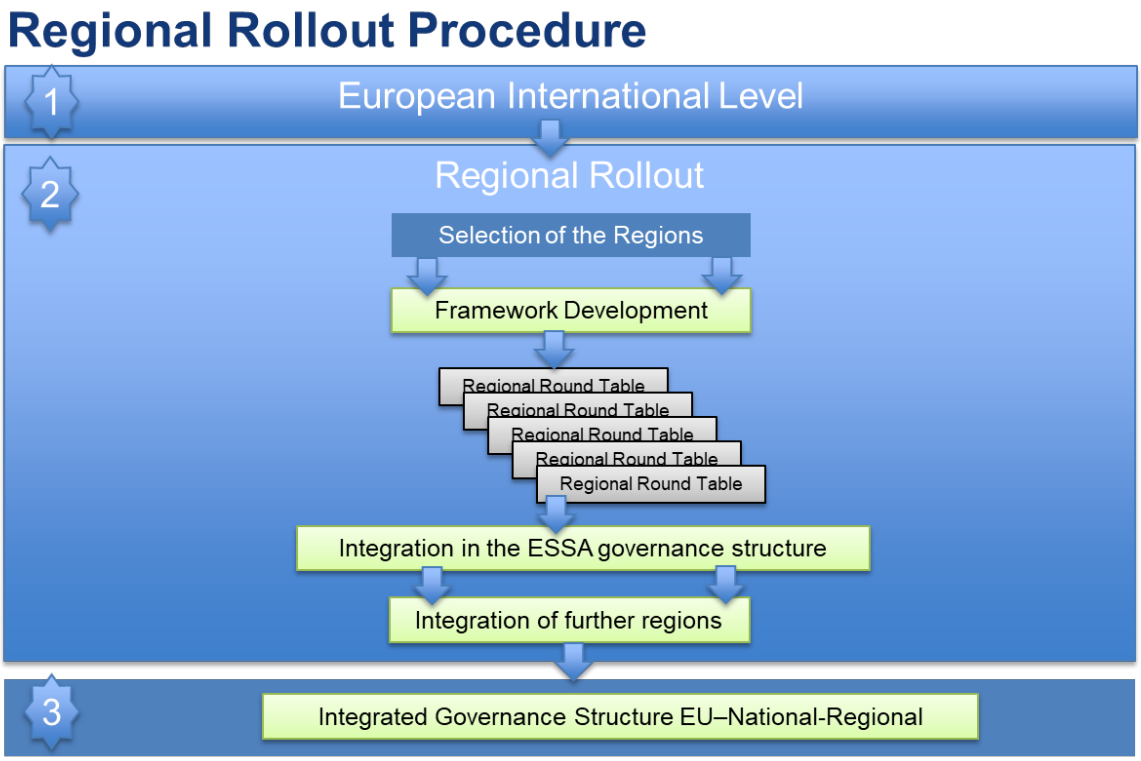


Figure 43: European-National-Regional Rollout

Against this backdrop we set up skills and training related ecosystems in nine countries or regions. Although there were common topics (such as image and recruiting, poor relationship with public authorities, disconnection between formal training and companies' requirements) in the end all the ecosystem development *processes* were different depending on the composition of the actors, the defined priorities and processes, and the specific regional demands.[8] All in all, with these rollout activities we integrated more than 100 additional stakeholders in our Skills Alliance: companies, public authorities, associations, unions, research institutions, universities, vocational schools, training providers and others. Because of the successful national-regional processes ESSA is setting up of a European-national-regional European Community of Practice (ECoP Steel) for supporting National-Regional Training Ecosystems, exchanging good practice and mutually learning from each other.

[8] A detailed summary of all the different ecosystems could be found in Deliverable D6.2.

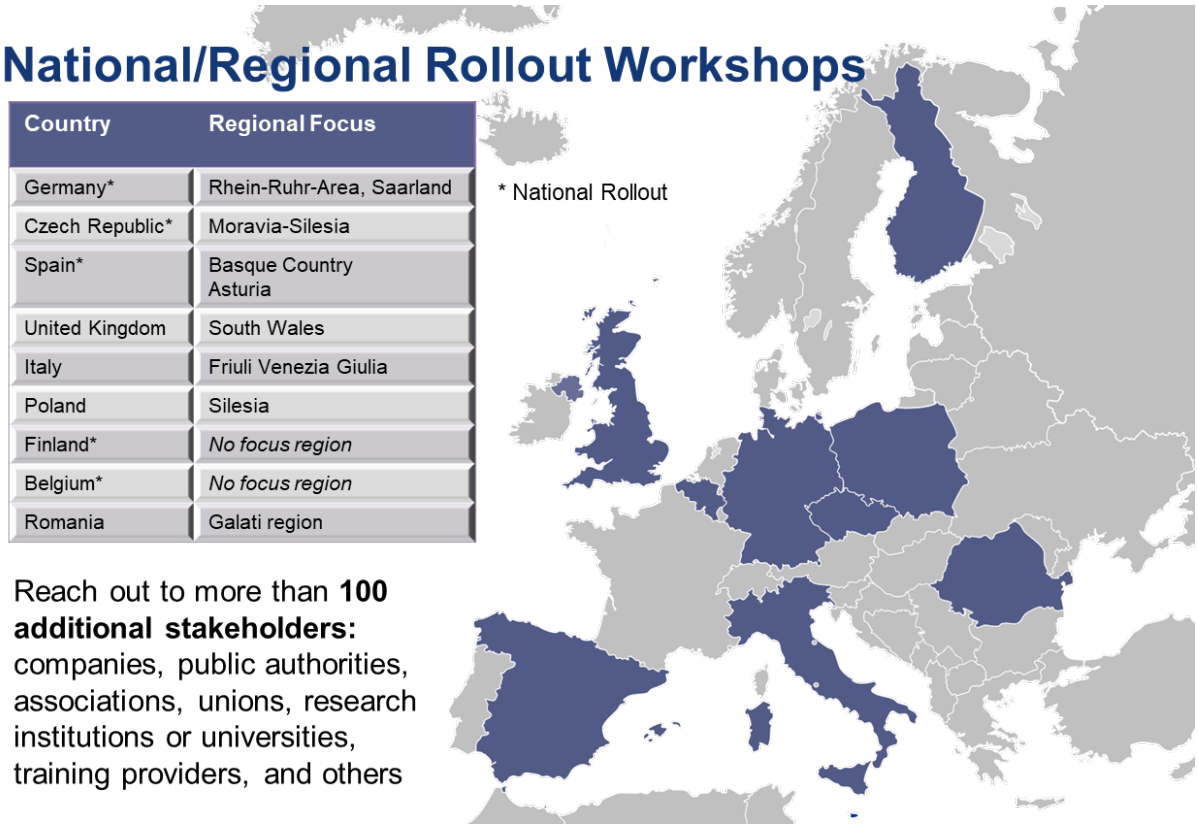


Figure 44: National/Regional Rollout Workshops

Follow-up activities of the National-Regional Ecosystems will focus on (taken up and prioritised differently by the countries and its regions):

- Image and Recruiting: New Narrative of the Steel Industry
- Digital and Green Transformation: Hydrogen Usage and Impact on Skills
- steelHub Interlinks to the Regions, including how to combine online and on-the-job, work-based learning
- Specific SME Regions and Specific Skills Needs and Adjustment Strategies
- Human Resources Demands in Rural Steel Areas.

3.4 Image - Recruitment - Talent Management

As underlined in the rollout workshops of the national-regional ecosystems, the image of the Steel Industry is still a major challenge for recruiting and retaining a high skilled workforce. Evidenced also by the ESSA national-regional rollout activities, this was emphasised already by the Steel Sector Careers Blueprint as well. Given the high importance of the issues of image and talent management for the European steel sector, ESSA is developing a repository for relevant image and recruitment campaigns on the project website (chapter 3.4.4), which will include the measures and results presented below.

It was noted that students and job-seekers with no contact or experiences with the steel sector rate the image more negative than the respondents having already knowledge of the Steel Industry. However, redundancies, shift working, low salaries for low skilled work, and environmental impact are arguments against a job in the Steel Industry. This has to be reflected in image and recruitment campaigns and talent management strategies.

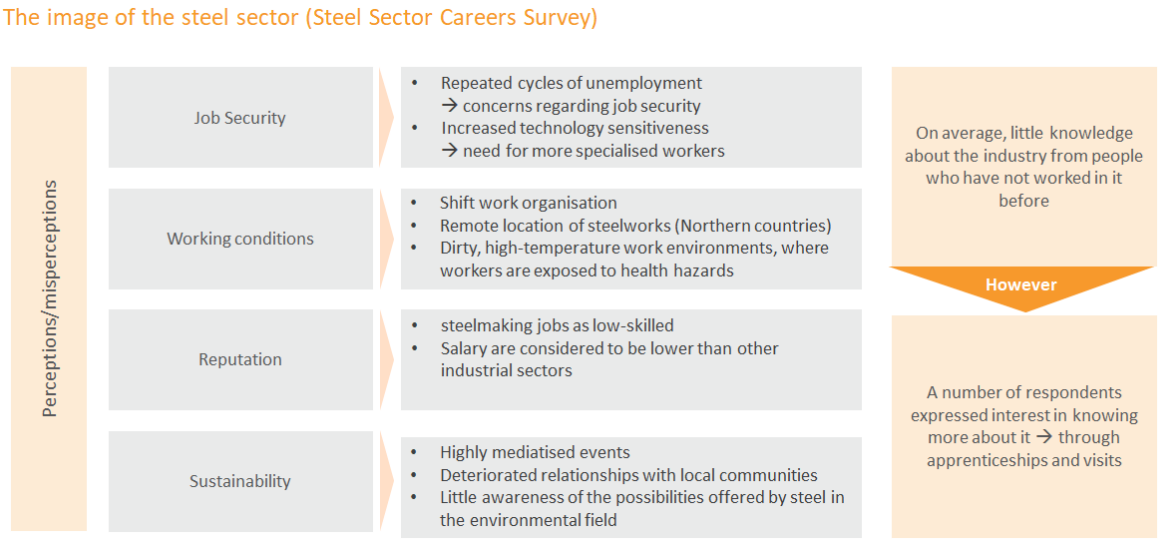


Figure 45: Image of the steel industry (Steel Sector Careers presentation)

Image improvement together with the increase in competitiveness and a decrease in the environmental footprint is key for the Steel Industry. This impacts directly and indirectly on the future workforce: Getting talented people for the most in demand jobs, recruiting and retaining talents and high skilled workers. It is thereby of utmost importance that the efforts promised by the steel industry in image campaigns are actually reflected in the companies. Only in this way can the requirements of applicants be met and high-skilled workers actually be retained in the companies in the long term. In this respect, the ESSA Online Repository also takes up the requirements by applicants.

3.5.1 Most in-demand jobs in the steel industry in the next 5 years

Not only training and new learning arrangements are of relevance for adjusting the skills and competences of the steel workforce. Not at least activities and campaigns to improve the **image** of the steel industry for **recruiting and retaining talents** could be linked to skills adjustment strategies deriving from the technological foresight and related skills requirements radar of the ESSA Technological and Skills Foresight Panel (ETP). The development of strategies 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, as well as strategies increasing the workforce mobility and diversity (e.g. increasing the attractiveness of the steel industry for women) are relevant to overcome the aging workforce.

Therefore, digital and green transformation by new Industry 4.0 technologies could be an opportunity to enhance and change the image of the steel industry and to attract talents with digital and green affinity. At the same time, the transformations are also leading to job profiles being modernised, which could also increase the attractiveness of the sector. Suggested solution approaches of the ESSA rollout workshops called for rebuilding a positive image of the steel industry in the minds of the public and decision-makers with coordinated ‘campaigns’ to change the image and develop and disseminate new narrative, highlighting the steel industry's sustainability and transformation efforts 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 (e.g. through greater use of

social media) and showing more presence in schools and universities, to show the "new steel industry 4.0" changing the view of the general society (e.g. stable employment, good labour conditions, etc.) are also crucial measures.

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, 2019b) underlines this by showing some good practices that digitalisation is attracting and supporting talented people.

Steel industry activities have to improve the employer attractiveness also by **internal** own activities supported by policy. A broad range of these measures are already existing and in place (ESSA workshop results, see as well Steel Sector Careers Blueprint):

- Trade fair appearances (contact points)
- Emphasizing social aspects like social security, work-life balance
- Attractive payment with benefits
- Using and visualising contemporary HR instruments such as new leadership, coaching, mentoring, mobile work, part time contracts
- Positioning steel industry as a great employer, e.g. via LinkedIn, Twitter, publish news at regional level but also national wide to raise awareness of steel industry
- Address the global and a local steel industry perspective
- External advertisement via own employees, steel workers as ambassadors to attract people
- Use early contacts via internships, trainees for job options in the company, maximum utilization of working students and internships to spread practical knowledge and recruit talented people
- Operate expectation management among young employees at all levels
- Share with society the value of Steel industry in Europe, increase attractiveness for technical professions, fight against image as being dirty or not sustainable (e.g. spread special reports, showing investments in sustainability) addressing neighbourhood stakeholders; create an image of "green steel", promoted by society; politics must support, steel is environmentally friendly and sexy, but only with backing,
- Integrate the customer perspective in the “big picture”
- Permanent location security strategy vs CO2, dumping etc., communicating that there will be steel production in Europe in the future (convincing people to come to European Steel companies)
- Overcoming the trend to focus on academic professions - difficulty in winning "good" applicants for skilled workers, strengthen VET careers
- Reflect on regionalism: job offers "in the region", regional roots and strength, working with local NGOs in the neighbourhoods and city halls to support a good relationship, organize workshops with company and stakeholders
- Positive lobbying from internal and external players: good examples of work of "young" people (ambassadors)
- Secure future viability: credible future strategy and vision, hydrogen and CO2 reduced green steel image must have a market, "an ecologically oriented company on its way to transformation"
- Promote “positive” media, follow and expand social media strategy -> mass medium for potential applicants
- Digital transformation attracting candidates with digital affinity

- Steel industry as a secure employer with career development and long-term employment perspective, even in times of crises.

The Steel Sector Careers Blueprint lists about 20 jobs related to the labour market that will be important for the steel sector with a VET perspective (see figure below). Additionally, in ESSA it appears as result of the technological development and foresight that a lot of job profiles in most of the production and maintenance areas are and will be affected by a wide range of Industry 4.0 technologies. In contrast to other Blueprints (which are mainly focusing on disruptive game changers), in the steel producing and processing industry ESSA supposes that there will be no (or very less) new occupations and job profiles based on the technological development. It is more an upskilling of the existing workforce (not at least because of recruitment difficulties, discussed further below).

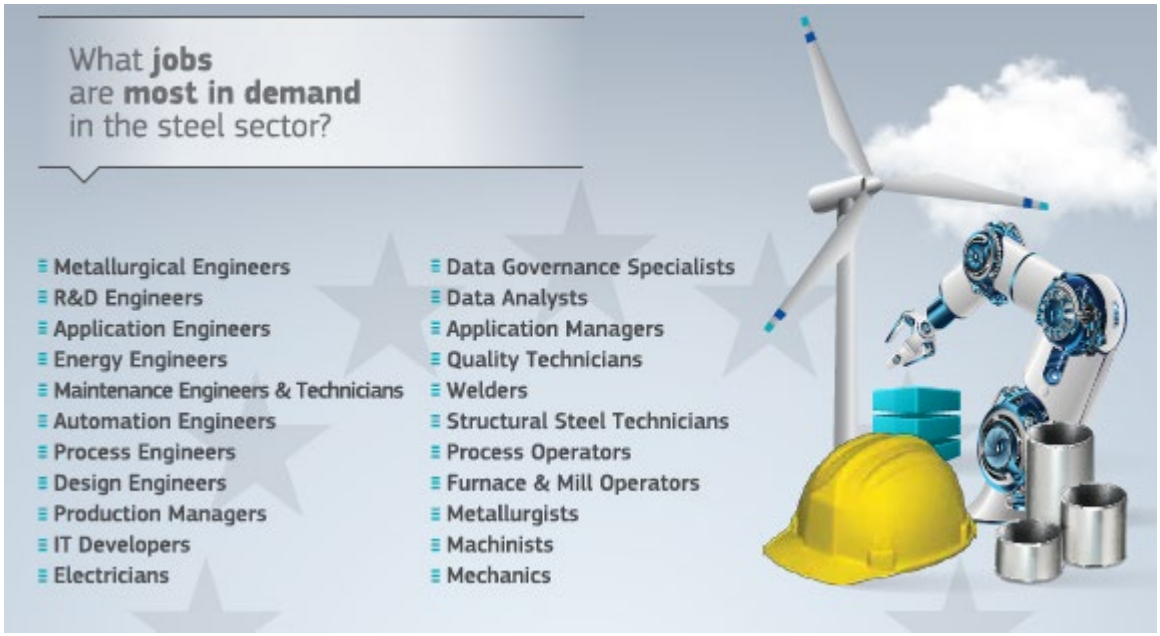


Figure 46: Most demanded jobs in the steel sector (European Commission, 2019)

ESSA focuses on a general upskilling of the existing workforce and specific job profiles (see chapter 2.2**).** However, the company workshops of ESSA and the last ESSA ETP (see Figure 25) stressed the view on the development of

- **Production process specialist** or "Production Craftsmen" who control or monitor running systems and repair defective systems and "Industrial Clerks" with a high level of technical understanding of production processes: Process control operator, process engineering (modelling and monitoring), operational technology engineer, plant operator “across disciplines, automation profiles
- **Employees, professions with (improved) IT skills:**
  - **Analysts** who are heard in the team - teams that listen to the analysts; skilled workers with good IT skills and IT specialist (application development and system integration); programmer / computer scientist
  - **IT and Cybersecurity** job profiles
  - **Process** technologists, automation engineer, measurement and control technicians
  - **Metallurgists.**

- **"Green" specialists:** environmental engineers, sustainability manager and advisor, recycling and renewable energy experts
- **Executives, leadership**: People at the workplace who can lead and motivate, HR professionals driving digitalization.

There might be a further differentiation of "simple" machine operators (happy to work eight hours monotonously on Conti shifts) on one side and employees who are more directly involved in digital optimisation of the production process, decentralised decision making and problem solving as well as higher digitalised maintenance specialists. Both perspectives are in place: incremental upskilling of the existing workforce and reduced performance and job loss (deskilling). Additionally, there is a need of jobs for employees with reduced performance: jobs and concepts needed for employees who may no longer work in continuous shift or physically demanding jobs. In the past, many easy jobs for these workers were given. But due job losses (due to automation), it gets more and more difficult to find other opportunities for them or to find digital tools to help these people to stay in the production line.

However, **flexible employees** are needed, aware of that tomorrow's jobs can be different and skills adjustments are needed (changing job profiles and skills).

3.5.2 Image and Recruiting Campaigns

The Steel Sector Careers Blueprint (SSC) listed the most relevant elements named by students and job-seekers to work in the Steel Industry (see figure below). Among them, the type of contract, type of work and remuneration, and exciting career opportunities play an important role. Additionally, it would be important to show that careers in the steel sector have a good reputation, are respected (and respectable), exciting, require digital skills, are not second-tier and that steel producers are making efforts to enhance the digitalisation and sustainability of steel production.

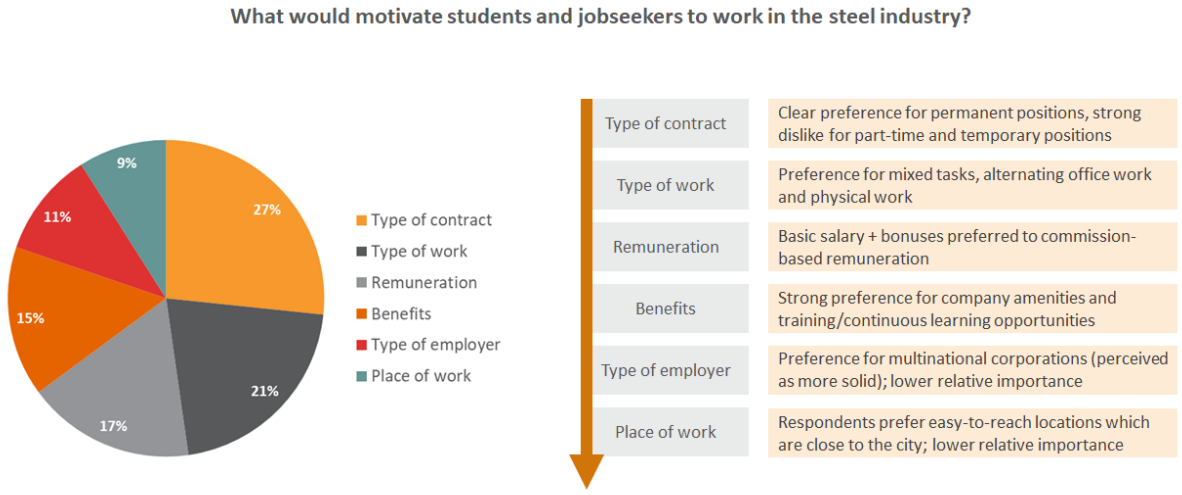


Figure 47: Motivation of students and job-seekers to work in the steel industry (survey of the Steel Sector Careers Blueprint)

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[9] 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 below) with and for new innovative products, being 100 percent recyclable.

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 National-Regional Training Ecosystem, see chapter 3.4.2). Therefore, steel companies have to deal with activities that binds directly people from schools, internships and universities. It has to be clarified that steel jobs have sufficient starting points for people with diverse interests but could also directly address specific target groups (e.g. increasing diversity by migrants, refugees, women; but also, those who would never study and are locally inflexible, early school leavers, disadvantaged people, to integrate them not only into the company 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).

[9] https://www.estep.eu/green-steel-for-europe/

How can "steel industry" present itself to target groups to be attractive?	Main challenges
• Image campaigns • Extend social media activities: show what young skilled workers do • show women as skilled workers on-site and at offices • Strong presence in the media world • Send ambassadors to schools • Retain good interns to the company • Maintain face-to-face events and face-to-face discussions (at universities / schools) • "Honest work at an excellent employer" (but authentically presented) • Image: We create green steel! • Create a "green" image for trade fairs and events • Launch projects and invite students • Concentration on comprehensive schools / junior high schools for future professional specialists • Show CSR activities (especially in the neighbourhood) and that it is still, in difficult times, present • Launch “family days” to involve relatives to work activities • Be partner with local media (e.g. discussing safety issues)	• Image of the steel industry as an "old and dirty economy" complicates attractive employer branding and manifests the steel industry as a dying dinosaur. • Future strategy of hydrogen based and digital transformation must be clearly highlighted and communicate through different channels. Positive steel industry transformation must be communicated in the press and led by politics. • Political backing for "green steel" in European Union and Member States necessary. • Active sourcing of candidates continues to gain importance. Maintaining contacts with cooperation institutions (school, university etc.) • Reality check for young applicants / trainees: expectation management. After vocational training danger of disillusionment in the continuous shift work. • Technical professions („blue collar workers") must become more attractive, since these workers control the running systems / maintenance systems • Quality and quantity issue: The steel industry needs experienced specialists in terms of quality and at the same time many workers in simple production work • Flexible workers with the ability to adapt personal skills are needed. • Successful recruiting starts in many places: e.g. employees as ambassadors, early affiliation of young people, show future viability of steel to point out interesting careers in steel industry • Two different strands: Short-term fixes (activities) and long-term fixes (getting into contact with young people)

Table 9: How to make the steel industry more attractive (ESSA workshops results)

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 focus 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 of the Steel Sector Careers Blueprint (newsletter, factsheet, posters, brochure, infosheet) are available for download in various languages (EN, ES, DE, FI, FR, IT, NL, PL) at Steel Sector Careers[10].

[10] https://single-market-economy.ec.europa.eu/sectors/raw-materials/related-industries/metal-industries/steel-sector-careers_en

Figure 48: More opportunities than you can imagine campaign[11]

Additionally, the Steel Sector Careers Blueprint listed related communication recommendations for steel image and recruiting campaigns:

Emphasise the prominence of steel in every aspect of modern society

Interviews: "Steel companies are carrying out cutting-edge research to meet the EU's targets on climate, and trends such as Industry 4.0 create new and stimulating challenges for anyone interested in ICT and technological research."

Best practice: #lovesteel campaign launched by World Steel

Target audience: ICT and environment science graduates who have not worked in the sector before

Give visibility to high-skilled positions that do not require physical strength and highlight task variety

Interviews: "The development of automated processes has already impacted steel production chains, reducing manual labour and physical stress."

Surveys: "Steel careers are still perceived as manual and physically demanding."
"Students and jobseekers attribute great importance to positions that combine sedentary work with physical work." (CBC analysis)
"The willingness to work in the steel sector could be strengthened by showing that steel careers require digital skills, offer exciting challenges and growth opportunities and are adequately remunerated." (linear regression)

Target audience: All, with a specific focus on the groups for which physical work represents a disincentive to consider the steel industry

[11] Steel Sector Careers Blueprint, https://ec.europa.eu/docsroom/documents/37463

Showcase the role of steel in reaching circular economy and sustainability goals

Surveys: The belief that steel companies make efforts to increase their sustainability has an effect on the willingness to work in the sector. (linear regression)

Desk research: "Nowadays, the vast majority of steel by-products are being reused and repurposed, and 40% of the European steel production is based on the recycling of scrap steel. In addition, research on high-strength steels has led to a 25% to 40% weight reduction in the steel products used in cars, buildings and packaging, leading to significant cuts in emissions and energy use."

Target audience: Jobseekers interested in sustainability and green economy

Help jobseekers understand how advances in AI and robotics will reshape the work organisation of the industry

Interviews: "Many roles that in the past required on-site presence and repetitive working shifts will be more flexible and allow to alternate on-site presence and home working."

Surveys: Several people, including the 'hopefuls' regard shift work as a serious constraint." (cluster analysis, Cluster 4)
The belief that working in the steelmaking industry is a prestigious occupation is an important determinant for the willingness to work in the steel sector. (linear regression)

Target audience: Those who have not worked in the sector before

Showcase the industry's efforts towards health and safety

Interviews: "Steelmaking is still considered a dangerous occupation."

Surveys: 67% of Survey 2 respondents agree that there is a high risk of work accidents in the steel sector.

Target audience: All

Establish partnerships with innovative steel companies to show what modern plants look like

Surveys: Out of the sample of students, graduates and jobseekers, 71% consider jobs in the steel industry as very manual/physical and only 24% agree that working conditions in steel plants are generally good.

Interviews: "Many modern steel plants are state-of-the-art facilities using cutting-edge technology. These days, working in a steel plant is more like working in either a laboratory or control room".

Target audience: All

Carry out campaigns promoting careers in metallurgy and STEM-related studies in primary schools and high schools

Desk research: Since one of the causes of skills shortages seems to be the lack of students enrolling in relevant STEM-related studies, steel companies should tackle the challenge of talent shortage early on, engaging with primary schools to increase the attractiveness of STEM and bring pupils closer to manufacturing.

Best practices: PET IJMond, Becas Robótica Educativa and Aula STEM, "Machina et Schola", Olympiades des Sciences de l'Ingénieur, 3-19

Target audience: Primary school and high school pupils

Encourage companies to use their employees as ambassadors in communication campaigns

Surveys / Interviews:
- The steel sector is widely seen as low-skilled, characterised by manual and repetitive work
- There is a general lack of awareness of the career variety offered by the steel industry
- Many respondents interested in ICT and R&D would be willing to work in the industry if offered suitable positions

Target audience:
- Primary target: Cluster 1 – moderately willing to work in the industry, low attractiveness
- Secondary target: Cluster 2, Cluster 3 – low willingness to work in the industry, low attractiveness

Best practice: Why #Ilovesteel campaign launched by World Steel

Beside digitalising and greening the steel industry 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 support 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.

Figure 49: ArcelorMittal Poland community engagement sustainability report 2019 (ArcelorMittal, 2019)

In the course of the rollout workshops, additional image and recruitment campaigns were also collected, which will also be made available in the ESSA online repository. To give just one more example, the Steel Academy of the Steel Institute VDEh has launched a campaign to encourage young high school graduates to study metallurgy and materials engineering.

The aim is to promote career opportunities in the steel sector and to create enthusiasm for the profession of steel cook[12].

3.5.3 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 retention of young qualified talents will mark the operations of the coming years.

Therefore, ESTEP Focus Group 'People' together with EUROFER launched an EU-wide survey answered by 268 talents identified by steel companies estimating their values, ambitions and needs. The survey points out clearly that the talents attach importance to personal carrier development. 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. 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.

[12] https://studier-metallurgie.vdeh.de/

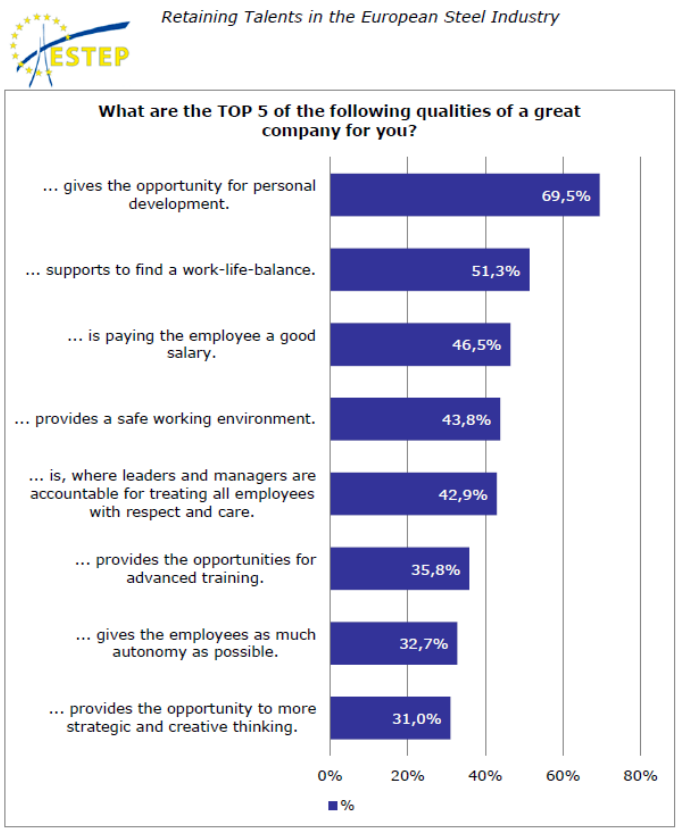


Figure 50: Talent management in the steel industry - results of the ESTEP survey (2015)

The report shows as well that if the talents could be hired and they got first experiences in their new job in the Steel Industry that their expectation have been satisfied to a great (43% of the talents) or somewhat extent (53%), only 3% were very little or not at all satisfied. This is very much in line with the result of the Steel Sector Careers result, that the image of the Steel Industry is improving when gathering experiences with the sector. The ESTEP Talent Management Report further stress that the employed talents claim with 89% their experiences made in the Steel Industry are strongly helpful in other industries (transferable skills) and 77% would like to advise a job in the Steel Industry to a friend (Echterhoff & Schröder, 2015, p. 19).

The talents are very compatible with the skills requirement (for digital skills in general, but especially found in ESSA). Among the cognitive competence list the five top ranking competences in which the respondents would like to develop were strategic thinking (68% of the respondents indicated willingness to have competence development in this area), change management (62%), decision making (60%), effective communication (54%) and innovation (52%).

3.5.4 ESSA Repository for Image and Recruitment Materials

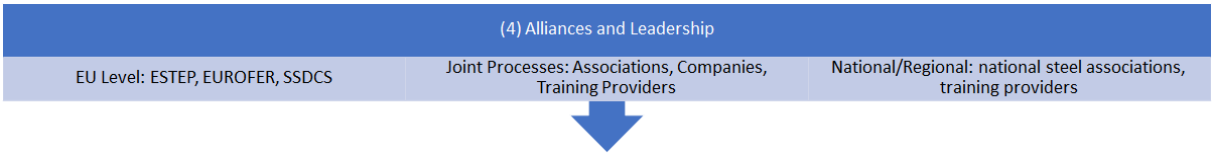
As already mentioned, recruitment measures and workshop results described above are presented and collected in an online repository on the ESSA homepage. Materials collected during the ESSA rollout in the framework of the Regional Training Ecosystem (RTS) are also included here, as the topic was discussed a lot during the individual rollout workshops. 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, the 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.

4 Alliances and Leadership: ESSA Governance



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 the main European Steel Sector stakeholders, integrating steel companies, education and training providers, associations and social partners, and research institutions right from the beginning in 2018. The consortium 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 and beyond.

Therefore, ESSA is a sustainable European Steel Skills Alliance **beyond the project life span** with reliable leadership governance and systematically linking the European Blueprint with the European, national, and more relevant, the regional level of steel regions (see chapter 3.4.2). Therefore, ESSA is run further embedded in existing structures of ESTEP, EUROFER, the Sectoral Social Dialogue Committee on Steel (SSDCS), and industriALL on the European level first. Within these governance structures cross-stakeholder activities are initiated and launched, as well as internal integration of skills adjustment within the activities of the associations, companies, training providers, and steel regions.

4.1 ESSA Partnership as the Ground for a European Steel Community Involvement

The partnership comprises about 40 partners now, out of them 24 project consortium partners:

- **Steel companies:**
  thyssenkrupp Steel 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), ArcelorMittal Spain Training Centre
- **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, Wirtschaftsvereinigung Stahl 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, RINA/CSM, Visionary Analytics VA

completed by 20 **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, ArcelorMittal Italy, Fédération Métallurgie CFE-CGC, Metalowców NSZZ „Solidarność", UK Steel, SAAT Consulting, Greensteel Academy / Liberty Steel, Commercial Metals Company (CMC), Swansea University, ArcelorMittal Germany.

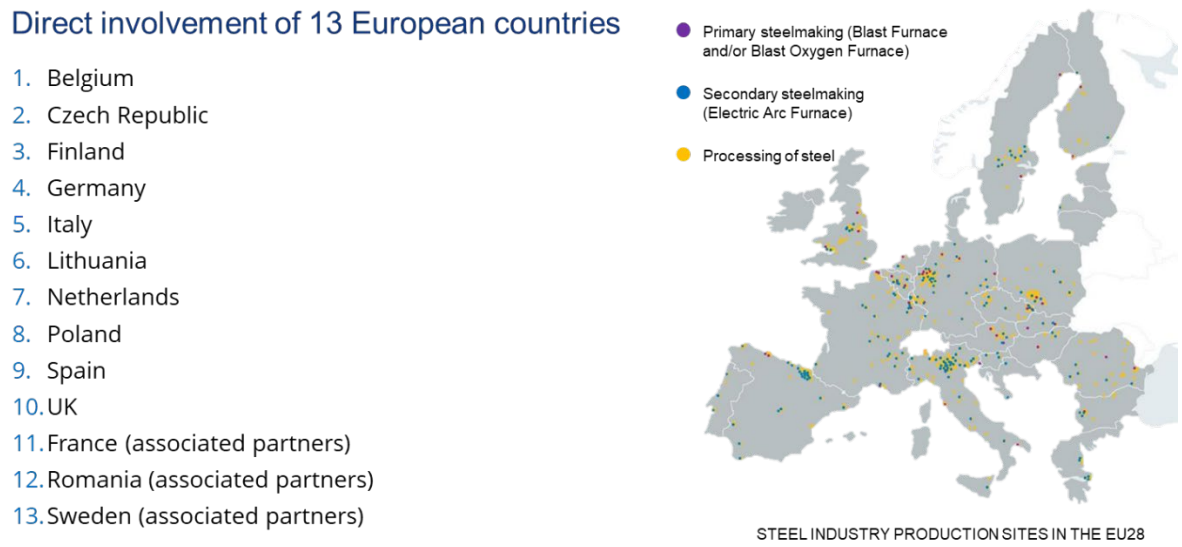


Figure 51: European Steel Industry integration

Affiliated organisations to the above are also included and will provide access to their respective members. The partnership is directly involving **13 EU countries**: Belgium, Czech Republic, Finland, Germany, Italy, Lithuania, Netherlands, Poland, Spain and UK, completed by France and Sweden (associated partners). Nevertheless, via EUROFER, industriALL, CIELFFA, and steel company subsidiaries in other countries ESSA is **covering the whole steel industry member states** in Europe, including steel processing and the SME perspective.

To broaden the perspective beyond the Steel Industry ESSA integrated institutions in the partnership not focusing (only) on the sector, e.g. EIT RawMaterials and the Council of European Professional Informatics Society (CEPIS) completed by several European networks (this cooperation has to be elaborated and defined further, establishing concrete links with ESSA).

The dedicated main roles are:

- **Steel companies:** defining skills needs, developing training tools, good practice exchange, feedback on blueprint and implementing, testing of tools and programmes, involving company related training organisations, roll-out to other company sites
- **Training providers:** defining skills demands and answers to it, developing training tools and strategies for the blueprint, leadership and train the trainer programs, developing new methods and learning arrangements
- **Steel associations / social partners:** setting-up the Skills Alliance; feedback, assessment of the blueprint strategies and tools, dissemination, involving national VET organisations, roll-out of the Blueprint on the European and national level
- **Research institutions:** management of the project, research on technological, economic, skills development, VET system integration, strategy development for the Blueprint
- **External experts:** integration of technological and skills expertise.

This huge partnership is and will be engaged in supporting measures for the transfer, implementation, monitoring, cooperation and dissemination (EU and Member State Level) as well as for national-regional roll-out activities (National-Regional Training Ecosystems):

- Steel companies and social partners (associations and unions) are central and are engaged 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.
- 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 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, EQAVET, etc.). A contribution to policy recommendations (including collaboration with EU and Member State Stakeholders, national funding institutions) was also done by the research institutes.
- 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 participating organisations, or stakeholders, have been selected because each is – in different ways – strategically committed to the European steel industry. Key stakeholders, including those directly involved in the project and those to which the project relates, have been integrated and will drive the identification and analysis of the skills intelligence related

to the execution of the Blueprint and for the design and development of the network beyond the funding period of the project.

4.2 European Governance of ESSA

Based on and fostered by the huge partnership, the European governance of ESSA was initialised and tested, and finally accepted as part of already existing European steel industry support structures (see Figure 52:

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**: mutual learning by exchanging, initiating, developing, and implementing good practice for skills and training.

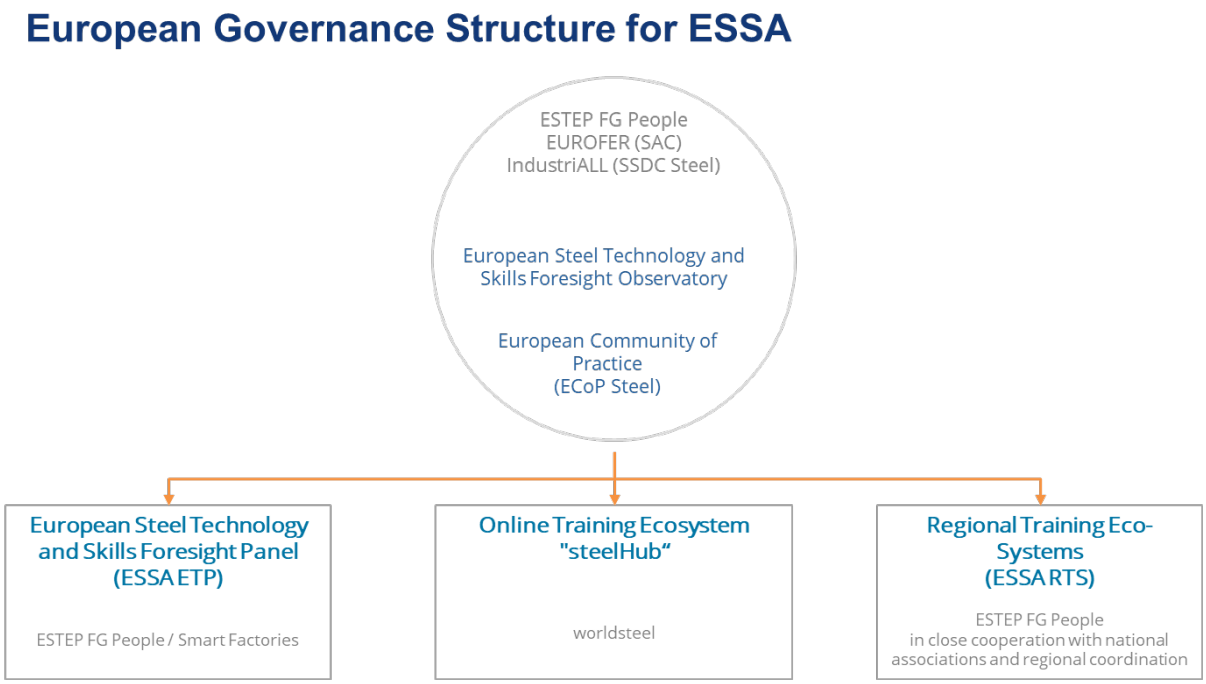


Figure 52: European Governance of ESSA

The European Steel Technology and Skills Foresight Observatory (ESSA ETF) will take over the leadership of the ESSA Alliance cooperating closely with existing and supporting associations and platforms, mainly ESTEP, EUROFER, SSDCS, and industriALL. Under the head of ESTEP Focus Group People, the Observatory will coordinate its activities closely and in collaboration with the European steel stakeholders:

- Strategies for gaining political support, mobilizing human resources and engaging stakeholders for the Blueprint and Skills Alliance
- Further Blueprint development, implementation, operation and monitoring on the European Level

- Communication and involvement strategy for skills adjustments (e.g. new skills demand and development and upload of training measures in the steelHub)
- Rollout of new information, tools, measures to the steel regions
- Implementation and transfer plans elaborated with the national steel associations
- Setting-up of ad-hoc or regular sub-committees for hot topics – mainly incorporated in existing committees
- Coordination national/regional rollout activities and National-Regional Training Ecosystems: national steel associations, training providers
- Organising joint processes of associations, companies, training providers to optimise skills adjustment strategies and VET strategies, tools, curricula across:
    - Associations: linking European and national, regional VET cooperation, ...
    - Companies: joint training programmes, …
    - Training Providers: exchanging best practices, advertising the steelHub, …

Division of Responsibilities and Leadership
The ESSA governance structure (see Figure 52) based Tin the ESSA Foresight Observatory is integrating stakeholder representatives of all steel relevant areas (as described above), ensuring a quadruple helix perspective (industry, policy, education and science, and as much as possible civil society (mainly at the regional level, where people live and work)) and a continuous social innovation process to establish and improve new social practices in skills adjustments.

The transfer of the results into practice includes a new coordination and **distribution of responsibilities**. Responsibilities but also duties and interaction for continuous learning have to be *newly balanced and interrelated* between industry, VET systems, and the individual learner, supported by new policy frameworks, for instance:

- Steel industry focusing on company specific short-termed adjustment of skills needs
- VET systems on basic and transversal competences and skills relevant across sectors
- Individuals by improving self-learning capabilities and a lifelong learning attitude, empowering individual lifelong learning capabilities
- Policy by developing new innovative frameworks supporting lifelong learning (e.g. through individual learning accounts.

Future development of education and training programs might focus also on different responsibilities, tasks and procedures of the workforce and the executives (based on the results of company workshops):

Workforce appeal:

- Work independently in complex topics with digital media
- Admitting the lack of skills of employees
- Identify issues proactively, don´t be driven by development
- Personal responsibility of learning, sharpen the individual responsibility of the employees as regards to training
- Closing skills and knowledge gaps independently by oneself
- „Find one´s feet“ quickly, even under tendencies of rationalization and shorter cycles of innovations - that means: learn the strings on your own
- Understanding high costs, understanding promising measures
- Open feedback culture

- Culture of lifelong learning ("Learning oriented company"): understanding of training as benefit to employability.

However, self-responsibility requires guidance: It is theoretically possible to take over responsibility for closing the open skill gaps, however on the practical side, it is quite difficult. Pull factors (schemes for career progression) and push factors (fundamental training) are needed. Otherwise, one gets lost in the system. The capacity of people to select learning targets autonomously is limited, difficult without guidance. Empowering courses at the beginning are important to provide people the basic cognitive tools to identify their learning targets. This includes also a new responsibility and role for the executives (mainly related to the workforce appeal above).

Executives roles:

- Have confidence in employees
- Lead confident
- Conditions for self-learning require active role of executives (impart confidence and implement self-learning).
- Need of cultural change, executives should become mentors, ambassadors.
- Stay role model – identify and break new grounds
- Open feedback culture
- Identify issues proactively - don´t be driven by development
- Identify significant changes of the future and control the demand for training in time
- Identify the needed skills of employees
- Provide orientation how to achieve sustainable success
- Demand Performance
- Important role of white collar to fill skill gaps of the blue collar

Strategic Orientation

The strategic orientation of the ESSA Alliances and Leadership is completing the more top-down vison for a Skills for Industry Strategy (2020)[13] with alliance building within a social innovation process integrating the steel sector stakeholders as much as possible to ensure a bottom-up perspective. Related to this some proposed actions of this EU study are covered by ESSA in this way:

- The European Foresight Observatory include the appointment of "Skills Leaders" or Nodes at European, national, and regional level, increase cross-border collaboration, set-up of a one-stop-shop (including the steelHub and the ECoP of Steel Regions), incentivise VET upskilling, promotion campaigns (including talent development and detection among women), certification measures, empower VET systems to review their curricula rapidly and easily, develop new partnership models, discussing of new skills funding branding (e.g. Lifelong Learning and Skills Insurance).
- National-Regional Training Eco-systems are in line with the proposed "Set-up of Territorial Skills Councils, definition and implementation of Territorial Skills Strategies", fostering the concept of "Lifelong Learning Centres" - "Aligning the efforts of all leaders involved to ensure the setting-up of relevant partnerships with key stakeholders and the development and implementation of a comprehensive and holistic territorial skills strategy".

[13] http://skills4industry.eu/skills-industry-curriculum-guidelines-40

5 Implementation and Rollout

Because of the differences in VET systems and skills needs in the European countries and regions, ESSA is not a one size fits all solution but an orientation framework to be adjusted and linked to the steel regions (covering also the national level, because public responsibility for VET is often placed at the national government level). A common strategy for continuous improvement and adjustment of skills, competences, and occupations institutionalised in piloted National-Regional Training Eco-Systems is needed where people live, work and learn. Additionally, SMEs and steel *processing* companies are more often focused on a region than big global steel companies, and this is a good way to address them as well. Same applies for the *integration of (national) unions*: They are more active at the company and regional level (and not so interested in European solutions, also being handicapped by language barriers).

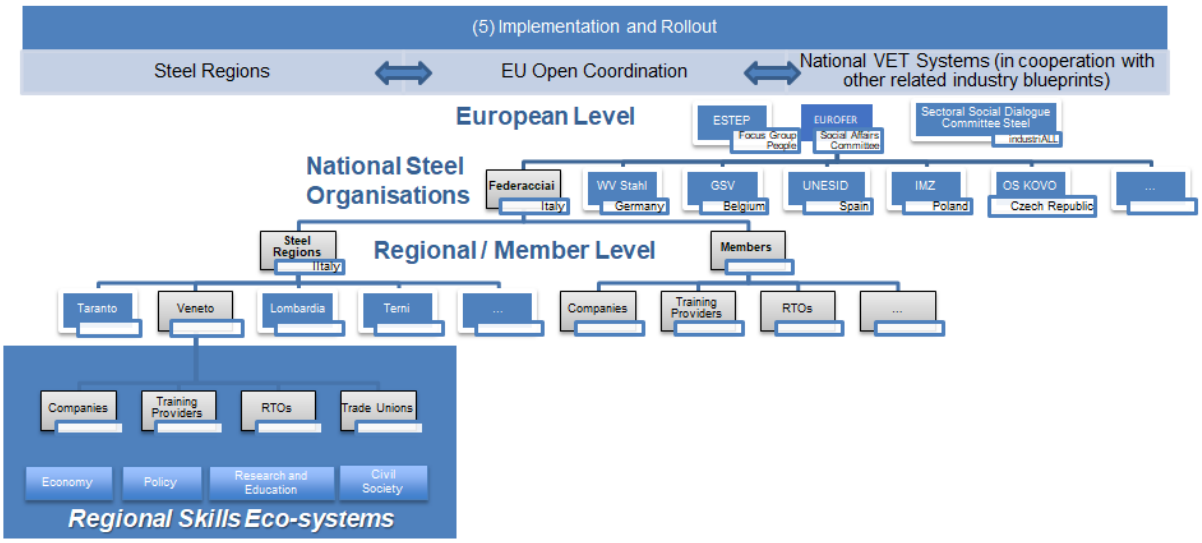


Figure 53: European - national - regional rollout

With the European Open Coordination method, the European ESSA Blueprint is offered as a general framework and orientation to support specific national and regional skills adjustments in the steel companies and regions. This includes policy and funding recommendations and pathways (e.g. via co-financing of ESF/EFRE and national/regional funds). Whilst most steel-relevant education is provided by companies in-house and on the job, stakeholders acknowledge the importance of seeking collaborations between the industry, public bodies and education providers (as stated by the Steel Sector Careers Blueprint). In line with the Steel Sector Careers proposal for combined school- and industry-led initiatives ESSA rollout activities and implementation is focusing on the regional level where people live, work and learn with active involvement of companies and VET schools ensuring the "dual approach".

The rollout is coordinated, supported and implemented by the ESSA Foresight Observatory in collaboration with the European steel associations and platforms (ESTEP, EUROFER, SSDCS, and industriALL). Especially the existing national steel associations and unions are involved in the rollout activities. Within the member states there is and will be a focus on steel regions (steel industry clusters). Within these clusters different specific (depending on the main regional employment, education and training, and social demands) Regional Skills Eco-systems were established connected with the steelHub (Online Training Eco-system).

Starting with the nine pilot 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 and social partners (esp. unions) at the regional level within the eco-system structure and governance.

The **national VET Systems** are covered but to lobby for new curricula and training content should be done in cooperation with other process industry related Blueprints (such as Construction, Automotive, Manufacturing, Textile, Industrial Symbiosis). A common strategy should prepare the results, offers and demands of different Blueprint for supporting and integration in the national VET systems. This approach will reduce the burden, time and effort of the national VET institutions as well as it will increase the lobby and influence of the single Blueprints. Here the new *Pact for Skills* Partnerships could be a good place for joint actions.

ESSA will be linked with the European Commission current and planned actions and frameworks: such as the Pact for Skills and esp. the Large Scale Partnership Energy Intensive Industries, the European Year of Skills 2023, the Digital Education Action Plan, Cedefop's work on skills, other Blueprints for Sectoral Cooperation, and the New Skills Agenda 2020. 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.

If existing in the selected **steel regions** ESSA will collaborate with the European **Centres of Vocational Excellence** (CoVEs)[14], the **European Smart Specialisation Platform**[15] and the European Cluster Collaboration Platform[16] (already integrated steel collaboration clusters are SIDEREX (Basque Country, Spain) and Polo de Acero (Aviles, Spain).

Regional Dialogues are setting the ground for the Regional Training Eco-systems, to be checked what kind of support is needed from the national-regional (steel associations, training providers, VET institutions, policy, funding) and the EU level.

To sum up, the ESSA implementation and rollout strategy was conducted by integrating stakeholders from different areas:

- Associations / Social Partners: Structure and Leadership
- VET system institutions: Pathways for skills supply, integration of ESSA trainings
- Companies: Skills requirements, training offers and usage
- Research and Education: Research, education and training
- Civil Society: Integration of social innovations in education and employment, social integration

on **different levels**:

- General Level:
  - Integration in existing governance and coordination structures
  - Alignment with other steel industry related Blueprints (automotive, construction, industrial symbiosis, additive manufacturing, …)

[14] https://ec.europa.eu/social/main.jsp?catId=1501&langId=en
[15] https://s3platform.jrc.ec.europa.eu/
[16] https://www.clustercollaboration.eu/

- European Level:
  - Open Coordination in close cooperation with ESTEP, EUROFER, industriALL, Sectoral Social Dialog Committee
  - European Steel Technology and Skills Foresight Panel and Observatory
  - Online Training Eco-System steelHub
- Member State Level:
  - National Steel Associations as connection points
  - Trade Unions
  - VET System Institutions
- Regional Level:
  - Regional Training Eco-Systems (ESSA RTS): establishing regional skills frameworks, partnerships and development processes

6 Policy Recommendations and Legislative Framework

Based on the ESSA results and an analysis of the legislative framework, specific policy recommendations have been formulated on different levels and for different stakeholders.

Legislative Framework

The steel industry not only represents an important asset for the European economy but also embodies significant historical value for the establishment of the European Community. Historically, steel production was one of the two main strategic industries, along with coal, in which a common European project was first launched, even before the establishment of the European Economic Community. The forerunner of the European Union (EU), the European Coal and Steel Community (ECSC), was established in 1952 to unite European countries economically and politically to secure long-lasting peace (European Union, 2017). Therefore, as one of the core economic and historical assets of the European economy, the European steel sector takes seriously the embrace of the core values and principles of the EU, particularly with regard to human rights, including those of its workers.

The common principles and values that underlie life in the EU are: human dignity, freedom, democracy, equality and the rule of law, respect for human rights (European Union, 2017). Therefore, the European Union is committed to supporting democracy and human rights in its external relations, in accordance with its founding principles of liberty, democracy and respect for human rights, fundamental freedoms and the rule of law.

These principles, of course, apply to the working rights and working conditions of the people in the EU countries. Every EU worker has certain minimum rights relating to:

- **health and safety at work**: general rights and obligations, workplaces, work equipment, specific risks and vulnerable workers
- **equality law: equal opportunities for women and men** (equal treatment at work, pregnancy, maternity leave, parental leave) and **protection against discrimination based on sex, race, religion, age, disability and sexual orientation**
- **labour law**: part-time work, fixed-term contracts, working hours, employment of young people, informing and consulting employees

The European Commission is aiming to shift to a human-centric orientation in the workplace. For this purpose, as mentioned above, the Commission has already 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.

Individual EU countries are responsible for making sure that their national laws protect these rights laid down by EU employment laws (Directives) (European Commission, n. d.-c). National directives and legislations of the UK, Germany, Poland, Italy and Spain are already in line with the EU employment directives.

With the Industry 5.0 concept, 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 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.

Furthermore, ESSA 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.

Against this backdrop, 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.

Policy Recommendations

Digital transformation and climate change represent the main drivers of innovation for European industry. In particular, green and digital technologies help to increase energy and resource efficiency and contribute to keeping materials in use for a longer time. However, the right skills are needed to implement, operate and exploit these technologies to best effect at the workplace. The ESSA project has developed a sector-driven Blueprint following a bottom-up social innovation process to address skills needs, which integrates all the

relevant stakeholders (companies, training providers, research institutions, associations, and social partners). It has identified where there is need for re- and up- skilling and talent recruitment, and identified strategies for developing a highly skilled workforce, proactively addressing skills gaps, and engaging the workforce with new technological innovations. As part of the Blueprint we offer policy recommendations to support these strategies and address the deep transformations the industry is currently experiencing.

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:

- **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 programs, 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.

Our 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. 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 (see Deliverable D7.1 Policy Recommendations; ESSA, 2023).

7 Steps Foreseen

Our Mission is still a continuous and **proactive adjustment of the future skills demands by the steel industry and for the steel industry**.

Figure 54: Mission and main objectives of ESSA

The ESSA Roadmap 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, coordinating the national-regional rollout activities.

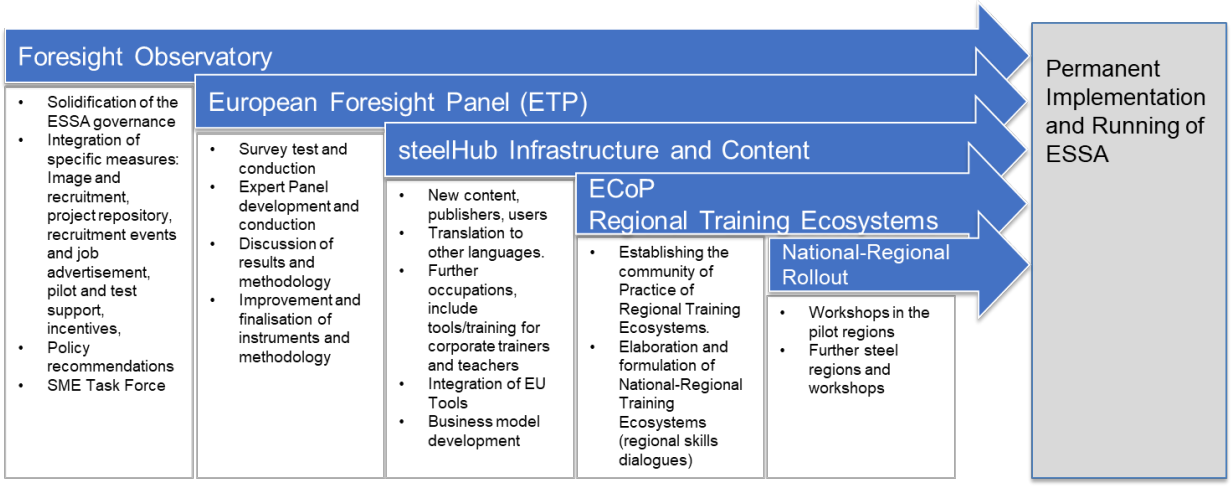


Figure 55: ESSA Roadmap

The Observatory, steelHub, and the European Community of Practice are now 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 Clean Steel Partnership, 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 National-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), the "ESSA Task Force SME" was founded, ensuring and integrating the SMEs perspective.

Central elements and offers of the ESSA Blueprint are:

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**.

The European Foresight Observatory 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 55), 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 Eco-Systems (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.

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 National-Regional Training Eco-Systems (ESSA RTS) to be combined with online training if possible.

Large Scale Partnership Energy Intensive Industries (Pact for Skills)

Essential component for the sustainable further running and connecting the European Steel Skills Alliance and Agenda ESSA is its integration in the Large Scale Partnership Energy Intensive Industries (LSP EII)[17] under the Pact for Skills. This new partnership will integrate

[17] https://pact-for-skills.ec.europa.eu/about/industrial-ecosystems-and-partnerships/energy-intensive-industries_en

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 = cross-sectoral and **industrial symbiosis skills** specific blueprint
- 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)).

The LSP EII was launched at the 10th of May 2023, endorsed by Commissioner Schmit and Commissioner Breton (European Commission, 2023).

As the LSP EII just started, up to now 24 signatories from steel, minerals, water, engineering, non-ferrous metals, and logistics are founding the ground for a kick-start of the LSP. Other partners of the Blueprints are in an internal approval process for their participation. We have 5 companies (also training providers), 5 industry associations, 3 training providers, 11 consultancies and research institutions (some of them are also training providers).

The following steps will be discussed in the Kick-Off Meeting in autumn 2023:

- Regular meetings of the LSP with specific topics, Kick-of Meeting in September / October 2023
- Branding and coordination
- Governance structure and business model development
- Extending membership (missing sectors, sector associations)
- Integration of the two Blueprints: communalities and sector specific needs, acquiring further signatories
  - steelHub and SKILLS4Planet online platform integration
  - Awareness campaign for Industrial Symbiosis
- Cross-sectoral Campaign on Image, Recruitment, Talent Management
- Supporting EU programming P4Planet, CSP, Industry 5.0 (Strategic Research and Innovation Agenda update)

- Application of a proposal for funding further steps of the Blueprint implementation and development, integration of new job profiles, SME focus, sector specific skills needs, Process Industry 5.0, and other topics not covered by the two Blueprints ESSA and SPIRE-SAIS
- Cooperation with other LSPs, Blueprints (Automotive, Hydrogen, …), networks (e.g. EUWIN), and Projects (e.g BRIDGES 5.0)
- Development of a *Process Industry 5.0*, operationalisation concerning skills

Annex

A1 List of Figures

A2 List of Tables

A3 List of Abbreviations

Abbreviation	Meaning
ADDIE model	Analysis Design Development Implementation Evaluation model
AI	Artificial Intelligence
BIBB	Federal Institute for Vocational Education and Training
BOF / BF	Basic Oxygen Furnace - Blast Furnace
BTEC	Business and Technology Education Council
CEDEFOP	European Centre for the Development of Vocational Training
CEPIS	Council of European Professional Informatics Society
CFE-CGC	French Confederation of Management - General Confederation of Executives
CIELFFA	European Federation of the National Associations of Cold Rolled Narrow Steel Strip Producers and Companies
COCOP	Coordinating Optimisation of Complex Industrial Processes
CoVEs	Centres of Vocational Excellence
CSP	Clean Steel Partnership
CSR	Corporate Social Responsibility
CVET	Continuing vocational education and training
DB	Database
EAF	Electric Arc Furnace
ECD	Evidence-Centered-Design
E.N.T.E.R.	European Network for the Transfer and Exploitation of EU Project Results
ECVET	European Credit System for Vocational Education and Training
EFRE	European Regional Development Fund
EIT	European Institute of Innovation and Technology (e.g. RawMaterials)
eLLa4.0	excellent Leadership and Labour 4.0
EQF	European Qualifications Framework

EQAVET	European Quality Assurance in Vocational Education and Training
ESCO	European Skills, Competences, Qualifications and Occupations
ESF	European Social Fund
ESSA	European Steel Skills Agenda
ESSA ETF	European Steel Technology and Skills Foresight Obersvatory
ESSA OTS	Online Training Ecosystem
ESSA RTS	Regional Training Ecosystem
ESTEP	European Steel Technology Platform
EU	European Union
EUROFER	European Steel Association
H2	Hydrogen
HR	Human Resources
HTSM	High Tech Systems & Materials
ICT	Information and communications technology
ILO	International Labour Organization
IMZ	Institute for Ferrous Metallurgy
IoS	Internet-of-Services
IoT	Internet-of-Things
ISCO	International Standard Classification of Occupations
IT	Information Technology
IVET	Initial Vocational Education and Training
KET	Key Enabling Technology
KPI	Key Performance Indicator
LMS	Learning Management System
LSP EII	Large Scale Partnership Energy Intensive Industries
LTI	Learning Tools Interoperability
NGO	Non-governmental organisation
NVQ	National Vocational Qualification
OPEX	Operational expenditures
PBL	Problem-based Learning
PjBL	Project-based Learning
pre-VET	pre Vocational Education and Training
R&D	Research & Development
RCS	Real Case Solving
RFCS	Research Fund for Coal and Steel (RFCS)
ROBOHARSH	Robotic workstation in harsh environmental conditions to improve safety in the steel industry
RTO	Research and Technology Organisations
SCORM	Sharable Content Object Reference Model
SME	Small and medium-sized enterprises
SPIRE	Sustainable Process Industry through Resource and Energy Efficiency
SAC	Social Affairs Committee
SSC	Steel Sector Careers
SSDCS	Sectoral Social Dialogue Committee on Steel
STEM	Science, technology, engineering, and mathematics
SWIC	South Wales Industrial Cluster
TRL	Technology Readiness Level

VET	Vocational Education and Training
WP	Work Package
Abbreviation	Meaning
AI	Artificial Intelligence
BOF / BF	Basic Oxygen Furnace - Blast Furnace
BTEC	Business and Technology Education Council
CEDEFOP	European Centre for the Development of Vocational Training
CFE-CGC	French Confederation of Management – General Confederation of Executives
CIELFFA	European Federation of the National Associations of Cold Rolled Narrow Steel Strip Producers and Companies
COCOP	Coordinating Optimisation of Complex Industrial Processes
CSR	Corporate Social Responsibility
DB	Database
EAF	Electric Arc Furnace
E.N.T.E.R.	European Network for the Transfer and Exploitation of EU Project Results
ECVET	European Credit System for Vocational Education and Training
EFRE	European Regional Development Fund
EIT	European Institute of Innovation and Technology (e.g. RawMaterials)
eLLa4.0	excellent Leadership and Labour 4.0
EQF	European Qualifications Framework
EQAVET	European Quality Assurance in Vocational Education and Training
ESCO	European Skills, Competences, Qualifications and Occupations
ESF	European Social Fund
ESSA	European Steel Skills Agenda
ESSA ETF	European Steel Technology and Skills Foresight Obersvatory
ESSA OTS	Online Training Ecosystem
ESSA RTS	Regional Training Ecosystem
ESTEP	European Steel Technology Platform
EU	European Union
EUROFER	European Steel Association
H2	Hydrogen
HR	Human Resources
HTSM	High Tech Systems & Materials
ICT	Information and communications technology
ILO	International Labour Organization
IMZ	Institute for Ferrous Metallurgy
IoS	Internet-of-Services
IoT	Internet-of-Things
ISCO	International Standard Classification of Occupations
IT	Information Technology
IVET	Initial Vocational Education and Training
KET	Key Enabling Technology
KPI	Key Performance Indicator
LMS	Learning Management System
LTI	Learning Tools Interoperability

NGO	Non-governmental organisation
NVQ	National Vocational Qualification
OPEX	Operational expenditures
PBL	Problem-based Learning
PjBL	Project-based Learning
pre-VET	pre Vocational Education and Training
R&D	Research & Development
RCS	Real Case Solving
RFCS	Research Fund for Coal and Steel (RFCS)
ROBOHARSH	Robotic workstation in harsh environmental conditions to improve safety in the steel industry
RTO	Research and Technology Organisations
SCORM	Sharable Content Object Reference Model
SME	Small and medium-sized enterprises
SPIRE	Sustainable Process Industry through Resource and Energy Efficiency
SSC	Steel Sector Careers
SSDCS	Sectoral Social Dialogue Committee on Steel
STEM	Science, technology, engineering, and mathematics
TRL	Technology Readiness Level
VET	Vocational Education and Training

A4 Legislative Framework

Directives and Legislation at European Level

(1) Health and safety at work is one of the areas where the EU has had the biggest impact – with a solid legal framework covering the maximum number of risks with the minimum number of regulations. As set out by principle 10 of the European Pillar of Social Rights, workers have the right to a high level of protection of their health and safety at work. They have the right to a working environment adapted to their professional needs and which enables them to prolong their participation in the labour market.

Legal basis

Article 153 of the Treaty on the Functioning of the European Union gives the EU the authority to adopt legislation (directives) in the field of safety and health at work, in order to support and complement the activities of Member States.

***Directive 89/391/EEC*, the so-called occupational safety and health (OSH) "Framework Directive"**, lays down the main principles to encourage improvements in the safety and health of workers at work. It guarantees minimum safety and health requirements throughout the European Union while Member States are allowed to maintain or establish more stringent measures.

The Framework Directive is accompanied by further directives focusing on specific aspects of safety and health at work. Together they form the fundamentals of European safety and health legislation (European Commission, n. d.-a). Some of the important policy documents are as follows:

EU strategic framework on health and safety at work 2021-2027 identifies key challenges and strategic objectives for health and safety at work and presents actions and instruments to address these in the coming years. It addresses the changing needs in worker's protection brought by the digital and green transitions, new forms of work and the COVID-19 pandemic. At the same time, the framework will continue to address traditional occupational safety and health risks, such as risks of accidents at work or exposure to hazardous chemicals. The strategic framework focuses on three key objectives for the coming years: (1) Anticipating and managing change in the new world of work (2) Improving prevention of work-related diseases and accidents (3) Increasing preparedness for possible future health threats.

The **European Pillar of Social Rights**, proclaimed on November 2017, is about delivering new and more effective rights for citizens. It has three main categories: (1) Equal opportunities and access to the labour market (2) Fair working conditions (3) Social protection and inclusion. In the area of fair working conditions, principle 10 of the pillar provides that every worker in the EU has the right to a healthy, safe and well-adapted work environment.

The **Communication on "Safer and Healthier Work for All - Modernisation of the EU Occupational Safety and Health Legislation and Policy"** is adopted by the commission in 2017. The document identifies the following three key actions in the field of safety and health at work: (1) Stepping up the fight against occupational cancer through legislative proposals accompanied by increased guidance and awareness-raising; (2)

Helping businesses, in particular micro-enterprises and SMEs, to comply with occupational safety and health rules;

(3) Cooperating with Member States and social partners to remove or update outdated rules and to refocus efforts on ensuring better and broader protection, compliance and enforcement on the ground (European Commission, n. d.-d).

(2) Equality Law: Equality between women and men and non-discrimination are common values on which the EU is founded and are firmly embedded in the Treaties of the European Union, the Charter of Fundamental Rights of the European Union and secondary legislation. Moreover, elimination of inequalities and promotion of equality between women and men and combatting discrimination based on sex, racial or ethnic origin, religion or belief, disability, age or sexual orientation are core obligations to be respected in all the Union's activities. With the entry into force of the Lisbon Treaty in 2009 mainstreaming is introduced in all policies and activities of the EU with regard to discrimination on grounds of sex, racial and ethnic origin, religion or belief, disability, age and sexual orientation. Moreover, with the entry into force of the Lisbon Treaty, the Charter of Fundamental Rights of the European Union has become a binding set of EU fundamental rights. The Charter prohibits discrimination on any ground, without limiting this prohibition to any specific fields and is addressed to the EU institutions, bodies, offices and agencies and to the Member States when they are implementing Union law (European Equality Law Network, n. d.-a).

The importance of European legislation for gender equality and non-discrimination at the national level can hardly be overestimated. For example, EU law requires (**Article 157 TFEU**) application of the principle of equal pay for equal work or work of equal value between women and men. The broad interpretation of the concept of pay by the Court of Justice of the European Union (CJEU) and its extensive case law on this article have certainly broadened the possibilities to combat both direct and indirect sex pay discrimination and to narrow the gender pay gap. Similarly, with regard to non-discrimination on the grounds of racial or ethnic origin, religion or belief, disability, age and sexual orientation, the importance of Article 19 TFEU must be underlined. This provision was included into the primary legislation of the Union so as to provide a legal basis for the adoption of directives imposing specifically the principle of non-discrimination with regard to these grounds. EU legislation prohibiting discrimination covers a broad personal and material scope by means of several directives, covering either the ground of sex, the ground of racial/ethnic origin, or the grounds of religion or belief, disability, age and sexual orientation. These directives all prohibit direct and indirect discrimination, victimisation, harassment and instructions to discriminate, and they provide for the possibility to maintain or adopt positive action measures to achieve full equality in practice

Key EU directives in gender equality and non-discrimination

*The so-called **Recast Directive (2006/54/EC)** on equal opportunities and equal treatment of women and men in employment and occupation has brought together some older directives. This directive requires the implementation of the prohibition of direct and indirect sex discrimination, harassment and sexual harassment in pay, (access to) employment and in occupational social security schemes.*

*A prohibition of direct and indirect sex discrimination applies to statutory social security schemes **(Directive 79/7/EEC)** and to self-employment **(Directive 2010/41/EU)**. Sex discrimination is also prohibited **in** access to and the supply of*

goods and services (Directive 2004/113/EC). In addition, some directives apply to specific groups, such as the ***Pregnancy Directive (92/85/EEC)****, which protects pregnant and breastfeeding women and women who have recently given birth,* the ***Work-life Balance Directive (2019/1158/EU)****, which provides a set of legislative and non-legislative measures to enhance rights to leave and flexible working arrangements for parents and careers, and the* ***Part-time Work Directive (97/81/EC)****. The great majority of part-time workers in the EU being women; the requirement of equal treatment of part-timers and full-timers is also relevant for them.*

The Racial Equality Directive (2000/43/EC) *prohibits discrimination on the ground of racial or ethnic origin in a broad range of fields, including employment, social protection and social advantages, education, and goods and services available to the public, including housing.* The ***Employment Equality Directive (2000/78/EC)****, however, is applied only to the field of employment and occupation but covers the grounds of religion or belief, disability, age and sexual orientation. The adoption of the Racial Equality Directive and the Employment Equality Directive initiated a movement throughout Europe, in EU Member States and beyond, towards the adoption of national non-discrimination legislations transposing the provisions of the directives. In many Member States, this movement implied quite profound changes to the existing legislative framework, through the amendment of existing legislation or the adoption of new unprecedented laws and regulations to specifically regulate the prohibition of discrimination in accordance with the directives' requirements (European Equality Law Network, n. d.-b)*

(3) Labour law defines one's rights and obligations as workers and employers.EU labour law covers 2 main areas:

(1) working conditions - working hours, part-time & fixed-term work, posting of workers;

(2) informing & consulting workers about collective redundancies, transfers of companies, etc.

EU policies in recent decades have sought to

- achieve high employment & strong social protection,
- improve living & working conditions,
- protect social cohesion.

The EU aims to promote social progress and improve the living and working conditions of the peoples of Europe - see the preamble of the **Treaty on the Functioning of the EU.**

The EU adopts directives which its member countries incorporate in national law and implement. This means that it is national authorities - labour inspectorates and courts, for example - that enforce the rules (European Commission, n. d.-b).

One of the main areas covered by EU labour law is **working conditions**. This includes provisions on working time, part-time, and fixed-term work, temporary workers, and the

posting of workers. All of these areas are key to ensuring high levels of employment and social protection throughout the EU.

In line with its Treaty, the EU defines minimum requirements at European level in the field of working conditions. The Treaty gives the European social partners a special role in the preparation of labour law initiatives at EU level. The Commission encourages the social partners to conclude agreements in this field. The Commission can also put forward legislative proposals to the Council and the Parliament (European Commission, n. d.-e).

> **Work-Life Balance**: Following the withdrawal of the Maternity Leave Directive, the Commission decided to take a broader approach in **addressing women's underrepresentation in the labour market.** One of the deliverables of the European Pillar of Social Rights is the Work-life Balance Initiative, which addresses the work-life balance challenges faced by working parents and careers.
>
> This initiative takes into account the developments in society over the past decade in order to enable parents and people with caring responsibilities to better balance their work and family lives and to **encourage a better sharing of caring responsibilities** between women and men. It is based on the results of the public consultation and two-stage social partner consultation, and the analysis of the accompanying impact assessment.
>
> The Communication: An initiative to support work-life balance for working parents and carers sets out a comprehensive **package of complementary legal and policy measures**, which are mutually reinforcing (European Commission, n. d.-f).
>
> **Adequate minimum wages in the EU:** Ensuring that workers in the Union earn adequate minimum wages is essential to guarantee adequate working and living conditions, as well as to build fair and resilient economies and societies as set out by Principle 6 of the European Pillar of Social Rights.
>
> Better working and living conditions, including through adequate minimum wages, **benefit both workers and businesses** in the Union. Adequate minimum wages contribute to ensuring fair competition, to stimulating productivity improvements and to promoting ***economic*** and social progress. They can also help reduce the **gender pay gap**, since more women than men earn a minimum wage.
>
> The role of minimum wages becomes even more important during economic downturns. Ensuring a decent living for workers and **reducing in-work poverty** is important during a crisis and also essential for a sustainable and inclusive economic recovery.
>
> In the majority of Member States, the adequacy of minimum wage is insufficient and/or there are gaps in the coverage of minimum wage protection,/ In light of this, the European Commission adopted a proposal for a Directive on adequate minimum wages on 28 October 2020. The proposal seeks to establish a framework to improve the adequacy of minimum wages and to increase the access of workers to minimum wage protection (European Commission, n. d.-a).

Directives and Legislation at National Level

The following acts of law are the main legislative instruments dealing with, (1) health and safety, (2) equality law and (3) labour law in the countries that constitute the ESSA project's

case study (UK, Germany, Poland, Spain and Italy). They establish the legal framework within which these issues are regulated in case country, outlining the rights and responsibilities of both employers and employees.

Germany:

(1)Health and Safety:

- *German Occupational Health and Safety Act (Arbeitssicherheitsgesetz)*
- *German Workplace Ordinance (Arbeitsstättenverordnung)*
- *German Hazardous Substances Ordinance (Gefahrstoffverordnung)*
- *German Noise and Vibration Protection Ordinance (Lärm- und Vibrations-Arbeitsschutzverordnung)*
- *German Personal Protective Equipment Regulation (PSA-Benutzungsverordn(3)ung*

(2)Equality Law:

- *General Equal Treatment Act (Allgemeines Gleichbehandlungsgesetz)*
- *Act on Equal Opportunities of Women and Man in the Federal Administration, Enterprises and Federal Courts (Gender Equality Act) (Gesetz für die Gleichstellung von Frauen und Männern in der Bundesverwaltung und in den Unternehmen und Gerichten des Bundes (Bundesgleichstellungsgesetz)*

(3)Labour Law:

- *Labour Courts Act (Arbeitsgerichtsgesetz)*
- *German Labour Protection Act (Arbeitsschutzgesetz)*
- *German Works Constitution Act (Betriebsverfassungsgesetz)*
- *Minimum Wage Act (Mindestlohngesetz)*
- *German Act on Part-Time and Fixed-term Employment Contracts (Teilzeit- und Befristungsgesetz)*

United Kingdom:

(1)Health and Safety:

- *Health and Safety at Work etc. Act 1974*
- *Control of Substances Hazardous to Health Regulations 2002*
- *Management of Health and Safety at Work Regulations 1999*
- *Construction (Design and Management) Regulations 2015*
- *Personal Protective Equipment at Work Regulations 1992*

(2)Equality Law:

- *Equality Act 2010*
- *Human Rights Act 1998*
- *Equal Pay Act 1970*
- *Race Relations Act 1976*
- *Disability Discrimination Act 1995*

(3)Labour Law:

- *Employment Rights Act 1996*
- *Trade Union and Labour Relations (Consolidation) Act 1992*
- *National Minimum Wage Act 1998*
- *Equality Act 2010*
- *Working Time Regulations 1998*

Poland:

(1)Health and Safety:

- *Act on Public Employee Occupational Safety and Health (Ustawa o bezpieczeństwie i higienie pracy)*
- *Act on Ergonomics and Work Safety (Ustawa o ergonomii i bezpieczeństwie pracy)*
- *Act on Chemical Substances and Preparations (Ustawa o substancjach i preparatach chemicznych)*

(2)Equality Law:

- *Act on Equal Treatment on the Labour Market (Ustawa o równym traktowaniu)*
- *Act on National and Ethnic Minorities and on the Regional Languages (Ustawa o mniejszościach narodowych i etnicznych oraz o języku regionalnym)*

(3)Labour Law:

- *The Polish Labour Code (Kodeks pracy)*
- *Act on Trade Unions (Ustawa o związkach zawodowych)*
- *Act on Employment Promotion and Labour Market Institutions (Ustawa o promocji zatrudnienia i instytucjach rynku pracy)*
- *Act on Social Dialogue and the Council of Dialogue (Ustawa o dialogu społecznym i Radzie Dialogu Społecznego)*

Spain:

(1)Health and Safety:

- *Prevention of Occupational Risks Act (Normativade Prevención de Riesgos Laborales)*
- *National Chemical Hazard Regulations (Normativa nacional de Riesgos químicos)*
- *National Risk Regulations: Biological hazards (Normativa nacional de Riesgos: Riesgos biológicos)*
- *National Physical Hazards Regulations: Noise, Thermo-hygrometric Environment, Vibrations, Radiation (Normativa nacional de Riesgos fisícos: Ruido, Ambiente Termohigrométrico, Vibraciones, Radiaciones))*

(2)Equality Law:

- *Organic Law on Gender Equality (Ley Orgánica paralaIgualdad Efectiva de Mujeres y Hombres)*
- *General Law on Disability Rights and Their Social Inclusion (Ley General de Derechos de las Personas con Discapacidad y de su Inclusión Social)*
- *Comprehensive law for equal treatment and non-discrimination (Ley integral para la igualdad de trato y la no discriminación)*
- *)*

(3)Labour Law:

- *Workers' Statute Act (Ley de Estatuto de los Trabajadores)*
- *Collective Bargaining Act (Ley de Negociación Colectiva)*
- *Act regulating temporary employment agencies (Ley por la que se regulan empresas de trabajo temporal)*

- *Growth and Employment Improvement Act). (Leypara la mejora del crecimiento y del empleo))*

***Italy**:*

(1)Health and Safety Law:

- *Occupational Health and Safety Act (Legge sulla salute e la sicurezza sul lavoro))*

(2)Equality Law:

- *Law on Equal Treatment and Promotion of Equality (Legge sull'uguaglianza di trattamento e sulla promozione della parità)*
- *Anti-discrimination Law (Legge contro la discriminazione)*
- *Law on Parental Leave and Work-Life Balance (Legge sulla genitorialità e sulla conciliazione dei tempi di vita e di lavoro)*

(3) Labour Law:

- *Act on workers' Statute (Statuto dei lavoratori)*
- *Decree on Individual and Collective Dismissals (Decreto legislativo sulle dimissioni individuali e collettive)*
- *Act on Fixed-Term Contracts (Legge sui contratti a termine)*

A5 References

ArcelorMittal. (2019). *Our steel, your world: Sustainability Report - ArcelorMittal Poland*. https://poland.arcelormittal.com/fileadmin/Content/raporty/Sustainability_Report_2019.pdf

Bayón, F., Goti, A., Akyazi, T., Cuypers, M., Muract, J., Götting, A., & Kohlgrüber, M. (2023). *Company Skills Requirements and Foresight* (ESSA Deliverable No. 3.2).

BIBB. (2018, July 16). *A hot job - process technologist in the metal industry: Updated training regulation enters into force on 1 August*. https://www.bibb.de/en/pressemitteilung_82105.php

Bitkom. (2020, June 2). *9 Erfolgsfaktoren für Digital Learning im Unternehmen, diue nach Corona wichtig sind*. https://www.bitkom.org/sites/main/files/2020-06/20200529_9-erfolgsfaktoren-fur-digital-learning-im-unternehmen_corona_fi.pdf

Breque, M., Nul, L. de, & Petridis, A. (2021). *Industry 5.0: Towards a sustainable, human-centric and resilient European industry*. Brussels. European Commission. https://doi.org/10.2777/308407

Cedefop. (2019a). *Crafting skills intelligence*. https://www.cedefop.europa.eu/en/blog-articles/crafting-skills-intelligence

Cedefop. (2019b). *Not just new jobs: Digital Innovation supports careers*. Briefing Note. https://www.cedefop.europa.eu/files/9143_en.pdf

Colla, V., Schröder, A., Buzzelli, A., Abbà, D., Faes, A., & Romaniello, L. (2017). Introduction of symbiotic human-robot-cooperation in the steel sector: an example of social innovation. *Matériaux & Techniques*(105), Article 505.

Echterhoff, V., & Schröder, A. (2015). *Retaining Talents in the European Steel Industry*. ESTEP. https://www.estep.eu/assets/Uploads/ESTEP-WG5-Report-TalentSurvey.pdf

elmlearning. (n. d.). *What is ADDIE? Your Complete Guide to the ADDIE Model*. Retrieved June 28, 2023, from https://elmlearning.com/hub/instructional-design/addie-model/

ESSA. (2021). *Sector Skill-Set Matrix - Matrix Database*. Version 2. https://www.estep.eu/assets/Uploads/ESSA-D4.4-Sector-Skill-Set-Matrix-Matrix-Database-Version-2.xlsx

ESSA. (2023). *Policy Recommendations*.

ESTEP. (2020). *Proposal for Clean Steel Partnership under the Horizon Europe Programme*. https://www.estep.eu/assets/Uploads/ec-rtd-he-partnerships-for-clean-steel-low-carbon-steelmaking.pdf

European Commission. (n. d.-a). *Adequate minimum wages in the EU*. Retrieved 29.6.23, from https://ec.europa.eu/social/main.jsp?catId=1539&langId=en

European Commission. (n. d.-b). *Health and Safety*. Retrieved 29.6.23, from https://ec.europa.eu/social/main.jsp?catId=148&langId=en

European Commission. (n. d.-c). *Labour law*. Retrieved 29.6.23, from https://ec.europa.eu/social/main.jsp?catId=157&langId=en

European Commission. (n. d.-d). *Rights at work*. https://ec.europa.eu/social/main.jsp?catId=82&langId=en

European Commission. (n. d.-e). *Strategic policy documents*. Retrieved 29.6.23, from https://ec.europa.eu/social/main.jsp?catId=151&langId=en

European Commission. (n. d.-f). *Working Conditions*. Retrieved 29.6.23, from https://ec.europa.eu/social/main.jsp?catId=706&langId=en

European Commission. (n. d.–g). *Work-life balance*. Retrieved 29.6.23, from https://ec.europa.eu/social/main.jsp?catId=1311&langId=en

European Commission. (2019). *Steel Sector Careers: Information leaflet*. https://ec.europa.eu/docsroom/documents/37352

European Commission. (2023, May 10). *Commission launches a large-scale skills partnership for energy-intensive industries*. Commission launches a large-scale skills partnership for energy-intensive industries

European Equality Law Network. (n. d.–a). *Introduction*. Retrieved 29.6.23, from https://www.equalitylaw.eu/legal-developments/16-law/56-introduction

European Equality Law Network. (n. d.–b). *Key EU directives in gender equality and non-discrimination*. Retrieved 29.6.23, from https://www.equalitylaw.eu/legal-developments/16-law/76-key-eu-directives-in-gender-equality-and-non-discrimination

European Union. (2017). *Treaty establishing the European Coal and Steel Community, ECSC Treaty*. https://eur-lex.europa.eu/EN/legal-content/summary/treaty-establishing-the-european-coal-and-steel-community-ecsc-treaty.html

Festo Didactic. (n. d.). *Lernfabrik 4.0: Qualifikation für die Produktion der Zukunft*. https://www.festo-didactic.com/ov3/media/customers/1100/dsi_lernfabrik_4_0.pdf

Gipple, J. (n. d.). *The Learning Ecosystem: What combination of learning methods work best for your training?* Retrieved June 28, 2023, from https://icslearninggroup.com/whitepapers/the-learning-ecosystem/

Howaldt, J., & Schwarz, M. (2010). *Social Innovation: Concepts, research fields and international trends*. http://www.sfs.tu-dortmund.de/odb/Repository/Publication/Doc/1289/IMO_Trendstudie_Howaldt_Schwarz_englische_Version.pdf

Kohlgrüber, M., Maldonado-Mariscal, K., & Schröder, A. (2021). Mutual Learning in Innovation and Co-Creation Processes: Integrating Technological and Social Innovation. *Frontiers in Education*, *6*, Article 498661. https://doi.org/10.3389/feduc.2021.498661

McCoshan, A. (2019, November 11). *Centres of Vocational Excellence: what do they mean for teachers and trainers?* https://epale.ec.europa.eu/en/blog/centres-vocational-excellence-what-do-they-mean-teachers-and-trainers

Muract, J., & Schröder, A. (2023). *Training Framework (steelHub): Development of training courses, measures, arrangements, tools and activities for integration within VET, company and association training programme* (ESSA Deliverable No. 5.1).

Murri, M., Colla, V., & Branca, T. A. (2023). *Digital Transformation in European Steel Industry: State of Art and Future Scenario*. Final version (ESSA Deliverable No. 2.1).

Probst, L., Pedersen, B., & Wenger, J. (2019). *Skills for Smart Industrial Specialisation and Digital Transformation: Final Report*. https://skills4industry.eu/sites/default/files/2019-11/EA0119570ENN%20Skills%20for%20Smart%20Industrial%20Specialisation%20and%20Digital%20Transformation%20-%20Final%20Report.pdf https://doi.org/10.2826/550778

Schröder, A. (2012). *Implementing Innovative Structures to Improve Lifelong Learning - A Social Innovation Process: The Example HESSENCAMPUS* (ZSI Discussion Paper Series

No. 28). Zentrum für Soziale Innovation. https://www.zsi.at/object/publication/2197/attach/DP28_Schroeder.pdf

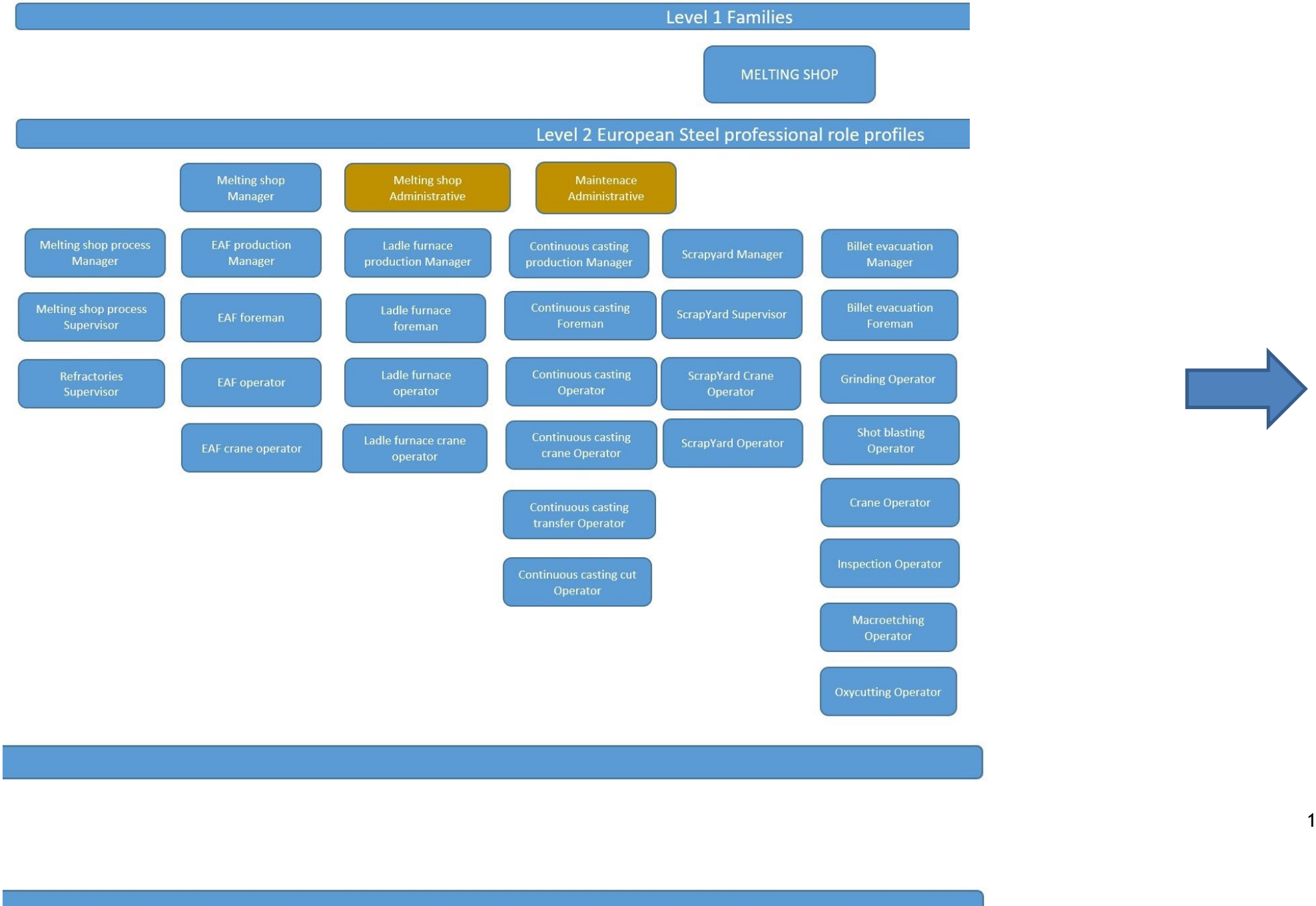
Schröder, A., Götting, A., Branca, T. A., Muract, J., & Colla, V. (2023). *Piloting and Implementing the Blueprint: Report on the piloting and sustainable implementation of the Blueprint*. framework / strategy, tools and measures (ESSA Deliverable No. 6.2).

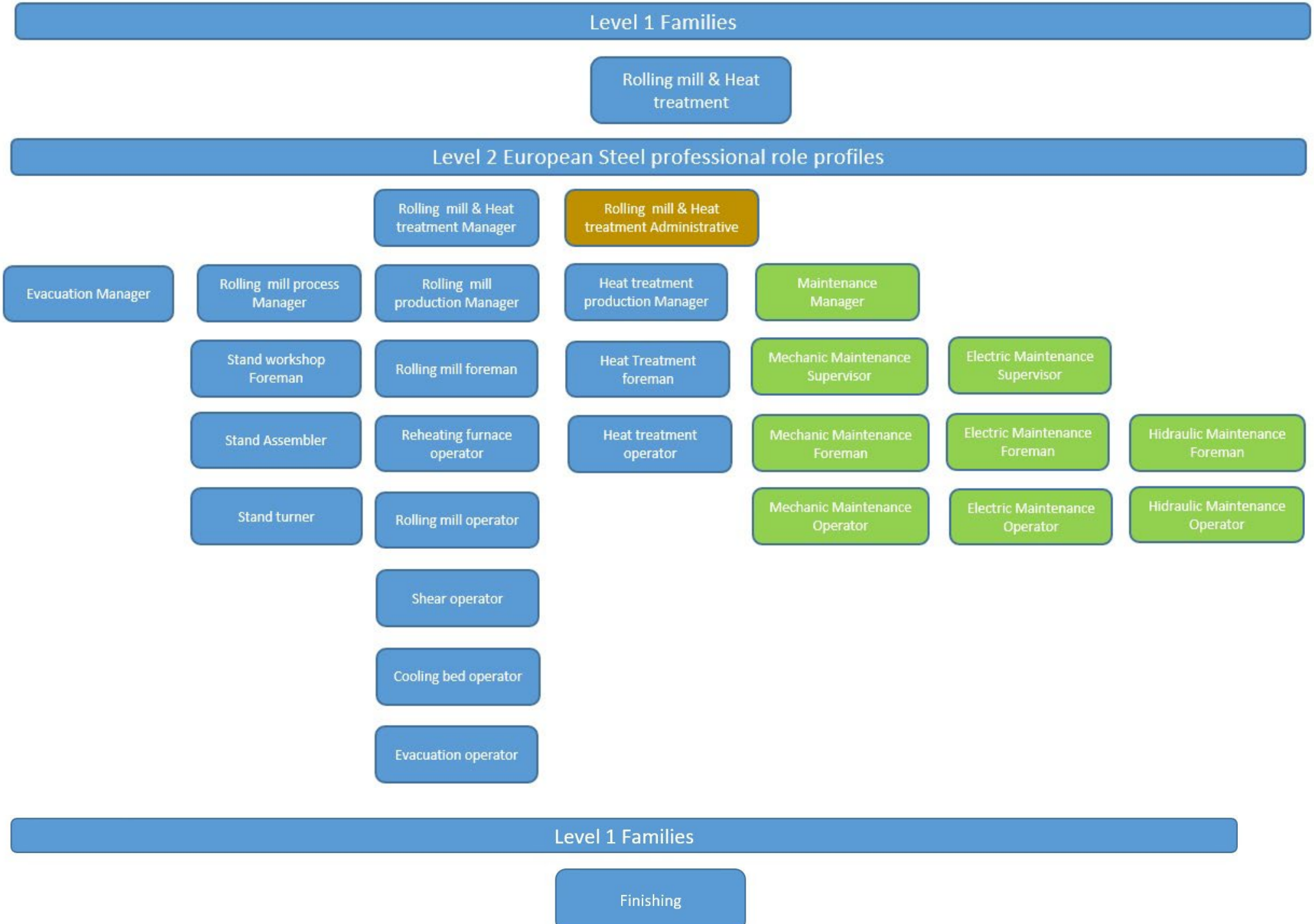
van Vulpen, E. (n. d.). *Understanding the ADDIE Model: All You Need to Know*. Retrieved June 28, 2023, from https://www.aihr.com/blog/addie-model/

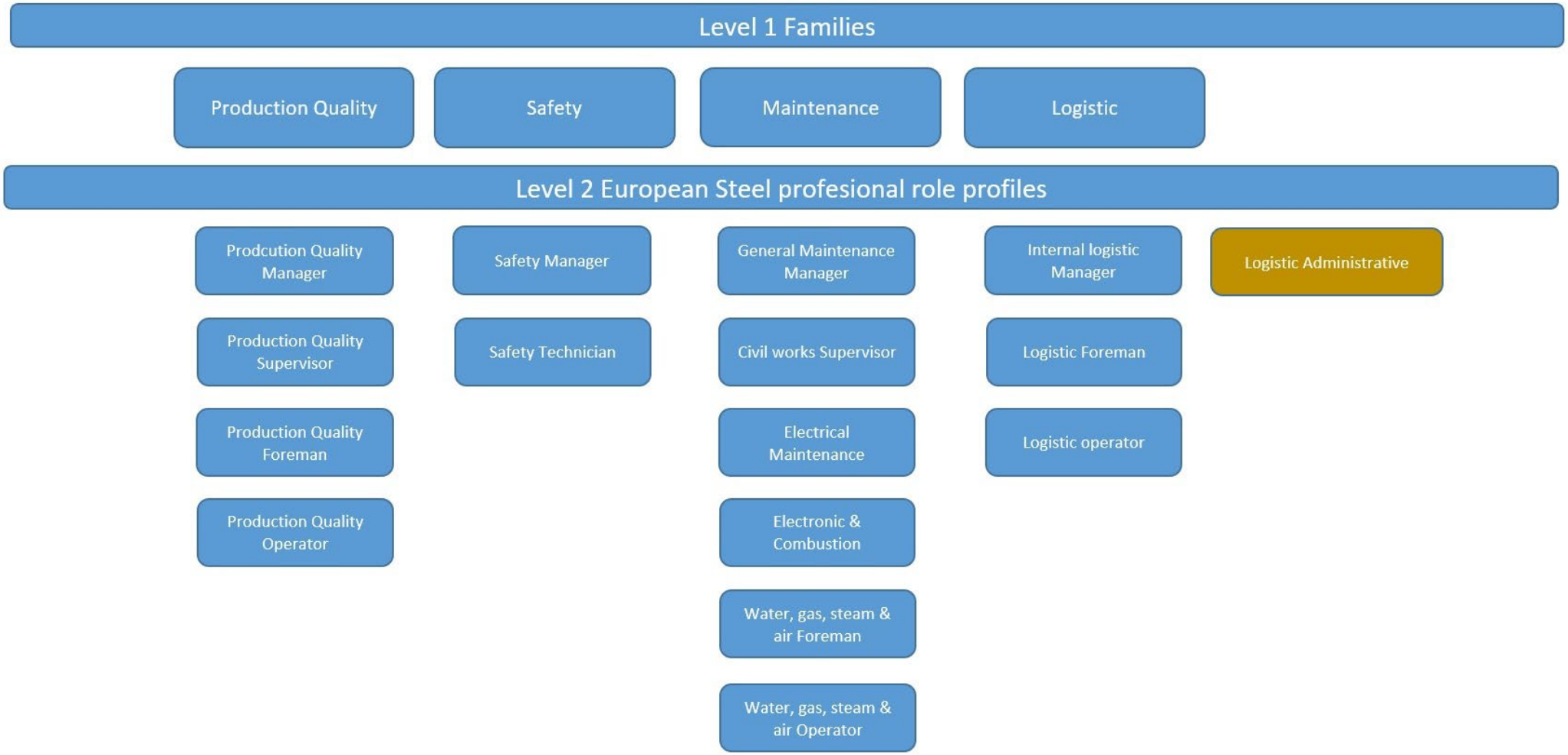
White Research, INTRASOFT International, & Rina Consulting - Centro Sviluppo Materiali S.p.A and Valeu Consulting. (2020). *Blueprint for Sectoral Cooperation on Skills: Towards an EU Strategy Addressing the Skills Needs for the Steel Sector*. https://op.europa.eu/en/publication-detail/-/publication/b809b029-99be-11ea-aac4-01aa75ed71a1 https://doi.org/10.2826/2092

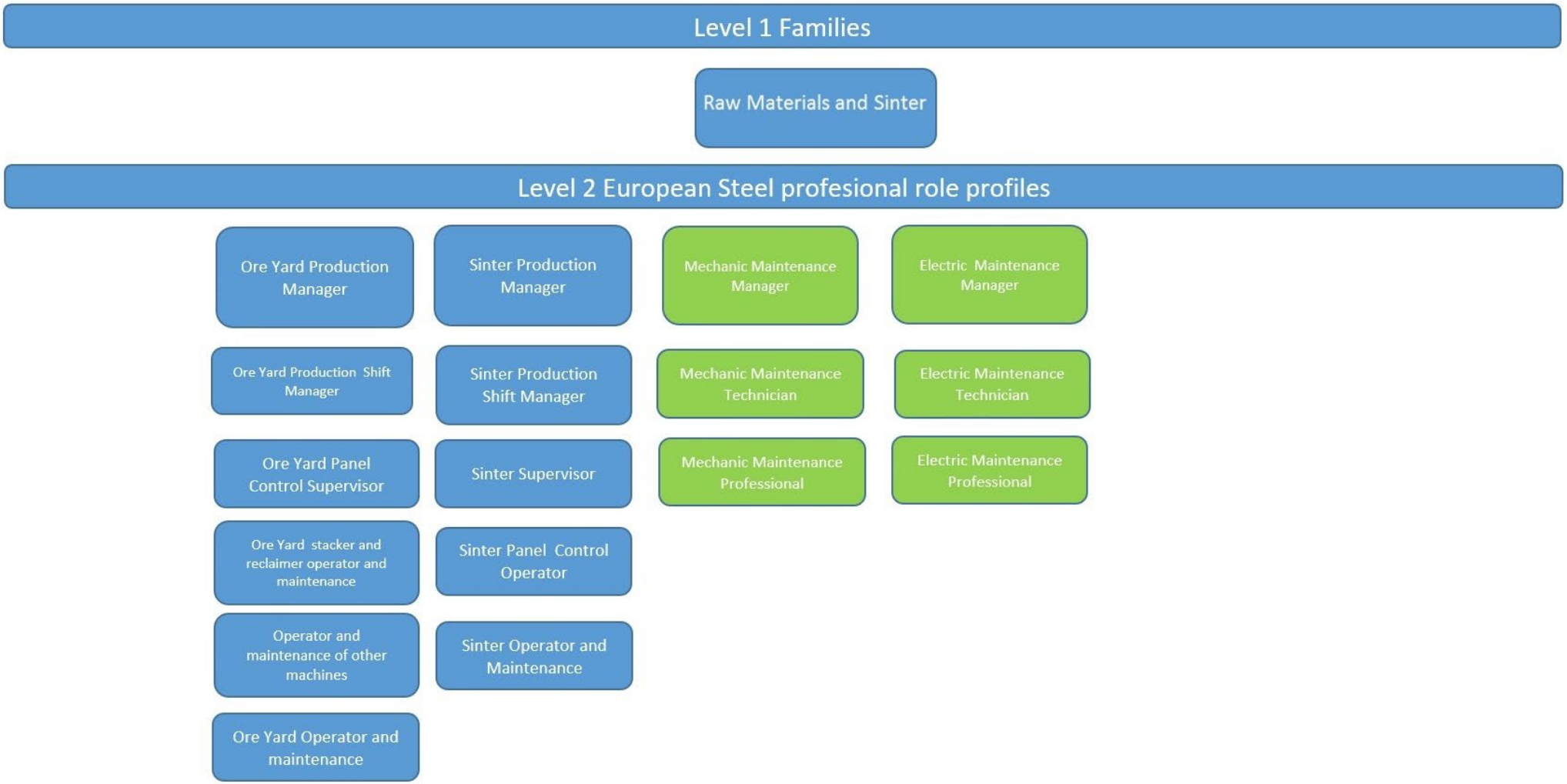
World Manufacturing Foundation. (2019). *The 2019 World Manufacturing Forum Report: Skills for the Future of Manufacturing*. https://worldmanufacturing.org/wp-content/uploads/WorldManufacturingFoundation2019-Report.pdf

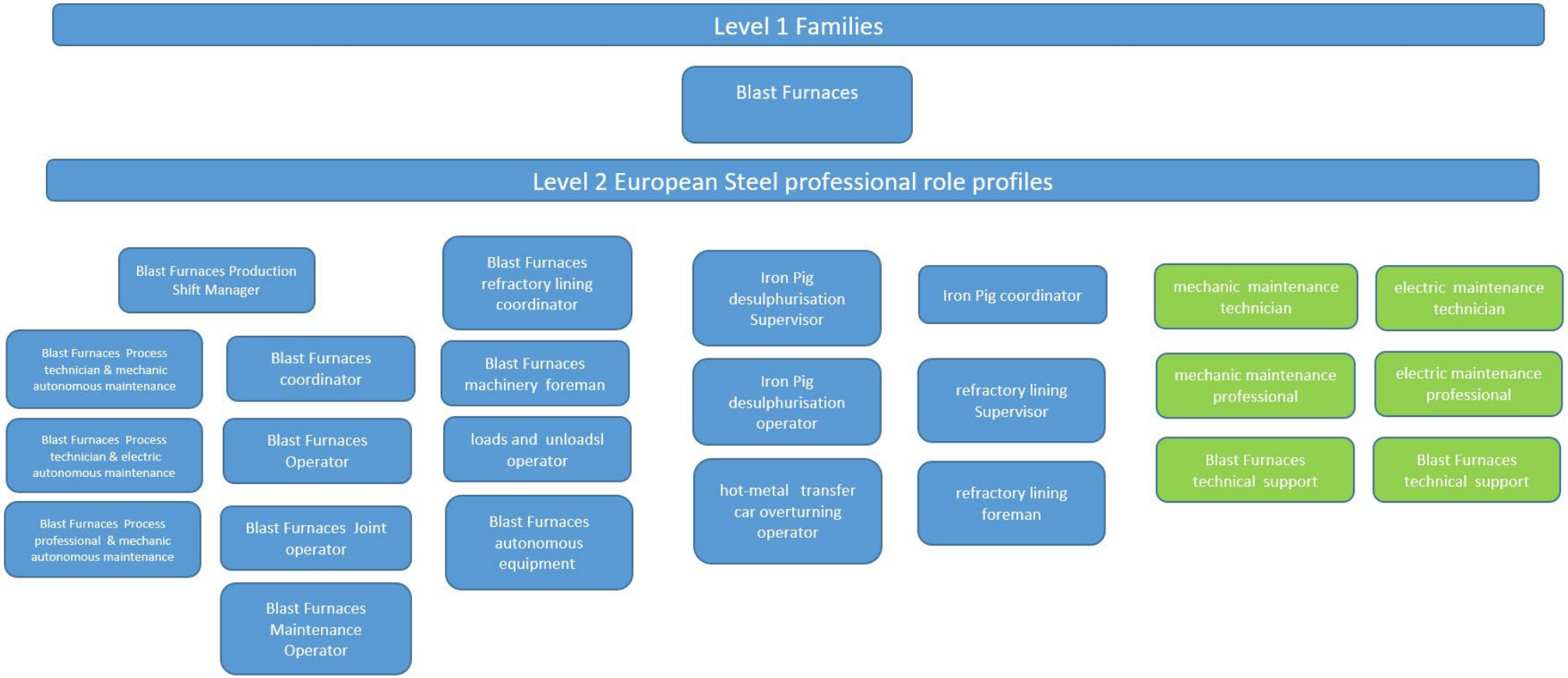
A6 Job Families Overview (blue: production, orange: administration, green: maintenance)

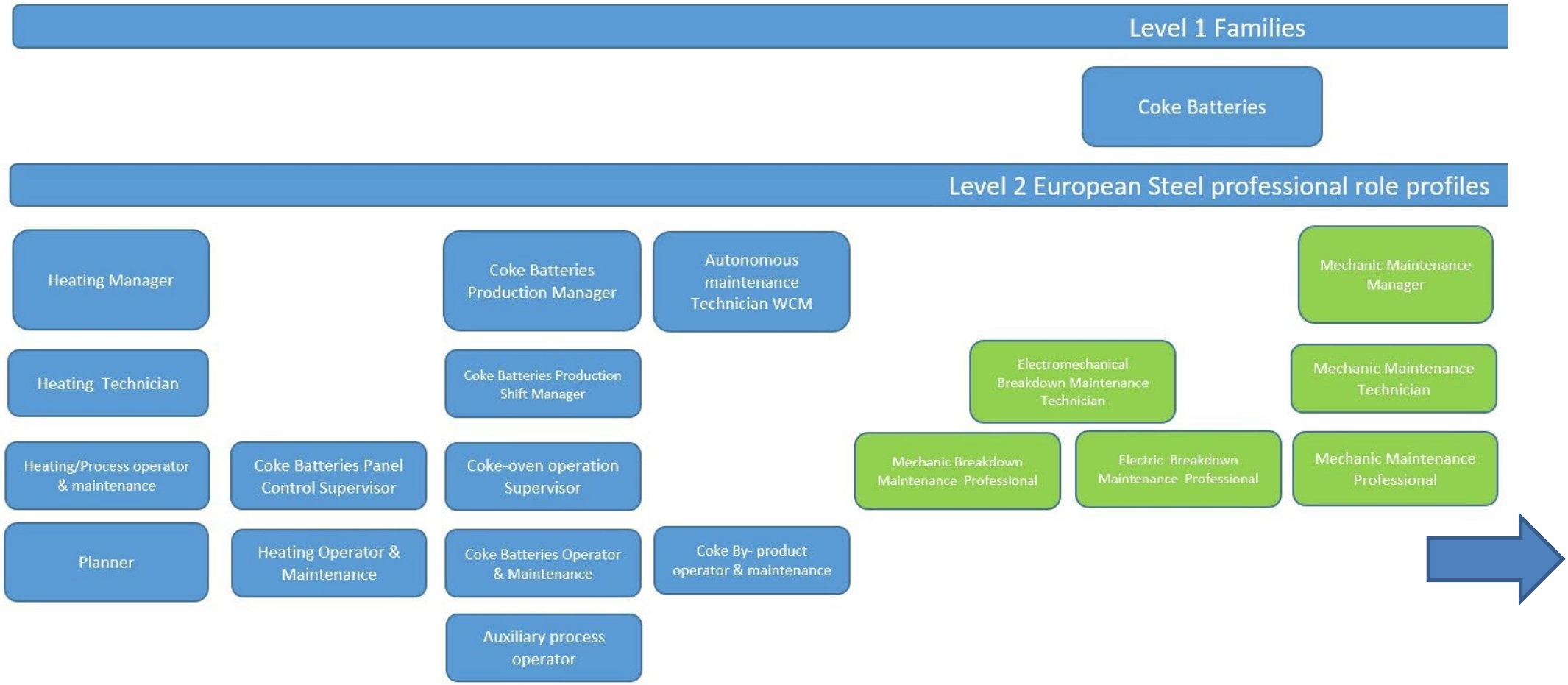


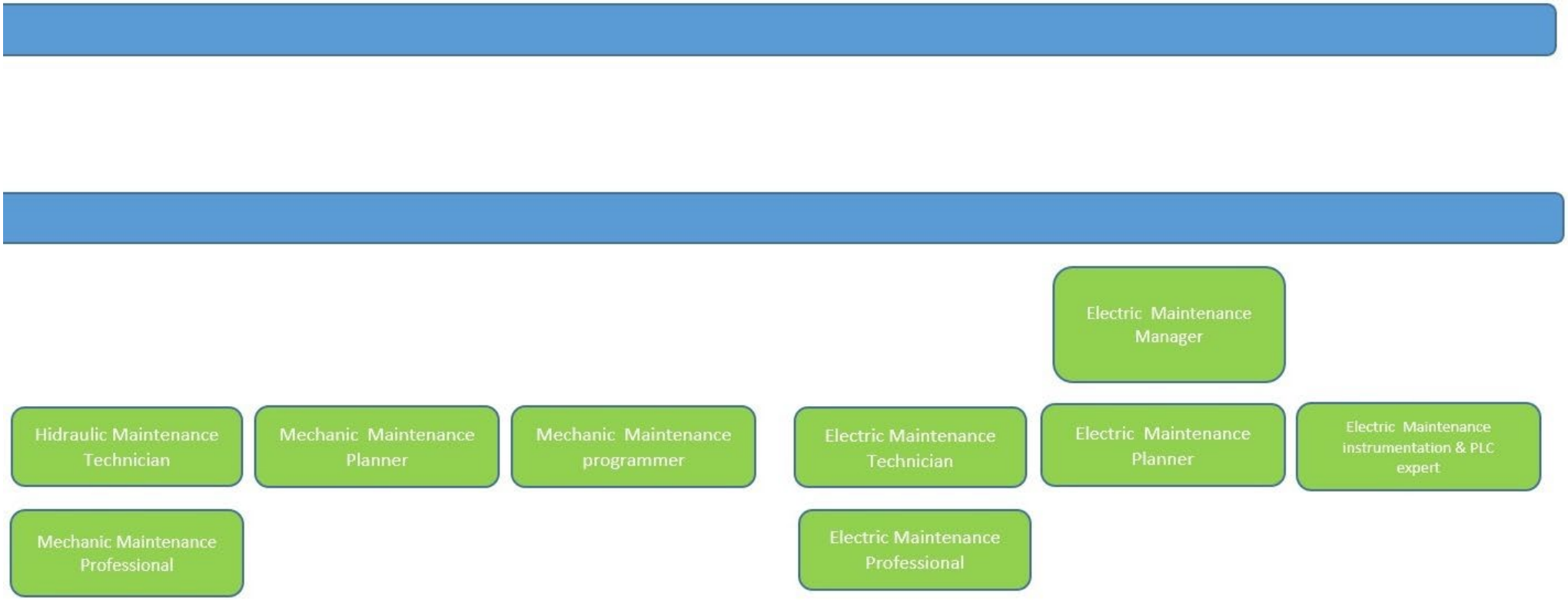

Level 1 Families
Rolling mill & Heat treatment
Level 2 European Steel professional role profiles
Rolling mill & Heat treatment Manager
Rolling mill & Heat treatment Administrative
Evacuation Manager
Rolling mill process Manager
Rolling mill production Manager
Heat treatment production Manager
Maintenance 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

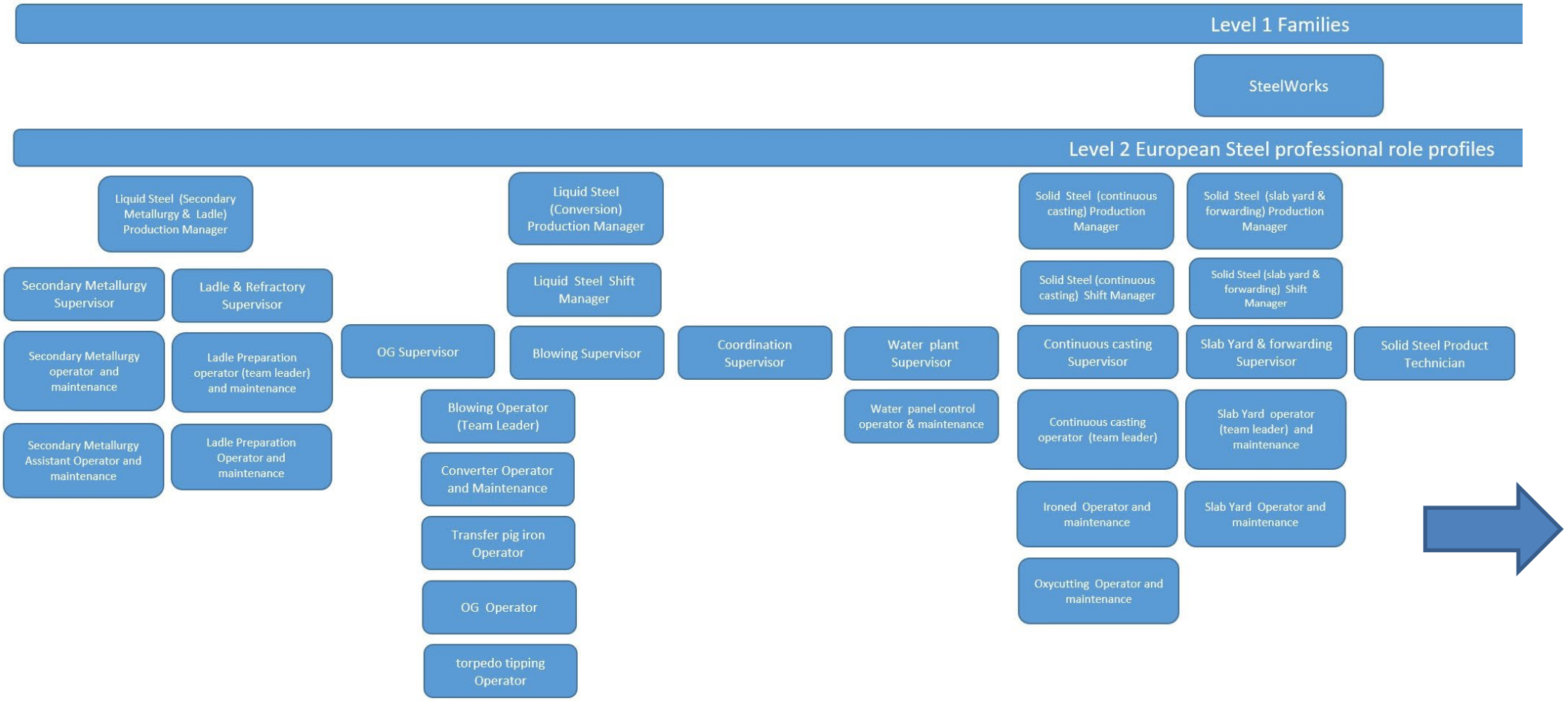

Level 1 Families
Production Quality
Safety
Maintenance
Logistic
Level 2 European Steel profesional role profiles
Prodcution Quality Manager
Production Quality Supervisor
Production Quality Foreman
Production Quality Operator
Safety Manager
Safety Technician
General Maintenance Manager
Civil works Supervisor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

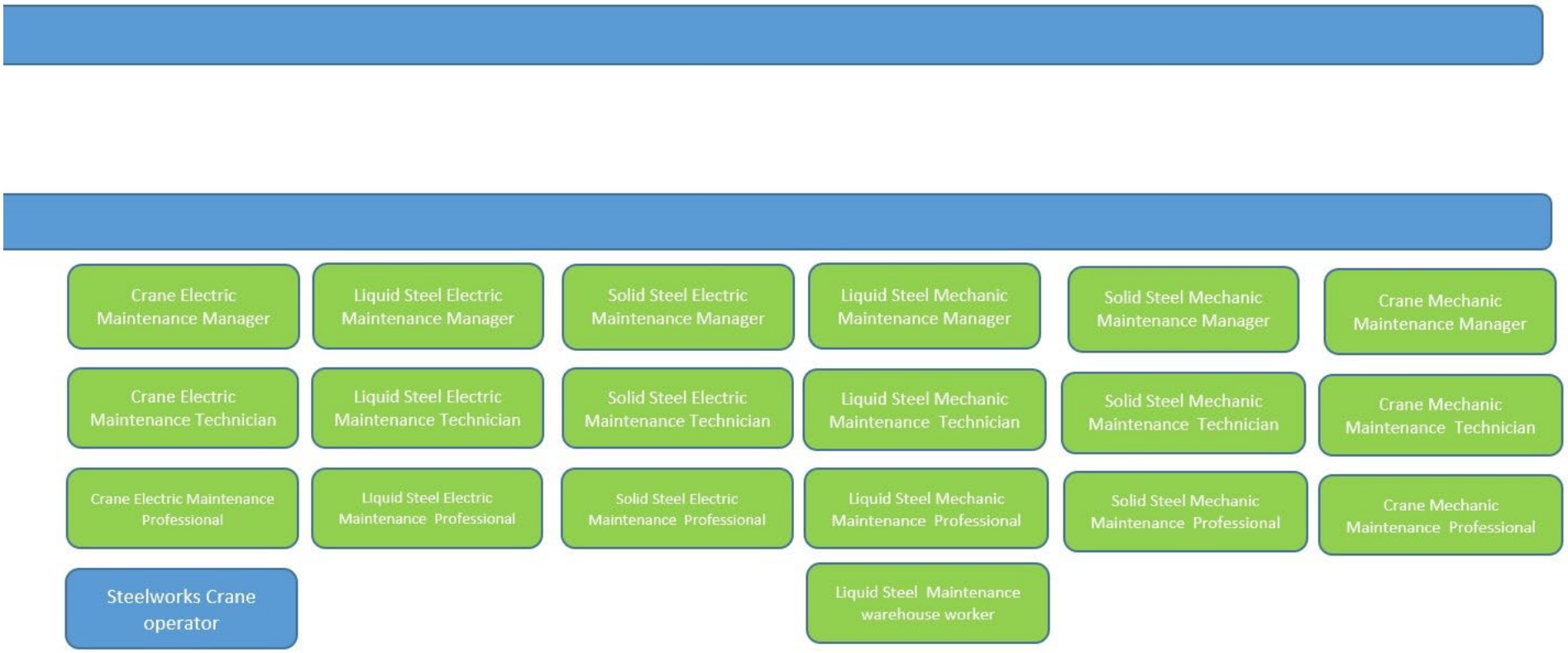

Level 1 Families
Raw Materials and Sinter
Level 2 European Steel profesional role profiles
Ore Yard Production Manager
Sinter Production Manager
Mechanic Maintenance Manager
Electric Maintenance Manager
Ore Yard Production Shift Manager
Sinter Production Shift Manager
Mechanic Maintenance Technician
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

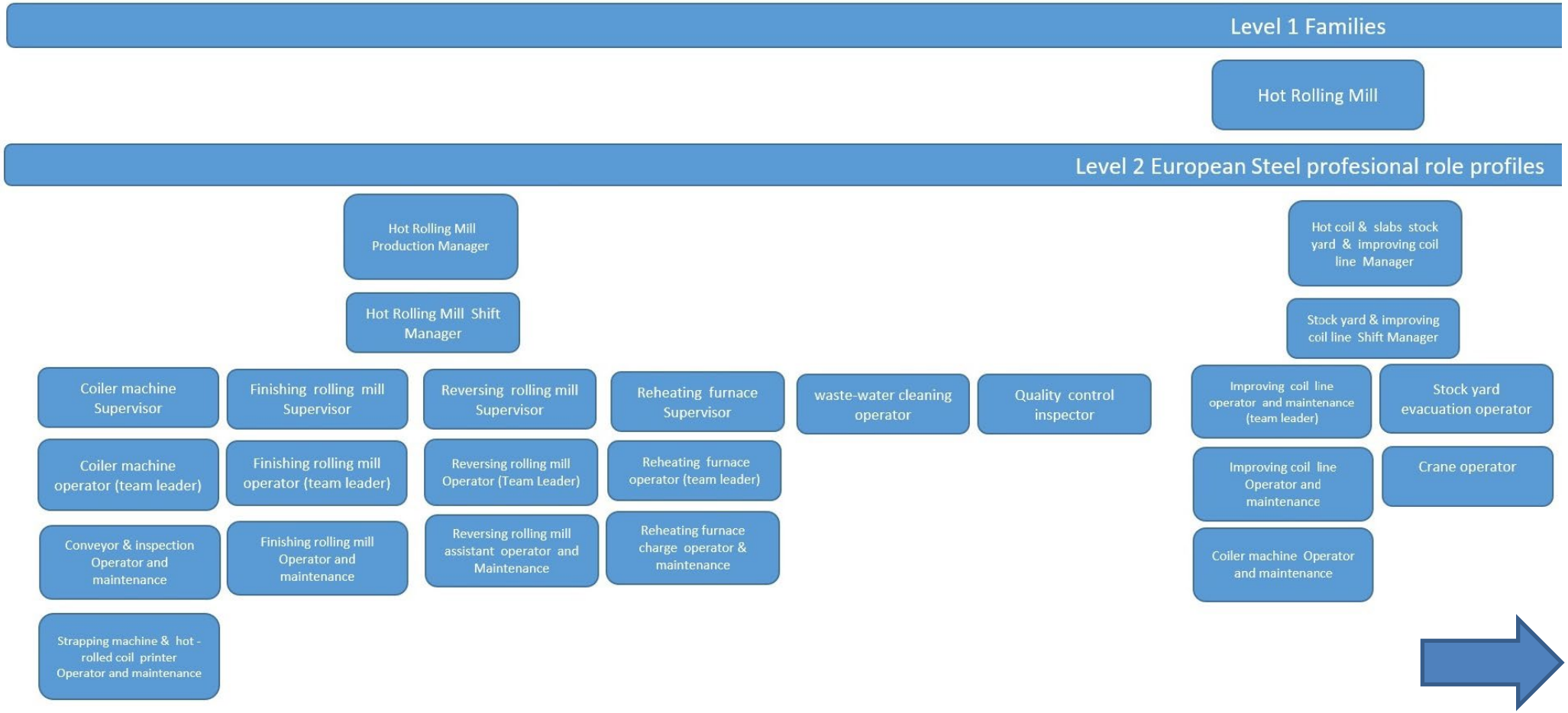

Level 1 Families
Blast Furnaces
Level 2 European Steel professional role profiles
Blast Furnaces Production Shift Manager
Blast Furnaces Process technician & mechanic autonomous maintenance
Blast Furnaces Process technician & electric autonomous maintenance
Blast Furnaces Process professional & mechanic 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

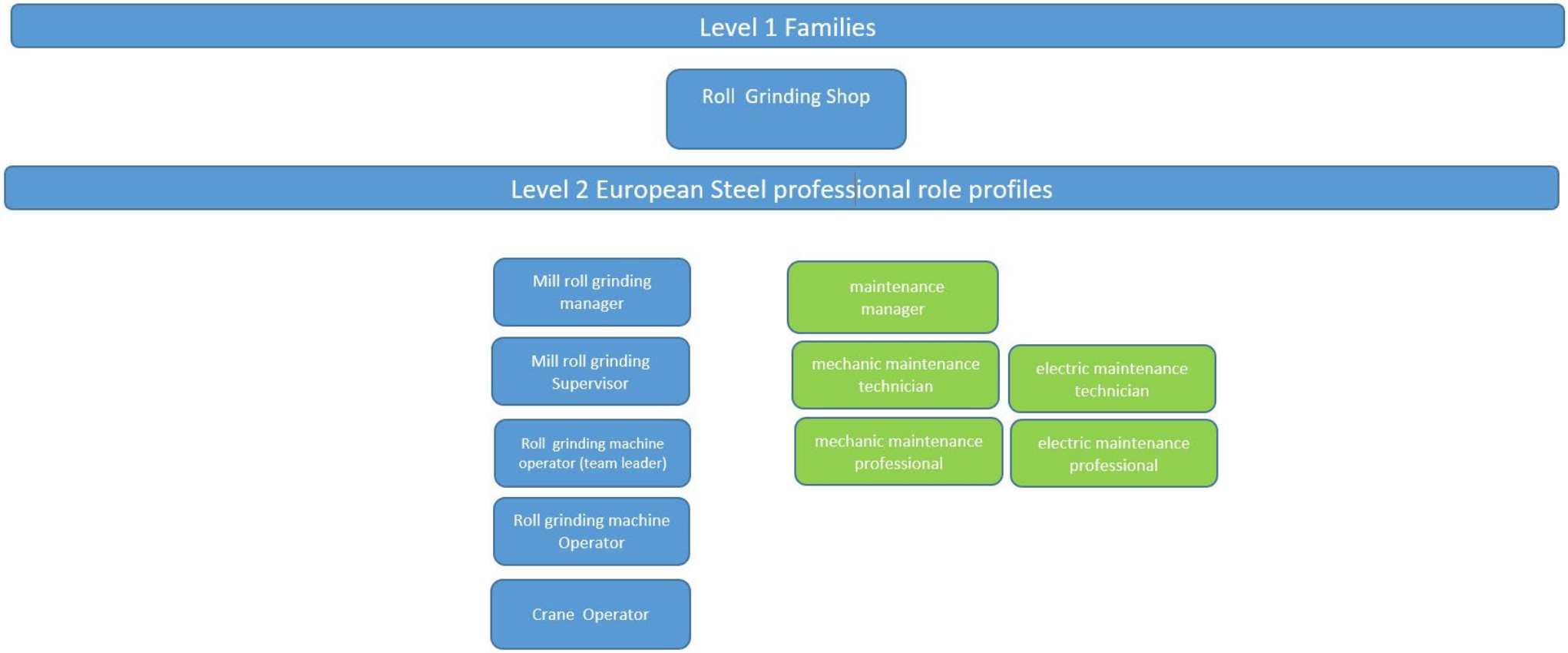

Level 1 Families
SteelWorks
Level 2 European Steel professional role profiles
Liquid Steel (Secondary Metallurgy & Ladle) Production Manager
Secondary Metallurgy Supervisor
Ladle & Refractory Supervisor
Secondary Metallurgy operator and maintenance
Ladle Preparation operator (team leader) and maintenance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

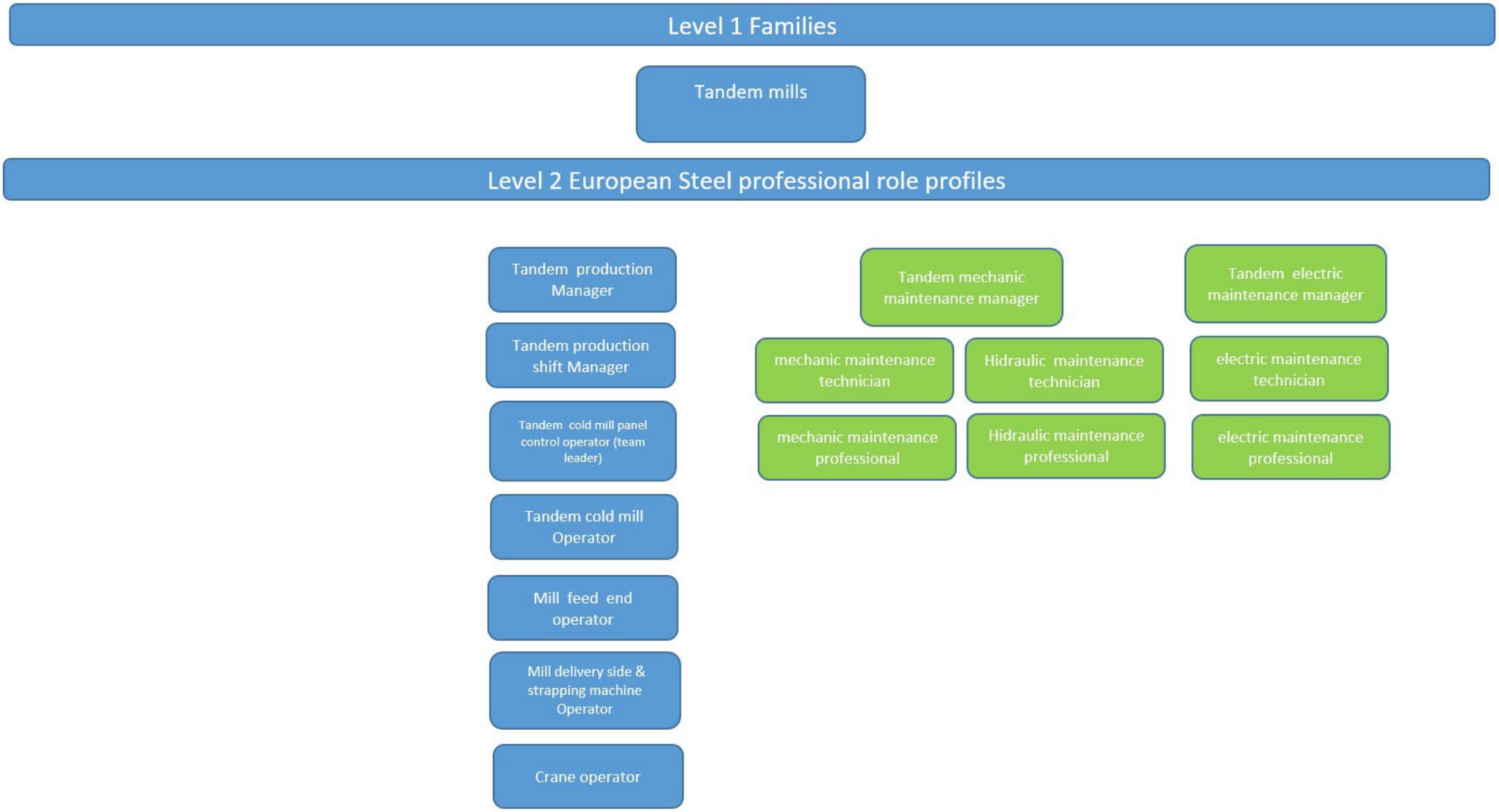

Crane Electric Maintenance Manager
Liquid Steel Electric Maintenance Manager
Solid Steel Electric Maintenance Manager
Liquid Steel Mechanic Maintenance Manager
Solid Steel Mechanic Maintenance Manager
Crane Mechanic Maintenance Manager
Crane Electric Maintenance Technician
Liquid Steel Electric Maintenance 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

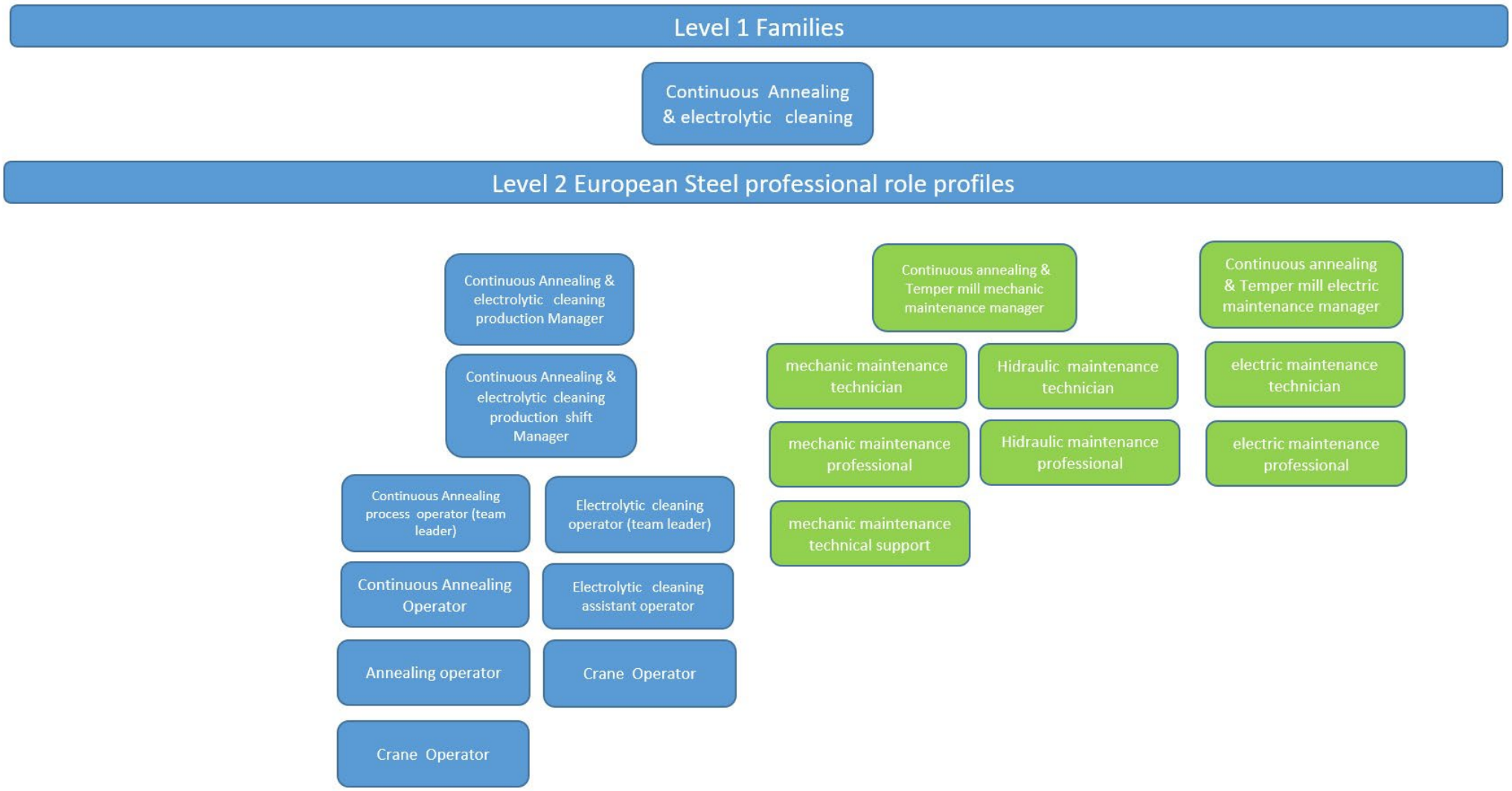

Level 1 Families
Hot Rolling Mill
Level 2 European Steel profesional role profiles
Hot Rolling Mill Production Manager
Hot Rolling Mill Shift Manager
Coiler machine Supervisor
Finishing rolling mill Supervisor
Reversing rolling mill Supervisor
Reheating furnace Supervisor
waste-water cleaning operator
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

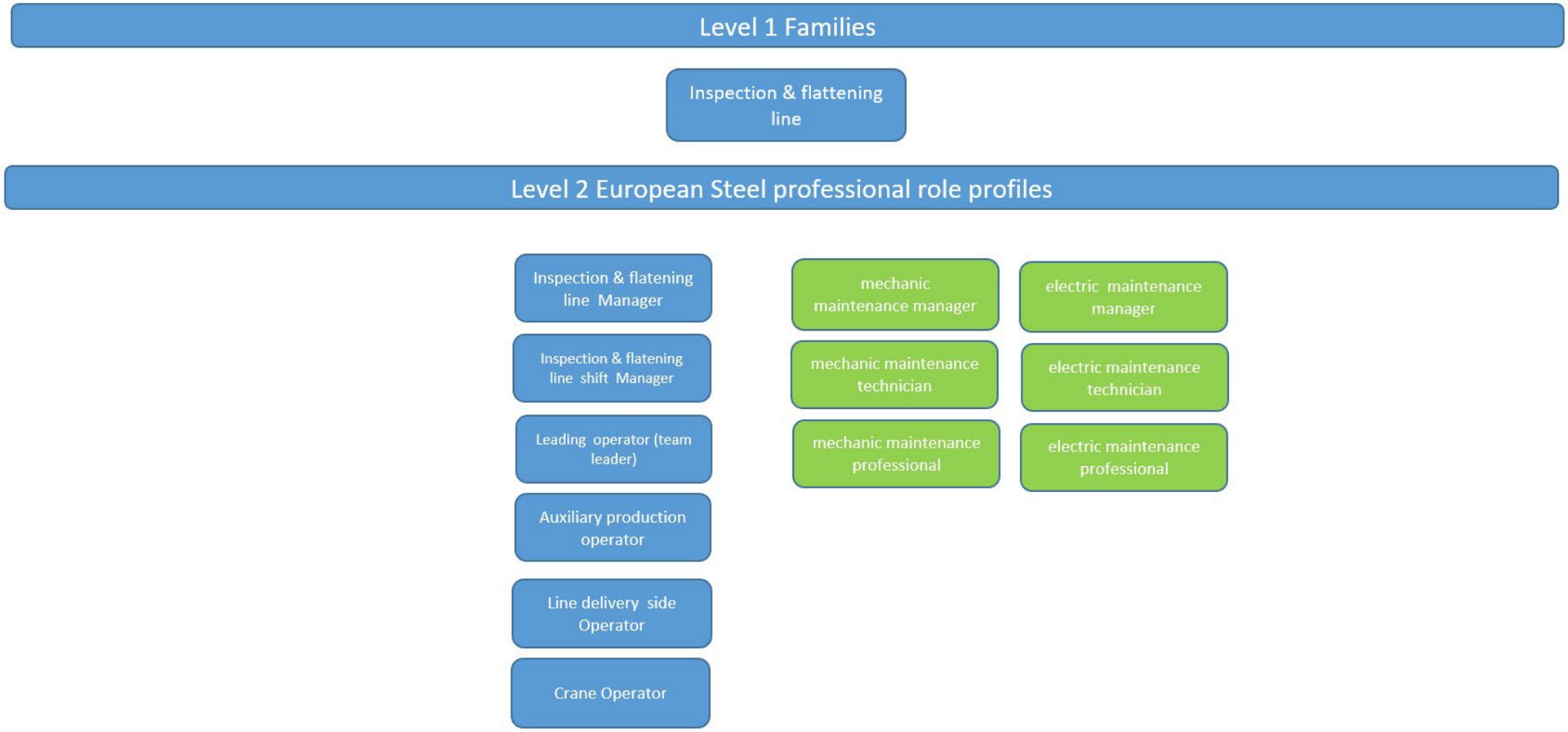

Level 1 Families
Tandem mills
Level 2 European Steel professional role profiles
Tandem production Manager
Tandem production shift Manager
Tandem cold mill panel control operator (team leader)
Tandem cold mill Operator
Mill feed end operator
Mill delivery side & strapping machine Operator
Crane operator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

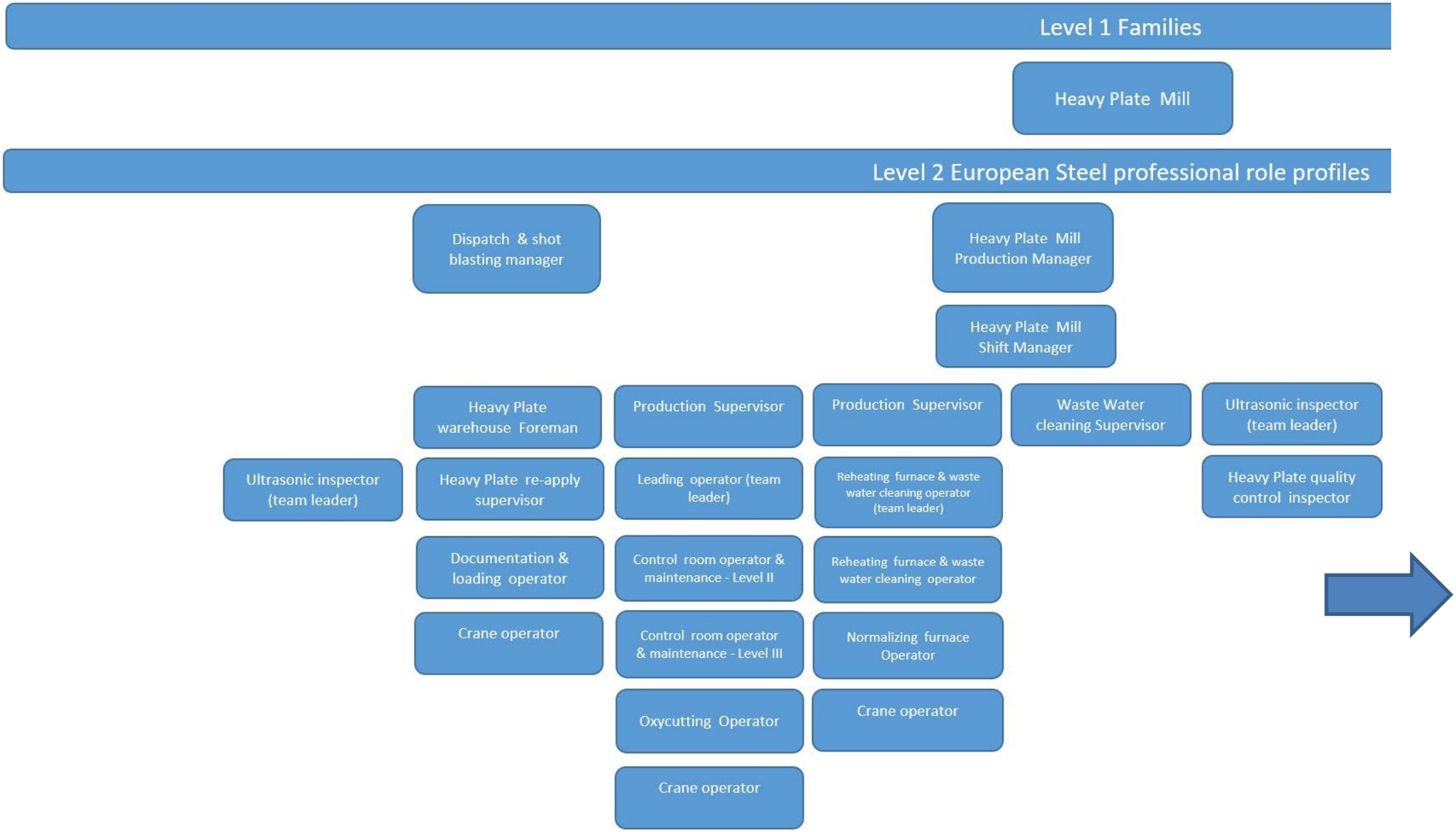

Level 1 Families
Continuous Annealing & electrolytic cleaning
Level 2 European Steel professional role profiles
Continuous Annealing & electrolytic cleaning production Manager
Continuous Annealing & electrolytic cleaning production shift Manager
Continuous Annealing process operator (team leader)
Electrolytic 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

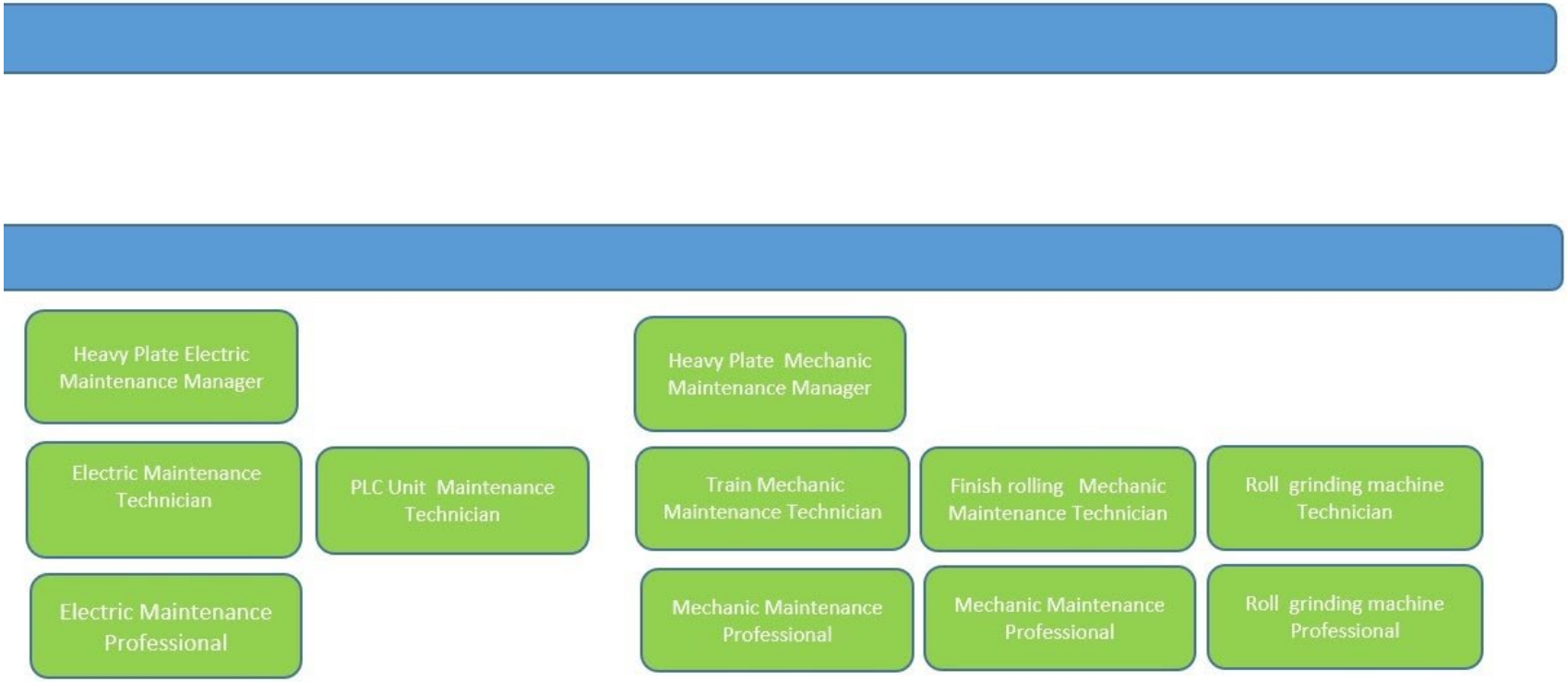

Level 1 Families
Temper mill
Level 2 European Steel professional role profiles
Temper mill production Manager
Temper mill production shift Manager
Tempering operator (team leader)
Tempering Operator
Crane operator

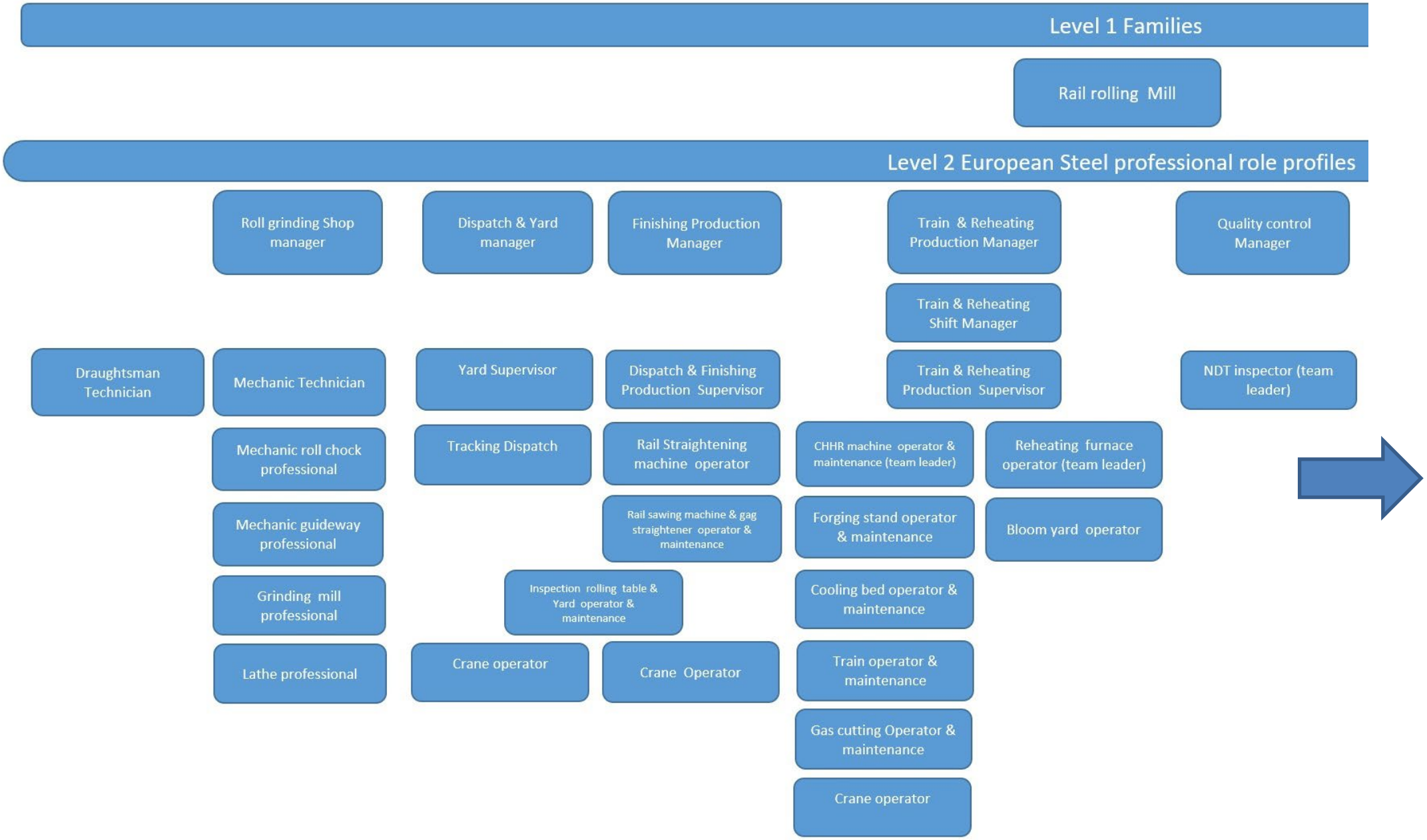

Level 1 Families
Tin Plate Line
Level 2 European Steel professional role profiles
Tin Plate production Manager
Tin Plate production shift Manager
Tin Plate process operator (team leader)
Tin plate process Operator
Tin Plate operator
Inspection line Operator
Crane Operator
Tin Plate mechanic maintenance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

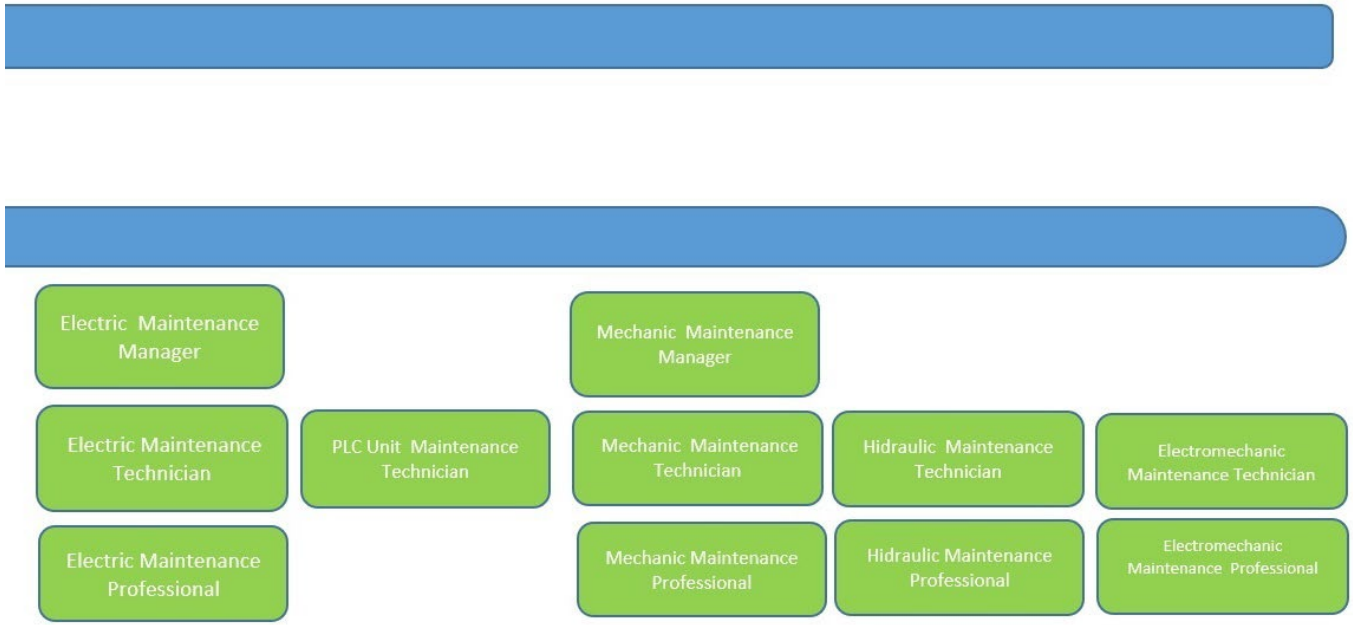

Level 1 Families
Galvanizing line
Level 2 European Steel professional role profiles
Galvanizing production Manager
Galvanizing production shift Manager
Leading operator (team leader)
Assistant leading operator
Inspection operator
Line feed end Operator
Line delivery side Operator
Welding machine Operator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

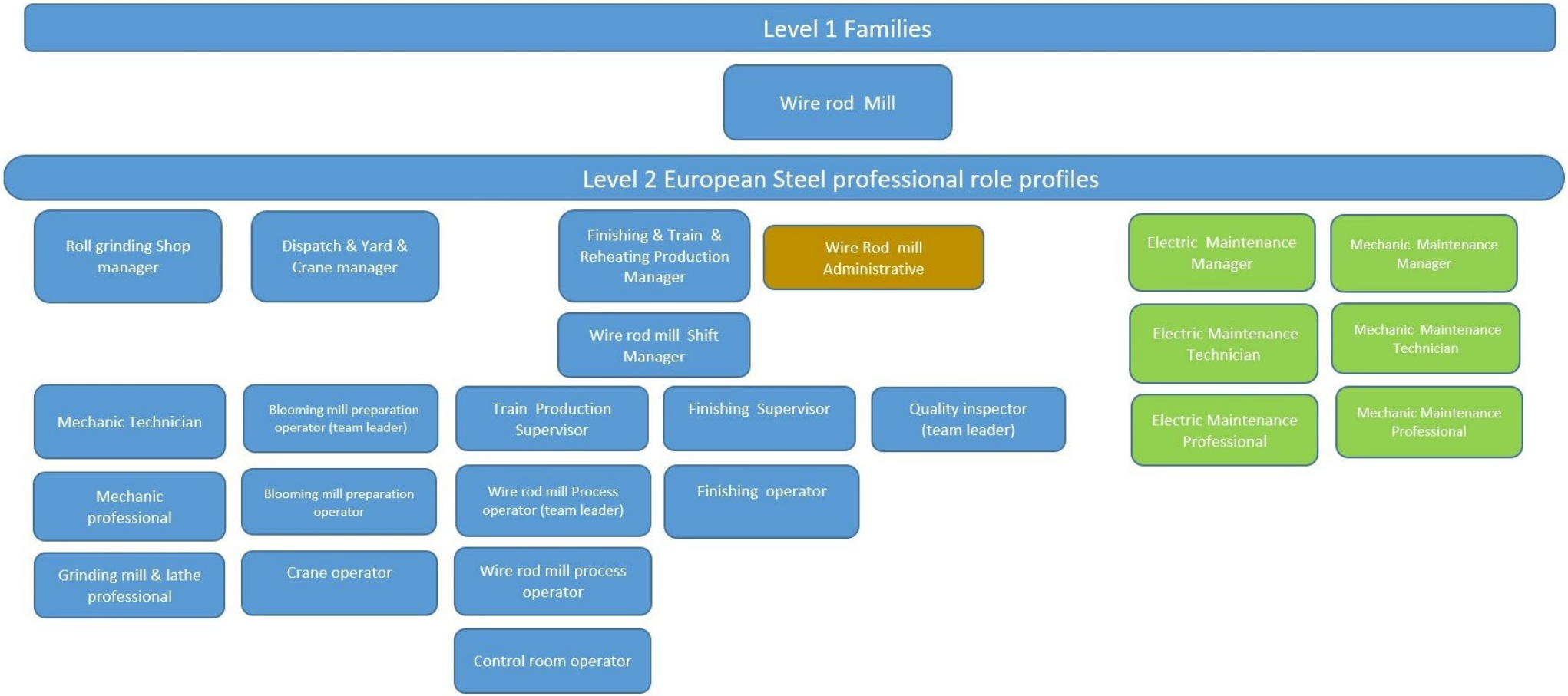

Level 1 Families
Inspection & flattening line
Level 2 European Steel professional role profiles
Inspection & flatening line Manager
Inspection & flatening line shift Manager
Leading operator (team leader)
Auxiliary production operator
Line delivery side Operator
Crane Operator
mechanic maintenance manager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

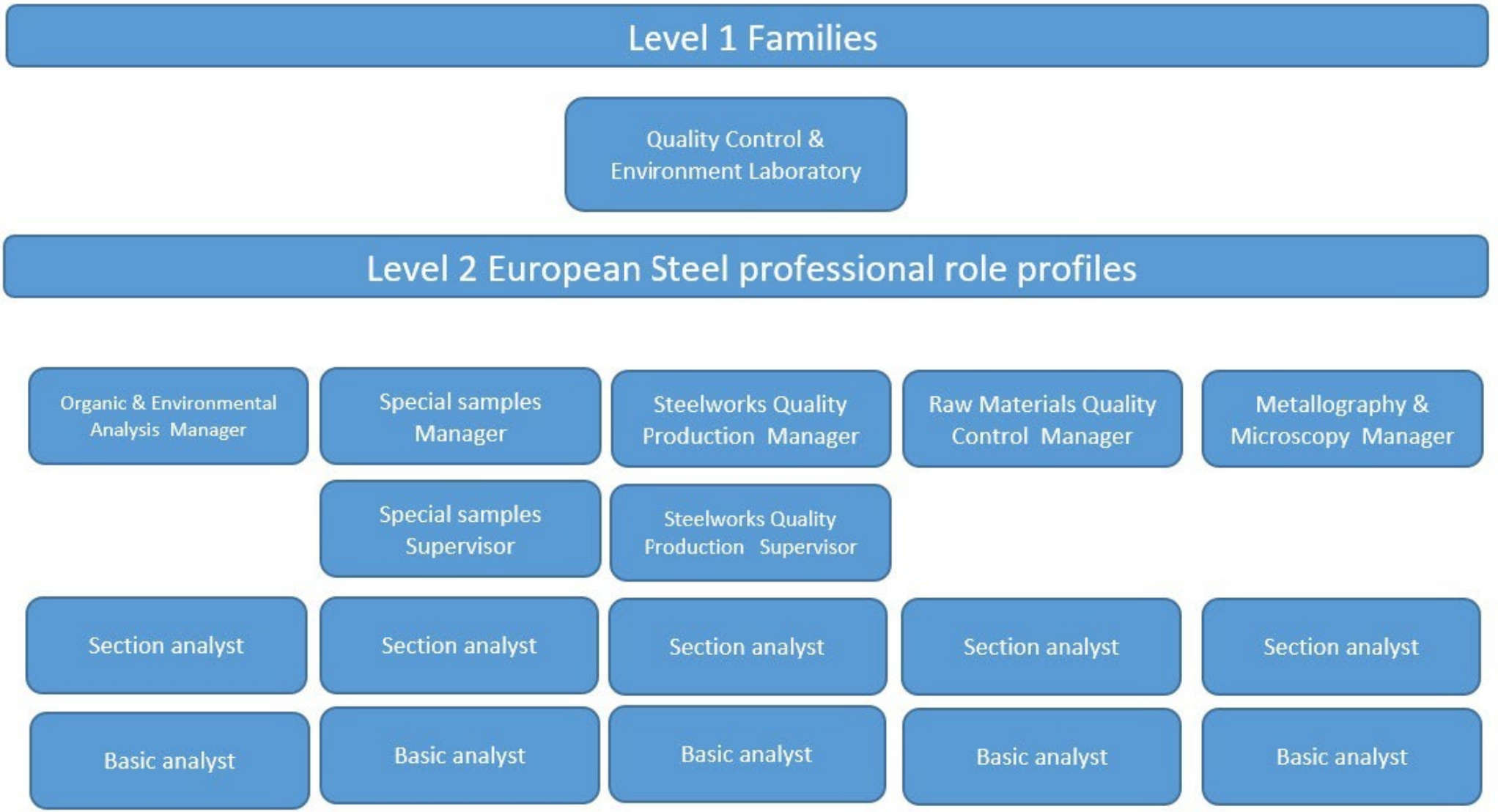

Level 1 Families
Heavy Plate Mill
Level 2 European Steel professional role profiles
Dispatch & shot blasting manager
Heavy Plate Mill Production Manager
Heavy Plate Mill Shift Manager
Heavy Plate warehouse Foreman
Production Supervisor
Production Supervisor
Waste Water cleaning Supervisor
Ultrasonic 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

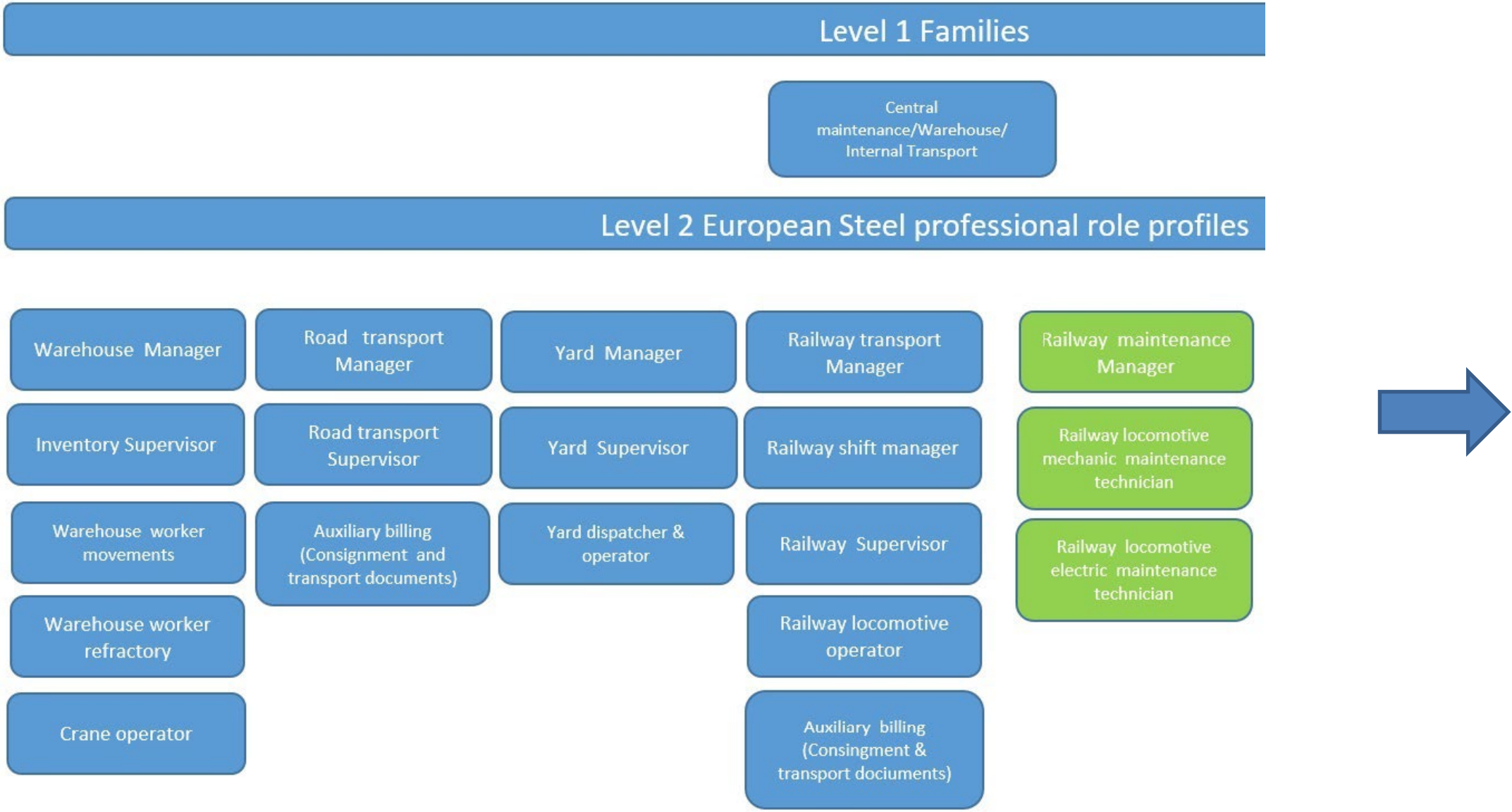

Heavy Plate Electric Maintenance Manager
Heavy Plate Mechanic Maintenance Manager
Electric Maintenance Technician
PLC Unit Maintenance Technician
Train Mechanic Maintenance Technician
Finish rolling Mechanic Maintenance Technician
Roll grinding machine Technician
Electric Maintenance Professional
Mechanic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

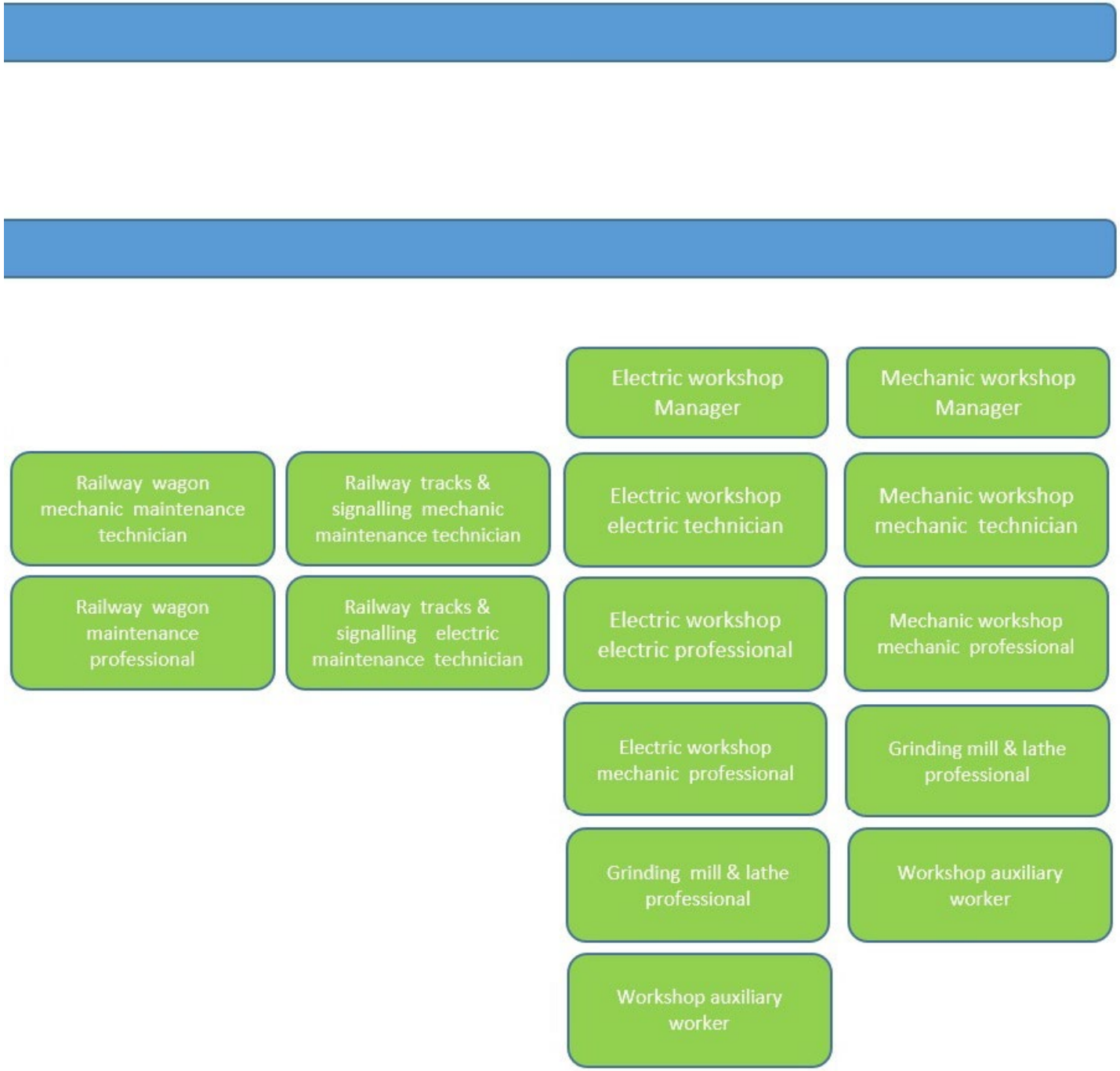

Level 1 Families
Rail rolling Mill
Level 2 European Steel professional role profiles
Roll grinding Shop manager
Dispatch & Yard manager
Finishing Production Manager
Train & Reheating Production Manager
Quality control Manager
Train & Reheating Shift Manager
Draughtsman Technician
Mechanic Technician
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

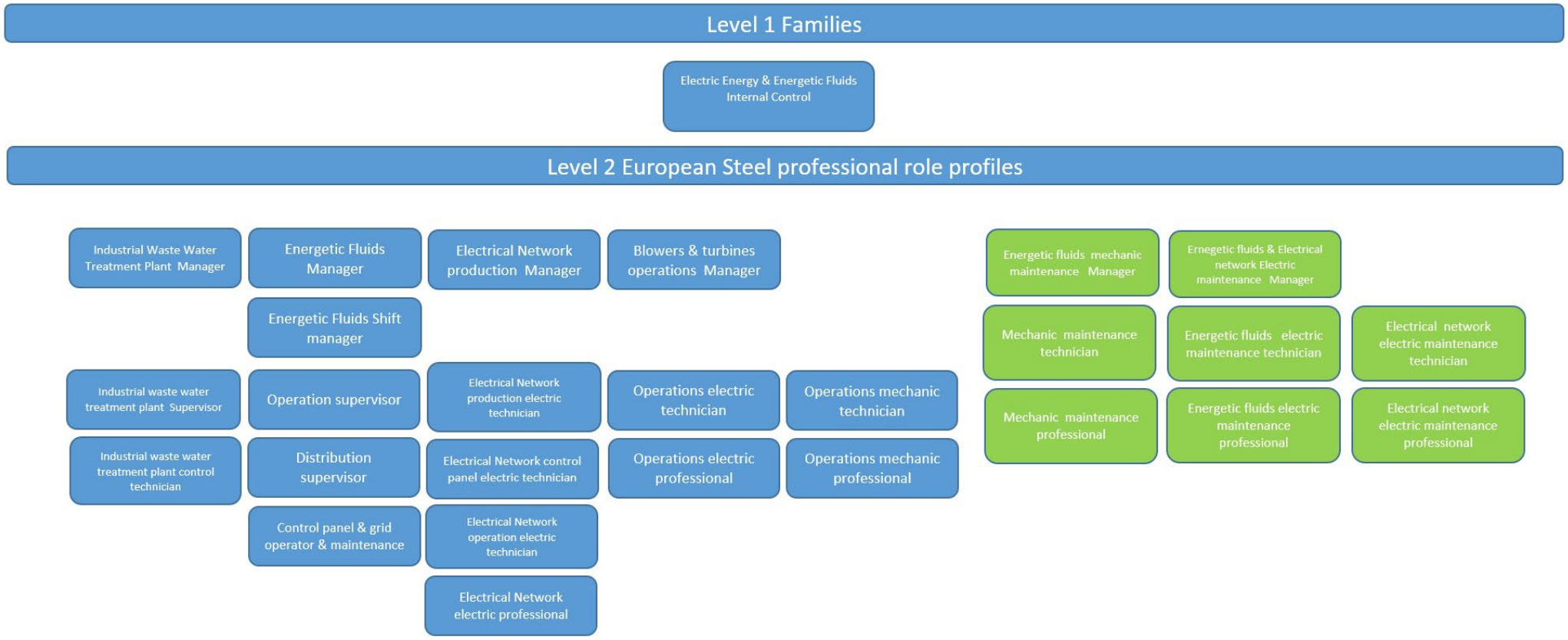

Electric Maintenance Manager
Mechanic Maintenance Manager
Electric Maintenance Technician
PLC Unit Maintenance Technician
Mechanic Maintenance Technician
Hidraulic Maintenance Technician
Electromechanic Maintenance Technician
Electric Maintenance Professional
Mechanic Maintenance Professional
Hidraulic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