



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

**Identification of National (Sector) VET
Qualification and Skills
(Regulatory) Frameworks for Steel**

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Executive Summary

The comparative research conducted for ESSA has identified some common trends in the case study countries (DE, ES, IT, PL, UK) and obtained some relevant insights in relation to skills gaps, systems' strengths and shortcomings, to inform cooperation between industry and VET providers.

- All the case study countries have recently undergone some VET reforms. Most commonly, reforms comprised:
 - activating dual training arrangements
 - relaunching and strengthening apprenticeship schemes
 - extending VET at the post-secondary level (EQF 4-6)
 - increasing flexibility of paths
 - better integrating social partners in the design of qualifications and in the training provision
 - establishing national quality assurance systems in line with the EU requirements
 - increasing transparency and defining national catalogues of qualifications
 - planning systematic reviews of qualifications
 - bridging cross-sectoral and occupation-specific skills and incorporating soft skills in the curricula (T-shape).

- Skills mismatches have increasingly been addressed through a more direct engagement of social partners (especially employers) in VET provision as well as in the existing feedback mechanisms (in Germany a solid and long-lasting cooperation in VET was already in place).

- Systematic reviews of vocational qualifications are needed to ensure that contents are up-to-date and vocational profiles are still relevant to the labour market. This is particularly important in the light of the accelerating pace of technological change.

- Recent reforms have introduced dual apprenticeship schemes, including in those countries in which VET was mostly school-based (e.g., Italy, Spain), with the aim to shorten the distance between formal training and companies. This results in an attempt to shift the whole system towards a more collective type of skills formation (see section 3.1).

- The competence of VET trainers is considered strategic to relaunch the attractiveness of vocational education and training.

- Permeability and flexibility of training paths have been enhanced through better connecting IVET with higher-level programmes and higher education. This aims to avoid dead ends and to reduce the divide between different programmes, allowing for more flexible and adaptive paths.

- All the case study countries have developed their own National Qualifications Repertoires and have undergone the process of referencing it to the EQF (except Spain). This increases transparency and comparability of qualifications through referring them to common and understandable descriptors.

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- As regards VET reforms, there is a latent tension between fast responses and mid- to long-term incremental adaptation. This appears to be exemplified by the cases of the United Kingdom and Germany. While fast responses might lack coherence and do not point to a long-term strategy (and could result in undermining trust in, and value of, VET), too rigid (and unidirectional) vocational paths have shortcomings in meeting the flexibility required by labour markets.
- In liberal market contexts, such as the United Kingdom, employers' increasing focus on updating and designing new qualifications might lead to a proliferation of narrowly defined occupational standards. This, in turn, might undermine the capacity of the system to deliver what ESCO defines as “skills with higher degree of reusability”, so limiting workers as well as businesses' resilience.
- Where the system is more fragmented, policy structures are both more complex and more unstable (e.g., the constant renewal the UK VET). This can inhibit both employers' and learners' engagement and trust.
- There is an urgent need to overcome the parcelling out of competencies and embrace a more holistic approach to occupational training.
- Completing IVET and obtaining a vocational qualification cannot be considered anymore the final goal, rather the first step in a continuous commitment to learning. In this respect, IVET acquires the status of foundational training, on which more specialised and up-to-date competencies can be built.

As regards skills and knowledge gaps, the research conducted has identified the following ten areas as the most common among the five case study countries¹. Based on the direction of the industry, VET provision should more effectively address these skills and knowledge needs (industry efforts to build skills to decarbonise operations i.e. so-called green skills cut across these areas):

- Digital skills
- Communication and connectivity
- Teamwork
- Analytical skills
- Metallurgical skills
- Problem solving and critical thinking
- Adaptation
- Advanced engineering
- IT skills
- Process/system knowledge

¹ Due to different national contexts, these skills gaps are not equally deep and are not evenly distributed across the case study countries. Moreover, in some case study countries, the deficits and challenges are not only well recognised and accepted, they are also being addressed. In other countries, however, VET system stakeholders do not appear to fully understand the challenges facing domestic industries, which leads to insufficient responses. A more detailed analysis for each country is offered in the national sections of this report.

SECTION I – Description of the deliverable and rationale

1.1 Description of the deliverable

This report focuses on the essential characteristics and main regulatory frameworks of Vocational Education and Training (VET) systems in five European countries involved in the ESSA partnership: Germany, Italy, Poland, Spain, UK.

This deliverable (D4.1) is one of the five outcomes of WP4 – *VET Requirements and Regulations/National VET Systems (relevant requirements and regulations for the Blueprint)*, which is aligned with, and a continuation of, the research carried out in WP2 - *Technological and Economic Development and Foresight*, and WP3 - *(Company) Skills Requirements and Foresight (Skills, Knowledge, Competences; Work 4.0)*.

The WP4 deliverables are devised as complementary to one another and aim to offer broad and comparable pictures of different aspects of the relationship between industry and vocational education and training. Specifically, this report intends to offer a picture of regulatory aspects and essential characteristics of the selected countries' VET systems, with a special focus on VET provision related to the Steel Industry.

The report moves from some general considerations about globalisation, market trends and technological innovation (which set the broad context for discussing the VET systems), to the process of *skills formation* and how this relates with vocational education and training in Europe. Subsequently, the report outlines the main characteristics and regulative frameworks of the five selected VET systems², how they function and relate with the labour market, with a special focus on how national VET systems are able to connect with, and respond to, the requirements of the steel industry.

1.2 Rationale

The anticipation of skills demands and their integration into VET provision are two of the most challenging and ambitious objectives of ESSA. Identifying skill needs and demands allows building appropriate training and curricula and strategizing for the implementation of new vocational education contents across the sector. This requires a clear understanding of how VET

² Here the concept of “system” is used in a general way, i.e. to indicate that vocational education and training is a complex set of programmes, processes and regulation, embedded in a wider legal, political and economic framework, namely the nation-state.

systems currently function across Europe, and how they provide relevant skills to the steel sector.

This report ties in strongly with the research conducted under WP2 and WP3, which has addressed the outcomes and consequences of market developments and technological innovation for the steel industry, and the current and future skills forecast within the sector.

The research conducted under WP4 focuses on establishing the relevant regulatory framework, functioning and vocational routes of five national VET systems, and on setting out the patterns of relations between national VET provision and steel companies in the case study countries.

The logic for selecting the case studies was primarily theoretical (Mason 2002): they have been selected because of their theoretical relevance and significance to the research questions addressed. What has guided the selection was them embodying different institutional layouts that influence the way vocational education and training is organised and carried out. Namely, the case study countries have been selected for their differences in terms of: (i) economic model, (ii) skills formation approach, (iii) overall organisation. This will be further illustrated in section II.

Before moving on, a clarification of the terminology that will be used is needed as it is essential for the purposes of this report to define what is intended by the terms: *occupation*, *job*, *qualification*, *skill* and *competence*.

An *occupation* is defined as the “set of jobs whose main tasks and duties are characterised by a high degree of similarity” (Cedefop 2014a, p. 186; ISCO-08).

A *job* is defined as the “set of tasks and duties performed, or meant to be performed, by one person, including for an employer or in self-employment” (Ibidem, p. 139; ISCO-08).

A *skill* is the ability to carry out the tasks and duties of a given job (ISCO-08) and is more specifically intended as the “ability to apply knowledge and use know-how to complete tasks and solve problems” (Cedefop 2014a, p. 227). It is acknowledged, however, that the concept of skill is extensively debated and the definition provided above is selected to fit narrowly with the aims and objectives of the ESSA project³.

A *competence* is the ability to apply learning outcomes adequately in a defined context or to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development (Ibidem, p. 47). The notion of competence is also highly debated, particularly in relation to skill⁴. The definition applied here, however, fits with aims and objectives of the ESSA project.

The concept of *qualification* can cover a range of different aspects. As clarified by Cedefop (Ibidem), it can be intended as a *formal qualification*, which is defined as “the

³ For a more extensive review of the concept and relevant scientific debates see Attewell (1990), Payne (2000), and Grugulis and Stoyanova (2011).

⁴ On the relationship between skills and competences see the distinction proposed by Boreham (2002) between process knowledge (skill) and mechanistic-reductionist (competence), and Clarke and Winch (2006).

formal outcome (certificate, diploma or title) of an assessment process which is obtained when competent body determines that an individual has achieved learning outcomes to given standards and/or possesses the necessary competence to do a job in a specific area of work. A qualification confers official recognition of the value of learning outcomes in the labour market and in education and training and can be a legal entitlement to practice a trade” (p. 202). Furthermore, the term qualification can also be used to signify a *job requirement*, meaning in this case the “knowledge, aptitudes and skills required to perform specific tasks attached to a particular work position” (Ibidem). From now on we will use the term *qualification* with the meaning of *formal qualification*.

Initial vocational education and training (IVET) is considered as the general or vocational education and training carried out in the initial education system, usually before entering working life (Cedefop 2014a).

Continuing vocational education and training (CVET) includes any education and training activity taken after initial education and training, or after entry into working life. It is aimed at improving or updating the knowledge and/or skills, acquiring new competences for a career move or retraining, and more in general, continuing personal or professional development (Cedefop 2014a).

1.3 Methodological note

The research is based on a mixed method approach, combining an exploratory survey, document analysis, semi-structured interviews and questionnaires.

The exploratory survey was aimed at understanding the experience of corporate partners with education and training as a basis for subsequent interviews. While document analysis is useful to set up an overall picture of the field(s) under investigation, qualitative interviews can add additional dimensions, or help to approach specific questions that emerge from the document analysis from a different angle, or in greater depth.

The five case study countries have been identified in relation to the characteristics of their VET systems and their representativeness of the European steel industry⁵. More specifically, the dimensions considered in relation to VET include the economic model embodied by the country and the type of skills formation system on which VET is based (see section 3.1.1), predominant learning arrangements (e.g. school based or apprenticeship based), the trajectory of the system in the last decade (e.g. academic drift vs vocational drift⁶).

An exploratory review of VET-related literature was carried out to identify the main scientific references and to establish a conceptual framework for carrying out the research. In parallel, an

⁵ Germany, Italy and Poland are ranked as the first three countries in terms of employment share in the steel sector in the EU28, while Spain and the UK are respectively 6th and 8th.

⁶ Cedefop (2020) defines any increase of the significance of VET (in relation to general/academic education at the same skill level) as a vocational drift, and any decrease as an academic drift.

online survey was launched to start mapping partners' expertise in the field of vocational education and training and industry skills needs.

1.3.1 Desk research and document analysis

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

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

The collected documents, which included scientific papers, institutional reports and national regulation, provided secondary data, insights and inputs to as a basis for the further stages of the research.

1.3.2 Qualitative interviews and questionnaires

Further to the results of the exploratory survey and desk research, and thanks to the support of the ESSA partners, semi-structured interviews to experts in steel production and vocational training were conducted remotely, given the inability to travel because of Covid-19 restrictions. The planned fieldwork in the five case study countries was therefore replaced by remote interviews conducted via online platforms.

In order to provide more options for participating in the research, the authors have also developed an online questionnaire for steel company representatives as a substitute for interviews where these were difficult to arrange (e.g. because of language issues or scheduling problems). The questionnaire was tailored on three categories of respondents: HR officers, Production Managers and Training Centre Managers. The online questionnaire was used in particular to conduct research in the steel companies in Poland and in Spain.

More generally, the interviews and questionnaires were addressed to representatives of steel companies, employers' associations, workers' unions and VET experts. The qualitative data generated in this phase was used to integrate, refine and consolidate the insights emerged from the initial desk research. Table 1 below summarises the reach of the empirical research activities. The numbers aggregate both interviews and questionnaires responses. The distribution of the interviews/responses points to a strong industry component, in accordance with ESSA industry-driven approach. This has helped to identify national and cross-national trends in terms of emerging skills needs and national VET programmes that feed into the industry.

Table 1 – Total Number of respondents

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

1.4 A premise: global market integration, technological innovation and substitution effects

Economic, digital and technological developments, in addition to increasing environmental concerns, are presenting the European steel industry with many challenges. As stated by Carl de Marè, Chairman of ESTEP, “global overcapacity and unfair trade practices are creating additional challenges. Thus, the road ahead for the European steel sector clearly shows the need for a fast introduction of innovative technologies while ensuring the competitiveness of the sector” (Estep 2017, p. iii). As the ambition of the EU steel industry “is to maintain and reinforce a global leadership, which is both sustainable and competitive” (Estep 2017, p. iv), Estep has identified attracting and securing qualified people and enabling digitalisation as two of the core strategies for supporting the industry.

Embracing technological innovation is therefore recognised as key for the sustainable future of the industry. However, technological innovation inevitably brings concerns on substitution of human labour and jobs loss (Cedefop 2018a). In a well-known article, Frey and Osborne (2013) stated that while computerisation has so far been confined to routine rule-based tasks, algorithms can now enter in a wide range of non-routine cognitive-based activities. Furthermore, progress in robotics is allowing robots to perform an extended set of manual tasks. The model developed by Frey and Osborne predicted a scenario in which “most workers in transportation and logistics occupations, together with the bulk of office and administrative support workers, and labour in production occupations will be at risk” (Ibidem, p. 44). Nevertheless, this position appears to be somehow biased, as it exaggerates the extent to which occupations can be automated (Arntz et al. 2017; Cedefop 2018a). A McKinsey report (2017) argued that less than 5% of occupations are completely automatable, even though 60% of occupations include at least one automatable task out of three.⁷

Although there is evidence that digitalisation has contributed to the polarisation of the labour market and to the erosion of jobs within the middle-skills range, automation allowed by robotics has mostly substituted jobs characterised by routine and non-cognitive tasks, while a sensible growth has been detected in high-skilled occupations and a moderate growth in low-skilled non-routine jobs requiring human interaction (Cedefop 2018a).

⁷ The Frey and Osborne (2013) paper illustrates perfectly the challenges that comparative international VET research faces. Osborne and Frey, being based in the USA, adopt ‘jobs’ (a relative narrow set of tasks) as the main unit of analysis. When work is conceptualised in this way, the risks posed by automation appear far greater than when work is conceptualised broader, for example in terms of ‘occupations’, which comprises multiple jobs and therefore a much wider set of tasks than jobs. Unsurprisingly, research that adopts ‘occupations’ as their main unit of analysis does not come to the same conclusions as Osborne and Frey (e.g. Dengler and Matthes 2018). In many contexts, VET actors do not clearly and consistently distinguish between jobs and occupations (or jobs and competences as another course of confusion and misunderstanding) which makes international comparisons difficult as it is often not sufficiently clear how certain key terms are used.

From an analytical point of view, when talking about technological innovation one should distinguish between product and process innovation. Here, some studies have found product innovation to be labour-friendly, while process innovation to be more job-destructive (Harrison *et al.* 2008; Vivarelli 2014). However, these two components are often interrelated, and process innovation is not always linked with job loss as various market compensation mechanisms can counteract the unemployment effects of process innovation (Vivarelli 2015). Plus, the spread of ICTs has proved to be a major job driver in European economies, although not yet enough to absorb job loss due to automation (Berger and Frey 2016; Cedefop 2018a). Nevertheless, “technological progress and ICT technologies have not only created new, typically high-skilled jobs [...] they are also expanding possibilities for individuals to undertake more interesting and productive tasks at work and online, leaving the more routine activities to the robots best-equipped to do them” (Cedefop 2018a, p. 25). Berger and Frey (2016), maintain that technological change has increased the demand for cognitive skills, at the same time reducing the demand for performing routine tasks. Thus, “investing in skill upgrading is a key policy lever not only to revive faltering productivity growth, but also to mitigate further unwanted increases in inequality while ensuring that ample economic opportunity is available to workers in the twenty-first century” (*Ibidem*).

SECTION II – Steel industry in Europe

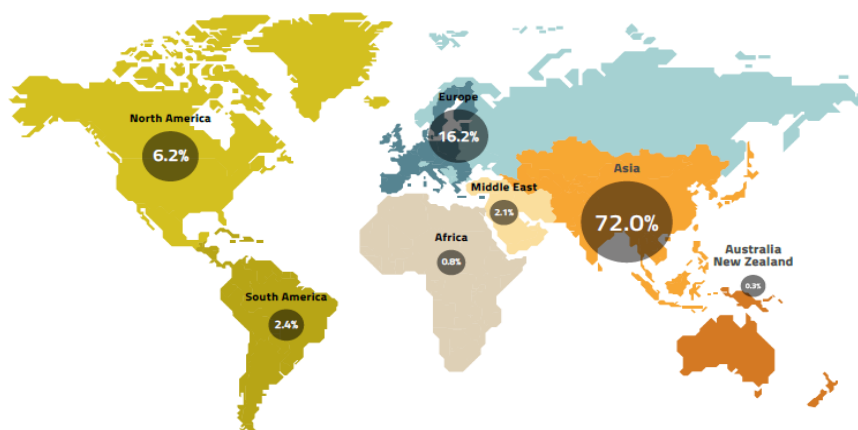
2.1 Current challenges and economic outlook

Economic trends in the EU have inevitably had an effect on the European steel industry. Economic growth predictions for the years 2020-2021 were dramatically changed by the impact of the Covid-19 global pandemic. The pandemic “has hit the EU economy and industry at a time when a significant slowdown had already been brewing” (Eurofer 2020a, p.7) and the effects of national lockdowns and stops in production are not yet entirely visible.

Eurofer has pointed to three major challenges that the sector is currently facing, namely the recovery from the Covid-19 crisis, the low-carbon transition and global trade⁸. In addition to this, the industry is actively engaged in transforming the public opinion of itself, a challenge which links directly with the need for attracting new talents to overcome skills gaps. In this respect, much has to do with how successfully the industry is able to convey the message that it “is not a dying fossil-based industry”⁹.

As regards production output and economic performance, the global share of European steel has further decreased from 17.2% in 2018 to 16%, while the Asian share has increased by 1.4 points, although direct employment in the sector at the European level has slightly increased (+ 0.3% in the same time frame, and + 2,4% between 2016 and 2019) (see Figures 1).

Figure 1 – Steel production by macro-region in 2021



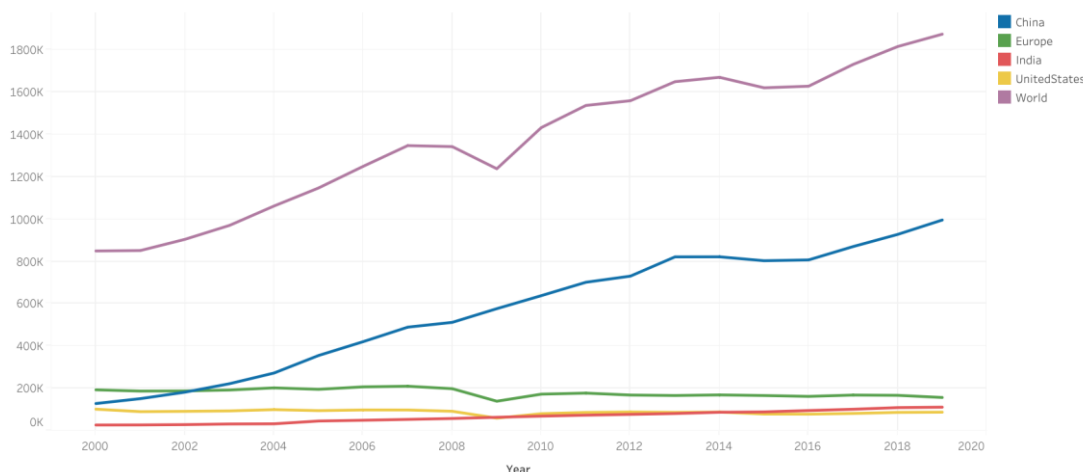
Source: Eurofer, *Steel in figures 2022*

Figure 2 – Global production of crude steel (in thousand tonnes) 2000-2019

⁸ Questionnaire response, Eurofer.

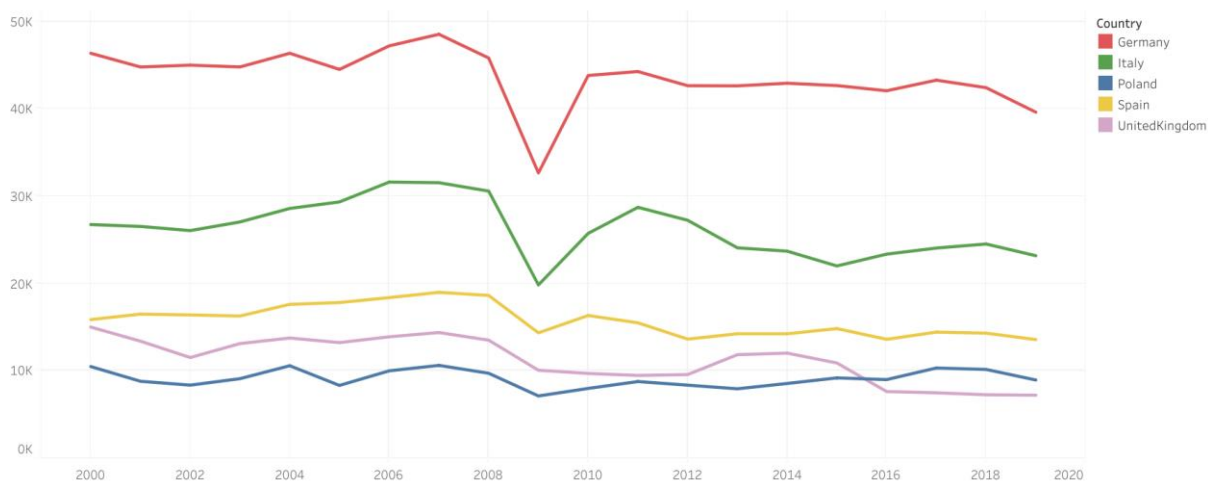
⁹ Questionnaire response, Eurofer.

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Source: Worldsteel data, own elaboration

Figure 3 – Production of crude steel (in thousand tonnes) in the 5 case study countries 2000-2019



Source: Worldsteel data, own elaboration

Figure 2 shows the stagnation of the European steel output and the increased production of China between 2000 and 2019, which accounts for most of the global output increase. At the European level, Germany remains the largest producer, followed by Italy. Focusing particularly on the ESSA project case study countries (Figure 3), we can see very similar trends (net of the different level of total output) with a visible fall in production due the financial crisis of 2008-2009 and a slight slowdown started between 2017 and 2018, coinciding with the introduced of protectionist measures by the Trump administration in the USA.

Overall, crude steel production in the EU in 2019 dropped by 6% compared to the production in 2018. Such a decrease reflects a continued deterioration in demand from steel-using sectors, coupled with a fierce competition in the domestic EU market, as well as in export markets (Eurofer 2020a).

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Since steel production highly depends on sectors such as automotive and construction, the broader manufacturing sector plays a crucial role. As one interviewee put it:

“Our steel is related to the automotive sector. We are very connected to this sector, so the future of the steel that we are producing is related to the future of the automotive sector in Europe. As simple as that”¹⁰.

Eurofer (2020) underlines how business conditions in the manufacturing sector have deteriorated since the end of 2017, with a steeper downward trend started in the second quarter of 2019, particularly in the automotive sector. The impact of the Covid-19 crisis has exacerbated such condition, hampering the recovery of steel-using industries and, consequently, the steel sector. In prospect, “it will also take time before new orders in industrial sectors translate into additional steel demand, provided that normal business conditions are restored after the end of the pandemic” (Eurofer 2020, p. 9).

In relation to end-markets, some concerns have been raised regarding the prospects of the sector:

“There is no vision of a lasting market expansion unless new markets such as North Africa open up. Alternatively, I expect a decline in manufacturing, and therefore in steel production, which will accompany the conversion of production processes towards less impactful ones. The closure of several steel plants in recent years is progressively delaying this transition. More protectionist choices in Europe may contain this decrease in production (but we are still in need of new markets)”¹¹.

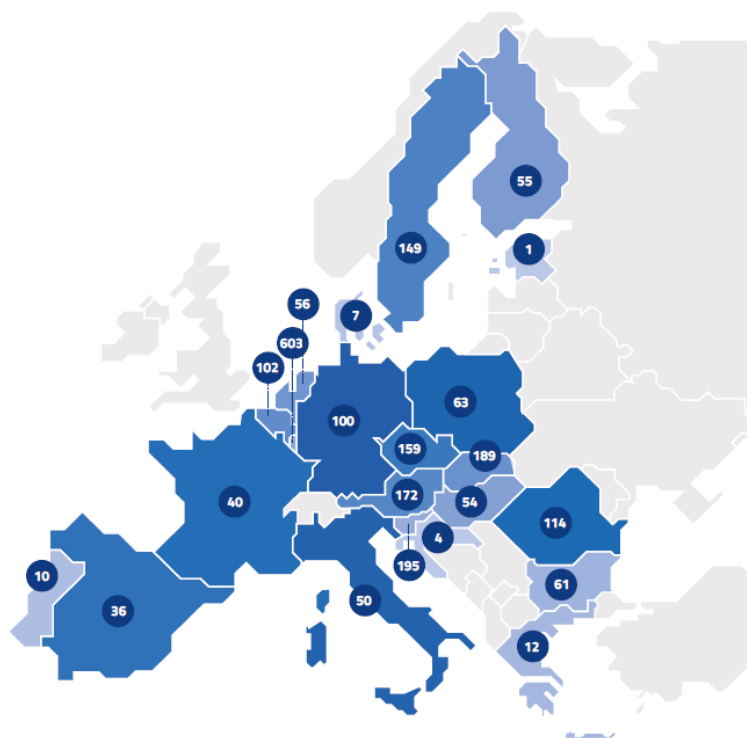
Moving from production to employment in the sector, Figure 4 below shows the density of employees in the steel industry in the EU-27 countries (normalised number of employees in 100,000 people), which shows a higher density in Sweden and Finland, followed by Romania and Germany.¹² Regarding the share of total employees in the EU steel industry, Germany, Italy and Poland are the top three countries, with a share of 26.0%, 9.3% and 7.5% respectively.

¹⁰ Interview transcript, HR officer in steel company, Spain.

¹¹ Questionnaire responses, senior production manager in steel company, Italy.

¹² Since 2022, Eurofer’s statistics are for EU-27 only, taking into account that the UK has left the European Union. The last available employment density figure for the UK from 2019 suggests that 26 people per 100.000 are employed in the steel sector (Eurofer Steel in Figures, 2020).

Figure 4 – Employment in the steel sector per 100,000 people in 2021



Source: Eurofer, Steel in figures 2022

As regards decarbonisation and environmental sustainability, a major driver of change in the coming years is represented by the European Green Deal. This pursues “a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use”. Such commitment explicitly refers to energy-intensive sectors like steelmaking, stating that the decarbonisation and modernisation of the sector are essential. This goes along with an explicit commitment to support clean steel breakthrough technologies leading to a zero-carbon steelmaking by 2030 (Evans and Stroud, 2014). Such concerns emerged also during the interviews:

“We've talked a lot about digitalisation. But you know, a bigger challenge might be green technology. Because there is so much pressure just now on reducing emissions. We produce super high-tech products, we do that really, really well. But the big challenge facing all of us in the sector is how do we do this in a greener way”¹³.

“Many initiatives under the EU Green Deal offer challenges yet needed steps to transform the steel industry into more environment friendly and carbon-lean. Examples are the CO₂ emission goals for 2050 and all the legislation that needs to be modified accordingly and

¹³ Interview transcript, workers' union representative, EU.

the initiatives arising from the new Circular Economy Action Plan, for instance. The European steel industry's own emissions reduction goals can be achieved, provided that the enabling framework is in place, also by the policy makers"¹⁴.

Current data from Worldsteel estimate a production of CO₂ of 1.85 tonnes for each tonne of steel produced. In relation to the net zero target, "Eurofer believes that the European steel industry could achieve carbon emissions cuts of 95% by 2050. This will nevertheless result in an increase in the total cost of production of 35-100% per tonne [...] with a requirement for 400 TWh of CO₂-free electricity, seven times the current consumption of the sector" (Sindex 2021, p.3-4).

Overall, it appears that blast furnaces and DRI (Direct Reduced Iron) furnaces will remain the main routes for European steel producers, and that EAF-based steel will only reach a share of 40% of production by 2050. At the same time, the main European companies are now engaged in the development of a DRI-Hydrogen solution including, for most of them, a transition from blast furnaces to EAF over the next 20 years (Syndex 2021).

2.2 Technological advancement

Estep's Strategic Research Agenda (2017) maintains that the future evolution of the industry will be driven by five needs: sustainability, quality, lead time, profitability and health and safety. To reach these goals, Estep's Agenda envisages a Smart Steel Factory, resulting out of vertical, horizontal and transversal integration¹⁵, and enabled by key technologies such as Internet of Things, Cloud Computing, Big Data and so on. This strategy and conceptualisation (which in Estep was referred to as *integrated intelligent manufacturing*) aligns largely with the more well-known German concept of Industry 4.0 (I4.0).

As it was pointed out, "Steel producers have high expectations. I4.0 and digitisation are cornerstones of their sustainability"¹⁶. However, the state of play of such key enabling technologies across Europe still appears uneven and it is difficult to sketch out a clear picture.

In general, automation has been recognised as crucial to the steel industry, something that has been constantly applied over the last decades to improve process optimisation and products quality:

"Familiarity with automation is intrinsic to the steel industry, at least for what I've seen over the last 35 years. Every 20 years or so, the plants are modernised, mainly due to the unavailability of spare parts. The size and energy involved tend to make automation levels basic, but this is not true everywhere [...] Obviously the reliability criterion applies, I automate to improve performance and reliability"¹⁷.

¹⁴ Questionnaire response, Eurofer.

¹⁵ Vertical integration is intended as the integration of all IT and automation components within a plant. Horizontal integration refers to the integration of the complete production chain, and transversal integration addresses the optimisation of technical, economic and environmental issues (Estep 2017).

¹⁶ Questionnaire response, Eurofer.

¹⁷ Questionnaire response, Production Manager in steel company, Italy.

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“I think Industry 4.0, we do need to look at it, but you're going to get different answers, depending on who you ask. Because you might have one company that they've already made a lot of changes [...] You might have others who've done no digitalisation, and they're not prepared, and maybe they're not going to do it in the best way. So, I think it really depends. The feedback we've got from a lot of our steel experts is the sector has already been digitised quite a lot already. So quite a lot of the big changes have happened”¹⁸.

“Steel is a sector that has already advanced considerably on its digitisation agenda”¹⁹.

Although the transition to automation and digitalisation appears to be nothing new in the steel industry, the degree to which the different Industry 4.0 technologies are implemented seem to vary. Eurostat data depict a diversified picture of the former EU-28 countries, as shown in Figure 5. Where the use of industrial robots appears as the most common trait within the manufacture of basic metals and fabricated metal products, the degree of adoption is at different stages. Also, there appears to be an evident difference in the adoption of other pieces of technology such as RFID and machine learning algorithms.

Figure 5– Percentage of companies using I4.0 technologies in 2020 in the former EU28 in manufacture of basic metals and fabricated metal products (excluding machines and equipment)²⁰



¹⁸ Interview transcription, workers’ union representative, EU.

¹⁹ Questionnaire response, Eurofer.

²⁰ To be noted that where percentage is zero the data for the indicator is missing.

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Source: Eurostat data, own elaboration

The work undertaken by WP2 within the ESSA project (Deliverable 2.1) shows how digitalisation is affecting the European steel industry, with the objective to increase efficiency and sustainability, and reduce environmental impact. D2.1 lists several processes that are being affected by digitalisation and smart technologies. Such processes include:

- Energy management

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- Water and wastewater management
- Blast furnaces management
- Basic oxygen steelmaking and casting
- Pollution prevention

In addition, D2.1 has identified several projects dealing with specific technologies that can be applied to the steel industry:

- Internet of things
- Big data analytics and cloud computing
- Robot-assisted production
- Production line simulation
- Self-organising production
- Smart supply network
- Vertical/horizontal integration
- Predictive maintenance
- Cyber security
- Augmented work, maintenance and service
- Self-driving logistics vehicles

While technologies advance at different pace, it can be assumed that the transition to smart steel production, once sufficiently advanced, will be irreversible. From this stems the need for a workforce that develops in parallel with the technological shift:

“This trend towards digitisation will necessarily require a significant degree of skills improvement to handle the technical aspects of industry 4.0 applications and tools in a digitised industrial environment. Currently this set of skills is in relatively short supply in Europe overall, and attracting candidates with the requisite abilities and aptitudes to the steel sector is an ongoing challenge”²¹.

Several authors have addressed the issue of developing a workforce adequate for Industry 4.0, applying to it different labels, such as *Human Capital 4.0* (Flores et al., 2020), *Operator 4.0* (Romero et al., 2016), *Workforce 4.0* (Estep, 2017), *Berufsbildung 4.0* (Germany’s concept for vocational training 4.0).

The Human Capital 4.0 approach, proposed by Flores et al. (2020), for instance, is intended as a ‘holistic shift in terms of competence, well-being, education and innovation. This futureproof workforce needs to be equipped with soft as well as technical competencies, cognitive and analytical skills, and emotional intelligence.

Romero et al. (2016) have developed the concept of Operator 4.0 moving from the need to create trusting human-machine interactions, making it possible for smart factories to capitalise not only on technologies, but also to empower their ‘smart operators’ with new skills and devices. In this perspective, the authors have proposed a typology of Operator 4.0 which aims at expanding the capabilities of the worker. This typology includes eight extended operators: a) Super-strength Operator (operator + exoskeleton), b) Augmented Operator (operator + augmented reality), c) Virtual Operator (operator + virtual reality), d) Healthy Operator (operator

²¹ Questionnaire response, Eurofer.

+ wearable tracker), e) Smarter Operator (operator + intelligent personal assistant), f) Collaborative Operator (operator + collaborative robot), g) Social Operator (operator + social networks), h) Analytical Operator (operator + Big Data analytics).

The idea of *Berufsbildung 4.0* was launched in 2016 by the German Federal Ministry for Education and Research (BMBF) in collaboration with the Federal Institute for Vocational Education and Training (BIBB). This is intended as a long-term strategy aimed at securing future-proof qualifications through an occupational screening of the jobs mostly affected by digitalisation and the required competencies. Particular attention is given to digital skills of both trainees and trainers and to aspects such as digital media communication and digital security²².

Within the steel sector, Estep's strategic agenda (2017) also mentions the idea of *Workforce 4.0*: safety will benefit from the minimal and remote interactions in harsh environments by means of intelligent systems and robots, both autonomous and piloted by humans, while local and global monitoring of plants and workplaces will guarantee health to workers and surrounding communities. Another important change, from Estep's point of view, is that operator skills will be oriented more towards maintenance and monitoring, rather than manual operations. Furthermore, projections on workforce trends estimate that about 20% of the current workforce will retire in the next ten years. Such transition is considered at the same time a challenge and an opportunity: a challenge from a skills and competences perspective, certainly, but an opportunity to leverage the change in the workforce composition as an endogenous driver of sectoral transformation. In strategic terms, "to ensure the ongoing competitiveness of a safer, cleaner and more technologically developed steel industry, a highly skilled workforce is required. In fact, highly skilled people are the vital resource for the industrial added value in Europe today and tomorrow" (Estep 2017, p. 43).

²² More information at: <https://www.bmbf.de/de/berufsbildung-4-0-3246.html>

SECTION III – Skills formation systems and skills mismatches

3.1 Skill formation and European VET systems

The main aim of ESSA is to address industry skills demands and challenges to support a sustainable, efficient and competitive European steel industry. Identifying skill needs and demands will allow building appropriate training and strategizing for the implementation of new vocational contents across the sector. This requires an understanding of how VET systems currently work and provide skills to the sector in different European countries.

Moving from a neo-institutionalist perspective, we maintain that each country presents peculiar “institutional struggles that determine the dominance of a certain paradigm. This approach helps us to understand the different organisational models existing across countries and nations” (Vallejo-Peña and Giachi 2018, p. 24). Institutions operating in a society are shaped by their historical path and, once considered in their joint combination, make up coherent models which can differ deeply from one another. If we assume that different institutional contexts produce different approaches with regard to market regulation, industrial relations and skills formation systems, then it is crucial to identify a set of case studies that embody these differences. A comparison between these is of great interest in the definition of a new skills agenda and strategy for the steel industry as it allows to identify good practices and criticalities associated with the different institutional models, as well as common trends.

3.1.1 The socio-economic context of skill formation

As acknowledged by socio-economic research, skills formation has a variety of important outcomes for the economic system. Furthermore, scholars are aware that the development and availability of skills is not a matter of straight rational choices but is highly dependent on the political-economic context (Busemeyer and Trampusch, 2011).

In this regard, the seminal classification developed by Hall and Soskice (2001) has triggered a wide range of contributions within the fields of economic sociology and sociology of education. Hall and Soskice’s Varieties of Capitalism (VoC)²³ distinguishes between Liberal Market Economies (LME) and Coordinated Market Economies (CME). The first, best embodied by the United States and the United Kingdom, is characterised by the primary role of the market in regulating the economic system’s dynamics. This leads to short-term strategies based on high returns and short payback and low trust relations between firms, and between firms and other stakeholders. CMEs, usually represented by Germany, are instead characterised by state intervention that regulates economic dynamics within the market. Here firms are strongly linked through sectoral associations and with the relevant social partners. Companies are encouraged to adopt more long-term strategies and are less dependent on financial markets.

²³ The VoC framework entails a wider discussion of the institutional similarities and differences among developed economies, which identifies the firm as the organising principle and is not singularly focused on skills formation. The VoC approach has also been vigorously critiqued and is considered as contentious by some. We utilise the framework as a heuristic to organise case study that does not require any further judgement on the value or validity of the framework as a whole.

From an innovation-skills point of view, VoC analysts point out that, within LMEs, fluid labour and capital markets make it easier for firms to engage in new ventures offering favourable conditions for radical innovation. This goes along with skills polarisation and a labour market comprising specialised professionals coming from higher education, and non-specialised workers that find it more convenient to invest in general and portable skills to cope with unpredictable market turns. CMEs instead rely on a solid fabric of relations between companies and social partners and wider welfare coverage, which makes it more convenient for workers to invest in specialised skills and commit to a life-long professional career. This leads to a more incremental approach to innovation (Hall 2015). Table 2 below provides an overview of the main features of LMEs and CMEs.

Table 2 – Hall and Soskice’s VoC typology

	Liberal Market Economies	Coordinated Market Economies
Main form of coordination to overcome transactions costs and collective action problems	Mainly markets - but firms may also use also networks and hierarchies (in the case of vertical integration)	Predominantly negotiation through corporatist institutions (but sometimes also through networks, hierarchies)
Characteristic interaction among stakeholders	Predominantly spot exchange and short-term (but also reiterated exchange among networked firms and orders and directives in vertically integrated firms)	Predominantly longer-term institutionalised meetings (but also reiterated exchange, orders and directives where appropriate)
Firm characteristics	Dispersed stock ownership, specialised managerial corporations, predominantly competitive relations with other firms, limited participation in sectoral associations	Concentrated ownership, often bank-controlled, strong participation in sectoral associations, cooperative relations with other firms.
Employment and Industrial relations	Short-term, market-driven employment relations. Few unions (company unions rather than industrial unions)	Long-term, negotiated employment relations. Strong, encompassing unions, industrial-level bargaining.
Skills	General	Sector specific
Role of the state	Limited to ensuring property rights, key public goods and maintaining the institutional context of the liberal market economy	Committed to facilitating the institutional architecture of co-ordinated outcomes, providing supportive industrial, economic and labour-market policies for co-ordinated market economies
Comparative institutional advantage	Radical innovation, services	Incremental innovation, manufacturing

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National cases	USA, UK	Germany, Scandinavia, Japan
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Source: *Nattrass and Seekings (2010)*

The institutional architecture impacts on how skills formation systems are organised. Culpepper and Thelen (2007, p. 24) have commented that the VoC model developed by Hall and Soskice “pays particular attention to the link between institutional structures and individual-level incentives, both for firms to train (or not) and for young people to acquire skills (and of what sort)”. Evans and Stroud (2016) point out that “the German ‘skills’ system is renowned for high levels of industry-specific, engineering and technical skills, cultivated within firms and in the wider VET system” (p. 266), while the LME model “is seen as conducive to high-risk processes of radical innovation, with a focus on a fluid labour market, a reliance on general skills and the production of goods requiring lesser skilled but lower cost labour” (Hall and Soskice 2001, p. 39). The UK has been described as functioning with a low-skill/low-pay equilibrium, and a “voluntarist market-based training systems mean[s] that there is little legal compulsion for employers to engage in skill enhancement” (Evans and Stroud 2016, p. 268). Furthermore, in LMEs, short-term financial strategies, weak employment protections and the tendency of firms to respond to market downturns by reducing workers encourage people to acquire more spendable general skills, rather than job-specific skills (Culpepper and Thelen 2007).

Nevertheless, some scholars draw a more nuanced picture of the strengths and weaknesses of the different systems (Thelen 2009). Some authors have pointed out that the German system is slightly unbalanced as it relies more on initial training (the apprenticeships) and less on further on-the-job training, and that it lacks certain high-end skills such as IT (Crouch *et al.* 1999). Likewise, Green and Sakamoto (2001) maintain that describing the UK as a country characterised by a low-skills economy focuses too much on the manufacturing sector and overlooks the experience of several service companies that rely heavily on high-level skills.

Amable (2009) considers the binary opposition between CME and LME as being too general to serve as a useful analytical framework. Too many countries are placed into the residual category of Mixed Market Economies (MMEs), which does not provide any useful insight. Therefore, Amabel suggests a more nuanced typology:

- neo-liberal (or market based) capitalism
- continental European capitalism
- social-democratic capitalism
- Mediterranean capitalism
- Asian capitalism.

These models of capitalism differ, *inter alia*, in terms of labour market and labour relations, social security and education and training systems. Amable (2009) describes the different models as follows:

- The market-based model (e.g. United Kingdom) relies on intense product-market competition that makes firms more sensitive to shocks and triggers higher flexibility of employment. Social protection is underdeveloped and there is little incentive to invest in specific skills since these would not be protected by the welfare state or by job security

and a rapid structural change would quickly devalue them. In such a context, competition extends also to the education system, where colleges and universities compete among them for attracting the best students, and students for entering the best universities.

- The Continental European model (e.g. Germany) combines a higher degree of employment protection and a less developed welfare state. Wage bargaining is coordinated and a solidaristic wage policy is developed. Productivity gains are obtained by labour-shedding strategies elaborated in complementarity with social protection.
- The social democratic model (e.g. Denmark) is characterised by a high degree of flexibility of the workforce: here the retraining of skilled workforce plays a crucial role in terms of adaptation. Other characteristics are a moderate employment protection, a high level of social protection, and an easy access to retraining thanks to active labour-market policies. Also, a coordinated wage-bargaining system enables a solidaristic wage setting which favours innovation and productivity.
- The Mediterranean model (e.g. Italy, Spain) is based on high employment protection and even less social protection than the Continental one. It relies on “a large set of family-based small firms, cross-participation in firms’ governance and the prominent role of the state in the economy” (Vallejo-Peña, Giachi 2018, p. 24). It is also characterised by a relatively low level of market competition and by a workforce with limited skills and level of education, which does not allow for the implementation of a high-skills/high-wages industrial strategy.

Other scholars, within the same research programme, have proposed specific characterisations for other European areas that could not fit the traditional LME/CME dichotomy. Nölke and Vliegthart (2009), for instance, have focused on the East Central Europe countries (e.g. Poland, Hungary) pointing out their difference in terms of political-economic model compared to the other European countries. Nölke and Vliegthart define the model embodied by these countries as a Dependent Market Economy (DME). These countries are characterised by “comparative advantages in the assembly and production of relatively complex and durable consumer goods”, which are “based on institutional complementarities between skilled, but cheap, labour; the transfer of technological innovation within transnational enterprises; and the provision of capital via foreign direct investment” (Ibidem, p. 672). Because of their dependence on exogenous inputs for innovation, DMEs do not seem to have a strong need in investing in innovation-related skills, resulting often in “an assembly platform for semi-standardised industrial goods” (Ibidem, p. 679).

3.1.2 Types of skills formation systems

Following Becker (1993), skills can be divided into general and specific, the first being fully transportable and spendable in a wide set of working contexts, the latter being context-dependent and relevant only for a specific job or for similar jobs in the same field.

As Thelen (2009) points out, the literature on skills formation and skills development refers mainly to three different levels, the micro-level of the individual worker, the meso-level of firms and the macro-level of economic systems. At the first level (micro), some studies have highlighted a relationship between education and training and wage (see, for instance, Ashton and Green 1996); at the meso level several studies have identified a relationship between skills development and firms’ productivity and adaptation to new technologies (Black and Lynch

1996; Bishop 1994); at the macro level, scholars such as Acemoglu and Pischke (1998) have maintained the idea that training can work as an engine for economic growth and can be associated with lower levels of unemployment, as further highlighted also by Lippman (2002) in relation to countries with well-established apprenticeships programmes.

Bussemeyer and Trampusch (2011), propose their own classification of skills formation systems. Focusing on two analytical dimensions, the degree of firms' involvement in the provision of initial vocational training and the degree of public commitment to vocational training, they produced a matrix that aims to capture the variety of training regimes. The types identified are:

- Statist skill formation systems (high public commitment/low firms' involvement), such as Sweden or France, which are often predominantly school-based. Here policy makers are committed to supporting VET as a viable alternative to academic higher education to foster the inclusion of people with weak academic qualifications into the labour market. In such systems, the involvement of employers is quite limited;
- Liberal skills formation systems (low public commitment/low firms' involvement), such as the US and the UK. In these countries, skills formation is guided through, and provided by, the market and within general education. The general education system provides qualifications that are usually integrated by internships and on-the-job training. In such countries there is also a considerable asymmetry between the value of academic and vocational paths;
- Collective skill formation systems (high public commitment/high firms' involvement), such as Germany or Netherlands. These are characterised by a strong commitment of both the state and firms to the formation of vocational skills. Here a high share of firms is available to support the costs of training and intermediary associations (employment associations, trade unions etc.) play a relevant role in the definitions of the VET framework;
- Segmentalist skill formation systems (low public commitment/high firms' involvement), such as Japan. Here, a high share of firms is supportive in providing further training to their employees through job rotation schemes, on-the-job and off-the-job training both in-house and in vocational schools.

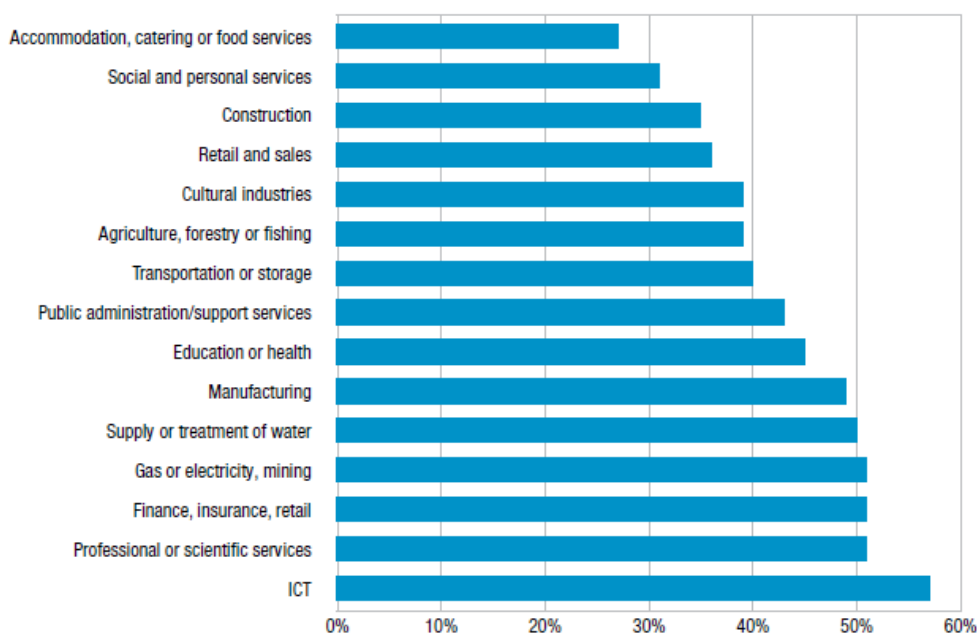
Lauder *et al.* (2017) try to systematise the literature on skills formation parting it into two main streams, *universal theories* of skills formation and *particularistic theories*. The first includes the *human capital theory* (Becker 1993), which states that there is a strong correlation between the level of education and training of an individual, his productivity and income. This hypothesis has three implicit assumptions (Lauder *et al.* 2017): a) that individuals are highly motivated to pursue higher levels of education and training as this will correspond to higher levels of income; b) that employers will always hire the most skilled workers; c) that employers will respond to upskilled workers by investing in technological innovation. Another *universal theory* is the *skill biased technological change theory* (Acemoglu 2002), which maintains that technological innovation endogenously drives the demand for upskilled workers. These two universal theories share the same background assumption that demand will directly respond to supply. Both theories have been criticised as they fail to recognise that the relationship between productivity and income and employers' response to the supply of qualified labour is not always linear and that technology can be skills replacing rather than skills biased (Lauder *et al.* 2017).

As for *particularistic theories*, these assume that the process of skills formation is embedded in the specific institutional framework and societal structures of the different countries. One of these is the *societal effect approach* (Maurice *et al.* 1986), which highlights the strong influence of national institutional configurations on the type and distribution of skills within a country. The VoC theory also belongs to this research stream. However, considering the economic trends related to globalisation, some scholars have raised the question whether what is being characterised by the VoC approach is not so much national economies but rather specific economic sectors within them (Lauder *et al.* 2017).

3.2 Skill mismatches

The idea of perfect and complete skills matching is a fantasy. While a certain degree of mismatch is to be considered a normal fact in a dynamic economy, the European Skills and Jobs Survey (ESJS) highlighted that “skill shortages that genuinely arise due to an absence of job-ready candidates affect Europe’s most innovative, internationally competitive and dynamically growing enterprises, posing productivity and growth constraints” (Cedefop 2018a, p. 13). However, it is also pointed out that institutions should not only focus on employers’ issues in finding the required skills, but also on the unrecognised and underutilised skills that are already available in the labour market: in this perspective, “policy-makers must carefully distinguish the part of skill shortages that may be mediated by adapting/reforming publicly funded VET systems from that which can be best tackled by a wider set of labour market and other policy reforms” (Ibidem, p. 15).

Figure 6 - Share of adult employees who experienced changes in technologies used in the workplace by economic sector, 2010-2014, EU-28



Source: CEDEFOP, European Skills and Jobs Survey

Table 3 – Share of adult employees who experienced changes in the technologies used in the work-place by occupation, 2010-2014, EU-28

Occupation	% of group	Occupation	% of group
ICT technician/Associate professional	67%	Legal, social and cultural professional	40%
ICT professional	60%	Skilled agricultural worker	40%
Science and engineering associate professional	57%	Assembler	40%
Production or specialised services manager	55%	Agricultural, forestry and fishery labourer	40%
Health professional	55%	General or keyboard clerk	38%
Electrical and electronic trades worker	55%	Street and other sales or services worker	38%
Science and engineering professional	51%	Street or related sales/services labourer	37%
Business and admin associate professional	50%	Teaching associate professional	36%
Stationary plant or machine operator	50%	Protective service worker	36%
Administrative or commercial manager	48%	Driver or mobile plant operator	36%
Hospitality, retail or other services	48%	Skilled forestry, fishery and hunting	35%
Teaching professional	48%	Other skilled trade (building, crafts or related trade)	35%
Health associate professional	48%	Sales worker	33%
Legal, social and cultural associate professional	48%	Labourer in mining, construction, manufacturing (building, crafts or related trade)	32%
Handicraft and printing worker	48%	Another building and related trades worker	31%
Metal, machinery and related trades worker	46%	Labourer in mining, construction, manufacturing (elementary occupations)	31%
Business and admin professional	44%	Personal services worker	27%
Other associate professional	44%	Personal care worker	27%
Chief executive, senior official or legislator	43%	Food preparation assistant	27%
Other clerical support worker	43%	Other elementary worker	22%
Customer services clerk	41%	Agricultural, forestry and fishery labour	18%
Numerical and material recording clerk	41%	Cleaner or helper	12%

Source: Cedefop, *European Skills and Jobs Survey (ESJS)*

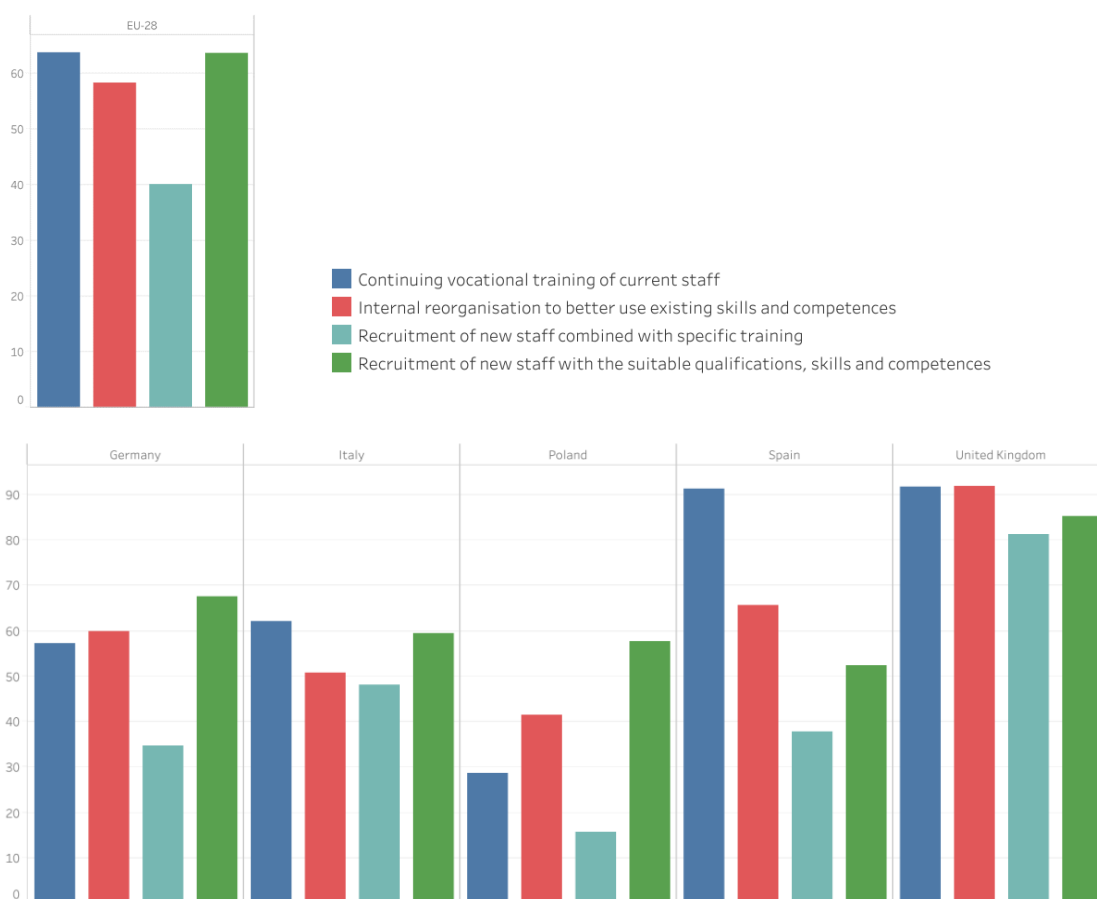
As shown in Table 3, 46% of European metal, machinery and related trades workers have experienced, between 2010 and 2014, changes in the technologies used in the workplace. A significant part of these changes is likely to be ascribed to the introduction of new digital technologies. Nevertheless, it has been stated that individual resilience in moving to a digital economy does not rely solely on good digital skills, but on a mix of cognitive *soft skills* such as problem-solving, creativity, learning to learn, communication, collaboration etc. (Cedefop 2018a). Indeed, the relevance of soft and transversal skills has been underlined in the development of new VET programmes.

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Cedefop’s Skills Panorama (Cedefop 2018e) estimates that 46% and 43% of the future job openings by 2030 will require respectively medium qualifications and higher qualifications, while only 11% of future jobs will be suitable for workers with lower qualifications.

The figures below offer some insight into the most common reaction in the European manufacturing industry to current and future skill needs (Figure 7) and into the most common skills targeted at the CVET level (Figure 8). At the European level, the most common strategies to overcome skills gaps are continuing training of staff and recruitment of new skills on the labour market. Figure 7, however, shows that strategies tend to change from country to country. Among the ESSA case study countries, Spain and the United Kingdom appear to rely more on continuing training and internal reorganisation, while Poland seems to be the country in which continuing training plays less of a role.

Figure 7 - Usual reaction to skill needs in the EU-28 and in the ESSA case study countries in 2015 (percentage of enterprises) in industry – excluding construction



Source: Eurostat data, own elaboration

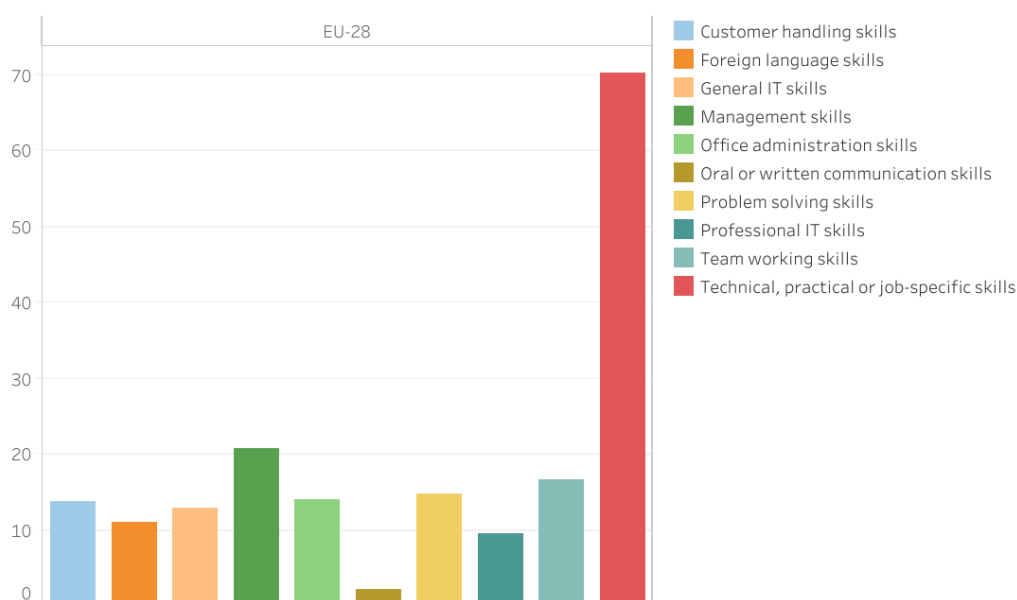
Concerning the skills mostly targeted by continuing VET, technical and job specific skills appear to be the most present, both at the European level and in the case study countries. This figure seems to confirm the statement given at the sectoral level by several interviewees from the steel industry (also supported by some literature, see for instance Cimini et al. 2020) that companies usually tend to be well organised to provide training on technical skills, while they

often struggle to fill soft skills gaps, lacking internal expertise. As it was explained by an interviewee:

“We are engineers and this is an engineering company. So, we do what we know. We know the industrial process and that is the comfortable part for us. The other part related to leadership, conflict management, negotiation, that doesn’t come natural for us”²⁴.

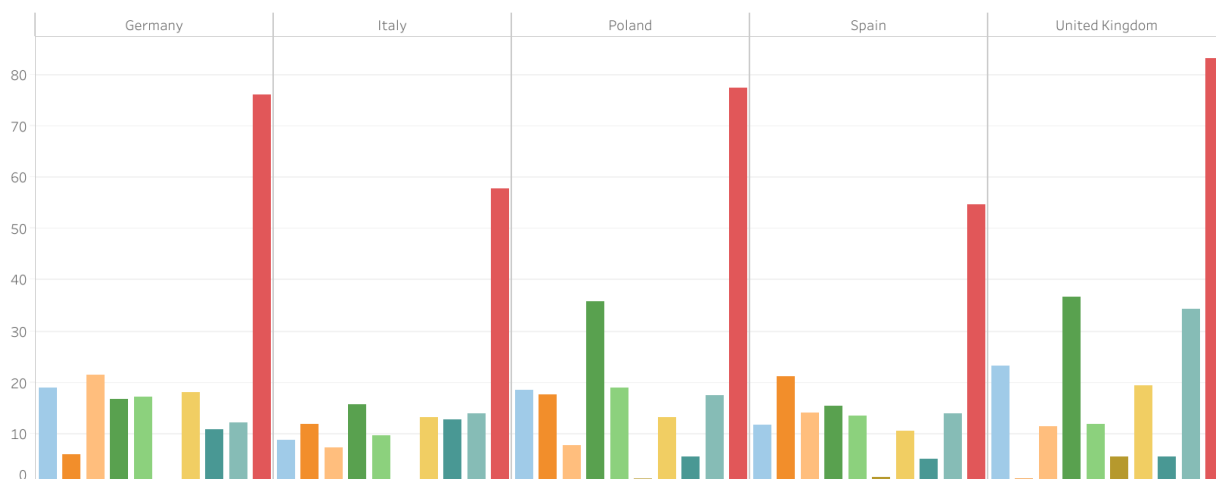
Among transversal skills, management appear to play a relatively important role in manufacturing industries at the European level, as well as in Poland and the United Kingdom. Oral and written communication skills, and professional IT skills, on the other hand, appear to be the less addressed.

Figure 8 - Main skills targeted by CVET courses in the EU28 and in the ESSA case study countries in 2015 (percentage of enterprises providing CVET courses) in industry – excluding construction



²⁴ Interview transcript, HR officer in steel company, Spain.

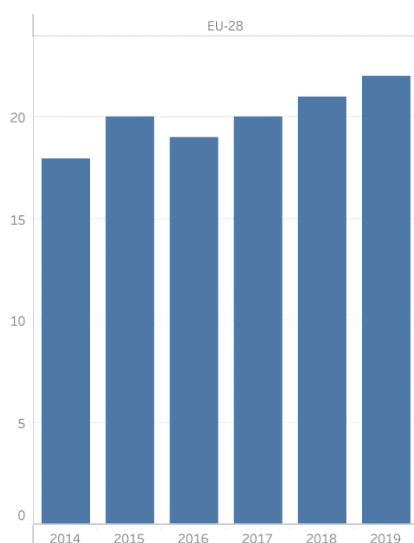
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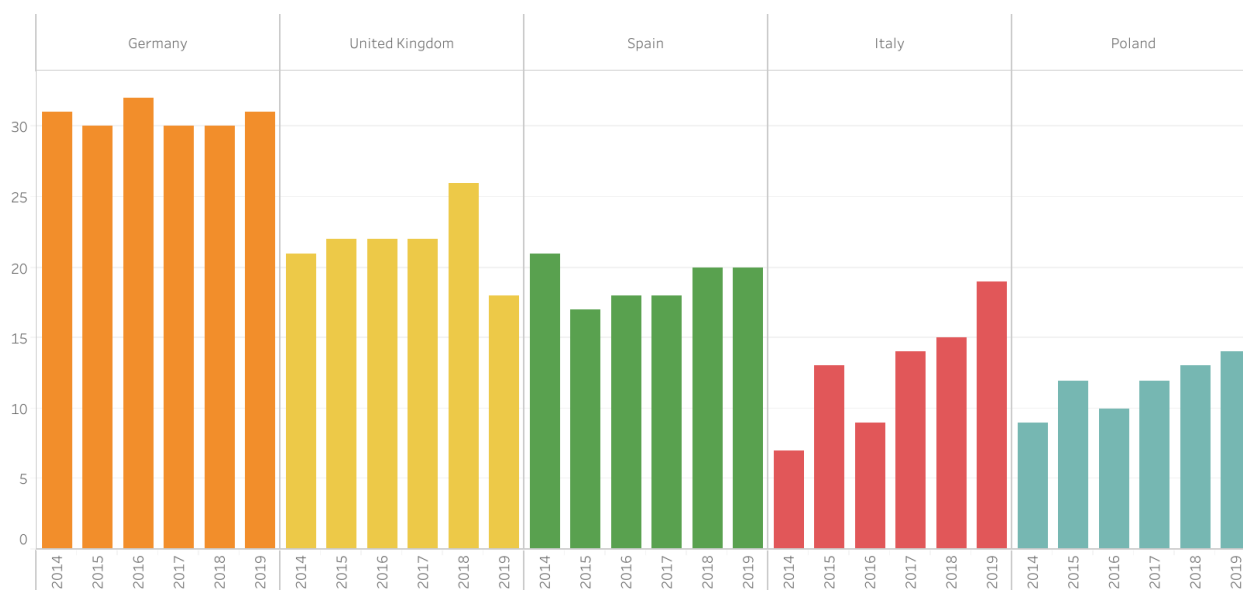
Source: Eurostat data, own elaboration

Regarding ICT skills, Eurostat offers more granular data on the enterprises that offered training in these area in the different subsectors. Figure 9 shows the share of companies in the manufacture of basic metals and fabricated metal products that provided such courses.

Figure 9 – Enterprises in manufacture of basic metals and fabricated metal products that provided training to develop/upgrade ICT skills of their personnel in the EU-28 and in the case study countries (percentage of enterprises)



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Source: Eurostat data, own elaboration

The data shows a higher commitment to upskilling workers in ICT in Germany (higher than the EU-28 average), while in Italy and Poland the percentage of companies offering such training is still under the European average and points to a lower attention to such areas of competence.

3.3 Skills mismatches in the steel industry: a wide-angle

An interesting starting point to depict how the skills landscape is changing in the industry is the recent World Manufacturing Forum Report, *Skills for the future of manufacturing* (2019). The report lists the ten top skills emerged out of the research conducted. These are:

1. Digital literacy
2. AI and data analytics
3. Creative problem solving
4. Entrepreneurial mindset
5. Ability to work safely and effectively with new technologies
6. Inter-cultural, inclusive and diversity-oriented mindset
7. Cybersecurity, privacy and data mindfulness
8. Ability to handle complexity
9. Communication
10. Openness to change

The work carried out by the World Manufacturing Forum points to a prominence of analytical and soft skills, which provides some background to our research. A questionnaire response from Eurofer confirms that some of the expectations outlined above apply also to the specific case of the steel industry:

“With high probability, the work in industry 4.0 will provide to all employees significantly higher complexity, abstraction and problem-solving requirements. In addition, employees

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are demanded for self-organisation, a very high degree of interdisciplinary, self-directed action, communicative skills and abilities”²⁵.

Although no specific secondary data is available on steel sector needs at the European level, various skills intelligence programmes launched by Cedefop help to shed some light on skills trends and mismatches in the sector. In particular, we consider here two occupational groups highly relevant for the sector, that of *metals and machinery workers*, and *machine and plants operators*.

Cedefop’s Skills Panorama (2019c) anticipates that jobs currently performed by metal and machinery worker will increasingly be filled by people with a higher educational attainment. Although the share of workers with medium-level qualifications will remain the highest (about 70%), about 11% of metal and machinery workers are expected to hold a higher qualification by 2030, an increase by 4% compared to the past.

Notwithstanding the profound changes brought in by technological innovation with robots and automated systems carrying out many tasks previously undertaken by these workers (Cedefop classifies this group as “high risk” of automation), many in this occupational group will still be required to set up, monitor and maintain such devices. This points to a clear increase in technical skills associated with monitoring, maintaining and diagnosing faults, along with digital skills that need to be continuously updated in line with technological advancement. The use of sensors will require workers to possess enough skills to read and interpret data and use them to make informed decisions.

Overall, Cedefop suggests that skills such as creativity and problem resolution, gathering and evaluating information, dexterity, autonomy, teamwork, and machinery usage will be the most relevant skills for this group in the next ten years.

This picture can be complemented with data provided by Ovate, the online tool powered by Cedefop and Eurostat that offers detailed information on the skills that employers demand based on online job advertisements (OJAs) in 28 European countries. Still considering the occupational group of metal and machinery workers, Ovate shows that the three more requested skills (at ESCO level 3) by jobs advertisements published in 2020 are: *adapt to change* (27.5%), *working in teams* (26.4%) and *mechanics and metal trades* (23.6%).

The picture is not much different for machine and plant operators. Skills Panorama (Cedefop 2019d) reports that the qualification level is expected to increase in this group as well: workers holding higher qualifications are expected to increase from 7% to 12% by 2030, while the medium qualifications segment will remain stable, making up about two thirds of the occupational group. Machine and plant operators appear to be more impacted by the technological transformation than metal and machinery workers. Cedefop, indeed, classifies this occupational group as “very high risk” of automation. Similarly, to metal and machinery workers, where jobs will be preserved, workers will need to possess higher digital and analytical skills to read and interpret data, as well as the technical skills to set up and maintain sophisticated pieces of machinery. Cedefop also suggests that skills that are likely to be developed in this group are those associated with chemicals and energy recovery. Again, these should be complemented by soft skills such as the capacity to gather and evaluate information, problem solving, teamwork, creativity

²⁵ Questionnaire response, Eurofer.

and decision making. Communication will be among the most important soft skills, since process integration will require operators to communicate more with colleagues in different departments. The top three skills (at ESCO level 3) requested in job advertisements for this occupational group, as shown by Ovate, are: *adapt to change* (41.1%), *working in teams* (35.2%) and *wholesale and retail* (19.3%).

The results of another relevant European project, Steel Sector Careers (White Research et al. 2020), highlighted that steelworkers are now required to possess higher technical skills than in the past, especially in the fields of engineering, material sciences, physics, chemistry and IT. In addition to this, the project has pointed out that companies now require a more holistic approach to occupational training, requiring workers to have ‘wider and more adaptable skillsets’ (*Ibidem*, p. 12). From this stems the necessity of adopting a T-shaped skills approach, this meaning training in “an area of speciality complemented with a series of transferable skills, which can be grouped in three overarching categories: general technical skills, digital skills and soft skills” (*Ibidem*, p. 56).

In addition to skills gaps produced by green challenges and technological advancement, the impact of the current Covid-19 pandemic on companies and the subsequent layoff of workers risks further worsening the skills gaps:

“What we're trying to really emphasise is if we lose these workers, we also lose their skills, we also lose their competences. And that's a big risk. Because then if this gets better, and everyone hopes it will, if production in the EU for steel goes up again, we'll lose all of this competence. And for employers that's costly, as well as a lot of cost to recruit new people, to retrain them, to fill in the skills gaps”²⁶.

Although we assume that cross-country variations in technological adoption (see section 2.2) play an important role in terms of creating skills gaps, we also find it reasonable to assume that the application of certain Industry 4.0 technologies will create relatively uniform future skills needs in the sector. The interviews carried out in the five countries have confirmed that skills gaps are a matter of concern for both companies and workers’ representatives and the importance of soft skills has been often underlined, in line with Cedefop assessments.

While a more detailed analysis of interview and questionnaires data on skills needs in the sector is offered in the next section for each case study country, it is interesting to note here, as a general aspect, an increasing attention paid to system and process knowledge by companies’ representatives. This stems from the increasingly integrated (or networked) character of production processes:

“We have done surveys within our company and there is one core message coming from this: ensure that apprentices have a contextualised understanding and understand the plausibility what is happening. [...] We offer programmable logic controller (PLC) for metalworkers. Normally metal workers will not learn PLC, it’s not their world, nonetheless, we have been asked to please introduce metal workers to PLC so that they will understand what electricians are actually doing and so that they can talk about it [...] The point is not

²⁶ Interview transcript, workers’ union representative, EU.

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to educate them deeply in these areas. Rather, the point is that they have what I call ‘overview knowledge’²⁷.

“They need to acquire a general process-knowledge, they need to know first of all how the overall processes and what are the different outcomes of these before starting to manipulate the real controls of machinery and interfaces”²⁸

From this originates an urgent need to overcome outdated modes of training the workforce based on parcelling out competences in narrow occupational specialisations:

“Until now, much has been built on a modality that was particularly linked to a model of specialisation that saw the parcel out of skills, knowledge and the professional profiles themselves. Therefore, recomposing the global capacity to understand the productive process is one of the themes on which there is a stronger demand, and is also a critical point”²⁹

Moving from this scenario, some have pointed to the need of a more systematic approach to identifying skills mismatches in the sector:

“[We need] to carry out an assessment of professional profiles and a general picture of skill mismatching in the sector, based on the growing demand for skilled labour and the new professional skills emerging from the sector's digitalisation processes, working on systemic strategies to create a training offer of excellence that takes shape above all in Academy projects and in joint projects between the company, the world of education and political institutions.”

This is in order to address skill needs, bringing together companies and training providers in *ad hoc* project partnerships, or establishing companies’ internal Academies.

²⁷ Interview transcript, training centre manager in steel company, Germany.

²⁸ Interview notes, Team leader in steel company, Poland.

²⁹ Interview transcript, workers’ union representative, Italy.

SECTION IV – National VET systems (case studies)

Having sketched the background of the European steel industry, we now move on to discuss the national case studies in terms of vocational education and training provision, particularly focusing on initial IVET as this sets the ‘starting line’ for any qualified workers entering the industry. The aim of the following national sections is to present, in a systematic and summarised way, the overall functioning of the system in each case study country, the qualification programmes that are most relevant to the steel industry, existing good practices and future prospects.

Drawing on the theoretical classifications presented above (paragraphs 2.1.1 and 2.1.2), and driven by theoretical sampling³⁰, we have selected five European countries that embody the main features of the typologies presented in Section II and different ways to organise the skill formation and delivery system. Table 4 summarises the features that informed the case selection, while Figure 10 offers a snapshot of the distribution of students between general education and vocational programmes in the five countries to illustrate the relative weight of VET.

Table 4 – Categorisation of the case studies

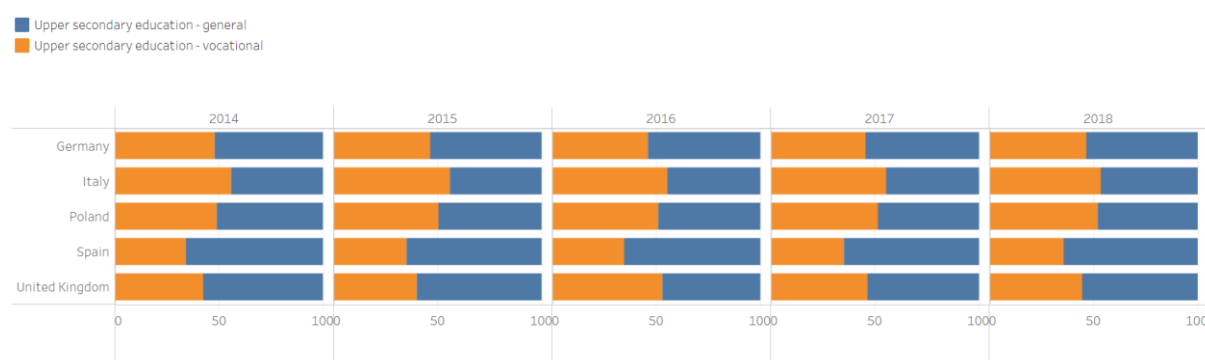
	Economic model (in relation with skills type)	Skills formation	Trajectory	Standardi- sation in IVET curricula	Distinction between IVET and CVET	Learning arrangements
DE	Coordinated Market Economy (Hall & Soskice 2001)	Collective (Busemeyer and Tramusch 2011)	Academic drift	High	Clear	Apprenticeship-based
ES	Mediterranean Capitalism (Ama- bel 2003; 2009)	Collective (Busemeyer and Tramusch 2011)	Vocational drift	High	Clear	School-based
IT	Mediterranean Capitalism (Ama- bel 2003; 2009)	Statist → (col- lective) (Busemeyer and Tramusch 2011)	Academic drift	High	Clear	School-based
PL	Dependent Market Economy (Nölke and	Statist → (col- lective) (Busemeyer	Vocational drift	High	Clear	School-based

³⁰ Mason (2002) defines theoretical sampling as a form of “strategic sampling” that implies selecting groups or categories to study on the basis of their theoretical relevance and significance to the research questions to be addressed.

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	Vliegenthart 2009)	and Tram-pusch 2011)				
UK	Liberal Market Economy (Hall & Soskice 2001)	Liberal (Busemeyer and Tram-pusch 2011)	Academic drift	Low	Blurred	Mixed

Figure 10 – Share of pupils enrolled at upper secondary general and vocational programmes (2014-2018)



Source: Eurostat data, own elaboration

In the perspective of the ESSA project, a comparison between the case study countries is significant as they provide practical examples of how different institutional contexts have generated different economic models, labour markets and skills formation systems, that are structurally coupled with the industry in different ways. Identifying the main characteristics of the VET systems in these countries, their mechanisms and the way they serve the industry and adapt to social change provide substantial insights to the design of the Sectoral Blueprint, which is the main outcome of ESSA. Table 5 summarises the essential features identified by our review. In the next section, we will address more in detail the specifics of each of the five national VET systems, after offering a short introduction on the steel industry in the country.

Table 5 – Summary of essential characteristics of case studies' VET systems

DE	ES	IT	PL	UK
Consensus-based regulation	Double VET route (education & employment)	National and regional VET provision (alternative paths)	System undergoing structural reforms - transitioning until 2022	Modular VET provision
Responsibility shared between competent Ministry and Länder	Responsibility shared between competent Ministries and Regions	Responsibility shared between competent Ministries and Regions	Responsibility shared between Ministries, Regional authorities and local authorities (<i>Powiat</i>)	Complex and fragmented governance

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Solid dual system	Recently introduced dual VET arrangements	Recently introduced dual VET arrangements	Recently introduced dual VET arrangements	Rising demand for apprenticeships
Holistic approach to occupational competencies	National catalogue of occupational standards	3 types of apprenticeship programmes	National catalogue of occupations and associated qualifications	Narrower understanding of occupational standards (compared to DE)
Technology neutral provision	Mobility between programmes	Mobility between programmes	Distinction between programme and qualification (certificate/diploma)	Distinguishing role of awarding bodies

4.1 Italy

4.1.1 Italy's steel industry

In 2017, Italy was the second largest steel-producer in Europe (after Germany), and the first for recycling of ferrous scrap. Steel plays a strategic role for the country's overall economy, supporting and feeding the entire supply chain of manufacturing (Federacciai 2018). Such result is even more appreciable considering that 2017 was a difficult year for the Italian steel industry, looking for instance at the cases of Taranto and Piombino³¹.

In 2019 there were 39 sites for steel production in Italy (also including non-operational ones, e.g. Piombino). These consisted of 37 electric arc furnaces, 2 oxygen converters and 3 blast furnaces (Federacciai 2020). Sites like Taranto and Piombino include both oxygen converter and blast furnace, as shown in Table 6.

Table 6 – Steelmaking plants in Italy (2016 data)

ROUTE	AREA
Blast Furnace	Piombino, Taranto, Trieste
Oxygen Converter	Piombino, Taranto

³¹ The steelworks in Taranto, started in 1964 as part of the state-owned company Italsider, was acquired by the Riva group in 1995 (and re-nominated it ILVA). In 2012, ILVA underwent a judiciary investigation for pollution and environmental crimes. In 2018, the plant was leased to ArcelorMittal under an agreement with the Italian government including a plan for modernising the site and improving the environmental impact. In November 2019, ArcelorMittal expressed the intent to rescind the contract for the lack of the guarantees promised by the Italian government. The steelworks located in Piombino was the first blast furnace in Italy. In the Sixties, it became part of Italsider and then privatised in 1992 by the Italian company Lucchini. In 2005, the majority of the shares was acquired by the Russian group Severstal. After a further crisis and the stop of production, the plant was acquired in 2015 by the Algerian Cevital, and then in 2018 by the Indian group Jindal.

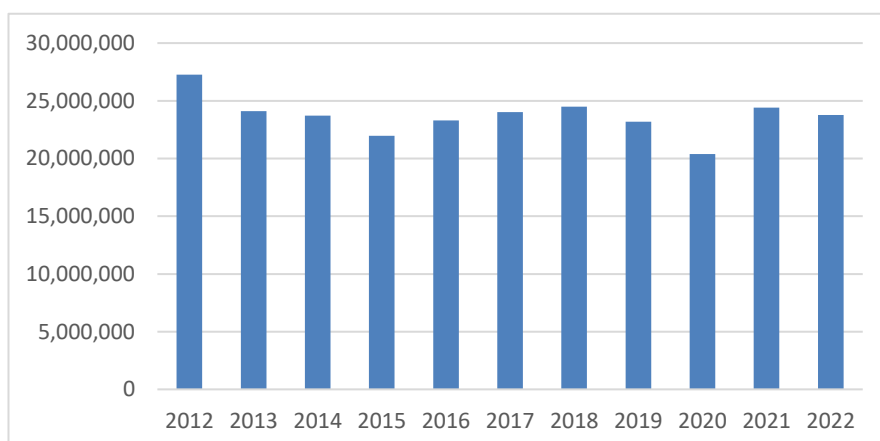
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Electric ARC Furnace	Aosta, Bergamo, Bolzano, Brescia, Catania, Cremona, Cuneo, Padova, Potenza, Reggio Emilia, Torino, Terni, Trento, Udine, Varese, Verona, Vicenza
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Source: Federacciai 2017

At the end of 2017, the number of employees in the primary steel industry decreased from 34,226 in 2016 to 33,668 workers, with a loss of 558 jobs over the previous year, confirming the downward trend in progress since 2008. This was probably the combined effect of the economic recession and the internal difficulties of the sector. Between 2008 and 2017, the Italian steel sector lost around 6,000 employees (Federacciai 2017). Since 2009, when crude steel production reached a low in the wake of the global financial crisis, the industry has struggled to recover the previous levels of annual output, which used to be above 30 million tonnes per year. After a partial recovery in 2010 and 2011, there has been a new decrease in production output (as shown in Figure 11), with output staying continuously below 25 million tonnes per year. After a low point in 2015, when production fell below 22 million tonnes, production stabilised until COVID-19 hit in 2020, causing another temporary blip as output has recovered in both 2021 and 2022³².

Figure 11 – Italy’s total crude steel production (all qualities) in metric tonnes



Source: Eurofer data

Finally, looking at the qualifications held by workers in the metal (production and processing) industry in 2018 (Table 7), they appear to be mostly coming from vocational education and

³² www.econopoly.ilsole24ore.com/2018/10/23/industria-siderurgica-italiana-acciaio/

training programmes, followed by post-secondary school diplomas. The share of university graduates, instead, appeared relatively small.

Table 7 – Metal workers in Italy by educational level (2018)

Compulsory Education	VET	High School Diploma	University Degree	Total
29.710 (22,2%)	56.610 (42,2%)	41.190 (30,7%)	6.480 (4,8%)	133.990 (100%)

Source: Excelsior Unioncamere

Some interviewees remarked that the challenges faced by the Italian steel industry are common challenges at the European level, such as CO₂ mitigation, competition with Asian steel producers, and difficulties in finding an end market. Indeed, the Italian production in 2019 showed a decreasing 4.5% compared to the previous year, highlighting the fact that the most suffering sector is automotive, which alone accounts for 14% of the national demand for steel products (Questionnaire response, sectoral training and consultancy body, Italy). Some have questioned the sectoral strategy at the national level, expressing concerns about the future of the industry, especially in the post-pandemic era:

“A little bit because the coronavirus, a little bit because of the condition of the steel industry in general is not a rosy picture. We do not know what we want to do with the steel industry in Italy, if we want a greener production. We have contributed until a few years ago to a good share of GDP, but now we are losing ground”³³.

Some companies appear to be committed to moving towards a different market approach, aiming at competing on high-quality steel and adopting a more flexible on-demand-type business model:

“One of the most relevant aspects is the fact that the Italian steel industry is progressively moving towards products [...] of high quality, with special steels, niche products and with manufacturing processes that are [...] more and more close to specialised supply chains. This is an important qualitative leap, capable of generating or reinforcing a competitive advantage through which the Italian steel industry can regain market space”³⁴.

³³ Interview notes, Technical Support Officer in steel company, Italy

³⁴ Questionnaire response, sectoral training and consultancy body, Italy

The same topic was touched upon by another respondent who reflected on the challenges of shifting to customised special products to colonise market niches:

“Steel production for a plant is a mix of speciality and commodity products. A company that has to produce millions of tonnes cannot survive on speciality products, on the other hand, on the import market there is plenty of common goods and at lower prices. If the market no longer requires commodities, then the price of speciality products increases [...] At this point, large plants become uncompetitive and we have to switch to smaller, more flexible sizes. Smaller and more flexible sizes, however, are not able to manage product development activities unless they are part of an adequate network supported by activities outside the steel industry”³⁵.

As regards environmental challenges, greening the industry and shifting towards a circular economy paradigm appears to be an ongoing process in the country and the share of steel produced in EAF has overturned in the last decade, with now only about 20% of the national production made through the BOF route. This is due not only to the slow decline of bigger companies based on BOF, but also to the emergence of a cluster of EAF-based companies located in the north-east of the country (Interview transcript, Trade Union representative, Italy). However, further improvements in terms of greening the industry have to deal with bureaucratic issues and political delays:

“We have been working on the environmental part for some time, but it is a very long road, especially for a plant as large as ours. Yes, at European level we have regulations that support us, but there are difficulties in applying them at the national level. The latest example is the European regulation for the circular economy, these are all directives that have to be transposed and it takes years. [...] On average, it takes Italy two years to transpose a European directive”³⁶.

As experienced in other countries, interviewees have also commented on the lack of attractiveness of the sector for young graduates:

“We often encounter difficulties in recruiting young, newly qualified technical profiles, mechanical experts, to be placed in companies with an apprenticeship contract [...] immediately after finishing secondary school, because very often the difficulty is linked to the fact that young people prefer to turn to work opportunities that are considered less strenuous”³⁷.

Another challenge that has been commented on concerns resistance to change, especially in bigger and more structured companies. Such resistance might take the form of unions’ disputes which can hinder the companies’ effort to adapt to the new conditions:

³⁵ Questionnaire response, Production Manager in steel company, Italy

³⁶ Interview notes, Technical Support Officer in steel company, Italy

³⁷ Interview transcript, sectoral training and consultancy body, Italy

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“Ours is a very unionised company [...] we have carried out several projects over the years, including polyvalence, which is a project to make operators more versatile. This tends to be in the interest of the workers because they are more versatile, they acquire skills, the company invests in them, but what is perceived is the dark side. From this point of view, ours is not an easy company because in a moment you find everyone against you”³⁸

Concerning the penetration of the Industry 4.0 paradigm in the sector, the data collected suggest that the level of automation is currently medium-high in Italy and that the automation process has been ongoing for about two decades:

“We could say that the sector ranks, on a scale of 1 to 100, above 50%, where experience with digital starts to be significant”³⁹

“Automation, optimisation, was already done, in the big steelworks, at the turn of the 90s and in the small ones about 10 years later”⁴⁰

However, innovations that are more typical of the Industry 4.0 paradigm, such as the extensive application of sensors and data analytics involving machine learning algorithms, appears to be not yet fully established. Italian steel companies appear to be currently in a process of incremental innovation and experimentations of the different possible applications of such technologies to the steelworks:

“The transformation took place mainly in the production areas; two and a half years ago, when I arrived, there were already the first experiments of some processes, of some more digital systems based on machine learning, rather than on artificial intelligence or Big Data analysis applied mainly to the quality context. That's where we started, analysing and recognising the defects in the strip we produce in a more intelligent way that is less dependent on human observation [...] For a couple of years now there have been systems based on learning intelligence... I don't think it's 100% active yet”⁴¹

Indeed, this view of Industry 4.0 as a continuous, rather than disruptive, development has been confirmed also by a Trade Union representative:

“We are seeing that, in some cases, there has been a leap forward in innovation, which in particular has to do with the process in this case, i.e. with all the sensors that were already there before and which are now being enhanced due to the construction of possible final machine learning that can control the production set-up in real time”⁴².

³⁸ Interview transcript, HR Officer in steel company, Italy

³⁹ Interview transcript, Sectoral training and consultancy body, Italy

⁴⁰ Questionnaire response, Production Manager in steel company, Italy

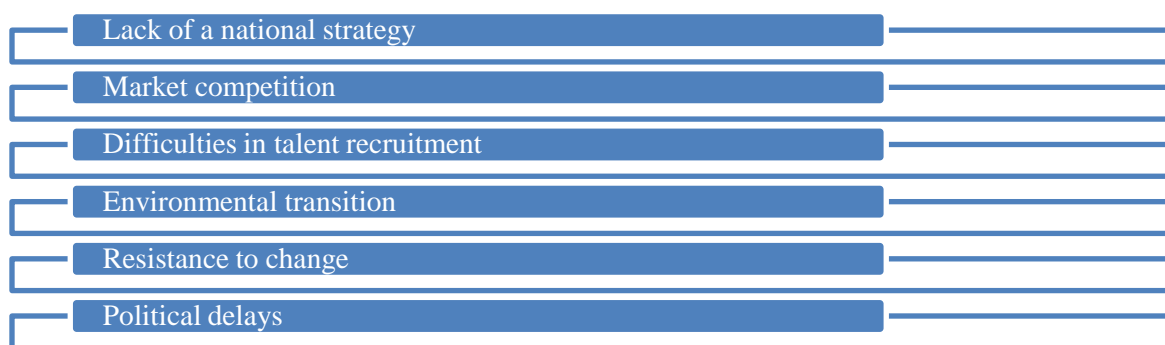
⁴¹ Interview transcript, HR Officer in steel company, Italy

⁴² Interview transcript, Trade Union representative, Italy

The type of applications that have been mentioned during the interviews cover a wide spectrum of applications, such as quality enhancement through the installation of image recognition systems, heat mapping, sensors to monitor a wider range of mechanical parts in the machines, thorough product tracking, predictive algorithms, real-time detecting movement of workers and machines to avoid incidents. Furthermore, data collection and analysis to monitor the environmental impact of production processes is an important application.

“As far as Industry 4.0 is concerned, we are making big investments in one of the great values of the company, which is product quality, which is a big strand. Here we have installed several technologies, some of them very sophisticated, such as automatic image recognition, which recognises a millimetre of scratch on a tape running at a speed of 10 m/s, this on several machines. These are technologies that allow us to classify our surface quality automatically, then give online and in real time the result of the tape that is coming out. Normally this is done with the operator looking at the tape, clearly with all its limitations”⁴³.

Figure 12 – Challenges faced by the Italian steel industry as emerged from the fieldwork



4.1.2 Industry perspective on skills gaps

In relation to the sectoral scenario outlined above, the respondents drew the attention particularly on two skills areas, which we can assume to be critical in Italy, that of technical skills related to IT and automation, and that of soft skills. Where technical skills have been mentioned by the interviewees, this was in relation to specialistic profiles, such as that of mechatronics, which bring together competencies in more traditional fields like mechanics and electronics, combining these with IT skills and the capacity to cut across subject boundaries:

“[We look for] highly specialised technicians, let's say mechatronics technicians if we have to define them. They have a basic knowledge of mechanics, IT and electronics, which are precious on the market. So it is difficult to find them, and when we do, we hang on to them because they are hard to find”⁴⁴.

⁴³ Interview transcript, Automation Manager in steel company, Italy

⁴⁴ Interview transcript, HR Officer in steel company, Italy

The issue of being able to cross subject and job boundaries has emerged often in the interviews. The capacity to have a more transversal view on industrial matters and connect with different profiles is indeed a skill that is highly appreciated and which requires some more holistic training:

“Make sure that the electrician knows what the mechanic is doing, the mechanic what the electrician is doing, and change these boundaries”⁴⁵

Also, general knowledge of new technologies and their rationale is required, since even ready-made solutions require a basic understanding of the background processes and outputs expected, in order to lead the technology:

“The technology is easy, it's up and running. But then you need someone who understands the phenomenon and makes the machine understand what it has to do. I have to give the system information so that it can learn on the basis of that information. So it is very important that the person using the system has a technological concept”⁴⁶

Along with the need to cut across subject boundaries, a strong need for a more thorough and holistic knowledge of processes and products made is becoming more and more important:

“The demand for professional profiles that are able to master, or at least know much better than before, the entire production process, the determination not only of the process itself, but also of the use of the product, and the composition of the product, has intensified”⁴⁷.

Having now an enormous amount of data in companies' databases, analytics has also emerged as an important area to cover. Some have indeed talked about the necessity to find those skills that would help them to make sense of an enormous volume of data:

“We have a lot of systems that bring out a lot of data that are not yet analysed as they should be, so we are inundated with data because maybe over time innovative software has been installed, but we still do not have clear interfaces for the user, so they are not used. We would need someone to help us understand what to do with this data”⁴⁸

Considering the variety and speed of new technologies currently available, some have reflected on the need to overcome technological determinism in training, but rather provide those essential skills that would help them to deal with such variety:

“Very often they have never seen the technologies that are in a steel plant, certain types of sensors, etc. Or, if I train them on a PLC, which one do I train them on? [...] I have to train

⁴⁵ Interview transcript, Automation Manager in steel company, Italy.

⁴⁶ Interview transcript, Automation Manager in steel company, Italy.

⁴⁷ Interview transcript, Trade Union representative, Italy.

⁴⁸ Interview transcript, HR Officer in steel company, Italy.

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them on an algorithm, I have to train them on a sequence of instructions. But that means giving them an almost engineering competence”⁴⁹.

Digital skills have also been recognised as critical for both operations and training, even more after the Covid-19 outbreak:

“What is certain is that there is a need for training on digitalisation, which does not only concern those who make IT their business, but the entire workforce. Moreover, compared to the current situation, i.e. the Covid emergency with all that it implies, the push towards distance learning processes, i.e. e-learning, whether in synchronous or asynchronous mode, all this implies a greater need to develop people's digital skills, because of the need to interact with dedicated training tools”⁵⁰.

Soft skills have been recognised as a crucial need by the Italian industry respondents. Communication, teamwork, problem solving, active listening, all these skills have been mentioned and underlined as an important gap to fill and crucial to the transformation of the industry towards more advanced configurations:

“What young people lack is a softer approach, let's say not so much technical skills, which in some cases are very present, but the person is missing a bit. In the sense that they are often very intimidated, they lack a bit of leadership ability, which, of course, can be developed in parallel with a role in the company, it is not that you arrive on the first day and you are a natural leader. But they are very afraid to take steps, to expose themselves. So we also work a lot on this, we try to push them to get out of their comfort zone, to ask questions, to expose themselves, to present their results”⁵¹.

“The problem is that they lack the curiosity to go further, they stop at the procedures they have been shown and learned and apply only that. [...] Even in the case of a black box, however, there is a component of autonomy and reasoning that needs to be put in place, and there is often a lack of willingness to step out of one's comfort zone”⁵².

Some respondents have commented on the transversal need for soft skills (both senior and junior profiles) and have explained how these are now integrated in some CVET provision:

“The development of transversal competences from our point of view seems to be a crucial and strategic aspect in the process of continuous training of the workforce in the sector. [...] We have implemented training courses aimed at production personnel, i.e. both teams and also team leaders or managers. Very often these courses, which concern the development of technical skills, also include a section on soft skills... leadership, problem solving, team building, conflict management, priority management”⁵³.

⁴⁹ Interview transcript, Production Manager in steel company, Italy.

⁵⁰ Interview transcript, Sectoral training and consultancy body, Italy.

⁵¹ Interview transcript, HR manager in steel company, Italy.

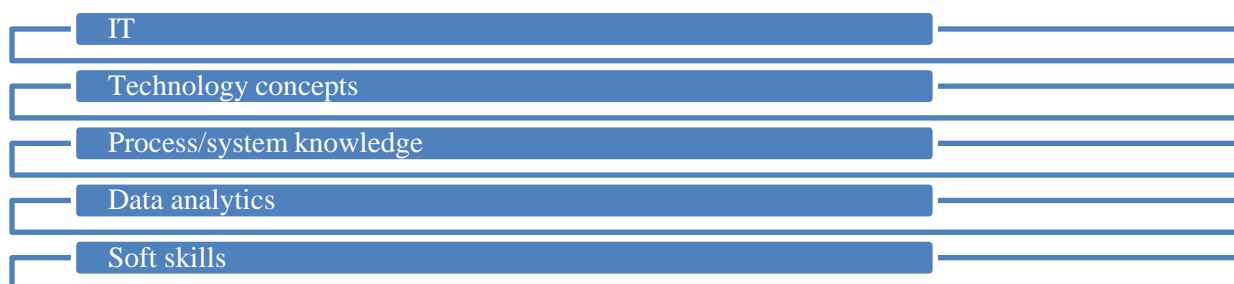
⁵² Interview notes, Technical Support Officer in steel company, Italy.

⁵³ Interview transcript, Sectoral training and consultancy body, Italy.

Other respondents, on the opposite, have maintained that the need for soft skills apply more to higher roles rather than operators, or even technicians, since these types of occupations are more bounded to a schedule and entail little need for creativity or problem solving most of the time.

“As far as soft skills are concerned, we are already at a certain level of professionalism there. Because my worker follows the machine. My worker, like the maintenance worker, follows a plan of interventions, a plan of activities. The cases where problem solving is needed are limited. The quality technician's work has little in the way of invention or analysis”⁵⁴.

Figure 13 – Skills and knowledge gaps in the industry as emerged from the fieldwork



4.1.3 Overview of Italy's VET system⁵⁵

In Italy, Law 53/2003 establishes the right and duty (*diritto/dovere*) to pursue one's education for at least 12 years before his/her 18th year of age, and that he/she should not leave education and training without a qualification. The lower secondary education program is completed at 14 years old; after that, students are required to choose between general education (high schools) and VET. At this stage young people can mainly choose between the following three routes:

- 5 years programmes in high schools (*Liceo*), technical schools (*Istituto tecnico*) or vocational schools (*Istituto professionale*);
- 3-4 years vocational training programmes (*Istruzione e Formazione Professionale - IeFP*);
- Apprenticeship.

At post-secondary level, students also have opportunity to opt for higher technical training programmes (*Istruzione e Formazione Tecnica Superiore - IFTS*, *Istituti Tecnici Superiori - ITS*) and short training courses at the regional level. VET courses also exist at the level of higher education.

VET governance in Italy is shared among different actors, mainly Ministries and Regional Governments, and supporting agencies, as described in Table 8.

⁵⁴ Interview transcript, Production Manager in steel company, Italy

⁵⁵ This paragraph is mainly based on INAPP *et al.* (2016). Vocational education and training in Europe – Italy. Cedefop ReferNet VET in Europe reports.

Table 8 – Governance and main actors in Italy’s VET

Ministry of Education	Defines the VET framework in school-based programmes (i.e. technical and vocational schools). As for post-secondary programmes (e.g. ITS), it sets the guidelines, redefines and updates the repertoire of occupational profiles and has monitoring responsibilities.
Ministry of Labour and Social Policies	The labour ministry defines the framework for interventions provided within the scope of strictly VET programmes (i.e. IeFP, which are implemented at the regional level), for training interventions for apprenticeships and for CVET provided within publicly funded programmes.
Regional governments	The regions and autonomous provinces are responsible for the planning, programming, organising and implementing (non-school-based) VET programmes at secondary and post-secondary level, for most types of apprenticeship-based training and for publicly-funded CVET.
Social partners	Social partners (trade unions, employers’ associations etc.), which have a general advisory role in VET policy and promote company-level training plans to be funded by the Regions or the joint interprofessional funds.
Tecnostruttura	It’s a body established by the Regions to provide technical assistance and coordination, as well as a common structure to carry out initiatives of elaboration, study, information and support to the regional policies (also relating to training and work).
INAPP – Institute for Public Policy Analysis	Monitors VET pathways at secondary and post-secondary level, apprenticeship training pathways and continuing training interventions. It is responsible for implementing and maintaining the Atlas of Work and Qualifications (<i>Atlante del Lavoro e delle Qualificazioni</i>). It’s also the Italian contact point for Cedefop.

In 2013, the National Repertoire of Educational and Vocational Qualifications (*Repertorio Nazionale dei Titoli di Istruzione e Formazione e delle Qualificazioni Professionali*) was established by the Legislative Decree No. 13. The Repertoire is the unitary framework for the certification of competences through the progressive standardisation of the essential elements of education and training certificates. It consists of all the diplomas, qualifications and certificates issued in Italy by an authorised institution or following an apprenticeship contract. The National Repertoire recomposes the system of qualifications issued in Italy with regards to the following routes: university, upper-secondary school, vocational education and training, regional qualifications, and apprenticeships.

Secondary education is divided into five-year school-based courses (high schools, technical schools, professional schools) and three- to four-years VET programmes of regional competence (*Istruzione e Formazione Professionale – IeFP*). It is now possible to fulfil the obligation of education and to exercise the right and duty to education and training both in the five-year school-based education and in the three-year or four-year VET courses (IeFP).

Vocational education and training (IeFP) is divided into three-year and four-year courses, aimed at obtaining respectively the qualifications of ‘operator’ and ‘technician’. Such qualifications, delivered at the regional level, are nevertheless recognised and expendable across the whole country, as they are recognised in the State-Regions Agreements of 27 July 2011 and 19 January 2012, and recently updated through the State-Regions Agreement of August the 1st 2019. The IeFP courses are carried out by VET centres accredited by the Regions, according to criteria shared at national level, or by the vocational schools, in a subsidiarity regime⁵⁶.

Technical and Vocational Schools are aimed at providing the learners with knowledge, skills and competences to carry out technical or administrative tasks, or qualified tasks in production fields of national interests (INAPP *et al.* 2016).

Upper-secondary and post-secondary VET programmes were reorganised in 2008 to better target the professional requirements of the labour market. Upper-secondary technical and vocational schools’ curricula were rationalised and consolidated reducing the overlap between similar ones and job placements were introduced. Vocational schools’ curricula have been amended again in 2017 to enhance provision. Schools have also been granted the possibility to customise part of the curricula to better meet the needs of the local labour market.

At post-secondary level, a higher vocational education and training programme (IFTTS, *Istruzione e Formazione Tecnica Superiore*) has been reorganised, and a new higher technical training programme (ITS, *Istruzione Tecnica Superiore*) has been established. The two post-secondary programmes are collectively organised by schools, vocational centres, universities and companies.

Both IFTTS and ITS are designed to have strong ties with the labour market and keep into account the industrial characteristics of the Regions. The ITS curricula include subjects such as “energy efficiency”, “new technologies for made in Italy” and “ICT”, makes extensive use of I4.0 enabling technologies for learning and training, and job placement is a substantial component of the programme. A reform in 2015, established the opportunity for learners to obtain a secondary vocational qualification or a diploma in a dual-mode to fill the gap between formal VET and companies and tackle youth unemployment.

Finally, VET profiles that belong to the strictly vocational route (*Istruzione e Formazione Professionale – IeFP*) have been updated and integrated in 2019 after a two-years review process. This has resulted in revised national standards with strengthened foundational and technical skills, and in the addition of new profiles (e.g. the profiles of “digital modelling and production technician” and “renewable energy technician”). Also, the Italian regions, which are granted the power to add other contents to the national standards, have collectively agreed to incorporate personal, social, learning and entrepreneurial competencies to the curricula.

⁵⁶ Supplementary subsidiarity means the possibility, for the students enrolled in the reformed five-year courses of vocational schools to acquire, at the end of the third year, also the corresponding professional qualification. Complementary subsidiarity means that the students enrolled in the vocational schools can obtain the relevant VET qualifications and or diploma in special classes expressly activated.

However, data provided by INAPP show a divide between northern and southern Italy in terms of IeFP routes: while northern regions seem to rely more on VET centres for the delivery of such IeFP courses, in southern regions these are mainly delivered through vocational schools in subsidiarity regime (see footnote 47). This can be explained considering the density of industrial districts in northern regions and the embeddedness of VET centres in the industrial fabric (INAPP 2019).

The rationale of the IFTS and ITS system established through the 2008 reform is to offer a consistent and integrated route for training at secondary and post-secondary level (*filiera lunga della formazione professionale*) to those learners willing to further specialise and increase their professional skills (INAPP 2019). The set-up of two complementary highly technical programmes represents the attempt of the country to establish a highly specialised training system, capable of matching the growing need of increasingly specialised labour on the side of companies. IFTS and ITS programmes could also support the transition to Industry 4.0 paradigm offering up-to-date and valuable skills to the industry (the “new technologies for made in Italy” area was indeed the most relevant one in 2017 with a total of 46 courses out of 97).

As regards apprenticeship, there are currently three types of schemes in Italy:

- a) Apprenticeship for achieving a vocational qualification in the IeFP or IFTS programmes (*Apprendistato per la qualifica ed il diploma professionale*)
- b) Professional apprenticeships (*Apprendistato professionalizzante*)
- c) Higher education and research apprenticeships (*Apprendistato di alta formazione e ricerca*)

The first scheme is addressed to people aged between 15 and 25 years and allows them to fulfil their right/duty (*diritto/dovere*) to education and training through a company-based apprenticeship, ending with the awarding of a formal qualification. These schemes are regulated by the State-Regions Conference Agreements and offer the opportunity to earn a IeFP qualification as an operator (EQF3) or a technician (EQF4), or a IFTS diploma (EQF 4).

The professional apprenticeship scheme is addressed to people aged between 18 and 29 years who want to further specialise and acquire a qualification defined through collective agreements at the sectoral level. This scheme is divided into two components, the acquisition of key skills within a training centre, and the acquisition of specific vocational skills within the company. These apprenticeships have a maximum duration of 3 years and allow the apprentice to earn a regional qualification.

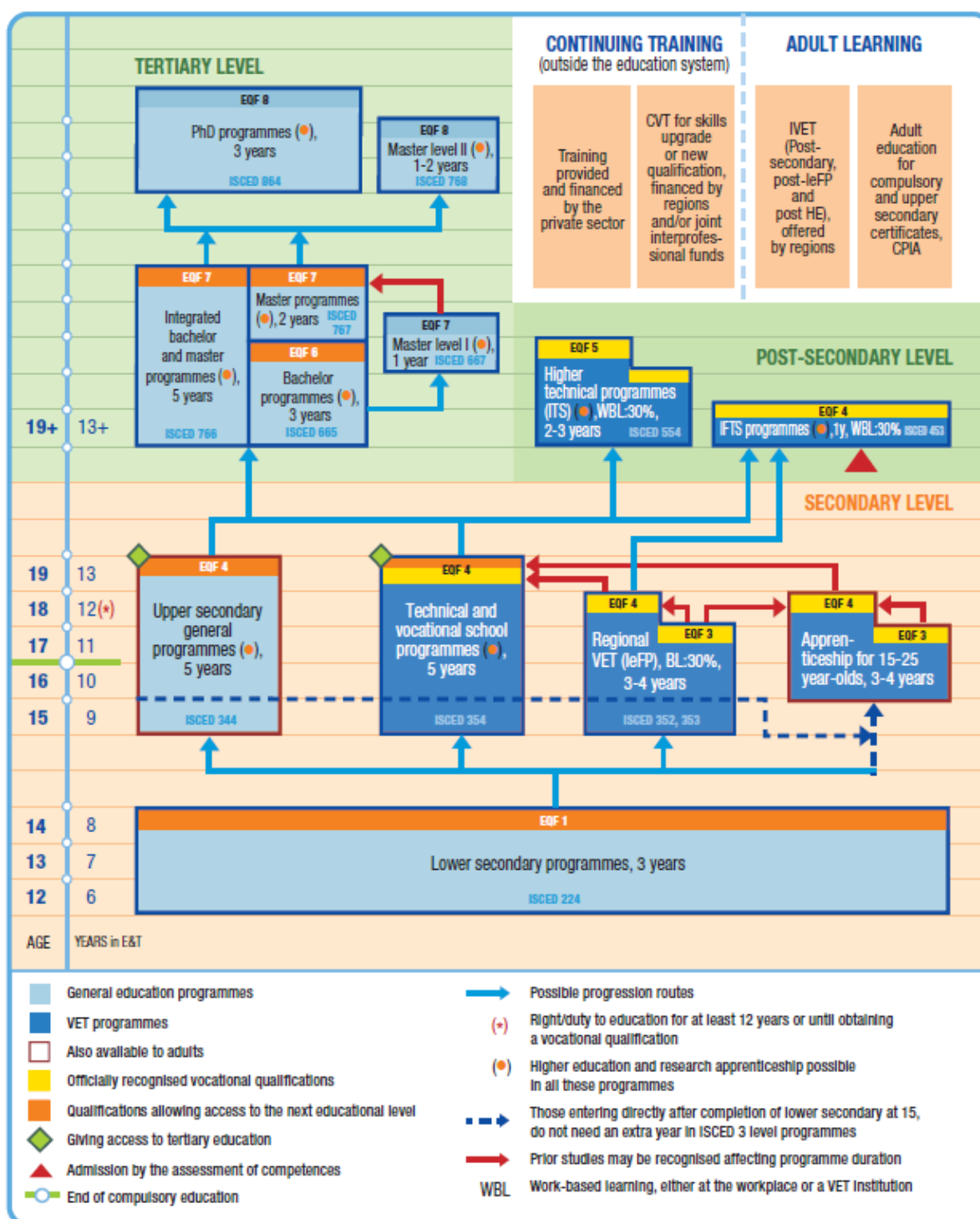
The third type of apprenticeship scheme refers to a contract aimed at the training and employment of young people between 18 and 29 years of age. It allows an individual to combine work and study in order to achieve a higher education qualification (bachelor’s degree, master’s degree, Ph.D.) or to carry out research activities. The individual is hired by the company on an apprenticeship contract, with the duty to achieve a defined qualification or develop a research project linked to his work profile. This type of contract offers employers the opportunity to include and build specialist skills in their staff, which can leverage innovation and productivity.

The experience of dual systems in continental Europe has shown that these are more effective in tackling the effect of economic crises on employment levels and to reduce the gap between companies' requirements and young workers' competencies. Thus, the Italian government has introduced in 2015 some principles of the dual system in general education and VET (INAPP 2019). The three instruments through which the dual system currently runs in Italy are the school-work alternance (*Alternanza scuola-lavoro*), the simulated educational enterprise (*Imprese formative simulate*), which refer to general education, and the apprenticeships schemes described above. In 2015, the new regulation expanded the qualifications achievable through the 1st type apprenticeship, set limits for training conducted outside the company and established tax incentives to encourage companies recruiting people between 15 and 25 years of age. The State-Regions Agreement of the 24th September 2015 hinges the dual system on the vocational education and training system by establishing the essential levels of performance, the training and organisational standards, the repertoire of current qualifications and professional diplomas and those relating to the first type of apprenticeship.

INAPP (2019) depicts a scenario in which the dual system appears more established in those regions with a stable and long-lasting VET offer (namely, north-east and north-west regions), while it appears to be struggling in those regions with a weaker VET culture (Central and Southern regions).

Figure 14- General Education and VET system in Italy

ESSA: Identification of National (Sector) VET Qualification and Skills (Regulatory) Frameworks for Steel (Deliverable 4.1 – Version 3)



Source: Cedefop and ReferNet Italy.

Considering IVET, Cedefop data (2017a) show that the percentage of IVET students at upper-secondary level in Italy is higher (55.8%) than the EU average (47.3%) and the share of upper secondary IVET students with access to tertiary education (80.7%) is also well above the EU average (66.7%).

On the other hand, as for continuing vocational training (CVET), the share of adults involved in lifelong learning programmes is lower (8.3%) than the European average (10.8%), with older

adults with a low level of educational attainment and unemployed adults less likely to engage in continuing training. In 2010, the average of Italian employees involved in continuing training programmes was still slightly below (36%) the EU average (38%) and only 11% of Italian employees were involved in on-the-job training, compared to an average of 20% in Europe (*Ibidem*). Considering the manufacturing sector, recent surveys have shown a significant turn in terms of on-the-job training in Italian companies. In 2015, 60,2% of Italian companies with at least 10 employees have put into place training activities for their workers. This data is relevant as it represents the highest value since 1993 (INAPP 2019).

Considering CVET and adult learning, each of the 20 Italian regions have consolidated a regional repertoire of vocational qualifications (though there is a strong convergence between the different regional repertoires) on the basis of which short-term courses (usually between 100 and 900 hours) are activated free of charge for a limited number of unemployed young adults (between 18 and 35 years usually) and founded by the European Social Fund (ESF), the Ministry of Work and Social policies, and regional funds.

4.1.4 Programmes and qualifications relevant to the steel industry

In relation to the steel sector, the following programmes offer curricula and qualifications that can lead to a job in the industry.

Technical schools offer a solid scientific and technological cultural background, favouring the development of skills that allow immediate access to the labour market. With the technical school diploma, it is possible to continue the studies at tertiary level in university or to further specialise in higher technical institutes. There are two sectors, economic and technological, in which the programmes are divided (Table 9). Each course has a duration of five years divided into two two-year periods and a fifth year. At the end of the five-year course, students take the state exam and obtain a secondary school diploma.

With the legislative decree n. 61 of the 13th April 2017 the vocational schools have become territorial schools of innovation, conceived as laboratories of research, experimentation and didactic innovation. Vocational school programmes include a common two-year unit and a three-year specialisation aimed at deepening the student's education according to the chosen address. The professional institutes are characterised by eleven fields of study (see table 10).

Table 9 – Example of steel-related curricula in technical schools (Istituti Tecnici)

Technological Area
Mechanics, mechatronics and energy
Transports and logistics
Electronics, electrotechnics
Informatics and telecommunications
Chemistry, materials and biotechnology

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Constructions, environment and territory
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Source: Ministry of Education, University and Research

Table 10 – Example of steel-related curricula in vocational schools (Istituti Professionali)

Industry and craftsmanship for Made in Italy
Maintenance and technical assistance
Water management and environmental remediation
Commercial services

Source: Ministry of Education, University and Research

Regional IeFP programmes last 3 or 4 years and end with the professional qualification of operator (EQF 3) and/or the diploma of technician (EQF 4) in a specific field. The Italian regions issue qualifications and diplomas recognised at a national level, as defined in the National Classification of Professional Roles. The repertoire of IeFP qualifications is currently made of 25 operator qualifications and 29 technician diplomas. Table 11 provides a list of national IeFP qualifications and diplomas related to the steel industry (though not all 4-years courses that lead to diplomas have yet been activated in all the regions) (INAPP 2019). The general profiles reported in Table 11 are often further articulated in specialistic curricula (e.g., Industrial automation technician for the installation and maintenance of systems).

Table 11 – Example of steel-related qualifications in IeFP (Istruzione e Formazione Professionale)

Operator (3 years)	Technician (4 years)
1. Chemical production operator	1. Building technician
2. Building operator	2. Electrical technician
3. Mechanical operator	3. Programming and management of production plants technician
4. Electrical operator	4. Industrial automation technician
5. Logistic systems and services operator	5. Heating systems technician
6. IT operator	6. Iron and non-noble metals processing technician
7. Water management and environmental remediation operator	7. Renewable energy technician

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8. Business services operator	8. Digital modelling and production technician
	9. Logistic services technician
	10. IT technician
	11. Business services technician

Source: State-regions agreement on VET national profiles and standards, 1 August 2019.

As for post-secondary VET programmes, these were reorganised in 2008 and aim at meeting the professional requirements of the labour market in relation to advanced technical skills. These programmes, namely ITS (*Istituti Tecnici Superiori*) and IFTS (*Istruzione e Formazione Tecnica Superiore*), are collectively organised by schools, vocational centres, universities and companies.

IFTS programmes were first introduced with Law 144/1999 (art. 69) and then reformed by Ministerial Decree of the 25th January 2008. IFTS are coordinated at regional level and are organised in 800-1000 hours courses, of which at least 30% to be spent as an internship in a company. Access requirement is the possession of a 5-years school diploma or a 4-years VET diploma. At the end of the program the candidate achieves a higher technical specialisation certificate (EQF 4). Regional programmes are defined by a National Repertory which includes 20 technical specialisations (see Table 12) that are linked with specific technological areas that have been defined as strategic for the country.

Table 12 – Example of steel-related IFTS specialisations (Istruzione e Formazione Tecnica Superiore)

Professional Area	Title of the Specialisation
Manufacturing and Handicraft	Techniques for manufacturing of made in Italy products
Mechanics, Plant and Constructions	Techniques for industrial design
	Techniques for the industrialisation of products and processes
	Techniques for programming production and logistics
	Techniques for the placement and maintenance of civil and industrial plants
	Techniques for environmental safety systems and industrial quality processes
	Techniques for environmental monitoring and management

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	Techniques for organising and managing construction sites
	Innovative construction techniques
	Networks and systems safety techniques
Culture, Information and IT	Techniques for designing and developing IT applications
	Techniques for the integration of TLC systems
	Techniques for database design and management

ITS programmes have been introduced with the Ministerial Decree of the 25th January 2008. The Interministerial Decree of the 7th February 2013 has also contributed in defining the governance and the organisation of the programmes (both IFTS and ITS). ITS are higher technological specialisation schools, coordinated at central level by the Ministry of Education, University and Research (MIUR). They are designed from the very beginning in order to have a strong link with the labour market, their programmes are defined in accordance with the Regions and keep into account the specific characteristics of the territory. ITS programmes last between 1800 and 2000 hours (of which at least 30% to be spent in a company) and half of the teachers are required to come from business and production. To access these courses, it is required the possession of a 5-years school diploma, or a 4-years VET diploma plus the accomplishment of an IFTS course. The completion of the programme leads to a higher technical diploma (EQF 5). The ITS programmes refer to the following 6 areas:

- a) Energy efficiency
- b) Sustainable mobility
- c) New technologies for life
- d) New technologies for made in Italy
- e) Innovative technologies for arts and cultural activities
- f) ICT

As regards continuing VET, resources have been mostly managed by the regions and autonomous provinces (often through European Social Fund regional operational programmes) and the social partners (through Interprofessional Funds). This training offer is complemented by that developed by private VET providers and by the companies themselves. In recent years, some relevant courses have been designed at the sectoral level to fill the gaps between VET and the industry and to support the transition to Industry 4.0. Two of the most interesting examples of this are the courses offered by Riconversider, the training body of Federacciai. These courses are named *Giovani d'acciaio* (Youngsters of steel) and *Metallurgia 4.0* (Metallurgy 4.0) (Table 13). As for training devised by companies' internal academies, the data acquired from one of the Italian case study companies shows that transversal skills were an important target for the company's internal training provision (Table 14).

Table 13 – Examples of sectoral upskilling courses activated by Riconversider

Giovani d'Acciaio
<p>The course lasts 240 hours and includes:</p> <ul style="list-style-type: none"> • Technical competencies related to mechanics and electronics, metallurgy and automation • Transversal competencies related to health and safety, environmental regulation, teamwork, organisational culture.
Metallurgia 4.0
<p>The course lasts 650 hours (class and WBL) and includes:</p> <ul style="list-style-type: none"> • metallurgical competencies • digital competencies and analytics • transversal competencies • Basic requirement: technical diploma

Table 14 – Example of internal training courses offered in an Italian steel company

Social and Personal Skills	Digital Skills
<ul style="list-style-type: none"> • Conflict management • Time management • Assertiveness • Innovation • Problem solving • Effective communication • Change management • Negotiation • English language 	<ul style="list-style-type: none"> • Excel • PowerPoint • Coswin 8i • SAP

4.1.5 Remarks on VET

Overall, the most interesting interviewees' comments on the Italian education and training system did not relate much to the organisation of the system itself, but rather to the approach to education and training. When reflecting on the impacts of new technologies and challenges on the steel sector, some have remarked the need for an approach that breaks with the Tayloristic attitude of parcelling out competencies. What the industry needs, is workers with a wider understanding of processes and a re-composition of the occupational skills profile:

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“Until now, much has been built on a mode that was particularly linked to a specialisation model that saw the fragmentation of skills, knowledge and the figures themselves. Recomposing then also from the point of view of the overall ability to know the production process is one of the issues on which there is a stronger demand”⁵⁷.

Also, the Italian school-based education and training system has been criticised for relying too much on straight patterns of learning, in doing so not stimulating enough the pupil’s capacity to abstract and solve unforeseen problems, which as seen as an important part of the work in a company:

“The school puts you in a position to solve problems that are already defined. It has given you the model, it tells you what doesn’t work and says apply the model and find me an answer. In our case you have a system that you don’t know, you see phenomena, you have to understand what the model is and you have to understand what is wrong with what is happening”⁵⁸.

As regards abstraction, the capacity to theoretically model complex systems is expected to be a key skill of a technician or an engineer. This resonates with the claims on the higher importance of acquiring process and system knowledge. The VET system is considered currently weak in developing this type of skills:

“From an educational point of view, unfortunately the subdivision of curricula by subjects is not conducive to this interaction, because there are compartments. What would be useful is a systems approach to plants, i.e., defining plants in terms of flows: energy flows, material flows, information flows, etc.”⁵⁹

The need for more practical in-company training has been advocated by several interviewees, similarly to other countries. The dual training option implemented in 2015 goes in the direction of aligning more schools and vocational centres to companies, a trend that is common to many other European countries. Some have underlined the need to ground the apprenticeship more in the daily problems that a worker would face⁶⁰. This would help to develop better problem-solving skills and to learn how to apply skills and knowledge to complex work environments. However, an interesting comment has been offered in relation to the risks of tailoring too much the training of workers to the needs of the companies through dual apprenticeships, and primary mission of education and training:

“I am always afraid to train people through companies because we will never have a cultural advantage, on the contrary. So they must be trained by the school, the apprenticeship is fine, but no more than that. Because when a person arrives in a company he/she will be the driving force of the future company and it must be able to give something back. Not immediately, because it is very difficult. But he must have concepts in his head so that after he has learnt what the company does, he is able to start pouring out what he has learnt in school. So for me the school must have more advanced programmes, it must not be flattened by the company, but must train people with a higher cultural level. This obviously means that when he arrives at the company that person probably lacks something to be able

⁵⁷ Interview transcript, Trade Union Representative, Italy.

⁵⁸ Interview transcript, Production Manager in steel company, Italy

⁵⁹ Interview transcript, Production Manager in steel company, Italy.

⁶⁰ Interview notes, Technical Support Officer in steel company, Italy.

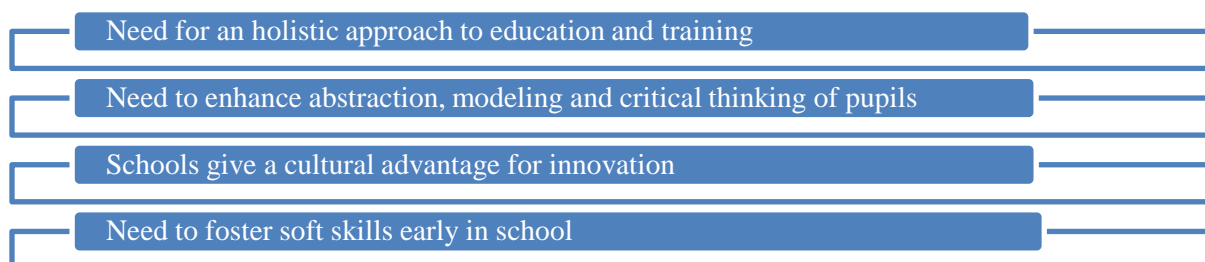
to use it immediately. But it is up to the company to give him the little that is needed to be able to use him”⁶¹.

Finally, with regard to soft skills, which have been identified as an important part of the current needs, it has been remarked that these need to be stimulated earlier in the school age. Indeed, where technical skills might well be present, soft skills are what is needed to move beyond the mere role of technician and become a supervisor with responsibilities of managing a team:

“We often find ourselves stuck with good technicians who don't get out of there. They may improve as technicians, but you can't entrust them with a team that has a lot of responsibility for both safety and the budget. So clearly you also need a certain approach from a character point of view, which I think would be appropriate if it were stimulated from school age, going as far back as possible”⁶².

A summary of the remarks is shown in Table 15.

Table 15 – Remarks on Italy's VET as emerged from the fieldwork



Need for an holistic approach to education and training
Need to enhance abstraction, modeling and critical thinking of pupils
Schools give a cultural advantage for innovation
Need to foster soft skills early in school

4.1.6 Feedback mechanisms

Since the alignment of VET provision with labour market needs is at the basis of VET's rationale, the type of mechanism that connects the two dimensions is an important feature of VET systems. Following the work of Markowitsch and Hefler (2018), here we will define such links as *formal feedback mechanisms*, meaning by this “purposefully implemented formal institutional procedures, determining the particular roles of various stakeholders in planned renewal of VET provision” (Ibidem, p. 287). Formal feedback mechanisms usually “have a legal foundation, are established on a permanent basis, and comprise two or more actors” (e.g., the state, employer and employee organisations) (Cedefop 2013). In pointing out the type of mechanism complementing a national system, we aim to offer some indication on what the possible avenues are to provide additional information about (sectoral) skills gaps and content integration to key players.

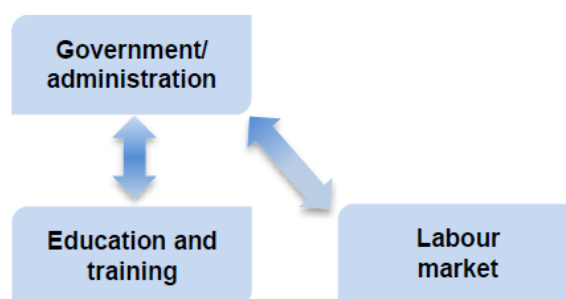
With respect to formal feedback mechanisms, Italy's VET system seems to incorporate a statist model of feedback mechanism (Cedefop 2013; Markowitsch and Hefler 2018) (see Figure 15). This normally consists of “a board, a committee, or a temporary working group, established by the ministry of education and responsible for developing new curricula or educational standards” (Markowitsch and Hefler 2018, p. 294). The actors represented in the board can include experts from schools, researchers, governmental bodies, or representatives from the corporate

⁶¹ Interview transcript, Automation Manager in steel company, Italy.

⁶² Interview transcript, HR Officer in steel company, Italy.

world. The board acts as a technical working group which then transfers its results to the responsible department of the ministry. This type of feedback mechanism is often present in centralised school-based VET systems. The participation of social partners in the process is usually informal rather than formal and limited to an advisory role. This type of feedback mechanism has been recognised as “the most frequent model of feedback mechanism in VET at upper-secondary level in Europe” (Markowitsch and Hefler 2018, p. 295). However, it has to be noted that when it comes to CVET, the Italian system allows for more direct involvement of social partners, especially when it comes to regulating professional apprenticeships through collective agreements, promoting in-company, sectoral and territorial training programmes funded by the regions or arranged through joint interprofessional funds.

Figure 15 – Statist feedback mechanism



Source: Cedefop (2013)

Although in Italy the responsibility for VET regulation is shared between the Ministry of Labour and Regions, the Regions can act through the standing committee of Regions and Autonomous Provinces, initiating a process similar to that outlined above. An example of this mechanism in action can be found in the revision of the national standards for three-years and four-years VET qualifications (IeFP). In 2017 the standing committee of Regions and Autonomous Provinces (*Conferenza delle regioni e delle province autonome*) started a process of reviewing of existing standards. The work was delegated to a technical committee representing the Regions in consultation with the Ministries of labour and education, as well as VET experts. The review brought to a revision of the national standards, which was then ratified by an agreement between the Regions and the Ministries of labour and education in August 2019.

4.1.7 Good practices

As regards good practices, important work in consolidating and making the Italian system more transparent was carried out in the last 10 years. The design and development of the Atlas of Work and Qualifications (*Atlante del Lavoro e delle Qualificazioni*) led to a first release in 2012 and then in 2016. The Atlas is a model for the representation of job content based on the description of activities commonly carried out in work contexts:

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“We had to build system for job description different from the classical one based on professional figures. This is one of the reasons why we described work by processes and activities and not by professional figures, following more the logic of the enterprise, the logic of the value chain”⁶³.

Activities are described independently of who is called upon to perform them, how they are performed and with what resources. They constitute the elementary unit of job description and are organised in larger sets referred to as activity areas. In turn, activity areas are functionally grouped into production processes. Finally, the processes are grouped into sectors which constitute the largest unit of aggregation in the Atlas (Mazzarella et al. 2017).

“We have built a job description system through the Atlas which maps all the economic and professional sectors, all the work processes which take place in the sectors, up to a level of detail of the working activities which are carried out, and then we have hooked these qualifications on this big job mapping. In this way we started to cross the information on qualifications with respect to the output, i.e. with respect to the professional outlet which they potentially declare to be the one of the qualification they issue, being the titular bodies. These convergences take place on an element of the Labour Atlas which is called ADA, area of activity. In *Atlante del lavoro* there are 850 ADA, and with 850 ADA we are able to read 90% of qualifications which are issued”⁶⁴

For the description of the processes, the value chain model (Porter 1988) was used. According to this approach, the overall value of a process can be broken down into intermediate value increments which together support the achievement of the final result characterising the process. On these intermediate values, smaller elements of the process have been identified: the sequences and areas of activity (ADA). ADAs are represented as groupings of individual activities organised according to a logical/chronological sequence and an operational, or managerial, content, aimed at achieving a specific result. Expected outcomes contain three types of information: the description of the product/service to be produced/serviced; the essential characteristics of the action to be performed; the levels of responsibility and of autonomy, with respect to performance. Expected results formulated in this way allow to make explicit and highlight the point of interconnection between the activities (what is done) and the competences and which resources, e.g. in terms of knowledge and skills, are required to perform such activities. Currently, the Atlas is made up of 24 sectors, 82 labour processes, 250 sequences, 840 ADAs 6,322 activities and 1,926 expected outcomes. Along with these, the Atlas integrates 7,200 qualifications from both general education and VET. The functions of the Atlas, in a context of lifelong learning, can be several:

- a. it can offer a handy tool to understand and make transparent the experience acquired through informal and non-formal learning;
- b. it can help to explicit individuals' tacit knowledge;
- c. it helps to connect qualifications with occupations within Italy's labour market through the descriptive elements listed above;
- d. it helps the design of CVET offer (e.g., Interprofessional Funds which are often used to found CVET in Italy have used its descriptive items as a reference for technical competencies)

⁶³ Interview transcript, VET system expert, Italy.

⁶⁴ Interview transcript, VET system expert, Italy.

- e. as regards qualifications' intelligence, the Atlas can help to point out the occupational areas in which there is a higher density of qualifications and those with scarce qualifications (and consequently a gap).

Along with these functions, the Atlas of Work and Occupations can also offer an institutionalised feedback mechanism in the sense described in the previous section. Indeed, as explained by the person who led the development of the Atlas, it has a regulated maintenance procedure which is open to inputs from many stakeholders:

“The Atlas has a maintenance procedure. [...] In order to be modified, it is necessary to have access to a procedure foreseen by the norm [...] which says that the Atlas can be modified (i.e. updated, developed, maintained) through the request of various subjects, including chambers of commerce, bilateral bodies, interprofessional funds, social partners (category or confederal). Then it generically speaks of stakeholders of the sectoral system”⁶⁵.

In such a way, the Atlas is a platform potentially open to all sectoral stakeholders for continuous updating and improvement of its descriptive elements, especially with regard to the transformations in processes and activities brought in by innovation. However, it has been pointed out that one of the potential weaknesses of the Atlas in this respect is in the voluntary participation of sectoral stakeholders, which makes the validations of the Atlas uneven (it has been estimated that about 40% of the Atlas descriptive elements have been validated by sectoral stakeholders).

As concerns labour market requirements and skills anticipation, a good practice that could be highlighted is the well-established information system “Excelsior”. The Excelsior system was established in 1997 as the result of a partnership between the Italian Union of Chambers of Commerce, Industry, Craft and Agriculture, and the Ministry of Labour. The system provides national and local data about job offer and job demand as well as professional and educational demand on the side of enterprises by economic sector. Excelsior aims at monitoring the prospects for work demand and the professional requirements, as well as training and skills needs expressed by companies. It is considered one of the largest surveys envisaged by the National Statistical Program and represents the most complete information device available in Italy for monitoring the professional and training needs of companies.

4.1.8 System trend

Important research was carried out by Cedefop (2020) in relation to VET trends in European countries in the past 25 years and future scenario foresight. The research has shown that Italy's VET system presented some differences compared to other southern-Europe countries, and that its trajectory resembled more that of Visegrád countries⁶⁶, with a share of VET students at upper secondary level decreasing from about 72% in 1995 to 56% in 2015. This has been explained mainly in terms of a decline in regional VET during the 90s as a consequence of its scarce capacity to cope effectively with de-industrialisation and/or innovation. In the same period, Italy's VET gradually shifted from being part of active labour market policy to become part of the national education and training system. As Cedefop notes, such reforms have aligned IVET at Regional level with other provision at the national level, overall consolidating the system.

⁶⁵ Interview transcript, VET system expert, Italy.

⁶⁶ Czech Republic, Hungary, Poland and Slovakia.

From this perspective, adopting Cedefop’s language, the most evident trend in Italy’s VET in the last 25 years (and which can be assumed to consolidate in the future) is a “academic drift”, coupled with a broadening and hybridisation⁶⁷ of the provision and an extension at post-secondary level (e.g., the IFTS and ITS courses). Despite this shift towards general education, some of the collected evidence still point to a clear distinction between general and vocational programmes, net of the broadening and hybridisation of VET.

4.2 United Kingdom

4.2.1 UK’s Steel Industry

Eurofer data for 2018 show the UK at the seventh position in the EU ranking for crude steel production, with a share of 4.3% and an output of 7.2 million tonnes (Eurofer 2019b). In the same year, the steel sector displayed a direct employment of 15,811 workers (*Ibidem*). Data show a significant fall in production compared to 2014 when the production was about 12 million tonnes. In September 2015, the UK steel industry faced a deep crisis, that led to reduction in capacity, or closure in some cases, of important plants located in England, Scotland and South Wales, with a loss of about 7,000 jobs (Rhodes 2018). An example of such closures is the case of the Redcar steelworks⁶⁸, which was closed in 2015 due to a combination of global and domestic factors (Coats 2021). The few remaining steelmaking plants are shown in Table 16.

Table 16 – Steelmaking plants in the UK

Blast Furnace and/or Oxygen converter	Scunthorpe, Port Talbot
Electric ARC Furnaces	Cardiff, Newport, Rotherham

Data show that the steel sector economic performance is in countertrend with the overall UK economic performance, which has increased by 68% from 1990 to 2015, while the steel sector has decreased of about 40%, moving from a weight of 0.4% on the whole economy to the 0.1% of 2016.

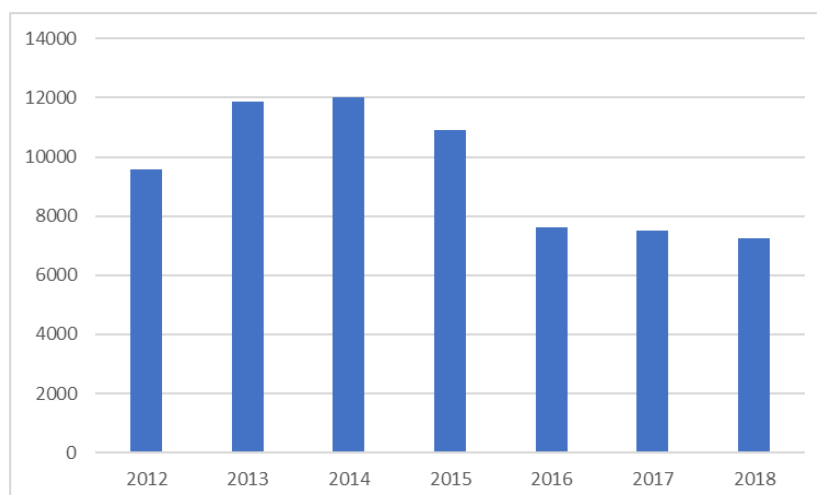
⁶⁷ Here the term hybridisation is used to describe the combination of vocational and general subjects in the curricula, resulting in broader qualifications that often give access to different further education and training options.

⁶⁸ The steelworks in Redcar, since 2011 property of the Thai company Sahaviriya Steel Industries, was closed in 2015 in consequence of the drop of steel prices, causing a loss of about 2,000 jobs. The steelworks in Scunthorpe, formerly owned by Tata Steel, was mothballed at the end of 2015 and then reopened as British Steel (owned by Greybull capital) in 2016. On May 2019 British Steel was placed into insolvency process. The collapse of the company was ascribed by the Chief Executive to a combination of weak market demand, high raw material prices, the weakness of sterling and uncertainty over the outcome of Brexit. In November 2019, the UK has announced the acquisition of the assets by the Chinese company Jingye, an acquisition that should safeguard about 4000 jobs at risk in the scenario of the closure of the Scunthorpe plants. Jingye is currently planning to invest about 1.2 billion pounds in British Steel over the next decade, including upgrading, lowering emissions and improving energy efficiency.

The analysis of the conducted interviews, as well as desk research, provides a summary of the main challenges that the British steel industry is facing. A brief account of the difficulties faced by the steel industry was given by one of our interviewees, a trade union representative:

“In the history of the steel industry in the UK, there have been hundreds of thousands of steel jobs, but then in the 80s [...] there was mass redundancies across the industry. And that had a real impact on those communities as well [...] And numbers have continued to decline, and then in 2016 there was the steel crisis, where it looked like the steel industry in the UK was essentially over or was going to be significantly reduced again [...] Since then we've been perpetually and just rolling from crisis to crisis. So you could say it's an ongoing crisis and the Coronavirus really hasn't helped the situation of steel companies at the moment. But they were already struggling because of Brexit and the uncertainty around that, because of dumping from China, and so yes, I'd say that we're still in a moment of crisis for the steel industry in the UK”⁶⁹

Figure 16 – UK total crude steel production (all qualities) in ‘000 metric tonnes



Source: Eurofer

As regards the uptake of technology the interviewees expressed mixed views. Although some in-company programmes aimed at modernizing the plants were mentioned, there were also some hints about old machineries in some plants. This has implications regarding knowledge retention:

“Some of the equipment, sort of control systems we have in place for blast furnaces [...] they probably belong in a museum. So, there is people out there who have got this knowledge. So, it's all about growing our talent, because we need to operate these systems. If we don't operate them, and we need to replace, you can imagine the sort of cost implications”⁷⁰.

⁶⁹ Interview transcript, trade union representative, UK.

⁷⁰ Interview transcript, training advisor in steel company, UK.

From the point of view of a trade union, the opportunities offered by some technologies have not been fully exploited yet in the UK:

“I guess in the UK it's been identified that companies, and industries in particular, aren't actually being smart with tech as we could be, and how can we promote that and actually encourage companies to take advantage of technology and to become more productive and to make hopefully workers lives easier and better as well”⁷¹.

The endorsement of the technological potential by the trade union was accompanied by a clear remark about the need of transforming the industry together with workers, and making sure that no worker is left behind:

“Automation is obviously a key thing within the works [...] And that's another thing I'd like to discuss...it's changing people's mindset. Because when people see automation, the first thing people see is job cuts. That's not the case”⁷².

This goes in parallel with the need to devise a national strategy for the green transition, powered by new technologies. The steel industry is the biggest industrial emitter of CO² in the UK and “with the net zero target by 2050 adopted by parliament in 2019, the steel industry is under pressure to act fast” (Syndex 2021, p.3). This will affect particularly Tata Steel and British Steel with their blast furnaces in Port Talbot and Scunthorpe respectively (Syndex 2021). One of the possible strategies to move in the direction of greener production is to rely more on EAF: since the UK is a net exporter of scrap (only a quarter is consumed domestically) there is potential to increase scrap usage for domestic production replacing the high level of imports (around 60%) (Syndex 2021). In this respect, the continuous improvement of scrap processing methods aimed at better separating alloys should favour the transition to EAF steelmaking which will have implications for jobs.

To address climate challenges and support domestic production, the government has issued a series of guidelines and measures, such as the *Industrial Decarbonisation & Energy Efficiency Roadmaps to 2050*⁷³ published in 2015, and the *Clean Steel Fund*⁷⁴ announced in 2019. The first looks at enablers, barriers and viable technical options for decarbonisation (considering both incremental and disruptive opportunities). The second is expected to support the transition to lower carbon iron and steel production through new technologies and processes (e.g., hydrogen), and maximise longevity and resilience of the sector.

However, the Syndex report (2021), points out several aspects that might impede or slow down the green transition. These are high cost of electricity, limited access to raw and pre-processed materials (e.g., iron ore, on which the Direct Reduced Iron process is based), insufficiently developed hydrogen production technologies and, in general, limited research and development in the sector (besides European level previous projects).

⁷¹ Interview transcript, trade union representative, UK.

⁷² Interview transcript, training advisor in steel company, UK.

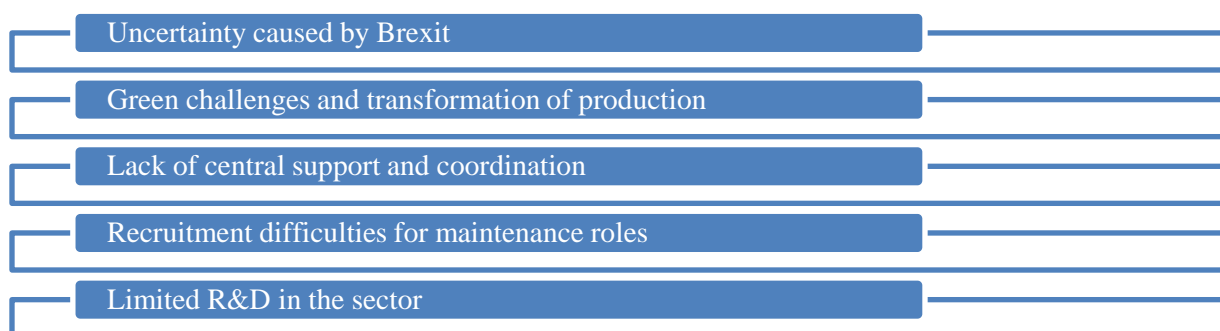
⁷³ <https://www.gov.uk/government/publications/industrial-decarbonisation-and-energy-efficiency-roadmaps-to-2050>

⁷⁴ <https://www.gov.uk/government/consultations/creating-a-clean-steel-fund-call-for-evidence>

In relation to labour market, some interviewees have highlighted issues with finding adequate electrical and mechanical maintenance profiles, while production workers appear to be easier to recruit.

As for training, the interviews have shown that the concept and function of internal Academies is becoming more prominent, in line with similar developments in other European countries. These are conceived as a core part of the training process, and could complement the training offer of colleges.

Figure 17 – Challenges faced by the UK steel industry as emerged from the fieldwork



4.2.2 Industry's perspective on skills

In relation to the scenario outlined above, the interviewees drew the attention on several skills gaps, summarised in this section. Steelmaking knowledge and skills remain an important part of the professional profile of the prospective worker, net of any technological or organisational change:

“The most basic one for me, would be steelmaking knowledge in general. So, the actual process of steel. We probably cover every role, you can imagine [...] but for me, the fundamentals have got to come from the basics with steelmaking. So, we have a very good scheme. But it is quite costly”⁷⁵.

As in interviews in other countries have also shown, from technological advancement and process integration stems the need of a more thorough process knowledge and understanding of knock-on effects, this has been remarked also in the UK:

“What I found within technical [...] was people's understanding and knowledge of the knock-on effect down the line in the process. So, if you were producing coke for the blast furnace, and you're producing poor quality coke [...] what effect is that going to cause my customer? Because it's a chain at the end of the day”⁷⁶.

⁷⁵ Interview transcript, training advisor in steel company, UK.

⁷⁶ Interview transcript, training advisor in steel company, UK

Similarly to the findings in other countries, also in the UK transversal (soft) skills are gaining importance. Leadership, decision making and problem solving have been referred to as critical emerging skills:

“The decision-making process, and problem solving is always a key thing for us. And I think the two go sort of coupled. And again, we have programs running in house, but it still comes around for people to understand and follow a sort of structured process when it comes to problem solving. Especially with the structures we have now, a lot flatter. The teams are more flexible, but we are still trying to push on the decision takers within those teams as well. It's getting better, but I still see there's an area for improvement”⁷⁷.

More in general, some have commented on transversal skills as being a core part of workplace skills, especially when workplaces are transformed by technology:

“Workplace skills will actually be lacking. And so, skills such as management, for example, critical thinking, I think will be more crucial as we increase the use of technology in different workplaces and leadership skills, actually, I think will be a real problem for young people entering the workforce who perhaps can't get that experience elsewhere. And probably skills that weren't seen as crucial, I think, with the increasing use of digital and tech...management leadership skills, critical thinking will be really valuable in the workplace”⁷⁸.

Such emphasis on leadership skill resonates with the findings of a study conducted by the Business in the Community group, which underlined the importance of leadership skills for UK firms attempting to develop new low-carbon business models and clearly stated that “developing the leadership skills we need for the transition to a sustainable economy is both urgent and critical” (Business in the Community, p. 7)

In line with the previous comment, the following also underlines the importance of a particular soft skill, namely adaptation. Since every company has to deal with change from a number of different points of view (organisational, technological, change in demands and regulation, etc.), a key skill would be the capacity to adapt to change and cope effectively with exogenous pressures and transformation:

“This is probably an internal thing, is about people adapting to change. It's a key thing for us. [...] The change in the mindset, and it comes back down to more difficult with the older generation, I would say as well. But I mean, we are driving change, trying to make innovation. We mentioned electric arc earlier. It's something that's going to be in the middle of us. And if we don't change, we're going to be left standing still”⁷⁹.

However, some maintained that soft skills could be more beneficial for higher-end roles, such as engineers and mentors, rather than apprentices:

[Apprentices] they do get teamworking, they get teamwork and communication. Communicating with engineers is one of the BTEC units. And there is also one for teamworking. But other than that, nothing again [...] I'm reasonably happy with how it is, I think perhaps the more experienced...perhaps some of the engineers would potentially benefit from that. And

⁷⁷ Interview transcript, training advisor in steel company, UK.

⁷⁸ Interview transcript, trade union representative, UK

⁷⁹ Interview transcript, training advisor in steel company, UK

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some of the mentors may benefit from that. But we offer coaching and mentoring courses, which, you know, cover softer skills⁸⁰.

Indeed, the same interviewee remarks that when soft skills play a stronger role, this is normally in graduate programmes:

“I've recently been developing a graduate program [...] and part of the of the program is an ILM [leadership and management] qualification, particularly around the softer skills. [...] There's also sort of grants and project management, etc.”⁸¹.

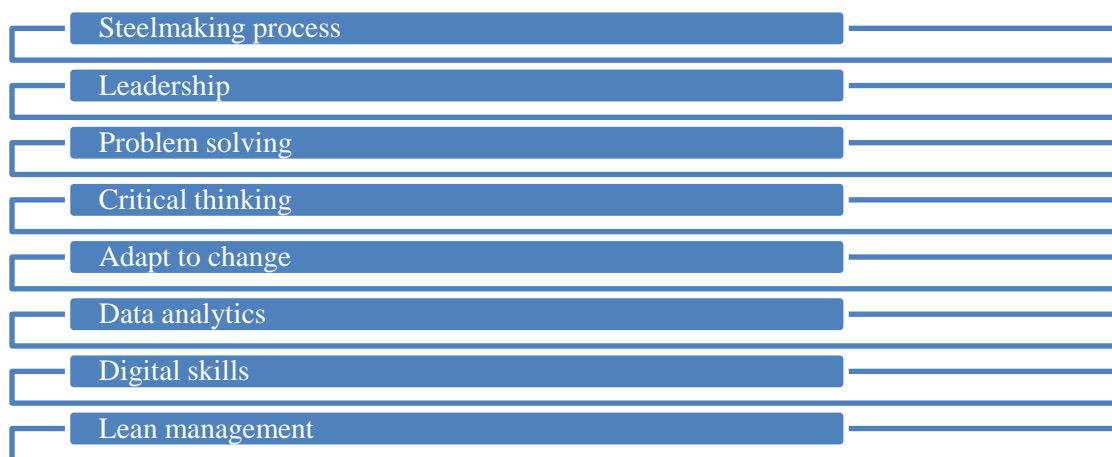
Another skill that has been highlighted as becoming more and more relevant for both junior and senior profiles is lean management.

A UK union representative talks about the importance of digital skills for the steel industry but warns about the need to build these on robust foundational skills:

[D]igital skills is massive for me, but also without forgetting that millions of workers in the UK still don't have basic literacy and numeracy skills. So, if they do not have basic literacy, numeracy, how will they have those skills to then be able to replicate it digitally?⁸².

Some pointed out the emergence of new specialists in data analytics and commented on the importance that the role is acquiring: “that's probably a growing division [...] they deal with a lot of the behind-the-scenes sort of IT”⁸³. It was also underlined that, due to the specificity of the technologies and software of the companies, a good strategy would be to train the analyst internally through apprenticeship schemes and tailor his/her competencies to the company's needs, rather than referring to the labour market to hire qualified analysts.

Figure 18 – Skills and knowledge gaps in the industry as emerged from the fieldwork



⁸⁰ Interview transcript, apprenticeship manager in steel company, UK

⁸¹ Interview transcript, apprenticeship manager in steel company, UK

⁸² Interview transcript, Trade union representative, UK

⁸³ Interview transcript, training advisor in steel company, UK

4.2.3 Overview of the UK VET system⁸⁴

Typical of LMEs (Liberal Market Economies), the UK is characterised by market-driven VET provisions, lack of meaningful trade union involvement, fragmented governance and a tendency to embrace a radical approach to reforms (see Table 17). The UK VET system is criticised as fragmented, complex and little more than a silo for less able young people not entering higher education (see Pring et al., 2009; Bosch & Charest, 2008).

Table 17 – Governance and main actors in the United Kingdom’s VET

Department for Education (England)	Policy-making responsibilities in England
Department of Education and Department for the Economy (Northern Ireland)	Policy-making responsibilities in Northern Ireland
Welsh Government	Policy-making responsibilities in Wales
Scottish Government	Policy-making responsibilities in Scotland
Office of Qualifications and Examinations Regulation (Ofqual)	Is the regulator of all vocational qualifications within the Regulated Qualifications Framework (RQF) for England. Ofqual is responsible for assuring that regulated qualifications reliably indicate the knowledge, skills and understanding students have demonstrated, and that assessments and exams show what a student has achieved. The RQF gives awarding organisations increased freedom and flexibility to develop qualifications that meet specific labour market needs.
Qualifications Wales	Established in 2015 to take over the responsibility of approving and reviewing qualifications, in addition to developing the design of new Qualification requirements and commissioning awarding organisations to develop new qualifications in Wales.
Scottish Credit and Qualifications Framework Partnership	Manages the Scottish Credit and Qualification Framework. The aim of the body is to ensure that all assessed learning and qualifications in Scotland are included on the Framework and to develop and promote the Framework as a Lifelong Learning tool.
ECCTIS	Is the national contact point for Cedefop. It works as a provider of solutions and services in international education, training, and skills, and in the development and recognition of globally portable qualifications.

Vocational education and training is available in the UK at both secondary and tertiary level, from EQF levels 2 to 7, although most qualifications are taken at levels 3 and 4. School-based

⁸⁴ This paragraph is mainly based on Abusland (2019).

programmes that combine general education with vocational elements exist alongside broad VET programmes and specialist programmes.

An interesting characteristic of the UK VET is that it is understood differently to most other European countries. As pointed out by Cedefop (2020), “vocational education and training in the UK has traditionally been understood as occupationally related training that takes place once a young person enters the labour market. In other words, it takes place after the end of compulsory school at age 16” (p. 131). Indeed, as remarked also by one of the interviewees:

“[The system] doesn't separate out initial from continuing vocational education in the way other systems do. Just vocational education and nobody in the in the sector really makes a distinction between initial VET and continuing VET. And it is much more modular than many of the systems, not all, but many systems that we then look to compare when we're doing our research, of course, are dual systems or have more of a full-time element to them. Whereas the UK system is more...modular would be the nicest way of putting it”⁸⁵.

Another distinguishing characteristic is the diversity of available training offers. VET in the UK is available in different forms (blended, full-time, part-time), and across many subjects and levels (Cedefop 2020). It can be purely work-oriented or combine more general and vocational contents. However, it has also been noted that the status of VET is generally low, and pupils prefer to continue their path in higher education (*Ibidem*).

In the four UK nations, skills are delivered through a range of organisations within the technical and vocational education and training (TVET) sector. These organisations are mainly:

- a) Schools, set at the lower secondary level and deliver core skills and vocational courses addressed mainly to young people from 14 to 18.
- b) Further Education Colleges (FE), which are the most important VET institutions in the UK and deliver vocational, core, enterprise and employability skills at secondary and tertiary level. Learners are predominantly young people 16 years old and upwards, but FE includes also a large number of adult learners.
- c) Universities
- d) Private Training Providers, these mostly deliver vocational and employability skills and offer courses for young people over the age of 16.
- e) Employers, which often provide on and off the job training and the opportunity for skills and competences update and upgrade.

The UK general education and VET provision is divided and organised in several national qualifications framework, such as the Regulated Qualifications Framework (RQF) in England and Northern Ireland, the Credit and Qualifications Framework for Wales (CQFW) and the Scottish Credit and Qualification Framework (SCQF) (see Table 18).

Within these macro-frameworks, specific VET repertoires are:

- the National Vocational Qualifications (NVQ), which feeds into the Regulated Qualifications Framework (as for England and Northern Ireland), and the Credit and Qualifications Framework for Wales;

⁸⁵ Interview transcript, VET expert, UK.

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- the Scottish Vocational Qualifications (SVQ), that feed into the Scottish Credit and Qualification Framework.

Table 18 – UK Qualifications frameworks

Framework	Authority/Regulator
RQF (England & Northern Ireland)	<ul style="list-style-type: none"> • Office of Qualifications and Examinations Regulation (Ofqual) • Council for the Curriculum, Examinations and Assessment (CCEA)
SCQF (Scotland)	<ul style="list-style-type: none"> • Scottish Credit and Qualifications Framework Partnership
CQFW (Wales)	<ul style="list-style-type: none"> • Welsh Government
FHEQ	<ul style="list-style-type: none"> • Quality Assurance Agency for Higher Education (QAA)

Source: Cedefop and ReferNet UK

As shown in Figure 19 as well as in Tables 19 and 20, the UK VET system is organised in a complex set of institutions and processes that includes providers, awarding organisations, funding bodies, qualification regulators, inspection agencies and employers' associations.

UK qualifications are provided by awarding organisations, external to the education or training provider. Awarding organisations are private companies, mainly funded by examination fees. They develop and deliver qualifications to meet government policy requirements and changing skills requirements and to respond in a dynamic and flexible way to the market demand. Awarding organisations must be recognised by the qualifications regulator before they can get involved in the development and accreditation of programs. Their role is to design and develop qualifications, to approve and monitor centres to offer qualifications to the required standards, to ensure that assessment is carried out in a way that is fair, valid and reliable and conforms to the rules, and to ensure equality of access to qualifications⁸⁶. The Regulated Qualifications Framework (RQF) currently recognises 225⁸⁷ qualification awarding bodies (in England and Northern Ireland). Qualification Wales recognises a total number of 98 awarding bodies⁸⁸. While the Scotland Qualifications Authority (SQA) recognises 38 awarding organisations⁸⁹.

Figure 19 – UK Technical and Vocational Education and Training system organisation

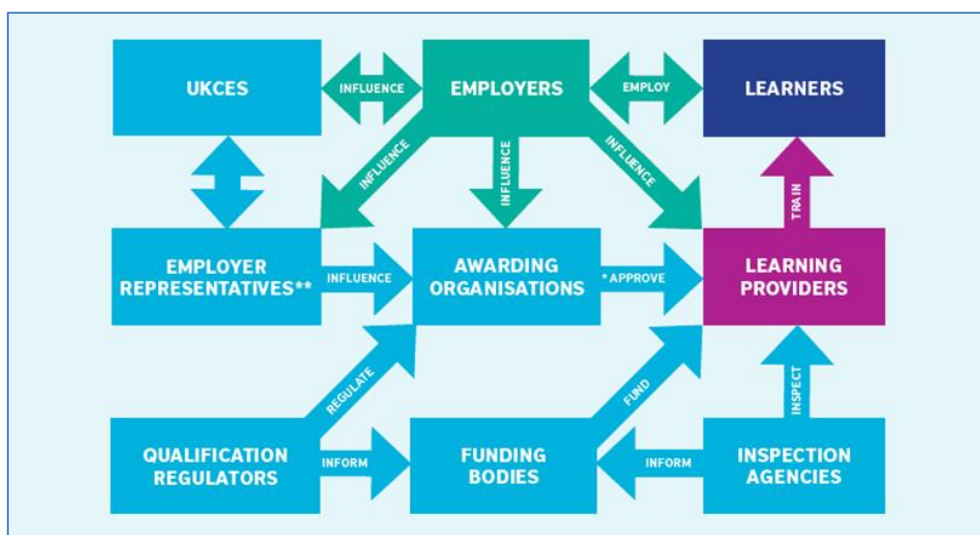
⁸⁶ https://eacea.ec.europa.eu/national-policies/eurydice/content/national-qualifications-framework-93_en.

⁸⁷ <https://register.ofqual.gov.uk/Search?category=Organisations&sort=relevance-None> (accessed October 14th 2019).

⁸⁸ <https://www.qualificationswales.org/english/our-work/regulating-awarding-bodies/directory-of-awarding-bodies> (accessed October 14th 2019).

⁸⁹ https://accreditation.sqa.org.uk/accreditation/Awarding_Body_Approval/Approved_Awarding_Bodies (accessed October 14th 2019).

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Source: British Council (2015)⁹⁰

Table 19 – UK policy-making authorities

England	<ul style="list-style-type: none"> • Department for Education (DfE) – all levels of education
Wales	<ul style="list-style-type: none"> • Welsh Government – all levels of education
Scotland	<ul style="list-style-type: none"> • Scottish Government – all levels of education
Northern Ireland	<ul style="list-style-type: none"> • Department of Education (DE) – schools and teacher training • Department for the Economy – further education colleges and higher education

Source: Cedefop and ReferNet UK

Table 20 – UK VET providers

England	<ul style="list-style-type: none"> • Schools/academies – general academic and vocational secondary education • Further education colleges – secondary and post-secondary VET • Independent training providers – secondary and post-secondary VET • Higher education institutions – higher vocational education
Wales	<ul style="list-style-type: none"> • Schools – general academic and vocational secondary education • Further education institutions – secondary and post-secondary VET • Colleges – secondary and post-secondary VET • Higher education institutions – higher vocational education

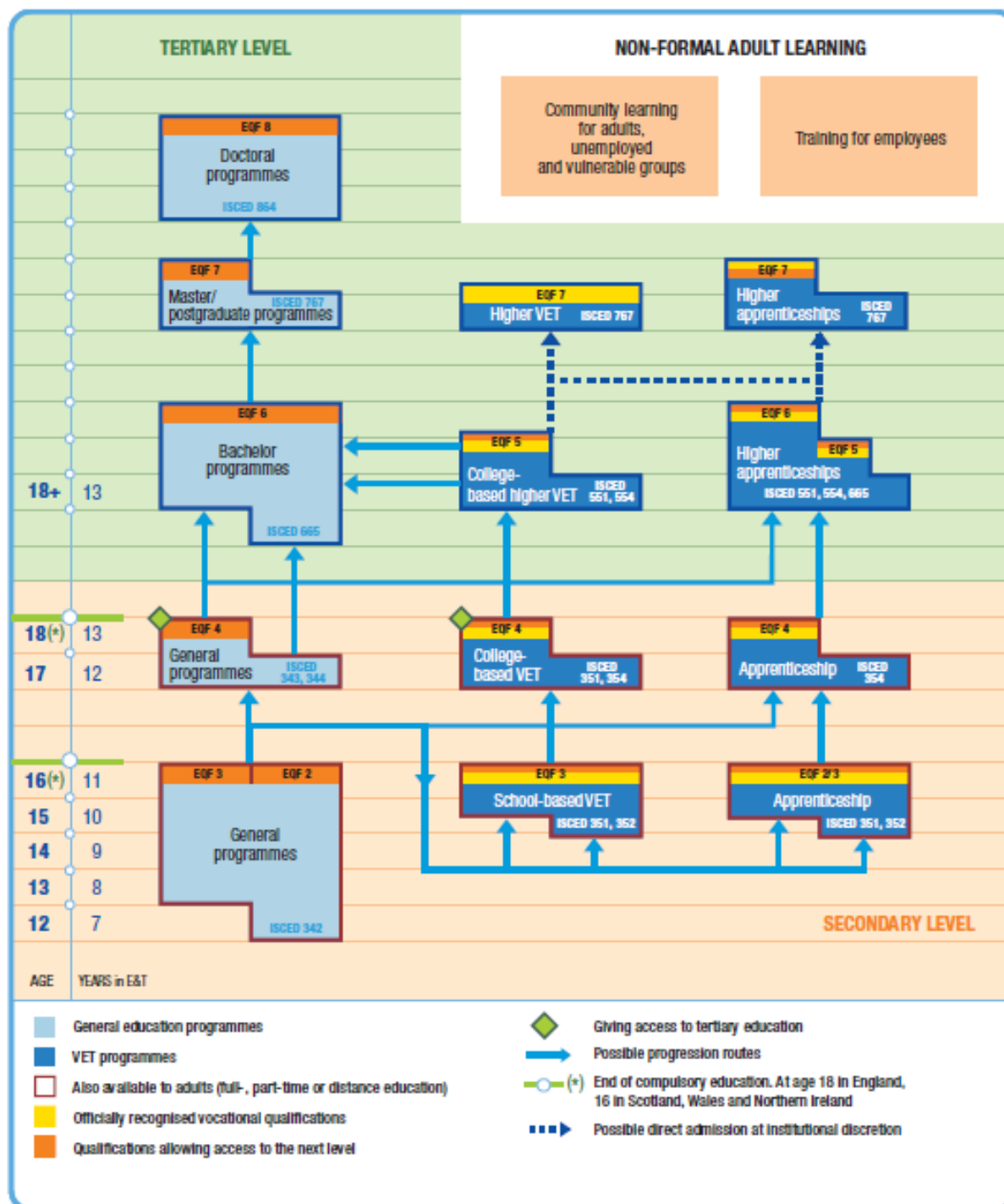
⁹⁰ UKCES (UK Commission for Employment and Skills) is now closed and its functions are now carried out by standards, qualifications and frameworks bodies in devolved parts of the UK and other various research activities (e.g. Employer Skills Survey).

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<p>Scotland</p>	<ul style="list-style-type: none"> • Schools – general academic and vocational secondary education • Tertiary colleges – secondary and post-secondary VET • Private training providers – secondary and post-secondary VET • Higher education institutions – higher vocational education
<p>Northern Ireland</p>	<ul style="list-style-type: none"> • Schools – general academic and vocational secondary education • Further education colleges – secondary and post-secondary VET • Private, community and voluntary sector providers – secondary and postsecondary VET • Training organisations - secondary and post-secondary VET • Higher education institutions – higher vocational education

Source: Cedefop and ReferNet UK

Figure 20 – General Education and VET system in the UK



Source: Cedefop and ReferNet UK

School and college-based VET is at EQF level 3 and 4 can be taken as an alternative to compulsory general education at secondary schools or as stand-alone qualifications at a VET college. Adults may also start VET at this level (see Figure 20).

There is a wide variety of qualifications at this level, including, for example, BTEC (Business and Technology Education Council) Awards, Certificates and Diplomas as well as NVQs (National Vocational Qualifications) and SVQs (Scottish Vocational Qualifications).

A characteristic of the UK VET provision is its modularity, meaning that programmes (e.g. apprenticeships) are often articulated in a combination of self-contained modules covering different subjects and skills, the completion of which awards different qualifications and certificates, rather than just one encompassing qualification:

“Because of the modular nature, it might be expected that you do other things besides that one course. So, you might not need health and safety, but actually you'd be expected to do a health and safety course as well [along with other modules]”⁹¹

“Some of the qualifications are very practical and don't involve a lot of theory [...] your NVQ [...] is actually only one part of what you're probably doing in the college. But you don't get a diploma for all of it in one go. You get your certificate for completing your NVQ [...] But you may also be doing functional skills”⁹².

The Scottish Qualification Authority (SQA) also recognises the certification of “Workplace Core Skills”, which are broad, transferable skills specifically developed to assess core skills in a work environment⁹³. They contribute to employability and are a component of Modern Apprenticeships in Scotland. The five Workplace Core Skills are: communication; numeracy; ICT; problem solving; working with others. Each Workplace Core Skill is available from SCQF level 3 to 6.

The British Department for Education is currently working on the development of new technical study programmes in England, T levels (EQF 4), with the aim to simplify the national VET system at the same time raising the credibility of qualifications with employers (see Table 21).

T Levels are 2-year courses that have been developed in collaboration with employers and companies and will be available in September 2020, following GCSEs. This programme will offer students a mix of classroom learning and ‘on-the-job’ training during an industry placement of at least 315 hours. They will provide the knowledge and experience needed to move to skilled employment, further study or a higher apprenticeship.

T Levels are intended to become one of the main choices for students after achieving the General Certificate of Secondary Education (GCSE) alongside apprenticeships for students who wish to learn a specific occupation on the job and A levels for students who wish to continue academic education.

T Levels will be based on the same standards as apprenticeships, designed by employers and approved by the Institute for Apprenticeships and Technical Education and will include the following compulsory elements:

- a technical qualification, which will include core theory, concepts and skills for an industry area alongside with specialist skills and knowledge for an occupation or career

⁹¹ Interview transcript, VET expert, UK.

⁹² Interview transcript, VET expert, UK.

⁹³ <https://accreditation.sqa.org.uk/accreditation/Qualifications>

- an industry placement with an employer
- a minimum standard in maths and English

Table 21 – T Levels prospective steel-related subject areas

Building services engineering
Craft and design
Design, development and control
Design, surveying and planning
Digital business services
Digital production, design and development
Digital support and services
Maintenance, installation and repair
Manufacturing and processing
Science

Source: Department for Education

It should be pointed out, however, that some have reported doubts⁹⁴ about the capacity of T Levels to engage employers on a large scale and to usher in equality between vocational training and higher education, considering them as the umpteenth attempt to systematise and relaunch vocational training offer in England. Another concern regards the number of enrolments necessary to sustain the programme, as it is questioned whether there will be enough students (particularly at colleges outside large urban areas) to make some of the pathways viable.

As regards VET in Wales, the qualification regulatory body in Wales (Qualifications Wales) is currently reviewing and reforming vocational qualifications in each major economic sector in order to find out whether current qualifications are effective in meeting the needs of learners as well as addressing the needs of companies.

⁹⁴ See the following articles: <https://feweek.co.uk/2018/05/15/what-are-the-biggest-problems-with-t-levels>; <https://www.prospectmagazine.co.uk/politics/a-top-education-official-has-warned-that-t-levels-are-a-problem-he-is-right>; <https://www.theguardian.com/education/2018/jun/12/t-levels-vocational-qualifications-forgotten-delayed>.

At EQF 5 level VET is mostly delivered through non-degree higher education qualification, usually under the requirement of the completion of a EQF 4 programme in school or VET college. These programmes are addressed to learners starting from 18 years old but may be also completed by people already employed looking for a career progression.

The entry in such programmes is at the discretion of the college, guided by the awarding body and provides qualifications such as BTEC Higher Certificates and Diplomas, and NVQs in England, Wales and Northern Ireland, and National Progression Awards, National Certificates, Professional Development Awards and SVQs in Scotland.

In England, a review of post-18 education in England was launched in February 2018 in order to identify mechanisms to help people make more effective choices between the different options available after the age of 18.

VET programmes available at EQF level 5 usually require the possession of an academic degree or of a non-degree higher qualification. Previous work experience in the specific field of the qualification is also taken into account and entry is allowed by the discretion of the college guided by the awarding organisation. These programmes usually involve people already employed looking for career progression. The qualifications delivered at this level, include BTEC Professional qualifications, such as Extended Level 7 Diplomas along with NVQs and SVQs.

In Table 22 we provide a summary of the main technical and vocational qualifications available in England, Wales and Northern Ireland. The summary is limited to these three countries due to their higher homogeneity when compared to Scotland. The inclusion of Wales is particularly justified by its being the country in which the ESSA rollout for the UK is taking place.

Table 22 – List of most common Qualifications in England, Wales and Northern Ireland

Qualification	Description
BTEC – Business and Technology Education Council	Specialist work-related qualifications that combine practical learning with subject and theory content. BTEC qualifications are available from entry level through to professional qualifications at level 7 (equivalent to postgraduate study). BTECs are designed for young people interested in a particular sector or industry but who are not yet sure what job they'd like to do. It is possible to study a BTEC at Level 2 or 3, either alongside academic qualifications or as part of a wider programme (such as an apprenticeship) or as a standalone course. Relevant sectors: applied science, business, construction, engineering, ICT, land-based ⁹⁵ .
Apprenticeship	All apprenticeships include elements of on the job and off the job training, leading to industry recognised standards or qualifications. Some apprenticeships also require an assessment at the end of the programme to assess the apprentice's ability and competence in their job role. Apprenticeships are available to anyone over the age of 16, living in the UK and have no upper age limit.

⁹⁵ <https://www.ucas.com/further-education/post-16-qualifications/qualifications-you-can-take/btec-diplomas>

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	There are different entry requirements depending on the industry, job role and apprenticeship level ⁹⁶ .
Foundation degree	Foundation degrees focus on a particular job or profession and are ideal for who is unsure about taking a full degree or study while work. Opportunity to gain professional and technical skills within a shorter time frame than a full degree. They usually take two years full-time to complete. It is possible to continue for a further year to gain a full honours degree ⁹⁷ .
HNC – Higher National Certificate & HND – Higher National Diplomas	Higher National Certificates (HNCs) and Higher National Diplomas (HNDs) are work-related, or vocational, higher education qualifications. They are Level 4 and Level 5 qualifications respectively. Relevant areas: computing and IT, construction and civil engineering, engineering, business and management ⁹⁸ .
AS level & A level	An ‘advanced level’ or A-level is a qualification offered across a range of subjects to school-leavers (usually aged 16-18 years old). A-levels are studied across two years: AS year (Year 12) and A2 year (Year 13). Usually, students study four subjects in their AS year; drop one, which they achieve an AS-level in; continue with the other three in their A2 year to achieve full A-levels in these ⁹⁹ .
Applied general	Applied general qualifications are level 3 qualifications for post-16 students who want to continue their education through applied learning ¹⁰⁰ .
GCSE – General Certificate of Secondary Education	A General Certificate of Secondary Education (GCSE) is a qualification normally taken by most UK students at the end of compulsory education. It takes two years (final exams when at 16). The equivalent in Scotland is Standard Grade. GCSEs are an important stepping stone for both getting a job or continuing studying. Except for compulsory subjects, the subjects available to study at GCSE level depend on the school. Relevant examples: business studies, engineering, manufacturing ¹⁰¹ .
NVQ – National Vocational Qualification	The NVQ is a work-based qualification which recognises the skills and knowledge a person needs to do a job. The candidate needs to demonstrate and prove competency in the chosen role or career path. NVQ’s cover a wide range of subjects for almost every occupational area in every business sector ¹⁰² .

⁹⁶ <https://www.gov.uk/government/publications/a-guide-to-apprenticeships>

⁹⁷ <https://www.ucas.com/undergraduate/what-and-where-study/choosing-course/foundation-degrees>

⁹⁸ <https://www.nidirect.gov.uk/articles/higher-national-certificates-and-higher-national-diplomas>

⁹⁹ <https://university.which.co.uk/advice/a-level-choices/how-are-my-as-and-a-level-studies-structured>

¹⁰⁰ <https://www.gov.uk/government/publications/2019-performance-tables-technical-and-vocational-qualifications/applied-general-qualifications>

¹⁰¹ <https://www.brightknowledge.org/education/gcses-explained>

¹⁰² <https://www.vocationaltraining.org.uk/nvq-overview>

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VRQ - Vocationally Related Qualifications	These are nationally-recognised, vocationally-related qualifications (VRQs) which provide the essential knowledge to do a job. Many Level 2/3 VRQs are an essential component of the Sector Skills Council's Apprenticeship framework. ¹⁰³
Key Skills	Key Skills are transferable skills that can be studied as part of a full-time or part-time course at school or an FE college. There are no minimum entry requirements and can be studied alongside other types of qualifications such as GCSEs. Subjects: communication, application of number, information and communications technology (ICT), working with others, improving own learning and performance, problem solving. Each Key Skill is assessed separately ¹⁰⁴ .

As for apprenticeships (see Table 23), these are available in the UK from secondary to tertiary level, from basic to advance and higher apprenticeship schemes.

Table 23 – UK Apprenticeship schemes

EQF	England	Wales	Scotland	Northern Ireland
8	Higher Apprenticeships	Higher Apprenticeships	Professional Apprenticeships	Higher Level Apprenticeships
7	Degree/Higher Apprenticeships		Professional/Graduate Apprenticeships	
6			Professional/Graduate Apprenticeships	
			Technical/Graduate Apprenticeships	
5	Higher Apprenticeships		Technical/Higher Apprenticeships	
		Modern Apprenticeships		
4	Advanced Apprenticeships	Apprenticeships	Modern/Foundation Apprenticeships	Apprenticeships
3	Intermediate Apprenticeships	Foundation Apprenticeships	Modern Apprenticeships	Apprenticeships/ Traineeships

Source: Cedefop ReferNet UK

¹⁰³ <http://www.imiawards.org.uk/Qualifications/Information/VRQs>

¹⁰⁴ <https://www.nidirect.gov.uk/articles/key-skills-qualifications>

Apprenticeships are typically structured in 80% on-the-job training and 20% classroom learning and is more suited to those who know what occupation they want to pursue, want to earn a wage and learn at the same time and are ready to enter the workforce at age 16.

In England, Wales and Northern Ireland, apprenticeships are offered within frameworks that include a work contract, a technical/occupational qualification within the RQF/CQFW and Functional Skills/Essential Skills/Key Skills/GCSEs in English, mathematics and other general subjects relevant to the profile.

- In England most apprenticeship frameworks are currently being replaced by new standards developed by groups of employers since 2015/16 which are occupation-focused (rather than qualification-led) and combine on-the-job training and study. New standards for metal-workers comprise subject-related theoretical knowledge (including environmental and data regulation where relevant) as well as technical abilities and soft skills such as communication, problem solving and teamworking. The acquisition of knowledge and skills is to be assessed by an independent assessor from industry or a separate training provider to the one the student attended.
- Scottish Modern Apprenticeships include a work contract and are required to include SVQs or alternative competence-based qualifications and core skills such as ICT, problem solving, numeracy and communication.
- As for Wales, a review of the apprenticeship frameworks is currently considering issues such as design and accreditation of apprenticeships, how to move more apprenticeship above EQF2 level, how to make all apprenticeships occupation-specific and how to include key competences and Welsh language.
- In Northern Ireland apprenticeships are also being reformed. Traineeships at EQF3 and apprenticeships from EQF4 to 8 are currently being piloted. These new apprenticeships will last at least two years and training will be increased in terms of occupational range and introduced at higher education level.

Apprenticeship schemes from EQF 2 to 4 are usually addressed to young people, but apprentices may also be adult learners, who may also be already employed. Entrance requirements to apprenticeships usually vary depending on the specific field and the competition for some apprenticeship places can be strong.

At the completion of the chosen programme, an apprenticeship certificate is awarded along with a vocational qualification, such as BTEC First Awards, Certificates and Diplomas, NVQs and SVQs.

As for apprenticeships at level EQF 4, these may be completed at age 18, but many apprentices are adult learners who may already be employed before starting the programme. VET Entrance requirements to apprenticeships may vary depending on the occupational area and the level of the apprenticeship scheme. Competition for some apprenticeships is strong and good secondary qualifications at EQF 3 level in English and mathematics may be required.

EQF 5 level higher apprenticeships are addressed to adults (above 18), many of whom may already be employed. Entry requirement for these non-degree higher education qualifications is usually the possession of an EQF 4 qualification from school or college in either vocational

or academic subject areas. Entry is allowed at the discretion of the college guided by the awarding body.

Degree apprenticeship schemes (EQF 6 -7) provide a different pathway to obtaining university degrees. In such schemes, academic ability, including grades and numerical and reasoning skills, is assessed by the university or college, whilst candidates are also interviewed by a company in relation to a specific job (unless they are already employed with the company). Both employers and universities must agree that the applicant meets their requirements. Apprenticeships at this level are called higher apprenticeships, higher level apprenticeships, degree apprenticeships, graduate apprenticeships, professional apprenticeship, technical apprenticeships and modern apprenticeships.

A certificate may be awarded along with a vocational qualification, such as a Foundation degree, BTEC Higher National Certificates and Diplomas, along with NVQs and SVQs. Usually, degree and professional apprenticeships result in the award of a bachelor's degree (EQF 6).

Wales is currently piloting Degree Apprenticeships with delivery initially focused on skills gaps identified by Regional Skills Partnerships in digital, ICT and advanced engineering.

Scottish apprenticeship programmes were also renewed through the introduction of Higher and Graduate apprenticeships, designed in 2015-16. The distinctive feature of these schemes is the potential to obtain an HND qualification (EQF 5), or a bachelor's degree (EQF 6) leading to professionally recognised qualifications.

Higher apprenticeships at EQF 7 display the same requirements and characteristics of other degree apprenticeships at EQF level 6. At the completion of these programmes, an apprenticeship certificate may be awarded along with a master's degree.

4.2.4 Programmes and qualifications relevant to the steel industry

In England, the current apprenticeship schemes related to steelworks mainly fall under the broad area of “engineering and manufacturing”¹⁰⁵ and are mainly regulated by three authorities: Instructus, ProSkills and SEMTA(now Enginuity)¹⁰⁶.

- Instructus is an issuing authority for occupations in air conditioning, building services engineering, business and administration, cleaning, customer service, digital/information technology, electro technical, electrical and electronic servicing, enterprise and business support, facilities management, heating and ventilating, housing, human resources and recruitment, industrial relations, leadership and management, marketing and sales (also includes contact centres and third sector), plumbing, property and refrigeration.
- Proskills is the issuing authority for occupations in printing, mineral extraction and processing, health and safety and process and manufacturing of furniture, glass, ceramics, coatings and paper (also includes glazing, building products, wood and mining).

¹⁰⁵ <https://www.gov.uk/government/publications/a-guide-to-apprenticeships>

¹⁰⁶ <http://www.afo.sscalliance.org/frameworks-library/index.cfm> & [Engineering Skills for the Future | Enginuity](#)

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- SEMTA (now Enginuity) is the issuing authority for occupations in science, engineering and manufacturing technologies.

Below is a list of apprenticeship frameworks that could serve the steel sector in different UK regions (Tables 24-26):

Table 24 – Examples of steel sector related apprenticeship frameworks

Framework	Issuing authority	Level
Metal Processing and Allied Operations (Operator and Semi-skilled) (Wales)	SEMTA	2
Mineral Products Technology (Wales)	Proskills	4
Extractives and Mineral Processing Occupations (Wales)	Proskills	2, 3
Composite Engineering (England)	SEMTA	2, 3
Composite Engineering (Operator and Semi-skilled) (Wales)	SEMTA	2
Advanced Manufacturing (Wales)	SEMTA	6
Metal Processing and Allied Operations (Wales)	SEMTA	2, 3
Operations and Quality Improvement (England)	SEMTA	3
Engineering Environmental Technologies (Wales)	SEMTA	4
Data Analytics (Wales)	Instructus	4
Operations and Quality Improvement (Wales)	SEMTA	3
Information Technology Solutions Development & Support (Wales)	Instructus	5
Electrotechnical (Wales)	Instructus	3
Improving Operational Performance (England)	SEMTA	2
Improving Operational Performance (Wales)	SEMTA	2
Digital Application Support (Wales)	Instructus	2, 3
Energy Assessment and Advice - non statutory (Wales)	Instructus	3
IT, Software, Web & Telecoms Professionals (Wales)	Instructus	2, 3, 4
IT Infrastructure (Wales)	Instructus	3, 4

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IT Solutions Development & Support (Wales)	Instructus	3, 4
Building Services Engineering Technology and Project Management (England)	Instructus	3
Engineering Manufacture (England)	SEMTA	2, 3
Digital Degree Apprenticeship (Wales)	Instructus	6
Information Security (Wales)	Instructus	3, 4
IT Application Specialist (England)	Instructus	2, 3
IT, Software, Web & Telecoms Professionals (England)	Instructus	2, 3
Higher Apprenticeship in Information Security (England)	Instructus	4
Higher Apprenticeship for IT, Software, Web & Telecoms Professionals (England)	Instructus	4
Advanced Manufacturing Engineering (Wales)	SEMTA	4
Engineering Manufacture (Wales)	SEMTA	2, 3
Higher Apprenticeship in Advanced Manufacturing Engineering (England)	SEMTA	4
Engineering and Advanced Manufacturing Degree Apprenticeship (Wales)	SEMTA	6

Source: Federation for Industry Sector Skills and Standards

Table 25 – Examples of steel-related certificates and qualifications in England and Northern Ireland

Source	Title
RQF	City & Guilds Level 1 Award in Introductory Manual Metal Arc (MMA) Welding
RQF	City & Guilds Level 1 Award in Introductory Metal Fabrication (QCF)
RQF	City & Guilds Level 1 Award in Introductory Metal Inert Gas (MIG) Welding
RQF	City & Guilds Level 2 Award in Metal Fabrication (QCF)
RQF	EAL Level 1 Award in Introductory Manual Metal Arc Welding Skills
RQF	EAL Level 1 Award in Introductory Metal Inert Gas Welding Skills

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RQF	EAL Level 2 Certificate in Metals Industries Processes
RQF	EAL Level 2 NVQ Diploma in Metal Processing and Allied Operations (QCF)
RQF	EAL Level 2 NVQ in Metal Processing and Allied Operations
RQF	EAL Level 3 Diploma in Manual Metal-Arc (MMA) Welding Process
RQF	EAL Level 3 Diploma in Metal Inert Gas/Metal Active Gas (MIG/MAG) Welding Process
RQF	EAL Level 3 NVQ Diploma in Metal Processing and Allied Operations (QCF)
RQF	EAL Level 3 NVQ Extended Diploma in Metal Processing and Allied Operations
RQF	EAL Level 3 NVQ in Metal Processing and Allied Operations
RQF	ECITB Level 2 Diploma in Erecting Steelwork Components (RQF)
RQF	ECITB Level 2 NVQ in Constructional Steelwork Site Operations
RQF	OCR Level 2 NVQ in Fabricating Constructional Steelwork
RQF	OCR Level 2 NVQ in Metal Processing and Allied Operations
RQF	OCR Level 3 NVQ in Fabricating Constructional Steelwork
RQF	ProQual Level 2 Diploma in Steel Erecting
RQF	ProQual Level 3 Diploma in Fabricating Steel Structures in Construction
RQF	ProQual Level 3 Diploma in Steel Erecting

Table 26 – Examples of steel-related qualifications in Wales

Source	Title
QiW	City & Guilds Level 1 Award in Introductory Manual Metal Arc (MMA) Welding
QiW	City & Guilds Level 1 Award in Introductory Metal Inert Gas (MIG) Welding
QiW	EAL Level 1 Award in Introductory Manual Metal Arc Welding Skills
QiW	EAL Level 1 Award in Introductory Metal Inert Gas Welding Skills
QiW	EAL Level 3 NVQ Diploma in Metal Processing and Allied Operations
QiW	EAL Level 3 NVQ Extended Diploma in Metal Processing and Allied Operations

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QiW	ECITB Level 2 Diploma in Steel Erecting
QiW	ECITB Level 2 Diploma in Supporting the Fabricating of Engineering Construction Steel Structures – Plating
QiW	ECITB Level 3 Diploma in Erecting Engineering Construction Capital Plant Steel Structures
QiW	ECITB Level 3 Diploma in Fabricating Engineering Construction Steel Structures - Plating
QiW	Pearson BTEC Level 2 Extended Certificate in Blacksmithing and Metalworking
QiW	Pearson BTEC Level 3 Certificate in Blacksmithing and Metalworking
QiW	Pearson BTEC Level 3 Diploma in Blacksmithing and Metalworking
QiW	Pearson BTEC Level 3 Extended Diploma in Blacksmithing and Metalworking
QiW	Pearson BTEC Level 3 Subsidiary Diploma in Blacksmithing and Metalworking

Although it has been already pointed out that in the context of the UK VET system the distinction between IVET and CVET is blurred, we can still consider some training paths to be specifically devoted to continuous developing of skills (see Table 27). An example of these is the training offer coming from trade unions which can have their own training bodies to support both members and non-members:

“It is funded by an organisation called Unionlearn which the government gives money to. And we then use it to train up our members and also non-members in some instances as well. And there's a wide range of courses so there's digital skills courses, there's other things about how to get into employment”¹⁰⁷.

Also trade unions can establish learning agreements with different organisations, most often around health and safety or career development, setting out total amount of hours devoted to workers’ training.

Another interesting programme, specific to the industry, is the Metal programme for Materials and Manufacturing Training developed and offered by Swansea University.

Table 27 – Example of CVET offer relevant to the steel industry in Wales

Metal
Materials and Manufacturing Education Training and Learning (Metal) is an industry led project aiming to upskill people in the field of Advanced Materials and Manufacturing through the provision of short courses at level 4 and above. It is a work-based learning project that focusses on technical training modules to address skills shortages and provide industry with the skills required. Metal is

¹⁰⁷ Interview transcript, trade union representative, UK.

based within the College of Engineering at Swansea University and offers a series of Credit Qualifications that can be used towards professional development and further education¹⁰⁸.

Examples of the courses offered are:

- Introduction to Materials Engineering (21-30h)
- Online Manufacturing Technology (21-30h)
- Environmental Impact and Sustainability (21-30h)
- Introduction to CAD, 2D & 3D (21 -30h)
- Arc welding (21h)
- Practical metallurgy (3 days)

4.2.5 Remarks on VET

The interviews with industry professionals confirmed to a certain extent the essential features of a market-led vocational provision. On the one hand, companies tend to “shop” from colleges asking them to offer qualifications that best suit their business purpose:

“We've got some colleges and universities [...] And they say, ‘Oh, we have a unit or a module we can teach, or we can adapt it to your needs’, and we've had examples where people have actually said, is new to us, but we're prepared to develop something”¹⁰⁹.

On the other hand, colleges often act as private businesses themselves, and might try to offer qualifications that could be of interest for a variety of companies in different sectors to maximise return. In this respect, some concern has been expressed about colleges offering off-the-shelf qualifications that are considered easier to fulfil rather than qualifications that are fit for the needs of the demanding company. Also, despite the standards set by the regulator, the way these are offered and anchored to apprenticeships seem to vary from college to college. Companies' representatives have also expressed some negative remark about their capacity to influence the contents of the qualification based on their needs.

More in general, looking at the recent reform of apprenticeships in England, some have expressed concerns about the new standards. An interviewee stated:

“You don't really know what effect it's going to have. And as I say there are downsides because bigger companies can influence those apprenticeships much more. So even though most companies are not large companies. They're small and medium enterprises, but they don't have the voice to push around the big players at the table”¹¹⁰.

Other doubts have been expressed on the newly introduced T Levels, and in more general terms on the popularity of VET in Britain (especially when this is compared to general education):

¹⁰⁸ <https://www.project-metal.co.uk/>

¹⁰⁹ Interview transcript, training advisor in steel company, UK.

¹¹⁰ Interview transcript, VET expert, UK.

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“Why would you set a new level and a new two-year programme of studying when even at the moment we can't really get the engagement for current apprenticeships and qualifications?”¹¹¹

Regarding the adequacy of the delivered skills and knowledge, and ultimately of national standards, some industry representatives have underlined the gap between these and company needs, despite the standards being often employers-inspired:

“The colleges, they teach a unit for hand tools, using hand tools safely, etc. And the college standard is, you know, the college standard as per the national occupational standards. But the college standard is not really our standard. So, they can perhaps use a handsaw, or something like that in college or filing the small pieces of metal. They produce nice little things in colleges. And, you know, that isn't what's done on site [...] I would say that we go through the college system, and we go through the college qualifications to ensure that they [the apprentices] are up to a minimum standard. And then we push them on when they come on site”¹¹².

And commenting on college provision:

“I think it's been watered down. I think the qualifications are very much watered down. They're no longer specific. For instance, you could do a BTEC qualification and you could do both mechanical as well as electrical units in the BTEC and come out of the BTEC and claim that you're an electrical engineer because you've got this qualification. Even though half the qualification was mechanical, half was electrical”¹¹³.

Another concern was expressed in relation to the withdrawal of a steel-orientated qualification at level 2 because of low demands, perhaps pointing to a lack of widespread interest in specific qualifications in the sector. As explained by another interviewee, the current trend towards the rationalisation of the VET offer indeed might clash with specific sectoral needs:

“[T]hey're trying to reduce the number of courses out there, which has led to its own backlash. Because some of what appear to be very underused courses, the awarding bodies would say, well, that's because they are extremely specific, but they serve a specific sector need”¹¹⁴

Another comment underlined the responsibility of employers in directing workers to appropriate training and their often scarce knowledge of the opportunities offered within the system:

“The UK is dire in terms of what we do in comparison to European countries for training opportunities. [...] it's a bit general and probably not 100%, specific to steel, but workers haven't access in the training because employers aren't sure where to direct people to, and aren't giving employees the time to do the training”¹¹⁵.

¹¹¹ Interview transcript, trade union representative, UK

¹¹² Interview transcript, apprenticeship manager in steel company, UK

¹¹³ Interview transcript, apprenticeship manager in steel company, UK

¹¹⁴ Interview transcript, VET expert, UK.

¹¹⁵ Interview transcript, trade union representative, UK.

Some more general remarks underlined the political responsibilities in the current lack of appreciation of VET and concerns about the comparability of VET qualifications to general education diplomas:

“I think the biggest problem the UK has with vocational education is that it is much more of a political football than any other part of the education sector. So, policies are chopped and changed a lot more quickly for vocational education. [...] And this is where T levels came in at some point. And they fight over these things at a political level, which means that it's hard to know if it will be implemented, when it will be implemented and what sort of outcomes you'll see from it”¹¹⁶.

“I do worry sometimes that is a BTEC qualification equivalent to an A level. I know how much work I put into my A levels, is it really equivalent to that? We don't know. But that is, you know, that's my concern. And if you look at level two qualifications, you could do a level two qualification potentially within under less than a year. You know, if you consider that's a GCSE qualification, then GCSE takes many years in school to do. You know, that's also a concern of mine”¹¹⁷.

It has been remarked that the interest in digital skills has become prominent in the vocational agenda only in the last 5 years. Concerns have been expressed in relation to the actual effectiveness of digital training in VET:

“The apprenticeship standards should include digital skills. But again, the background research we did on that basically said that many companies still didn't feel that people were coming out with the digital skills they needed”¹¹⁸.

Figure 21 – Remarks on the UK VET as emerged from the fieldwork



4.2.6 Feedback mechanisms

With respect to formal feedback mechanisms, the UK relies on what has been labelled a “liberal model of feedback mechanism” (Cedefop 2013; Markowitsch and Hefler 2018) (see Figure 22). Such mechanisms assume that “VET providers are able to respond to the needs of the labour market in a direct and non-mediated way” (Markowitsch and Hefler 2018, p. 290). The labour

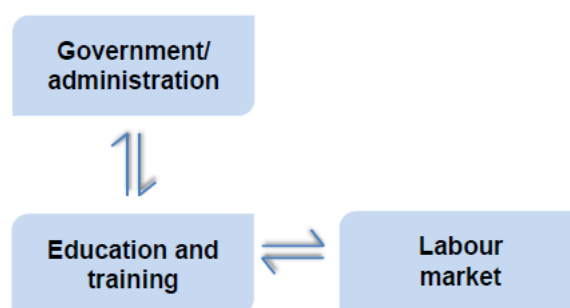
¹¹⁶ Interview transcript, VET expert, UK

¹¹⁷ Interview transcript, apprenticeship manager in steel company, UK.

¹¹⁸ Interview transcript, VET expert, UK

market itself, here, acts as a connector between learners and VET. This needs systematic reporting mechanisms to be in place to demonstrate that VET provision is actually capable of meeting the demands (of both learners and employers), and relies often on direct inputs from businesses to monitor the transformation occurring in the different industries. Liberal feedback mechanisms are usually characterised by marginal social partner involvement and more direct communication between employers and VET providers (Cedefop 2013). In this context, the State plays a limited role, setting the general framework for developing standards, monitoring quality of provision and regulate funding.

Figure 22 – Liberal market feedback mechanism



Source: Cedefop (2013)

An example of such mechanism at work can be seen in the definition of the recently introduced apprenticeship standards in England, carried out by the Institute for Apprenticeships and Technical Education, and in the sector reviews carried out in Wales.

4.2.7 Good practices

The sector reviews carried out by Qualification Wales in the context of Wales' VET are a systematic attempt to make the system more transparent to both learners and employers, and to provide the government with up-to-date information about the adequacy of the system. Here researcher take a cross-cutting look at the qualifications available for a particular economic sector, to assess whether the needs of employers and learners are being met. The research also looks at the underpinning qualifications system to understand its landscape and identify actions to take. This research programme started in 2016 and up to now four sector reviews have been completed: *Health and Social Care, Construction and the Built Environment, Information and Communication Technology, Engineering, advanced manufacturing and energy*¹¹⁹. The last review in engineering and advanced manufacturing is of relevance for the steel industry. Its final report (Qualifications Wales 2020) highlights that most stakeholders consider the vocational offer in the sector adequate for preparing learners for further study or employment. However, some concern was raised about contents not being always up to date. In particular, training in artificial intelligence, robotics and automation featured in a limited number of qualifications. Most of learning providers considered the range of qualifications available in the sector sufficient to meet the needs of employers and learners, but some have expressed the need for more specific qualifications in subjects like rail, energy and mechatronics. Apprentices, in particular,

¹¹⁹ For more information see <https://www.qualificationswales.org/english/qualifications/vocational-qualifications/sector-reviews/>

appear to be highly valued in the engineering sector. An interesting remark is that despite most of the employers had admitted the importance of qualifications as a benchmark for selecting apprenticeships and hiring workers, “behaviours were most valued. Most employers stressed the importance of positive behaviours, such as punctuality, motivation, resilience, enthusiasm, and a positive attitude” (Qualifications Wales 2020, p. 30).

4.2.8 System trend

As regards trends in VET and future prospects, Cedefop (2020) shows that in recent years various measures have been adopted in order to rationalise the system. The introduction of the new Regulated Qualifications Framework (RQF) in 2015, the rollout of apprenticeships standard and T Levels in England, and the review of vocational qualifications carried out recently by Qualifications Wales are all examples of such processes. This trend has been accompanied by a renewed focus on apprenticeships as a way to guarantee the connection between quality VET provision and business’ needs. When it comes to the system’s general characteristics, Cedefop (*Ibidem*) highlights that in the UK-England, in particular, in spite of a number of *ad hoc* reforms, the fundamentals of the system have not undergone major changes: it remains a market-driven system underwritten by minimum standards.

Training providers can still choose between a range of qualifications and awarding bodies when planning a course. Furthermore, training providers compete with each other on the education market to attract learners and companies. This explains the variety of the offer present in the UK system. The emphasis is still on the employers’ needs, which are asked to set minimum standards (to grant more flexibility based on business needs), although the participation of employers in councils and panels is voluntary. The voice of workers through trade unions, on the other hand, has been so far not incorporated to a considerable degree in the design of standards.

As Cedefop (2020) highlights, in spite of a remarkable increase in the number of apprenticeships offered (which can be attributed to an increased funding of such schemes by the government), this should not lead to considering the UK VET system shifting towards a more distinctive VET. Rather, the trend appears to be consistent with a continuous diversification and academisation of the system, despite some current attempts at rationalising VET provision (e.g., T Levels in England, and qualifications’ reviews in Wales).

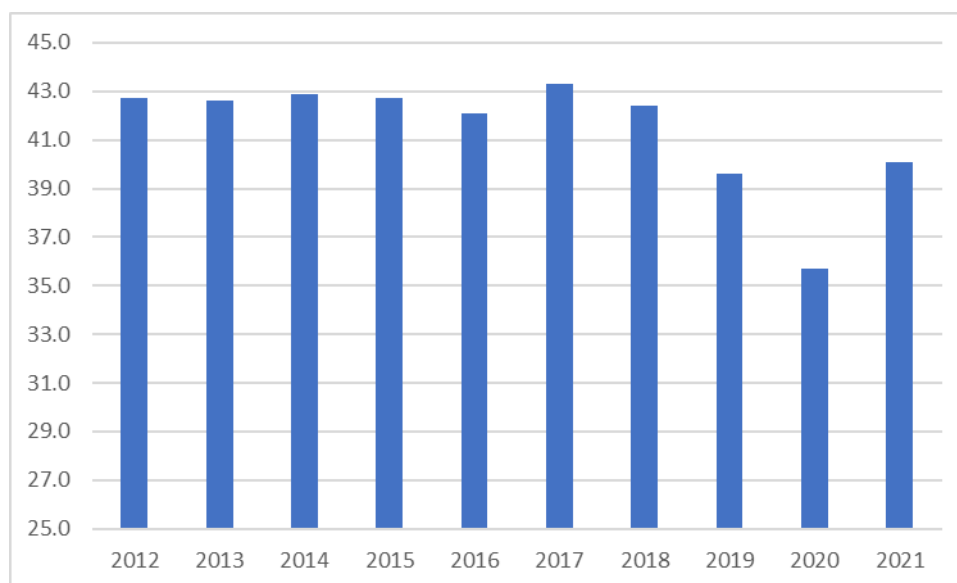
4.3 Germany

4.3.1 Germany’s Steel Industry

More than a century of steady growth of industrialised crude steel production in Germany ended in the mid-1970s when Germany’s annual output peaked in 1974 at around 54m tons. Linked to the wider economic upheaval in Europe in the 1970s and 1980s that followed the 1973 oil crisis, the German steel sector experienced a decade of gradual decline, before, since the mid-1980s, crude steel production has more or less remained stable and has fluctuated in a relatively narrow corridor between 38m and 46m tons annual output (see Figure 23). The latest available figures suggest that disruptions in response to COVID-19 had a significantly negative impact on crude steel production as output fell to 35.7m tons in 2020, the lowest annual output since

2009 (WV Stahl 2021). The stabilisation of German steel production was aided by a combination of concentration with regard to the ownership of steel production sites as well as modernisation of facilities and a turn towards higher quality and higher value steel products¹²⁰ (Bein 2016, Wirtschaftsvereinigung Stahl 2021, Schroeder 2019). This approach to focus on higher quality products has so far ensured the continuous relevance of the German steel industry as a foundational industry for other manufacturing sectors, most significantly for the automotive industry and the construction sector (Wirtschaftsvereinigung Stahl 2021).

Figure 23 – Germany total crude steel production (all qualities) in million metric tonnes



Source: Eurofer and Wirtschaftsvereinigung Stahl, *Fakten zur Stahlindustrie in Deutschland 2021*, p.12

In 2019, steel was produced in 20 sites in Germany, with steel works mainly concentrated in the West and the East of the country. Around 70% of total German steel production is based on the Blast Furnace route, while the remaining 30% is produced through the Electric Arc Furnace route, even though there were almost twice as many electric arc furnaces sites (13) than blast furnaces sites (7) in operation in 2017 (Wirtschaftsvereinigung Stahl 2021).

Figure 24 – Steel production by category

¹²⁰ Significant investment in new products, especially over the last decade, means that more than 50% of German steel is high-quality steel and more than half of the more than 2,500 currently available steel types have been developed during this period (Bein 2016, Schroeder 2019). The relative proportions of stainless steel and of rolled products have also increased over the last 40 years.

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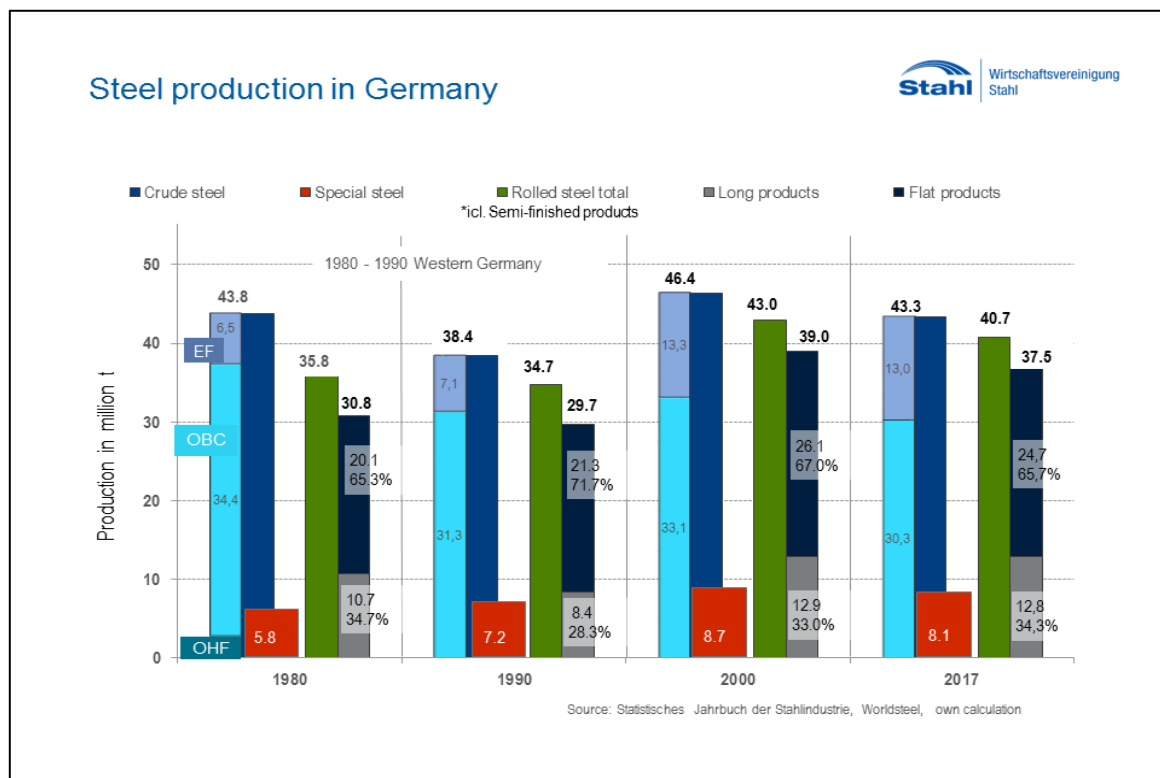
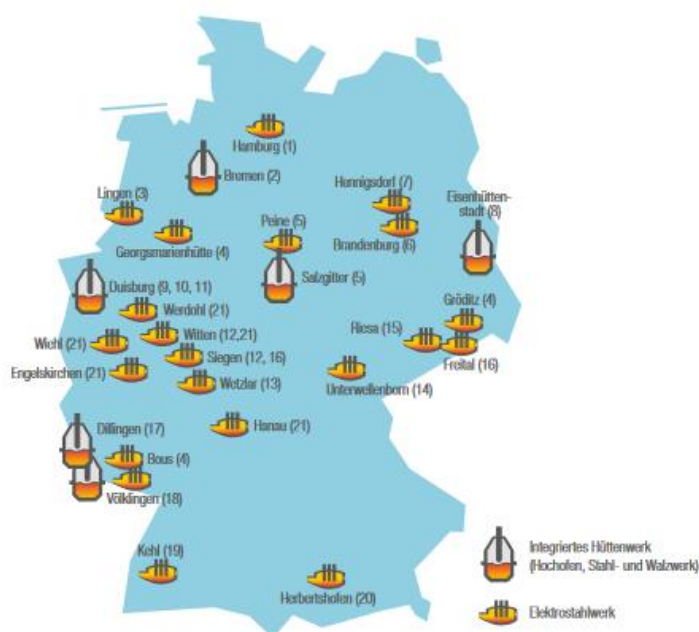


Figure 25 - Locations of steel production in Germany, 2020¹²¹

¹²¹ Translations: Integriertes Hüttenwerk (Hochofen, Stahl- und Walzwerk) = integrated steel plant (blast furnace, steel plant, rolling mill); Elektrostahlwerk = Electric Arch Furnace; Rohstahlerzeugung 2016 in Mio. t = raw steel production 2016 in million tonnes; Gesamterzeugung Deutschland 2016: 42.1 Mio t = total production Germany 2016: 42.1 million tonnes

Standorte der Stahlerzeugung

Rohstahlerzeugung 2020 (Gesamterzeugung Deutschland): 35,7 Mio. t



Deutschland ist Standort für technologisch führende, hochwettbewerbsfähige Stahlhersteller.

- | | | |
|------------------------------------|----------------------------------|----------------------------|
| (1) ArcelorMittal Hamburg | (9) thyssenkrupp Steel Europe | (17) Dillinger Hüttenwerke |
| (2) ArcelorMittal Bremen | (10) HKM | (18) Saarstahl |
| (3) Benteler | (11) ArcelorMittal Duisburg | (19) Badische Stahlwerke |
| (4) Georgsmarienhütte Holding | (12) Deutsche Edelstahlwerke | (20) Lech-Stahlwerke |
| (5) Salzgitter | (13) Buderus Edelstahl | (21) Übrige Stahlstandorte |
| (6) Brandenburger Elektrostahlwerk | (14) Stahlwerk Thüringen | |
| (7) Hennigsdorfer Elektrostahlwerk | (15) ESF Elbe-Stahlwerke Feralpi | |
| (8) ArcelorMittal Eisenhüttenstadt | (16) BGH Edelstahl | |

Stand: Januar 2021
Quelle: VW Stahl

Similar to other steel producing countries, increased concentration of ownership has been regarded as the appropriate response to global over-production and cost pressures. Of the 42.6m tons of steel produced in Germany in 2016, the biggest steel producer in Germany, Thyssenkrupp Steel Europe, accounts for more than a quarter of the annual production, while the biggest three German steel producers – Arcelor Mittal is the second largest and Salzgitter AG third – account for more than half of German steel production (see Figure 25).

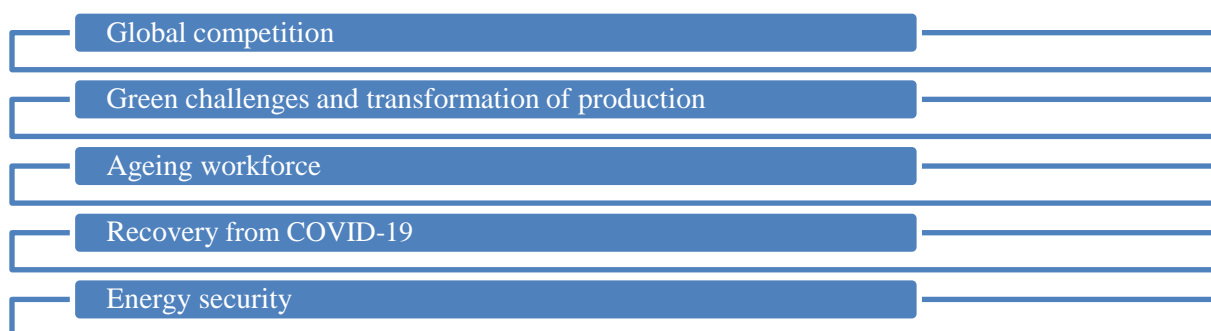
A significant effect of concentration and modernisation efforts has been the massive reduction of the steel workforce in Germany. While there were around 288,000 people directly employed in the German steel industry in 1980, almost 4 decades later, in 2016, only 85,000 people were directly employed in the industry. Consequently, productivity in the steel sector has increased significantly over the last 40 years. In 1980 and 1992, the industry produced 152 tons and 222 tons respectively of crude steel per year per worker; by 2020 this figure has increased to almost 500 tons crude steel per year per worker (Wirtschaftsvereinigung Stahl 2021, p. 10).

The future of the German steel industry will depend on and be predominantly shaped by the EU's and Germany's strategies and actions to adapt to climate change. The legally binding CO2 emission reduction targets agreed as part of the Paris Agreement require the steel sector to reduce its emissions by 80 to 85% by 2050 compared to emission levels in 1990 (Eurofer 2019).

As the Eurofer ‘low carbon roadmap’ suggests the optimisation of currently available steel-making technologies (including using these technologies in ‘uneconomic’, i.e. loss-making, ways) can at best reduce emissions by 40%. A future steel industry therefore either requires not yet available breakthrough technologies such as hydrogen-based steel making or significant reductions in output to comply with the legally binding emission targets.

Another future challenge for the steel industry, and the main focus for the ESSA project and this report, is dealing with the effects of an ongoing technological transformation across industry in general that is often captured by terms such as digitisation, digitalisation, automation and Industry 4.0. ESSA WP2 (D 2.1) details the technical dimensions of these developments, while ESSA WP3 and 5 jointly investigate what the technological change means for the skills or competence profiles of a variety of steel-production-related jobs. In this report, we concentrate on the wider national Vocational Education and Training (VET) system that to some considerable degree determines the competences, skills and abilities of the industrial workforce in general and of the steel workforce in particular.

Figure 26 - Challenges faced by the German steel industry as emerged from the fieldwork



4.3.2 Industry perspective on skills gaps

In Germany, the issue of skills and knowledge gaps is a relatively minor concern for industry and did not really feature as such in interviews with representatives of the industry. One reason for this is the fact that broad and deep occupational qualification pathways exist which prepare workers well for a variety of tasks and jobs. Another is that industry is pro-actively involved in the occupational education of apprentices and students and are therefore able to shape their education in ways that suits its needs. Industry is also actively participating – together with trade unions and the state – in the continuous shaping of occupational curricula and vocational training offers and are therefore in a good position to align demand and supply of requisite competences.

Interviewees from the steel industry mentioned ‘skills gaps’¹²² mainly in the context of recruitment. As the steel industry relies to a large extent on apprenticeships to satisfy its staffing needs, the main issue in this regard is that the gap between school education of prospective apprentices

¹²² In the German context, interviewees tend to speak about ‘competences’ and ‘ability to act in an occupational context’ – the meaning of these terms has very little to do with the English term ‘skills’ which can mean just about anything (see Payne 2000).

and basic educational requirements to start an apprenticeship is becoming bigger. In other words, steel producers struggle to find sufficiently qualified school leavers who are willing to become apprentices in the steel sector. The Head of Training of a large German steel company sums up recent developments in the following way:

“Two paradigm changes have occurred over the last few years: first, they have now a situation for a few years where more people start Uni than an apprenticeship.¹²³.... The second paradigm shift – which points to a continuity of the first paradigm change – is that the *Abitur* (A-Levels) is now the most common school qualification, which has implications for the further qualification trajectory: people with *Abitur* are likely to consider first university”.

In practice this means first that the supply of apprenticeship places has outstripped demand from school leavers and second that the pool of prospective apprentices has lower educational attainment. This means in turn that steel companies struggle to recruit sufficient numbers of apprentices despite continuously increasing their recruitment efforts to accommodate school leavers who lack sufficient competences. As a consequence, German steel companies have to invest more and more in additional vocational education and training, for example in the form of ‘transition programmes’ (see section 4.3.3), where potential apprentices receive additional education to ready them for dual apprenticeships. In some regions this is useful to allow pupils with a migration background to catch up on their language skills but they can also be useful to improve basic skills such as reading and writing. To ensure sufficient supply of apprentices, companies have to integrate transition programmes into their vocational training.

“This has to do with increased efforts to attract potential applicants and then also with increased efforts in prepare the applicants so that they are ready to start an apprenticeship in the first place. So some refugees need to attend a language course for a year or others who were not very good in school need to get some additional reading and writing support for half a year. So for us this means that apprenticeships increasingly last for 4 or 4.5 years instead for 3 and 3.5 years. We might even have to do this routinely in the future, so they might get a degree from the company-run school before they start an apprenticeship. But we have to do this and the company is footing the bill for it because otherwise we cannot fill the positions in the production areas in a few years. And the less they know or the less they are capable of when they apply the more we need to put in in advance”¹²⁴.

Another consequence of the wider educational trends in Germany is that the population of apprentices has changed somewhat. While traditionally almost all apprentices were pupils who left school after 9 or 10 years, there are now apprentices with *Abitur*, those who started but did not complete University degrees and also people who seek a career change in their mid-30s or 40s:

“Most still come directly from school, this has been traditionally the most established route, but this is changing in the sense that the route to our apprenticeships becomes more and more

¹²³ A reversal of the balance between supply and demand in the apprenticeship ‘market’ means that since 2017/18 apprenticeships offers increasingly outnumber applicants for apprenticeships: <https://statistik.arbeitsagentur.de/DE/Navigation/Statistiken/Fachstatistiken/Ausbildungsmarkt/Aktuelle-Eckwerte-Nav.html?jsessionid=AB399AB941B6A27DCFA46D50ACF9D152>.

¹²⁴ Interview transcript, Head of Training in steel company, Germany

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diverse. Over the last few years we noticed this change. For example, we get more and more applications from older people, many already past the 30 and some even past 40 years old. These are mainly people leaving university without degree but also people who have changed career or who want to go back to a career that they have done in the past”¹²⁵.

Higher school attainment of potential apprentices, somewhat counterintuitively, is, however, not necessarily advantageous for steel companies, as a another steel industry representative explained:

“With regard to qualifications, we have the whole spectrum from lower secondary level pupils [*Hauptschüler*] to *Abitur* students to those who started but then stopped a University degree. But to be frank, we are not that interested in their certificates but in what they can offer. And we certainly do not have a target to have 50% *Abitur* people here in the technical occupations. Rather, we want to have less in the technical occupations because it doesn’t help us if they all leave for University afterwards”¹²⁶.

A common complaint of interviewees was that the potential of apprenticeships for a fulfilling and interesting working life is not well understood. This contributes to the move away from apprenticeships towards *Abitur*.

“This [apprenticeship] route does not mean that you cannot develop properly – a lot of our apprentices do this as well. For example, we know that 50% of our apprentices who are still here have taken on senior roles in the company. This does not necessarily require a degree, but this can be via *Meister* or Technician [*Techniker*] qualification – the point is people develop quite well even if they do not do an *Abitur* straight away”¹²⁷.

Despite these trends, the industry representatives from large companies we have spoken to reported that they can still just about fill their apprenticeship offers albeit only due to increased efforts. One representative from the cold rolling industry which mainly consists of small and medium sized companies reported, however, that they struggle to attract enough applicants for particular apprenticeship programmes despite increased efforts. One common theme is that most apprentices are from the local region, which makes it possible to concentrate engagement and recruitment drives locally.

“We have gone to schools already 15 years ago, but it is true to say that the effort has increased or I put it like this: the number of applications has gone down ... and we have to intensify specific individualised relations with schools to find applicants or also to get pupils into the company so that they can have a look and understand what is on offer here. But yes, we definitely do more and we also do this quite consciously from year to year by expanding on our efforts. But we are still able to manage and this is certainly not the case for all other companies”¹²⁸.

Common approaches to bolster recruitment include various engagements in local schools, open days, girls’ days, public talks, advertising campaigns and internships for pupils. Where possible

¹²⁵ Interview transcript, Head of Training of in steel company, Germany.

¹²⁶ Interview transcript, Head of a training academy in steel company, Germany.

¹²⁷ Interview transcript, Head of a training academy in steel company, Germany.

¹²⁸ Interview transcript, Head of a training academy in steel company, Germany.

and available, companies have joined regional initiatives that bundle efforts from a variety of stakeholders to improve recruitment.¹²⁹

It is also worth noting that the German steel industry also struggles to recruit sufficient numbers of graduates or so-called ‘talent’ (see Echterhoff et al. 2020 for an extensive analysis). This concerns mainly graduates with an engineering or economics background. The main problem in attracting talent is the relative unattractiveness of working conditions in steel sector compared with, say, the automotive or tech sector. While the former requires shift work and is characterised by noisy and often dirty and hot work environments, then latter can attract talent with flexible working times and a high-tech work environment.

With regard to actual mismatches between required competences and the content of steel-sector relevant qualification programmes no clear picture that indicates structural problems emerged from interviews. The majority of interviewees appeared to be satisfied with the structure and content of German apprenticeships, the main route into working in steel production, and other qualification programmes such as dual studies or university studies (see section 4.3.4 for more details on the different programmes) despite being very aware of the increasing impact of digitalisation and Industry 4.0 on work processes. Interviewees generally suggested that as long as apprentices developed sufficient social and personal competences, including and chief among them the ability to learn, they will be able to cope with new technological developments:

[T]eaching and learning technical skills to some depth is generally not the problem. This means we have barely anyone who does not get the ‘Ohm’s Law’ or the lever principle if they understand the text and if they are willing to spend more than 5 minutes watching a YouTube video on the topic. And that is why we are totally optimistic about future challenges. I do not talk about programming robots or something like this. We have this a little bit with regard to IT apprentices but in general we are at the user end of future developments, especially in steel production. So yes, while it might be the case that future steel workers will use more AI or will work with robots and experience all sorts of other technical change, the basic fact is that they do not need to programme or install any of this on their own. That is why I and we all here are very optimistic because all of these technical competences needed to operate and use the technology can be learned as long as the workers have solid foundations.

In this particular case, the optimism of the Head of a Training Academy of a large steel company was also borne out of the view that steel workers are mainly technology users and not technology producers, which means that there is no inherent need for apprentices to deeply understand how these technologies work. The basic requirement is that they are able to work out quickly how to best utilise new technologies

Another interviewee, also a Director of a Training Academy of a steel company, shared the sentiment that the most important task of the VET system is to develop social and personal competences of apprentices instead of focussing on technological knowledge:

We do not have the boundaries between occupations and we also do not have attitudes such as ‘Oh, I am something better than this person’. These two points help us to achieve the main goal:

¹²⁹ One such initiative in the Ruhr area which is an important steel region in Germany is the ‘Initiativkreis Ruhr’: <https://i-r.de/>

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to develop social and personal competences. And it does not matter what job is concerned, yours or mine, without sufficient personal and social competences I would not be able to do my job properly. The [technical] knowledge itself does not do anything. I am an engineer but what do I gain today from my engineering knowledge acquired 30 years ago? This is comparatively limited.

In this interview, the reason why technological knowledge is relatively unimportant is linked to its temporally limited usefulness. The main idea conveyed by this interviewee is that as long as apprentices have solid and broad foundations and retain both the ability and willingness to learn new things, the training centre will have done its job well.

Only one interviewee expressed explicitly a range of critical points concerning the VET system as a whole and the mismatch between what apprenticeships offer and what the steel industry needs in particular. With regard to the latter aspects, one point concerned the breadth of existing apprenticeship programmes which he perceived to be as too broad as apprentices were forced to learn things that they would never use within steel companies.

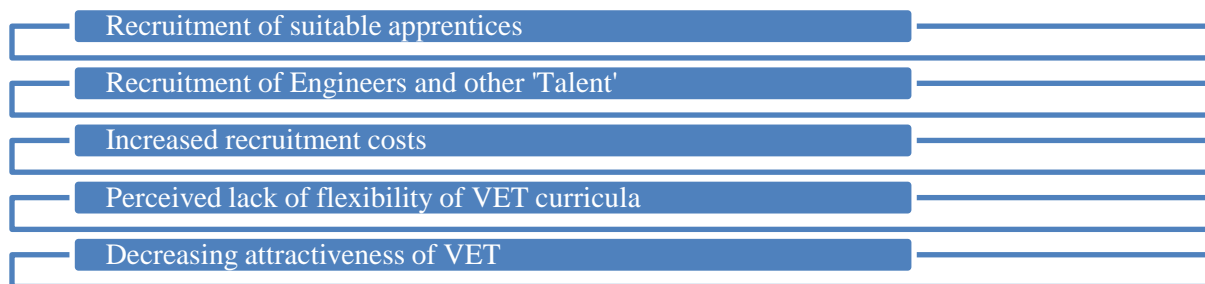
The thing is this: in the current German system, to drive a crane, you need to learn an occupation for 3 years, while in the UK, you would do a 2-month course and you can then drive the crane. The German system over-qualifies people with regard to what they are then actually asked to do, so while we qualify them, we then ask German workers to unlearn/ignore or forget a lot of what they have learned. This leads to frustrations because people's jobs and people's occupational training are to a large degree unrelated.¹³⁰

Another point concerned the fact that too many specializations were offered too early on in apprenticeship cycles:

Example electrician: we offer 5 different electrical qualifications here and each has a different school and company curriculum and different examination policies. Without this, I could educate them all in the first year together in the basics without any need for differentiation and separation. They can then consider where they want to specialise in depending on their first-year experience: some might prefer automation technology and others find climate technology more appropriate. In Germany, we ask 17, 18 and 19 year olds to make this decision before they even had a chance to figure out what it really entails. Instead, we could tell them: go into the cluster electronics and then, once you see what this offers, you can specialise. I believe that in the German system we ask people far too early to make decisions that are irreversible or at least very hard to reverse.

Figure 27 – Skills and knowledge gaps in the industry as emerged from the fieldwork

¹³⁰ The interviewee explicitly recognised that this idea is controversial and relatively unpopular in Germany. Other interviewees would challenge his claims and would defend the breadth and depth of apprenticeship curricula on the ground that it provides workers with sufficient flexibility in the face of rapid technological change and enables them to adapt to changing conditions.



4.3.3 Overview of Germany's VET system

The German VET system is a subsystem of the German education system. General education is a devolved matter in the German federal system and falls therefore mainly under the responsibility of the 16 *Länder* (or federal states), although they operate within a legal framework agreed and overseen at national level. While the *Länder* also play a central role within the German Vocational Education and Training system, the importance of national standards, for example with regard to structure, content and examination methods, means that there is less regional variability in the German VET system compared with the general education system.

In the German VET system two broad types of vocational education can be recognised and distinguished: (1) state-recognised and (2) unrecognised VET provisions. All state-recognised VET provision is in some way government-regulated. Within the category of state-recognised provision, two main forms of vocational education and training can be distinguished: (1) school-based VET provisions and (2) the so-called 'dual system'. The most obvious difference between the two forms centre around the way education and training is delivered: while school-based VET provisions are exclusively delivered in schools (class-room centred), dual VET provisions combine school-based learning with practical training, usually provided within companies. A more subtle difference between the two forms relates to their governance. The regulation of school-based VET provisions is the responsibility of the individual states (*Länder*), while the ultimate responsibility for regulating the dual system lies with the central government. A third significant difference relates to the relative importance of the two forms within the German VET system. Of the approximately 522,000 vocational training contracts concluded in 2014 in Germany, only about 20,000 were school based, which means that the dual system is the dominant form of VET provision in Germany. For this reason and for the fact that the steel-sector occupations relevant for the ESSA project require 'dual' education and training, the focus of what follows will be mainly on the dual system.

4.3.3.1 Legal Basis of Recognised Dual VET Provisions

When applying a regulatory lens to 'dual' recognised VET provisions in Germany, a distinction must be made between 'dual apprenticeships' and 'dual studies' as two different legal frameworks regulate these areas. The former is regulated at a federal level through the Vocational Training Act (*Berufsbildungsgesetz*), which then specifies areas of responsibilities for a range

of actors including the 16 federal states.¹³¹ In this context, the concept of ‘duality’ contains three principles (e.g. Ebner and Uhly 2016):

1. Learning takes place in both schools and companies
2. Training is oriented on the principle of ‘occupationality’ (which means vocational training is about learning an occupation)
3. Consensus-oriented decision-making that involves the social partners at all levels)

Dual studies, in contrast, always involve Higher Education institutions such as Universities or Universities of Applied Sciences [Fachhochschulen] and thus are regulated at federal level through the Higher Education Framework Act (*Hochschulrahmengesetz*) that sets the parameters (or the frame) for more specific regulation at Länder level through *Landeshochschulgesetze*, which might be best translated as Higher Education Acts at the level of federal states (which means that there are 16 different acts of this nature in Germany).¹³² In this context, the meaning of ‘duality’ is somewhat plainer:

1. the duality of locations where learning takes place which are foremost companies and higher education providers
2. the duality of content that combines the training of vocational and academic competences
3. the duality of qualifications as graduates of dual study programmes acquire both a degree and an occupational qualification

In contrast to dual apprenticeships, social partners and the state have no legally defined role when it comes to organisational, contractual or curricular aspects of dual studies that are the sole responsibility of autonomously acting higher education providers, although they have to pass accreditation processes before they can offer dual studies.¹³³ Higher Education providers have overall legal responsibility for the content of courses, companies, in this context often referred to as ‘cooperating companies’ have also an important role to play as students, in order to pursue dual study options either already work in companies and need to be afforded time off work or students sign a contract with a cooperating company which is then responsible to provide the practical elements of the dual study option.

4.3.3.2 Governance of Recognised Dual VET Provisions

In the German VET system, responsibility for governance is shared between central government, federal states as well as organisations representing employers (professional chambers) and employees (trade unions, worker councils). The system operates at three administrative

¹³¹ For this section, the usually salient distinction between initial and continuous VET is not relevant and this section applies to both. As those who initially pursue an ‘apprenticeship track’ can continue their VET education on the ‘university-track’ and vice versa, a useful rule of thumb to know in which regulatory regime one moves is to check whether a higher education provider (they can take different forms in Germany, see details further below) is involved as these institutions tend to be governed by the Higher Education Framework Act and not the Vocational Training Act.

¹³² <https://www.bibb.de/dokumente/pdf/HA169.pdf>

¹³³ In practice, however, companies have some say in the design of programmes.

levels, which are described in detail in the following sections. Table 28 already summarises which actors are involved in what way in the German VET system:

Table 28 - Governance and main actors in Germany's VET system

BMBF	National	Policy-making responsibilities at national level; Oversight and Monitoring responsibilities
BIBB	National	Practical implementation of VET policies; VET research
Main Committee	National	Tri-partite (state, employers, trade union) body within BIBB with both executive and advisory responsibilities concerning vocational education and training at national level
Conference of the Ministries for Education (Kultusministerkonferenz or KMK)	National/ Federal State	Coordination responsibilities to align federal and Länder approaches to education
(16) Ministries of Education (Kultusministerium)	Federal States	Policy-making and oversight responsibility with regard to vocational schools
Vocational Training Committees	Federal States	Tri-partite (state, employers, trade union) body in each of the 16 federal states with both executive and advisory responsibilities concerning vocational education and training at Länder level
Competent Bodies	Regional/ Local	Employer-run organisations with oversight and certification responsibilities concerning dual apprenticeships
Vocational Schools	Local level	Delivery of school-based VET curricula
Ausbildungsbetriebe (companies allowed to train apprentices)	Local level	Delivery of company-based VET curricula

National level

The overall responsibility for VET policy and regulation lies with the Federal Ministry for Education and Research (*Bundesministerium für Bildung und Forschung*, BMBF). As such, the Ministry has overall responsibility for the design of dual training content for all state-recognised occupations. The national recognition of VET provisions ensures that VET provisions – with regard to the ‘school-component’ in the form of a ‘framework curriculum’ (*Rahmenlehrplan*) and the ‘technical/practical component’ in the form of ‘training regulations’ (*Ausbildungsordnung*) – follows the regulations adopted by the federal government.¹³⁴ It also has some responsibility to promote dual VET provisions and to support dual system provisions financially through subsidies for apprentices (*Bafög*), subsidies for providers to fund additional training capacity and funding of research to keep VET system up to date.

The Ministry also has important monitoring functions as it is responsible for the publication of Annual VET Reports (*Berufsbildungsberichte*), which provide an overview of the annual developments concerning the German VET system.

Crucially, the Ministry is responsible for the main legal text regulating vocational education and training, the Vocational Training Act (*Berufsbildungsgesetz*), which was introduced in 1969 and has been substantially amended in 2005.¹³⁵ The Act defines the scope of dual VET provisions and the roles and responsibilities of the three main parties (government, employers, trade unions) involved in VET provision at different levels (national, state, regional). Importantly, the act also specifies which institutions and organisations are recognised as ‘competent bodies’ (*Zuständige Stellen*)¹³⁶ which, at a regional level, have important oversight functions (see further below).

Moreover, it is also responsible for the implementation of programmes intended to improve VET provisions and for the legal supervision and funding of the Federal Institute for Vocational Training (*Bundesinstitut für Berufsbildung*, BIBB).

The BIBB is the core institution for consensus building between all parties – state, federal state, and social partners (institutions representing employers and employees) involved in VET at national level. This is reflected in the make-up of its ‘Main Committee’ (*Hauptausschuss*) which is the central decision-making body within the BIBB as well as the main advisory institution in relation to vocational matters to the relevant government ministries. It represents, in equal numbers, the four main parties involved in vocational education policies. This means there are 8 representatives of the Federal Government, the Länder, Employers and Employees. Additionally, there are two advisers admitted into the committee, one representing the Federal Agency for Work (*Bundesarbeitsagentur*) and the other is representing the umbrella organisation of local communities (*kommunale Spitzenverbände*).

Its main tasks prescribed by the Vocational Training Act are:

¹³⁴ Hippach-Schneider and Huismann, 2016: 14.

¹³⁵ A new amended version appears to have been introduced in January 2020.

¹³⁶ The English-speaking literature tends to translate *Zuständige Stellen* as ‘competent bodies’ even though the alternative – ‘relevant authorities’ – appears to capture the meaning more accurately. We will use both terms interchangeably.

- To support vocational education and training through annual VET-oriented scientific research programmes and the publication of results
- *Under direction from the Federal Ministry*, it is also supposed to:
 - i. participate in the preparations of training regulations and other VET-related regulations
 - ii. participate in the preparation of the Annual VET Report
 - iii. participate in the release of VET-relevant statistics
 - iv. support VET pilot schemes including their scientific evaluation
 - v. participate in the international cooperation around vocational education and training
 - vi. execute other additional administrative tasks on behalf of the Federal Ministry
- *According to general administrative guidelines*, the BIBB is also supposed to support industry-wide (*überbetriebliche*) institutions that provide VET and to help with the planning, formation and development of these institutions.
- Run and maintain the database of all recognised occupations requiring formal training (*Ausbildungsberufe*).

Additionally, the BIBB is also involved in the training of healthcare workers and it is free to take on additional tasks outside the statutory functions provided the Federal Ministry agrees. While the national focus and the tripartite decision-making mechanisms make it very difficult if not impossible for any particular sector to influence the broad direction of the VET system, there are still avenues for sectors to shape the course of VET developments to some extent due to the way the BIBB is internally organised. Within Section 2 of the BIBB¹³⁷, which is responsible for ‘structure and regulation of occupational qualifications’, several working areas (*Arbeitsbereiche*) are oriented towards particular occupational groups (*Berufsgruppen*). For occupations critical to steel production, of particular interest are working areas 2.3. Industrial and Technical Occupations, which include about 40 occupations that are classified as being specific to the metal and electronics industries to which the steel industry belongs and 2.4 Electrical, IT and Scientific occupations. Within 2.3. a dedicated BIBB administrator is responsible for about 40 occupational qualifications.¹³⁸ Part of the administrator’s task is to coordinate updates of occupational regulations or restructuring though the initiative for more significant reforms has to come from the social partners.

Any attempts to adapt or change steel-sector relevant dual system I-VET provisions require the involvement of the BiBB as it is the coordinating institution.

¹³⁷ See: https://www.bibb.de/dokumente/pdf/bibb_organigramm_english.pdf The BIBB describes the tasks of Section 2 as follows: ‘Department 2 modernises and redevelops training and continuous training regulations and develops the basis for the further development of the regulatory work. Accompanying the regulations, demand analyses for new occupations and evaluations of issued regulations are carried out with the aim of ongoing quality assurance and improvement of the regulatory work. Implementation aids support the implementation of new training occupations.’ (<https://www.bibb.de/de/469.php>)

¹³⁸ Given that the automotive industry and most manufacturing industries are part of this metal and electronics industry, the steel sector is rather marginalised.

Given that the BiBB itself is representing the various parties with distinct interests related to vocational education and training, these parties – state, Laender, and Employees need to be engaged if any changes to dual system I-VET are envisaged.

Federal State (Länder) Level

Education, including responsibility for vocational schools and Universities, is a devolved matter in the German federal system. This, inevitably, gives the 16 federal states of Germany an important role in the German VET system.

The most important institution is the ‘Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic’ (*Kultusministerkonferenz* or *KMK*), which is a body that represents all Ministers of Cultural Affairs of the 16 Länder as they have political responsibility for educational provisions in Germany. One important function of the Standing Conference is to ensure the coherence and compatibility of educational provisions across the 16 Länder. For KMK decisions to become legally binding, however, all individual Länder parliaments respectively have to approve them.

Just like at the national level, where state, employers and employees are institutionally bound together in decision-making processes, each Land has Vocational Training Committees, with equal representation of employers, employees and the highest state authorities. They advise the state governments on vocational training issues in schools and also contribute to designing schemes that support disadvantaged youths and provide opportunities for additional qualifications that require school-based training. Any measures that require country-wide changes to curriculums at schools in general and vocational schools in particular will inevitably involve the KMK and the Vocational Training Committees of the Länder.

Regional Level

As indicated further above, the Vocational Training Act also defines ‘competent bodies’ (or relevant authorities) which are institutions who are in charge of supervising or monitoring VET provisions ‘on the ground’, i.e. in the regions of Germany (see Table 29). This function is usually fulfilled by occupational associations, some of which have existed for centuries in the form of guilds. Different sectors are supervised by different competent bodies:

Table 29 – Competent bodies for monitoring VET provision

Occupations in:	Competent Body according to Vocational Training Act
Crafts and Trades	Chambers of Craft and Trades [Handwerkskammer]
Industries and Commerce	Chambers of Industry and Commerce [Industrie- und Handelskammer]
Agriculture	Chambers of Agriculture [Landwirtschaftskammer]

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Judicial Administration	Chambers of Lawyers, Attorneys and Notaries [Rechtsanwalts- und, Notarkammer]
Auditing and Tax Consultancy	Chambers of Public Accountants and Chambers of Tax Advisers [Wirtschaftsprüfer- und Steuerberaterkammer]
Health care	Chambers of Physicians, Dentists, Veterinarians and Pharmacists [Ärzte-, Zahnärzte-, Tierärzte- und Apothekerkammern]
Areas not represented by dedicated Occupational Chambers	Länder can appoint representative competent bodies

The competent bodies are compelled by law to fulfil a range of important functions and tasks:

- certify companies' capacity to train people,
- check ability of trainers
- advise companies and apprentices
- receive, check and register training contracts and provide counselling services
- oversee overall organisation of exams: setting dates and establish exam boards

From the perspective of the steel sector and its VET requirements, Chambers of Industry and Commerce are the most relevant competent body.

Local Level

Actual vocational education and training takes place at the local level. The duality of the VET system means that there is a split between practical or work-based training and theoretical training. The theoretical aspects of training as prescribed in the respective framework curricula (*Rahmenlehrplan*) of each occupational qualification programme usually takes place in dedicated publicly funded VET schools (*Berufsschulen*). In the German system, this entails both technical, occupation-related and non-vocational contents. In the German system, the school-based education tends to be concentrated in the first half of the apprenticeships, while work-based training is concentrated in the second half.

The practical, work-based component of VET provisions tends to take place within companies that have been accredited as training providers (*Ausbildungsbetriebe*). Large companies such as the main steel producing companies in Germany usually have their own dedicated training centre with a dedicated training staff, where apprentices first acquire basic technical skills before they are embedded in real work teams during the latter stages of their apprenticeship. Smaller companies, a category to which many companies in the cold-rolling industry belong, usually do not have training centres and rely on assistance provided by other, larger companies

with the requisite facilities or on training centres run by industrial chambers. The practical training follows the legally binding training regulations (*Ausbildungsordnungen*) that cover both technical, occupation-specific and occupation-transcending, general content.¹³⁹

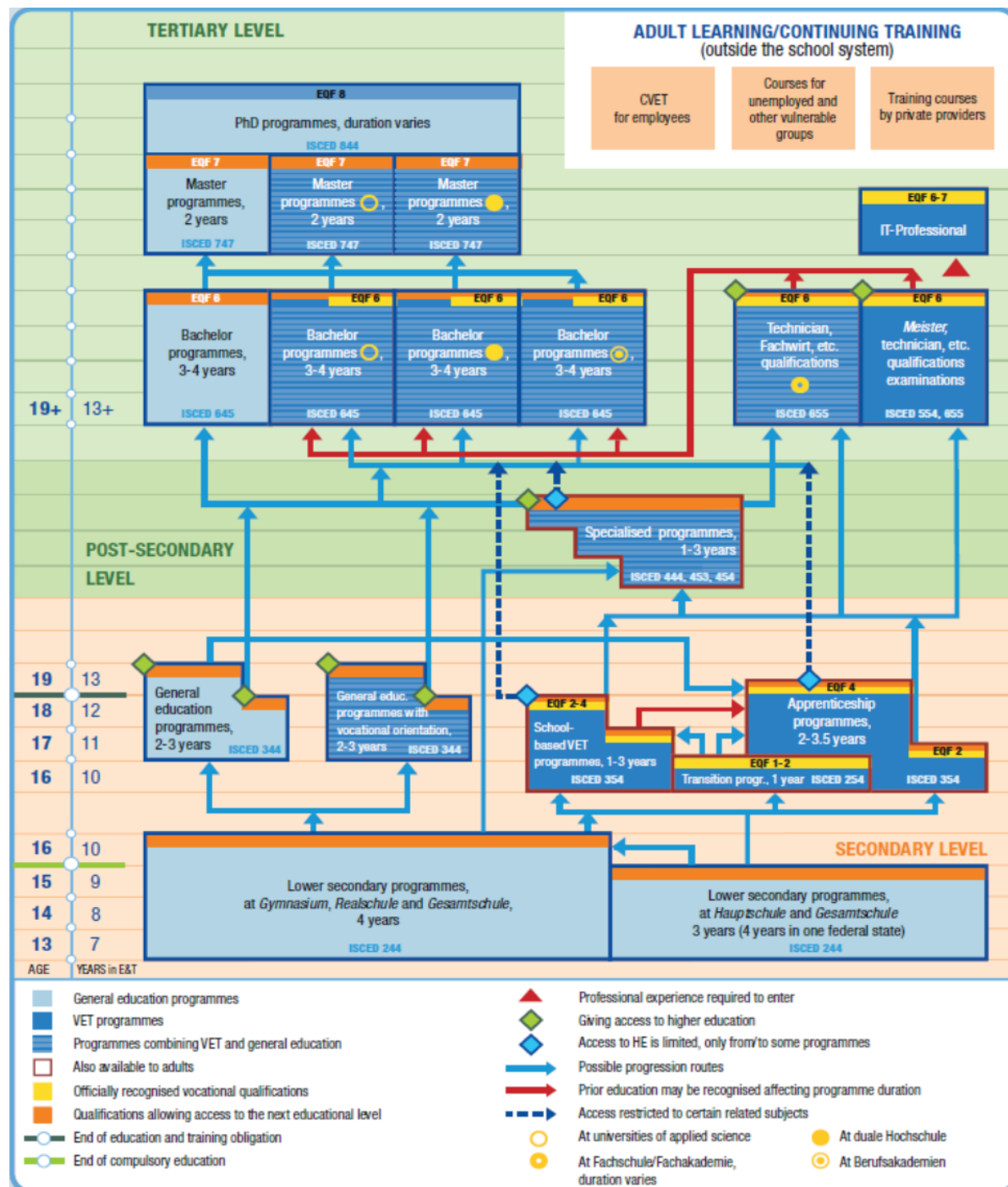
Examination of both theoretical and practical aspects of an apprenticeship is the responsibility of the relevant chambers, which in the case of the vast majority of steel-production related occupational training programmes are the regionally organised Chambers for Industry and Commerce.

¹³⁹ Depending on the way content is taught, interview partners working in company-run training centres suggested that there is considerable ‘unstructured’ time, up to 6 weeks, that can be used to teach students

4.3.4 Programmes and qualifications relevant to the steel industry

As mentioned above, the German VET system is part of the wider German Education System (see Figure 28 below).

Figure 28 – The German Education System



Source: Cedefop ReferNet Germany

The Cedefop ReferNet graphic (Figure 28) puts its emphasis on completeness and connectedness of all formal education programmes in Germany. As the focus of this report and of the

ESSA project overall is on the steel production-related VET qualifications, the first task is to reduce complexity and detail by identifying those aspects of the VET system that are the most relevant for the steel industry.

A simpler way to depict the options provided by the German Education system and to select those that are the most relevant for steel production is to simply distinguish between academic and vocational options at different educational levels (see Table 30).

Table 30 - Academic and vocational qualification programmes in Germany

	Academic Programmes	Vocational Programmes	
		School-based	Dual
Secondary Level	1. Secondary School (General Certificate of Secondary Education)	A: Transition programmes (1 year)	
		B: School-based VET programmes (1-3 years)	C: Dual System Apprenticeship programmes (2-3.5 years)
	2. General Educational Programmes	D: General Education Programmes with vocational orientation	
Post-Secondary Level		E: Specialised Programmes at Senior Vocational School (<i>Berufsoberschule</i>) or at Specialised Upper Secondary School	
Tertiary Level	3. Bachelor Programme at University (3-4 years)	F: Technician other professional qualifications	G: <i>Meister</i> , technician etc. qualifications/ examinations
	4. Bachelor Programme at Applied University (3-4 years)	H: Bachelor Programme at Occupational Academy (<i>Berufsakademie</i>) (3-4 years)	I: Bachelor Programme at Dual College (<i>Duale Hochschule</i>) (3-4 years)
	5. Master programmes at University (2 years)		J: Master programmes at Dual College (2 years)
	6. Master programmes at Applied University (2 years)		K: IT-Professional (2 years)
	7. PhD programmes (3+ years)		

Table 30 has been adapted from Hippach-Schneider and Huisman (2016, p. 13) and slightly modified by inserting shading into some of the boxes.

The orange and mauve shaded areas signify those qualification programmes that are the most relevant for those working in steel production. The orange shaded areas show I-VET programmes and the mauve shaded box shows the main C-VET programme. This is not to say that people who have completed other programmes cannot work in the production-oriented parts of the steel industry. Some critical jobs will require engineering or management degrees.¹⁴⁰ There has also been a long, albeit discontinued tradition of employing people with steel-sector atypical qualifications such as bakers or carpenters and training them on the job during boom periods.

The remainder of this section will describe in greater detail the steel relevant qualification programmes. These concern only a small subset of all qualification programmes offered in the German VET system. In total, the German VET system offers around 320 different recognised occupational qualification programmes requiring formal training (*Ausbildungsberufe*) in 2021.¹⁴¹ The vast majority of them are entirely irrelevant to provide those wanting to work in steel production with the right qualifications as they concern commercial or craft occupations.¹⁴² Even the group of so-called metal and electronic occupations mentioned further above, which comprises around 40 occupational qualification programmes, is not a definitive guide to identify all steel-production relevant occupational qualifications. In fact, there are only two recognised occupational qualifications that are steel-sector specific: process technologists specialising in iron and steel metallurgy and process technologists specialising in steel forming.

4.3.4.1 Transition programmes

Transition programmes are quantitatively relatively unimportant¹⁴³ but have been included here because interviewees from the German steel industry have made us aware that they form part of increasing efforts to fill dual apprenticeship places with suitable candidates (see above in section 4.3.2). These programmes provide an additional year of learning and are designed to prepare prospective apprentices for more regular forms of post-compulsory vocational education and training such as dual system apprenticeships.

¹⁴⁰ It is worth mentioning that the steel industry also employs graduates from regular universities in the area of steel production and processing. These are usually students with an economics or engineering degree. While highly important for the industry, university degrees are not the focus of the ESSA project, mainly because of the fragmented nature of University curricula. In contrast to the standardised dual apprenticeship programmes, University degrees vary greatly from university to university and are therefore very difficult to analyse. It is then also practically impossible to derive any wider lessons from such an analysis that could contribute to the ESSA Blueprint. In practice, larger and well-organised steel companies have informal and sometimes formal arrangements with local universities. Companies might offer work experience while universities might adjust their degrees to cater for the needs of local industries including steel. The steel industry is still facing a significant recruitment challenge when it comes to graduates due to the relative unattractiveness of its jobs compared with jobs in the automotive or tech sector

¹⁴¹ For the full list, see: <https://www.bibb.de/dienst/veroeffentlichungen/de/publication/download/17368>

¹⁴² This should not be surprising as the vast majority of occupations have nothing to do with metal production or the maintenance of industrial production systems.

¹⁴³ They account for 14% (270,000 in 2018) of those entering the German training market.

4.3.4.2 Dual System Apprenticeship programmes

Dual system apprenticeships are the most common qualification programmes completed by those who work in steel production jobs. Schroeder (2019) suggests that there were around 4,600 apprentices in sector that employs a total of about 85,000 people. It used to be the quantitatively most important educational pathway for those leaving the compulsory education system but this has changed in recent years, with significant consequences for steel companies.¹⁴⁴ The name obviously derives from the fact that these programmes involve both school- and company-based learning. School-based learning mainly covers general and theoretical knowledge, while the company-based learning allows apprentices to gain practical experience and to apply theoretical knowledge. While apprentices are supposed to be embedded in real work contexts, their status remains that of learners rather than of workers. A lot of medium and large companies, including steel producers, have also set up dedicated training centres or academies on their premises, which effectively turns the dual system into a triadic system as such training centres create a hybrid space that combines school-based and practical learning. During an apprenticeship, learners spend roughly equal time in vocational schools and companies.

Apprenticeships usually deliver Level 3 and Level 4 occupational qualifications and are relatively time-intensive: Level 3 dual apprenticeships usually require 2 years of full-time learning while Level 4 programmes tend to require 3.5 years. Curricula are broad and deep, encompassing both general and vocational educational elements. While the majority of vocational elements is occupation-specific, all dual apprenticeship curricula also include a suite of standardised transversal elements to develop environmental, digital, personal and social competences.

To become an apprentice, learners have to sign apprenticeship agreements with companies that are qualified to do so (these companies are referred to as ‘Ausbildungsbetriebe’ [apprenticeship employer]). Apprentices have to pass an interim test at half point of their training period to be able to continue. They then have to pass an exam at the end that tests both theoretical and practical competences. These exams are organised and conducted by the relevant Chambers (see 4.3.3.2 above).

Interviews with steel sector representatives as well as analysis of apprenticeship offers by German steel companies shows that there is no uniform set of occupational qualifications utilised by each and every steel company. Several factors emerge that influence which occupational qualification programmes are offered to prospective apprentices. One is related to the shape of companies: the ESSA project includes the whole spectrum of ‘steel companies’, from large integrated steel works that include coking plants, melt shops and rolling mills to smaller cold-rolling companies that concentrate entirely on steel forming. The former require a far more diverse set of qualifications than the latter. Another factor relates to the size and geography of companies: some large companies occupy several square kilometres of land and tend to have large company-operated transport networks that includes rail, roads and shipping, which means

¹⁴⁴ In 2018, just under 500,000 people started a dual apprenticeship which accounts for about a quarter of all those entering the German training market.

that some steel companies offer to qualify inland sailors and train drivers in addition to the more steel-production related technical as well as a host of commercial occupational qualifications. There are also company-specific traditions and idiosyncrasies that might influence which occupational qualification programmes are offered. For example, some companies build their maintenance teams around mechatronics, while others utilise electricians and mechanics alongside each other.

While there is no definitive list, it is still possible to identify a range of core occupational qualifications that are relevant for steel production and are thus offered by German steel companies.¹⁴⁵ Following the approach of ESSA WP3 that identifies steel-production jobs according to different task areas, Table 31 lists the task areas related to steel production in the left column, the aggregated occupational qualification programmes (OQPs) in the middle column and 15 steel-sector relevant recognised occupations requiring formal training in the right column.

Table 31 – Steel-relevant qualification programmes in Germany

Task Area	Occupational Qualification Programme	Recognised Occupational Qualification
Maintenance	Industrial Electronic Occupations [EQF 4]	Industrial electrician specialising in industrial engineering; Electrician for automation technology;
	Industrial Electrician Occupations [EQF 3]	Industrial electrician specialising in industrial engineering; Industrial electrician specialising in devices and systems
	Industrial Metall Occupations	Industrial Mechanic; Plant/ Facility Mechanic; Tool Mechanic; Milling machine operator
	Mechatronic Occupations	Mechatronics fitter
Melt-Shop (Furnace & Casting operation)	Process Technologist Occupations	Process technologist for the metalworking industry - specialising in iron and steel metallurgy
	Skilled Metal Worker Occupations	Skilled metal worker specialising in cutting procedures

¹⁴⁵ Schroeder (2019) cites research by the German Steel Association (Wirtschaftsvereinigung Stahl) that suggests that there are 11 technical occupational qualifications relevant to the steel industry.

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Rolling Mill (Mill Operation)	Skilled Metal Worker Occupations	Process Technologist for the metalworking industry - specialising in steel forming
	Skilled metal worker	Skilled metal worker specialising in metal forming and wire technology
Logistics	Warehouse logistics operator	Warehouse logistics operator
Quality Control	Materials Tester (MT)	MT specialising in metallurgy

As mentioned above, this list represents the most common apprenticeship programmes offered by steel companies. These companies will also offer, among other things, a wide range of commercial apprenticeships which are not the focus of the ESSA project and are therefore not considered. The list also does not imply that each steel company offers all of these apprenticeship programmes. The occupational qualification programmes listed in Table 31 will be analysed in greater detail in ESSA Deliverable 4.4.

4.3.4.3 Dual Study

The option to pursue a ‘dual study’, i.e. to combine work practice with the acquisition of theoretical technical knowledge, has existed in Germany for more than 40 years.

According to the BIBB¹⁴⁶, four broad dual study models can be distinguished in the German system:

1. *Dual study programmes that integrate training* combine study with training in a recognised training occupation. The study phases and the vocational training are interlinked both in terms of time and content. In addition to the degree, a second recognised qualification in a training occupation with a chamber examination is acquired.
2. *Practice-integrated dual study programmes* combine the study programme with longer practical phases in the company. There is a connection between the courses at the university and the practical training. A prerequisite for enrolment in a practice-integrated degree programme is a contractual commitment to a company, often in the form of an employment contract or an internship or traineeship contract.
3. *Career-integrating dual study programmes* are those for continuing vocational education and training. The study programme is combined with part-time work. This model also provides for a reciprocal content-related relationship between the professional activity and the study programme.
4. *Part-time dual study programmes* are similar to distance learning programmes. The study programme is completed alongside full-time employment, mainly through self-

¹⁴⁶ <https://www.bibb.de/de/8655.php>

study with accompanying seminars. In contrast to normal distance learning courses, in this model the company makes a specific contribution that is conducive to the study. This can be, for example, through practice-related topics for study assignments, release from work for the attendance phases and the provision of company work equipment.

The first two options can be categorised as being part of the initial VET system, while the last two are continuous training opportunities.

Dual study as a vocational training option is becoming increasingly popular in Germany. While the overall percentage of students enrolled in dual study programmes still amounts to a very small proportion of total pupils enrolled in VET programmes, this is a rapidly developing and growing part of the VET system. In just 15 years, between 2004 and 2019, both the number of dual study courses and the number of cooperating companies more than tripled, while the number of dual students more than doubled from around 40.000 in 2004 to almost 110,000 in 2019.

The vast majority of courses, more than 70% in 2019, are offered by universities of applied sciences (*Fachhochschulen*) that are traditionally more vocationally oriented than classic Universities.¹⁴⁷ Other providers are dedicated ‘Dual Universities’ (15%), occupational academies (*Berufsakademien*) (10%), and others (which includes classic Universities) (5%).

With regard to degree programmes, of the more than 108.000 students enrolled in dual study programmes in 2019, about half pursue economics degrees, while a quarter is enrolled in engineering degrees and a further 12.000 study informatics. The analysis of the integrated occupational qualifications programmes shows a heavy concentration of technical occupations related to electric, metal and IT sectors as well as commercial occupations. The top 5 occupational qualifications that are part of the dual study programmes are all relevant for the steel industry, with industrial mechanics and mechatronics taking top spots.¹⁴⁸

The different forms of dual study programmes as well as recent trends have already been discussed further above under 4.3.2.4. Given the autonomy of higher education providers combined with the direct partnership with companies, it is very difficult to say anything general about steel-industry relevant dual study programmes. Our interviewees from the German steel industry confirmed that dual study options are popular with both companies and students.

In terms of steel-sector relevant study programmes, including both traditional and dual programmes, Schroeder (2019) cites research by the German steel association that identifies 17 steel-sector relevant higher education programmes, although some entries on this list, such as medicine and geology, seem only distantly related to the steel industry though large companies

¹⁴⁷ All statistics are taken from a recent detailed analysis of dual study programmes undertaken on behalf of the BIBB: https://www.bibb.de/dokumente/pdf/06072020_AiZ_dualesStudium-2019.pdf

¹⁴⁸ A list with the top 20 occupational qualifications obtained via the dual study route can be found here on page 22: https://www.bibb.de/dokumente/pdf/06072020_AiZ_dualesStudium-2019.pdf

tend to employ doctors and nurses to provide medical services on site.¹⁴⁹ Some of them can be pursued either in their traditional form or as dual study programmes as set out in Table 32:

Table 32 – Steel-industry relevant degree programmes

<ul style="list-style-type: none"> • Metallurgy & material technology / material engineering • Mechanical engineering • Electrical engineering or electronics • Physics, chemistry, process technology • Industrial engineering with business studies • IT • Mathematics 	<ul style="list-style-type: none"> • Civil engineering • Production technology • Safety systems • Supply and disposal technology • Agricultural sciences • Geology • Industrial environmental protection • Infrastructure management • Medicine • Logistic
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A review of offers available on the websites of a number of German steel companies results in the list of following dual study options within the sector:

- Mechanical Engineering
- Industrial Engineering
- Electrical Engineering
- Information Engineering
- Automation Engineering
- Computer Science/ Computer Engineering

The vast majority of offers are engineering related and steel companies tend to offer programmes mainly at Bachelor level although Master-level programmes are also available. Arrangements are usually made with local higher education providers as the split between class room and companies works best when distances are short. Depending on their location, some steel companies, for example those located in the Ruhr area, have local access to a great number of Universities while others that are located outside of major population centres might only have one or two options for cooperation on dual study programmes.

4.3.4.4 Steel-production relevant continuous VET programmes

In general, all German dual apprenticeship programmes come with a state-recognised and regulated continuous training route that results in so-called *Meister* (Master), Technician or Senior Specialist (*Fachwirt*) qualifications. These continuous qualifications are all EQF Level 6 qualifications and are therefore the VET-equivalent of academic Bachelor degrees. Eligibility to pursue these continuous qualifications requires a successfully completed dual apprenticeship in

¹⁴⁹ See for example this description of a medical service provider that is part of the tkse steel:
<https://www.thyssenkrupp-steel.com/de/karriere/arbeiten-bei-thyssenkrupp-steel-europe/unsere-tochtergesellschaften/precision-steel-als-arbeitgeber/arbeitsmedizinischer-dienst/arbeitsmedizinischer-dienst.html>

conjunction with substantive work experience (requirements differ from federal state to federal state, but the minimum requirement is at least one year work experience).¹⁵⁰

Within the range of continuous VET provisions, these qualifications are so-called upgrading training programmes as they build upon an existing VET qualification but develop a range of competences and skills that are required for higher-level jobs.

Both Meister and Senior Specialist programmes are organised in similar ways as both C-VET programmes are organised and overseen by regional Chambers for Industry and Commerce. Technicians, in contrast, is a qualification that is organised and awarded by professional schools or technical colleges [Fachschulen] which in turn are regulated by the federal states.

The main difference between Meister and Technician degrees on the one hand and Senior Specialist degrees on the other is that the former build upon technical, production-oriented I-VET qualifications, while the latter relate to more commercially oriented I-VET programmes.¹⁵¹ All programmes are designed to develop participants for medium-level leadership positions within companies. For example, the German Chamber for Industry and Commerce characterises those with Meister degrees in the following way:

- professionally experienced, industrial-technical managers with extended and in-depth knowledge of operational and business contexts
- professionally competent workshop managers with personnel responsibility
- Coordinators for the smooth running of production and the quality of products
- mediators between plant management and their employees
- operational supervisors with special responsibility for occupational safety and accident prevention

In comparison, the Senior Specialists qualification focuses more on competitiveness, marketing, finance, investment and HR aspects.

4.3.5. Remarks on VET

Compared to other VET systems, the German VET system has some specific features that need to be understood by anyone who wants to change or develop the system. Three core concepts are of high relevance in this regard: national standards, occupationality and technology-neutrality.

‘National standards’ refers to the fact that recognised occupational qualifications programmes such as apprenticeships are governed by the same regulations and share the same curricula across Germany. As suggested at the beginning of section 4.3.3, this distinguishes the German VET system from other aspects of state-controlled education as most aspects concerning education are devolved, meaning that the 16 federal states have their own regulations and prescribed educational content when it comes to compulsory school education. One advantage of

¹⁵⁰ See <https://wis.ihk.de/?id=156>

¹⁵¹ E.g. <https://www.handwerksblatt.de/bildung/fachwirt-und-meister-abschluesse-auf-augehoehe>

national standards is that it is very clear and transparent what someone having successfully completed an occupational qualification anywhere in Germany can be expected to know and to be able to do. The idea of *Beruflichkeit* (occupationality) has deep historical roots in Germany and can be traced back to the Middle Ages when institutions such as guilds and other professional associations controlled access to who was allowed to perform a range of tasks that were associated with occupations. Traditionally the idea was that an occupation required some sort of specific, regulated training and once acquired, a person would practice the occupation for the rest of their working lives.¹⁵² In recent decades, an updated or ‘modernised’ concept of occupationality has emerged and is currently influencing developments (e.g. IG Metall 2015) in the German VET system. According to IG Metall (2015: 9) In the modern version, specialised individual occupations are bundled together into core occupations (*Kernberufe*) with several flexible avenues for initial and continuous specialisations. (IG Metall 2015:9). Moreover, modern occupationality is characterised by an enhanced emphasis on process understanding, both with regard to work and wider business processes, a strengthening of self-dependent and responsible behaviour, and the overarching goal to provide learners with a comprehensive ‘occupational capacity to act’ [berufliche Handlungsfähigkeit]. The idea of technology-neutrality is fairly self-explanatory. Technical parts of VET curricula aim to be as non-technology specific as possible. This does not mean that technology does not play a role during training, on the contrary, as being able to use or work with certain technologies is a crucial part of vocational education and training. Technology neutrality means simply that as little prescriptions as possible are made with regard to what pieces of technology or equipment apprentices are trained on. For example, the framework curricula for industrial electricians suggests that one learning field concerns the ‘installation and maintenance of facilities and systems’¹⁵³ but it does not go any further in specifying which ‘facilities and systems’ this applies to. This allows training companies some freedom and flexibility. The common practice is to train apprentices on specific technologies that are used within the training company to prepare them for work, but many companies also use the opportunity to train apprentices on cutting-edge technologies that might not yet been implemented in the company to prepare apprentices for future technological change that is perceived to become more rapid by many.¹⁵⁴

Concepts such as technology-neutrality, occupationality and national standardisation shape the VET system and its qualification offers and programmes in particular ways and it is worth highlighting three aspects in this regard as they have consequences for the future direction of the German VET system: Modularity, Non-sector specificity, and duration of VET qualifications.

In some VET systems, training programmes can be put together very flexibly by combining a set number of self-containing, independent training modules (see for example the UK VET system, section 4.2). The underlying idea here is one of ‘mix and match’: each module accrues

¹⁵² As one interviewee from a large German steel producer pointed out, the related German terminology is instructive here: someone who just finished their training phase used to be referred to as ‘Ausgelernter’, i.e. someone who has finished the learning phases (with the connotation that they have learned everything that is there to learn)

¹⁵³ https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/1311008.pdf

¹⁵⁴ Almost all interviewees remarked upon the ever increasing speed of technological change.

credit and a particular qualification requires a certain number of credit. Some employers, including some German steel companies, are attracted to such a flexible system as it matches qualifications closer to the specific and particular requirements of the company. For example, one large steel producing company in Germany would like to bolt on additional modules to existing curricula of relevant occupational qualification programmes to deal with any perceived skill gaps.

This issue is controversially discussed at the moment. In Germany we have so-called occupational research institutions (e.g. universities or the BiBB), so there is a variety of discursive circles where this is an issue. And the debate is completely split: the issue centres around the meaning of ‘Beruf’ and ‘Beruflichkeit’ which is very different from ‘job’ – Beruflichkeit is definitely more than a job. So while our ideas with regard to modularisation chimes with the Bologna process of VET provisions, the current system is strongly rooted in the belief that a Beruf is something very special and it also comes with a strongly established system of authorities, responsibilities and hierarchies. This is hard to overcome and that is where the debate is at the moment. For us, as we are currently implementing modularisation, this is tricky because we always have to ask ourselves how much we can actually do because anything we do still needs to fit into the current system of occupations.¹⁵⁵

Another interviewee who strongly supports the concept of *Beruflichkeit* explained why it is so difficult to ‘modularise’ in the context of *Beruflichkeit*:

In the occupational framework, we simply describe final outcomes ... which means we describe final qualifications when we describe the occupational profile. And this is also the reason why it is so difficult to modularise occupational qualifications because the occupation is the whole thing, the complete outcome of everything you have done. ... This has a political dimension as well because the more I fragment occupational training, the more I take it apart the more it takes on the character of job-specific training and that is exactly what we do not want to do. So that is the difficulty of modularising and of course, you have to be able and you must be able to compartmentalise and to define particular areas and learning situation and specific outcomes and you could even go as far as to provide hundreds of learning nuggets but the difference is that in the German system you do this from a point of view of the whole occupation whereas in other systems all you have are the nuggets but no clear idea what the overarching thing is. The danger is that through modularization, the concept of the occupation gets destroyed and the actual aim: occupational ability to act or occupational competence gets lost in a system that only contains building blocks but no whole to give orientation. Again, from a didactic point of view you need to put stuff into smaller chunks but that is no problem if you have something to hold this together to ensure occupational competence.¹⁵⁶

Proposing reforms and changes to the VET system or to particular qualification programmes without taking the concept of *Beruflichkeit* into account, is unlikely to lead to any useful outcomes as many VET system stakeholders are deeply invested in the idea of occupationality, chief among them trade unions who can veto any reform proposals that they do not agree with.

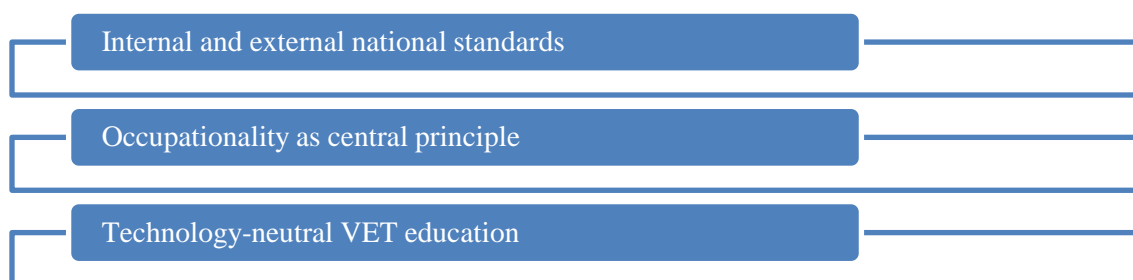
¹⁵⁵ Head of Training Academy of German steel producer

¹⁵⁶ German VET expert working in a VET institution.

A second consequence of the combination of occupationality, technology-neutrality and national standards, is that the majority of the steel-sector *relevant* initial VET qualification programmes are not steel sector *specific*. For example, one of the most relevant and widely relied on occupational qualifications for the steel sector is the so-called Prozesstechnologe/in (process technologist). Despite the high relevance for the steel industry, this is not a steel-specific qualification. Rather, it is a qualification that covers a wide range of important production-related jobs in a great variety of industries. An apprentice completing this programme in the steel sector will of course gain all of her or his practical experience within the steel sector but the learning outcomes of the qualification programme are thus that they can be expected to perform relevant jobs in any other industrial sector. This has also consequences for the level of influence that the steel sector, individual steel companies or steel-sector focused projects like the ESSA can have when it comes to shaping form and content of steel-sector relevant qualification offers.¹⁵⁷ While the steel sector might like to change some aspects of the content of the process technologist qualification to make it even more relevant, other sectors might have very different ideas. Given the relative size of the steel sector *vis a vis* other industrial sectors, unless there is an industry-wide alignment when it comes to changes that the steel sector might like to see it is unlikely that these will be implemented..

A third consequence worth mentioning is that German IVET qualification programmes are relatively time-intensive when compared to equivalent qualification programmes in other countries. Most steel-industry relevant apprenticeships at EQF Level 4 take between 36 or 42 months of training, while EQF Level 3 apprenticeships still last 24 months. The reason is that apprentices learn an occupation and not just a particular skill or task or job. This not only means a relatively broad technical training covering a wide range of task areas but also a solid basis of transferrable, non-occupation specific knowledge, skills and competences, which are increasing in relevance in the context of digitalisation and Industry 4.0.

Figure 29 – Remarks on the German VET system emerging from field work



¹⁵⁷ Although, as already indicated above, the steel sector employers and employees can try and influence occupational qualification developments through their respective membership in higher-level bodies such as the Associations of the Metal and Electro Industries or ‘Gesamtmetall’ (the Federation of German Employers’ Associations in the Metal and Electrical Engineering Industries) on the employers side and the IG Metall trade union on the employee side that are directly engaged in the VET system as social partners. Of course, the steel industry, through a variety of more direct feedback and engagement mechanisms organised by BIBB, industrial associations or chambers, can also try and shape VET developments. Several BIBB interviewees suggested that company feedback is generally fairly weak.

4.3.6 Feedback mechanisms

Feedback mechanisms within systems such as the German VET system are crucial to make optimal use of existing provisions and to instigate and direct change. Compared to other VET systems, the German system has exemplary structures that, in theory at least, afford fast and efficient feedback mechanisms at all levels (national, federal states, regional and local). As anywhere else, however, in practice feedback loops are not working as well as they could. One reason is the sheer size and complexity of the VET system, but under-resourcing and limited capacity of key actors also contributes to the practical difficulties.

From the perspective of steel companies, there are two different feedback loops that are of great importance. First, company internal feedback mechanisms are crucial to adjust company-run apprenticeship and other qualification programmes in ways that benefit companies. These feedback loops are important to optimise the externally imposed system framework. In the context of dual apprenticeships, for example, this means that while companies have to operate within a nationally standardised context, there is still scope to make the most of the given structures (see section 4.3.7 for a case study that illustrates this very well). It is the responsibility of companies to develop and utilise such feedback mechanisms. The larger German steel companies interviewed for this study all indicated that internal feedback mechanisms exist and that they are crucial to make the right decisions. These feedback mechanisms loops usually involve structured interactions between production areas and those responsible for training. The content of these interactions tends to concerns either specific requirements for qualifications concerning prospective apprentices or the introduction of new technologies which in turn might require new or additional qualifications. An example of the former was given by the Head of Training Academy of a large German steel producer who discussed how the company decides how many and what kind of apprenticeships they offer each year:

The planning for this [future apprenticeship intake] is quite lengthy which means that we are now [December 2019] start to plan for the intake in 2021. The planning involves the individual plants (Betriebe) and the operational and strategic HR staff there and the task is to see where there might be demand, how is the age structure looking like, what are the strategic plans and how do they affect demand, and who do you need in about 4-6 years when the 2021 intake have finished their qualifications.

An example for the latter kind of feedback interactions was given by another Head of a Training Centre in a different company. He was discussing how they integrate company-specific requirements into the development of an Industry 4.0 learning lab that apprentices and trainers of the Training Centre were putting together:

So we started by asking ourselves: what is our Industry 4.0 that we utilise in the company and so we started to talk to all sections and collected information about technologies but also about the data we collect and ask ourselves how we could integrate all of this into a learning lab.

A second form of feedback mechanism concerns the ways in which German steel producers can influence the national VET system. In section 4.3.2 it has been shown that governance as

well as decision-making of the German system is organised in a tripartite way, which gives employers and employees (via trade unions) a voice when it comes to important decisions concerning all aspects of the VET system. The most important decision-making forum at national level, the *Hauptausschuss* (main committee) is organised in this way. Despite direct employer representation, it does not mean, however, that the concerns of steel producers are directly represented at this level. Instead, employer organisations representing the concerns of the steel industry – in the case of Germany this is the *Wirtschaftsvereinigung Stahl* (WV Stahl) – has to lobby larger industrial employer organisations such as the *Gesamtverband der Arbeitgeberverbände der Metall- und Elektro-Industrie*, the *Deutsche Industrie- und Handelskammertag* or the *Bundesvereinigung der Deutschen Arbeitgeberverbände* to have their concerns addressed at national level. Given the shrinking relative size and significance of the German steel industry compared to other industrial concerns such as automotive or chemical industries, it is very difficult for specific steel concerns to be addressed, especially in a system that values occupationality and enforces national standards.¹⁵⁸

Despite this de facto under-representation of the steel industry in the *Hauptausschuss*, there are other ways for industry feedback to influence qualifications at national level. As mentioned above in section 4.3.4.2, most steel sector relevant qualifications tend to be grouped together as metal and electric qualifications. The internal organisation of the BIBB reflects this as there is a dedicated member of staff looking after the 40 metal and electric qualifications. In this more specific context, there is greater scope for steel industry concerns to be heard, albeit not directly but via larger bodies representing employer interests in the sector such as the *Gesamtverband der Arbeitgeberverbände der Metall- und Elektro-Industrie* of which *WV Stahl* is a partner.

Employer organisations such as *WV Stahl* or *CIELFFA* (European Federation of the National Associations of Cold Rolled Narrow Steel Strip Producers and Companies) as well as the BIBB also run regular surveys that provides individual companies with the ability for feedback on a variety of issues, including vocational education and training. Participation tends to be, however, relatively low.

4.3.7 Good practices

This following case description is based on an interview with the Head of the Training Centre of a large German steel producer that also operates globally. Just like any other German company, it operates within the confines and framework of the national VET system when it comes to their apprenticeship programme. Nonetheless, through some innovative ideas and a well-developed understanding of the competence needs within their company, they operate a training

¹⁵⁸ For example, a Head of a Training Academy suggested that their apprentices are over-qualified in the sense that a lot of what they learned during their apprenticeship was not relevant for steel jobs. For example, hydraulics is an integral and substantive part of the curriculum of industrial mechanics, which the company trains, even though hydraulics plays no role within steel production. National standards and occupationality prevent more steel-specific curricula as well as the importance of the automotive industry for the German economy. The interviewee suggested that the curriculum in question was largely determined by interests that represented car manufacturers. The German steel industry nowadays lacks the importance and political clout to shape curricula at national level according to its own interests.

centre that appears to be able to equip their apprentices with key skills required for Industry 4.0 and digitalisation such as teamwork, process- and system knowledge, flexibility, creativity and problem solving ability (BIBB 2017). This is quite a deliberate approach that treats formal VET system requirements as minimal standards that do not necessarily put limits on what companies themselves can do:

“Question: One critique of the German VET system is its rigidity and the silo-ism that comes with it. How is your approach that involves additional qualifications and a lot of informal learning compatible with the VET frame?”

Answer: I say it a bit casually: we are trying to provide excellent training and in the end, the IHK [chamber] can perform their examinations. Of course we adhere to all [formal] prescriptions, but I have never had anyone from the chamber or otherwise here controlling that this is really done. Our examination results are very good and we also force our graduates to take IHK exams just to keep their feet on the ground.... After a few semesters, we prepare them for a few weeks for the IHK exam and they usually pass them with 1's or sometimes 2's [highest grade is 1 on a scale to 5 or 6]. So the IHK examination is not a real barrier as it is just ensuring that some minimal standards are applied throughout the system...¹⁵⁹

From the interview data, at least four fundamental underpinning beliefs appear to influence the way training activities are structured. First, the VET system framework in which the company operates is acknowledged where necessary but training activities are designed to equip apprentices with a range of skills and competences that go well beyond the prescription of the VET framework. Second, more or less everything is regarded as a training and learning opportunity, whether this part of the formal curriculum or not. Third, develop an understanding of a wide range of what other jobs and activities within the company is seen as vital. Fourth, the best way to learn is to learn through practice.

4.3.7.1 The main goal: to develop social and personal competences

While apprentices in the German VET system get trained and educated in a range of transversal skills, the bulk of most curricula concentrates on the development of technical skills and competences. Given the rise of new digital technologies and ever- more integrated processes, one might think that technical abilities will also increase in significance. This training centre is not unique in their belief that technical skills are secondary and something that can be learned relatively easily. This sentiment has been expressed by a range of interviewees across the case study countries. What makes this companies approach so interesting is that the declared main goal of their apprenticeships is to develop social and personal competences to the maximum. One reason for this emphasis is the conviction that these kinds of competences are vital as they facilitate learning and the acquisition of new abilities:

¹⁵⁹ Interview transcript, Head of Training Academy of a steel company, Germany.

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“But the core and this is the core of occupational education is to develop personal and social competences. Because if we have developed those then people are in a good position to acquire other kinds of competences, knowledge and skills on their own. This is the philosophy that we pursue here”.¹⁶⁰

Another rationale for this emphasis on social and personal competencies is the strong belief that this enables people to do their jobs properly while working well together with others coming from different occupational backgrounds:

“And it does not matter what job is concerned, yours or mine, without sufficient personal and social competences I would not be able to do my job properly. The [technical] knowledge itself does not do anything. I am an engineer but what do I gain today from my engineering knowledge acquired 30 years ago? This is comparatively limited. On the other hand, I really need the knowledge that allows me to reach into different areas. As an engineer I need to see how I manage working together with IT people or admin staff or I am a mechanic but have to understand some electricians. I do not have to know everything, but the connectivity between people with different backgrounds helps immensely”.¹⁶¹

Our interviewee acknowledged that developing personal and social competences is complex and that there are no off-the-shelf solutions. They look for hints in applications of prospective apprentices that suggest that they already have some social and personal competencies:

“This is also something we actively look at when we receive applications: is someone engaged or active somewhere or are they just sitting at home and just interested in themselves as this gives us some indicator about private contacts and networks and their social connectivity”.¹⁶²

To develop these competencies, the training centre has developed an approach that constantly challenges apprentices to do new things and to embrace a wide range of informal learning opportunities. In line with the general approach to break down occupational boundaries, apprentices often engage in activities that have little or nothing to do with their occupational fields such as organising conferences or producing a short film introducing the local steel plant to outsiders:

“Our philosophy is to let people do stuff and to throw them into the deep end. So for example we have this annual trainer meeting and there I always take two apprentices and tell them: so now you two are in charge of organising the meeting and then they get stuck in”.

“Similarly with the ... plant tour video: we tell our apprentices to do these things. And they look at us and wonder: we have nothing, no video, no sound, no script, we cannot edit or cut. And we say: great, get on with it then, which means they have to start thinking about what they need and where they get it from. Of course, I am not going to sit with them for five hours, no, I let them think about it and then we make an appointment where we have an initial look at their plan and I might give them some tips or tell them what

¹⁶⁰ Interview transcript, Head of Training Academy of a steel company, Germany.

¹⁶¹ Interview transcript, Head of Training Academy of a steel company, Germany.

¹⁶² Interview transcript, Head of Training Academy of a steel company, Germany.

things to pay attention to and then they develop this bit by bit. So the ... plant video [is] 100% apprentice-made and they learn for themselves how to reach their goals”.¹⁶³

Another example of opportunities to develop social and personal competencies mentioned by our interviewee involve apprentices teaching other apprentices in their areas of expertise or that apprentices sometimes teach their trainers:

“So when the metal apprentices learn about the administrative side of things then they receive this from administrative apprentices and electricians learn their metal working skills from metal apprentices”.¹⁶⁴

4.3.7.2 Additional qualifications

Further above, the report highlighted the instrument of additional qualifications to respond flexibly to emerging skill demands. It was also highlighted that take up at company level is sluggish. One of the possible reasons for the limited take-up is that to formally gain these additional qualifications, an additional examination by the relevant Chamber is needed and this involves substantive fees. In contrast, in this company, all apprentices – whether they are in technical or administrative – are expected and encouraged to gain a range of additional qualifications that often go far beyond the narrow confines of their occupations and future jobs and include robotics, project management, pneumatics, industry 4.0, language courses, communication training and many more. There is however no expectation on the part of the company that apprentices need to formally get their participation certified or formalised.¹⁶⁵ Instead the aim is to enable apprentices to at least gain a basic understanding so they can talk about it relatively fluently with colleagues as well as to reduce resistance to and anxiety about the use of new technologies.

“What we have said that we want to do is on the one hand educate our people in the basics but on the other hand also provide them with a wide range of additional qualifications. For example, we offer PLC [programmable logic controller, which is important for the automation of processes] for metal workers. Normally metal workers will not learn PLC, it's not their world, but nonetheless we have been asked to please introduce metal workers to SPS so that they will understand what electricians are actually doing and so that they can talk about it with electricians. Or robotics because we have robots in the production lines and we think it is important that they at least get an idea. Same with gear box/ transmission/ drive technology because in almost all technology there is some transmission technology in there. We also offer I4.0 courses so that people can be introduced to the technologies associated with that. The point is not to educate them deeply in these areas. Rather, the point is that they have what I call ‘overview knowledge’ [... and] that they develop a basic understanding [...] If they have used or seen smart glasses once during their apprenticeship, they will first realise that using them is fun and second that it is not that difficult to use them. Its

¹⁶³ Interview transcript, Head of Training Academy of a steel company, Germany.

¹⁶⁴ Interview transcript, Head of Training Academy of a steel company, Germany.

¹⁶⁵ The exceptions are with regard to qualifications such as crane operation, fork lift driving and welding, where formal certificates are pre-requisites for performing these activities in practice.

very easy, but you have to have done it or seen it once before. So we do this to reduce any anxiety that might come with being confronted with new technologies”.¹⁶⁶

There are of course limits, as the Training Centre manager explained – “metal workers will not do 10 finger typing ... and no administrator will do hydraulics but all our apprentices will do most of these courses” – but the principle is clear: all apprentices are expected to learn as much as possible about other activities within the company, not because the apprenticeship curriculum demands it, but because it makes sense for the company as they require their staff to collaborate and work together.

“When we opened the training centre here, the metal workers and the electricians did not want to work together, they didn’t want to move in at all. There were real barriers between the occupations but today no one is talking about this anymore. Of course there is the usual banter, but this is normal. Now electricians and metal workers and those with admin backgrounds work hand in hand together. They got to know each other and each other’s background and they have started to value the respective experiences and expertises. This creates a totally different network and totally different connectivity as if everybody is just doing their own thing. And that also translates into the everyday working in our company where we expect people to work together”.¹⁶⁷

The company is able to educate their apprentices in these various activities by streamlining the delivery of compulsory curricular activities and making use of slack within the curricula, which provides them with an additional 6 weeks of training time.

With regard to the additional costs that such a comprehensive and interdisciplinary approach to training entails, our interview partner insisted that this makes good economic sense for the company:

“The philosophy is here that if you train people you train them well and it creates costs in any case so investing a bit more for very good training makes sense from the companies point of view. Because when you look at the total training costs then this is just a very small part (what you pay extra for excellent training) and you mustn’t try saving too much at this stage because the savings you might make during the apprenticeship stage might be negated if you need to train them when they are already in work”.¹⁶⁸

The interviewee admitted, however, that such an approach to investment in staff is only possible due to the stability of their staff body. There is very little staff turnover and the majority of those in leadership positions within the plant has been trained within the company.

4.3.7.3 Industry 4.0

The company, as already mentioned above, also trains apprentices on aspects of Industry 4.0. For this purpose, it has created an Industry 4.0 lab as part of the training centre that allows apprentices to engage with a wide variety of Industry 4.0 technologies in a compact setting. The

¹⁶⁶ Interview transcript, Head of Training Academy of a steel company, Germany.

¹⁶⁷ Interview transcript, Head of Training Academy of a steel company, Germany.

¹⁶⁸ Interview transcript, Head of Training Academy of a steel company, Germany.

unique philosophy underpinning the educational approach of the company shines through in this context as well. Industry 4.0 labs become more and more popular as training devices and they can be bought ready-made on the market. The company was looking into off-the-shelf solutions but then decided to turn a problem into an opportunity by letting their trainers and apprentices lead the process:

“We have started with a white sheet of paper as we have said that we do not want to buy one of the shelf because doing this will inevitably mean that it contains technologies that we do not use in the company. So we started by asking ourselves: what is our Industry 4.0 that we utilise in the company and so we started to talk to all sections and collected information about technologies but also about the data we collect and ask ourselves how we could integrate all of this into a learning lab. And then we started to build it and the whole process involving development and implementation was performed by our apprentices and our trainers. Also the film that you can see on the internet was done entirely by apprentices. This is our approach: we give them tasks, sometimes hard and sophisticated ones and they tell us we cannot do it but we say you can do it and then they do it and as a matter of fact they normally succeed”.¹⁶⁹

A beneficial side effect was that this process also served as a continuous training exercise for the trainers who got to understand the Industry 4.0 technologies utilised in the lab very well which helps them to teach future apprentices.

4.3.8 System Trends

This section of the report will review the responses of the German VET system in the last decade or so to digitalisation and Industry 4.0. Overall, the response of the German VET system can be characterised as highly adaptive (Antonazzo et al. 2021), which refers to a proactive approach to exogenous pressures. This involves a reflexive analysis of the challenges as well as the development of solutions through collective and collaborative adaptation and modification of the existing systems in light of the challenges.

Changes and modifications in light of the increasing significance of digitalisation and industry 4.0 for organisations and working practices take place in a myriad of ways at a range of different levels. There is a thriving academic VET-focussed community that does valuable theoretical and empirical research to foster a better understanding of current and future developments. This research takes not only place in Universities and Colleges, but also in VET-focussed research institutes as well as within state-run institutions such as the BIBB and companies. The ESSA project is just one of dozens of European and national projects to better understand the implications of digitalisation and Industry 4.0.

Moreover, digitalisation itself helps to collect and distribute vital VET-related information that strengthens the VET system. There are numerous web-portals that provide detailed information

¹⁶⁹ Interview transcript, Head of Training Academy of a steel company, Germany.

about apprenticeships or career development opportunities. For example, sites such as Berufenet¹⁷⁰, run by the German Agency for Work, are an easy-to-use portal for in-depth apprenticeship and job information. Also noteworthy is the continuous training information system¹⁷¹, a database run by the German Chamber for Industry and Commerce, that provides an easily navigable portal to thousands of quality-controlled continuous training opportunities in Germany. There are also regional networks such as the aforementioned Initiative Ruhr-Kreis¹⁷² that tries to increase the attractiveness of the Ruhr Region to talents through a mix of economic, educational, and cultural initiatives, events and activities.

In short, there are numerous large and small activities at all levels of the German VET system that contribute to the ability of the system to adapt to the challenges brought by digitalisation and Industry 4.0. This section of the report will highlight some major responses at the national level by the Federal Institute for Vocational Education and Training (BIBB) in Germany, which integrates and mediates the interests of all major VET stakeholders – state, employers and trade unions. Given the standardised nature of state-regulated I-VET and C-VET provisions, major initiatives and innovations by the BIBB have the capacity to lead to wide-spread and fundamental changes to VET practices. This section will highlight three responses by the BIBB to Industry 4.0.

According to staff in BIBB interviewed in the context of the ESSA project, the term *Berufsbildung 4.0* (VET 4.0) was invented in direct response to the term Industry 4.0 that emerged at the beginning of the last decade.

“[W]e also took up this buzzword Industry 4.0. But of course we are also responsible for other sectors of the economy, including the commercial sector, the skilled trades, and the service-oriented professions, and when we talk about Industry 4.0, we also exclude these sectors of the economy ... so we thought about how we could solve [this].... Among other things, we have also tried to describe the [development of VET] with 4 phases analogous to Industry 4.0 with Vocational Training 4.0 as the last stage and established this a bit as our brand term. We have also always said that digitisation goes a bit beyond this brand wording, which has always been important to us because digitisation has existed for quite some time when we think of CAD systems and so on. What is new is this networked idea and we have always tried to put this in the foreground. For us, Vocational Education 4.0 means innovative training concepts, digital tools, digital media, the corresponding competencies on the part of the training staff, and that, so to speak, working together in a network - that's how we have tried to define it for ourselves to a certain extent”.¹⁷³

It was quickly realised that the anticipated technical and organisational changes related to Industry 4.0 (and digitalisation) would also result in changes to job profiles that in turn required changes at the vocational education and training stage (e.g. Zinke, et al. 2014) .

Three key features characterise the VET 4.0 approach of the BIBB:

¹⁷⁰ <https://berufenet.arbeitsagentur.de/berufenet>

¹⁷¹ <https://wis.ihk.de/>

¹⁷² <https://i-r.de/>

¹⁷³ Interview transcript, VET Expert, Germany.

- Trend towards fewer core occupations with a range of specialisations
- Portfolio of voluntary additional qualification
- Strengthening key transversal skills provisions

4.3.8.1 Core Occupations (*Kernberufe*)

An essential part of the work that the BIBB does is the so-called order activities (*Ordnungsarbeit*) related to occupations. This entails research anticipating new requirements and/or characteristics of occupations, modernising existing occupational qualification programmes or the development of new occupations as well as the evaluation of implemented measures. To ensure some degree of cohesion when it comes to modernising occupational qualifications, the BIBB has centralised guidelines that structure the order activities. In 2007, a few years before the ‘invention’ of the Industry 4.0 concept, the Ministry for Education and Research that oversees the activities of the BIBB issued a guideline that tried to retain the principle of occupationality while affording greater flexibility for the vocational education and training.¹⁷⁴ The guideline suggested that in future related occupations that share some content should be put together into occupational groups (*Berufsgruppen*). Occupational groups share core qualifications that ensure the principle of occupationality is retained while a range of optional specialisations ensure greater flexibility according to the specific needs of companies (see for example Zinke et.al. 2017).

The implementation of this approach involving core occupations and a number of specialisation options is underway but will take more time. One reason for this is that this approach requires considerable empirical research to ensure that changes to occupational qualifications make sense and meet the needs of social partners. In this context, the BIBB has pioneered some innovative research programmes that focusses either directly on occupations in the form of occupation screening or on whole sectors in the form of sectoral screening. The aim of these research efforts is to get to a thorough understanding of the changing nature of work in the context of digitalisation and Industry 4.0. This kind of research is empirical, large parts of it take place within companies and actively involves and engages trainers and workers, and it also combines quantitative and qualitative research.¹⁷⁵ Insights and recommendations can be checked and validated immediately with stakeholders within the partner companies.

Another reason is that occupational qualification programmes tend to be reviewed and reformed every 15 to 20 years and working through the range of occupational qualifications will take time. Interviewees from the BIBB seem confident, however, that this approach is here to stay and will increasingly shape the future qualification programmes in the German system.

From the perspective of the BIBB, this approach should work well as it simplifies a complex web of relatively similar and sometimes overlapping qualifications that compete with rather

¹⁷⁴ http://www.bosy-online.de/duale_Ausbildung/IKBB-Broschuere-10_Leitlinien.pdf

¹⁷⁵ For an overview of this research programme, including a link to all relevant publications (in German), see: <https://www.bibb.de/de/119072.php>

than complement each other (Zinke et.al. 2014: 7). From the perspective of companies, developments in this direction should also be very welcome as it simplifies the education of apprentices while affording the flexibility that is required in large organisations. The demand of a training centre manager from a large steel company regarding future qualification profiles shows, however, that the German VET system has some way to go:

“Take for example electricians: we offer 5 different electrical qualifications here and each has a different school and company curriculum and different examination policies. Without this, I could educate them all in the first year together in the basics without any need for differentiation and separation. They can then consider where they want to specialise in depending on their first-year experience: some might prefer automation technology and others find climate technology more appropriate. In Germany, we ask 17, 18 and 19 year olds to make this decision before they even had a chance to figure out what it really entails. Instead, we could tell them: go into the cluster electronics and then, once you see what this offers, you can specialise”.¹⁷⁶

4.3.8.2 *Voluntary additional qualifications*

The idea of voluntary additional qualifications that can be pursued in parallel to the compulsory elements has been introduced in 2005 into the German VET system.¹⁷⁷ These take the form of self-containing modules that involve a certain prescribed minimal training time as well as formal certification by the relevant Chambers.

A recent addition to the portfolio of additional qualifications related to all industrial metal and electronic occupations are modules that focus specifically on digitalisation and Industry 4.0 aspects. Seven of these were introduced during a recent modernisation of these occupational qualification programmes in August 2018¹⁷⁸:

- System integration
- Process integration,
- IT-based system/ plant/ facility modifications,
- Additive manufacturing
- Digital Networks
- Programming
- IT-Security

An evaluation about the uptake of these additional qualifications done in 2020 showed, however, that the new offers are not yet widely used by apprentices and companies. Companies suggested that only very few apprentices appear to show an interest in learning more about the additional qualifications and even fewer actually complete the qualifications. Of the seven programmes, the most popular are additive manufacturing and programming.

¹⁷⁶ Interview transcript, Head of Training Academy of a steel company, Germany.

¹⁷⁷ <https://www.bibb.de/dienst/abp/de/35953.php>

¹⁷⁸ <https://www.bibb.de/de/129499.php>

4.3.8.3 *Renewed Focus on Transversal Skills: four standardised learning fields*

As mentioned above, German dual apprenticeships take a relatively long time to complete compared with I-VET programmes in other countries. This is partly the case because German apprenticeships do not just focus on narrow, job-specific technical skills but also contain elements that are more related to general education. There has also been traditionally a strong focus on transversal skills and competences that are not job or even sector specific. Based on a recommendation of the Main Committee [Hauptausschuss] in November 2020, four non-occupation specific learning areas have been made a standardised and universal part of all recognised I-VET apprenticeship in Germany.¹⁷⁹ The four areas are:

- (1) Organisation of the training company, vocational training as well as labour and collective bargaining law,
- (2) Health and Safety at work,
- (3) Environmental protection and sustainability and
- (4) Digitised working world.

Interestingly, industrial steel-sector relevant initial qualifications, have already benefited from these four consolidated learning areas since 2018 as part of a recent update of all industrial metal and electro apprenticeships initiated jointly by the relevant social partners.¹⁸⁰

The first two themes had already been part of the vast majority of dual apprenticeship curricula. The first thematic complex educates apprentices in the basics of labour law, the role of social partners, further VET opportunities and so on, while the second transfers knowledge related to accident prevention, safe working practices, fire prevention and formal health and safety regulations. The last two areas reflect more recent developments concerning the proliferation of digital technologies and a growing realisation that environmental protection and sustainable production systems are pre-requisites for the long-term survival of humanity. The digital ‘module’ focuses on basic digital skills such as data input, data protection and the rudimentary workings of digital technologies and networks. The environmental thematic complex is also very general and basic with a focus on environmental regulations and working practices that reduce or avoid waste and environmental harm.

¹⁷⁹ <https://www.bibb.de/dokumente/pdf/HA172.pdf>. These four learning areas will become legally enshrined part of all apprenticeship programmes from August 2021 onwards.

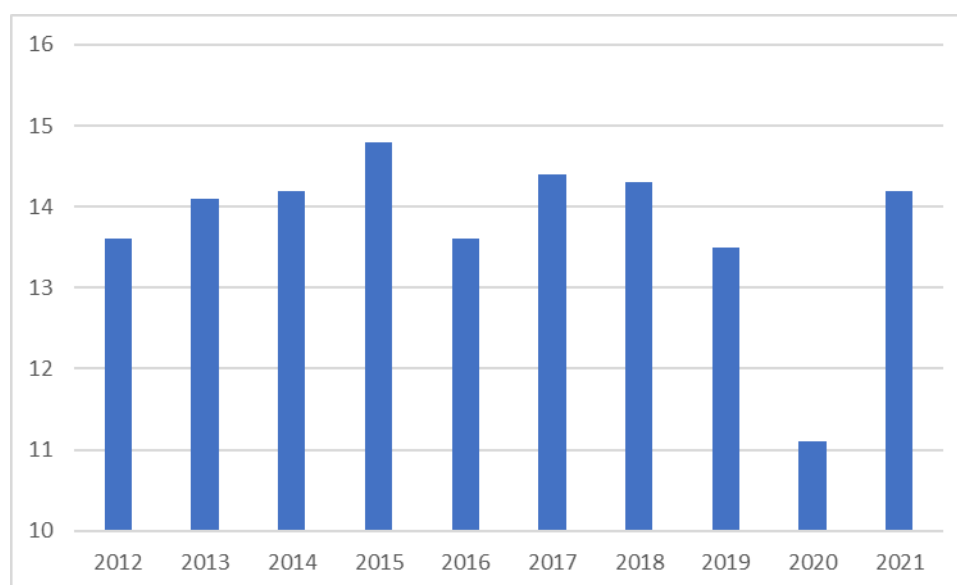
¹⁸⁰ https://www.bibb.de/de/pressemitteilung_81176.php

4.4 Spain

4.4.1 Spain's steel industry

Eurofer data for 2018 show Spain at the fourth position in the EU ranking for crude steel production, with a share of 8.5% and an output of 14.3 million tonnes (Eurofer 2019b) (see Figure 30). In the same year, the steel industry displayed a direct employment of 17,352 workers (Ibidem). Data also show an increase from the output of 2012 (about 13.6 million tonnes) to the peak of production in 2015 (14.8 million tonnes). The Spanish steel industry has a strong export orientation, with about the 60% of steel exports destined for the EU market¹⁸¹. The downturn in manufacturing activities has impacted on the Spanish steel industry, with a decrease of demand from all the main buyers of Spanish steel, infrastructure, mechanical equipment and automotive sectors. Lower demand, combined with decreasing product prices and increasing prices for iron ore have reduced the margins of companies. Further contraction is expected for the years 2019-2020. Another crucial issue that limits the competitiveness of the industry is energy cost (about 30-50% higher than France or Germany) which negatively impacts especially on electric arc furnaces (which make up about 75% of the steelmaking in Spain).

Figure 30 – Spain total crude steel production (all qualities) in million metric tonnes



Source: Eurofer

The current condition of the steel industry in Spain does not seem much different from the picture at the European level. Spain is also facing pressures deriving from global market competition, and the main challenge seem to be penetrating new market segments, thanks to competitive products and services:

“We are in a competitive sector. And this is on two main points, price and service. Here we have to compete internally in our continent and also with Asia. We have to compete in

¹⁸¹ <https://atradius.it/publicazioni/publicationsmarket-monitor-metals-steel-spain-2019.html>

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prices and also in services. We want to increase our production but it is very difficult to find new customers”¹⁸².

The dependence of the economic outlook of the industry on the performances and demands of other sectors, primarily the automotive sector, has also been underlined.

The industry has witnessed a substantial transformation in the last twenty years, shifting towards more technologically advanced solutions, in line with the 4.0 approach. The main characteristic of the steelworker in the past, namely physical strength, is not a critical requirement when most of the operations are digitalised:

“There has been a qualitative and quantitative advancement in the application of technology, and I have been working in this sector for more than 20 years. And the comparison that could be made between when I started and how technology is applied now is that in the past it was all manual work, basically manual work in which my colleagues used to look at your hands to get into work, if you had big, strong hands, you could work in the sector, if you didn't have big, strong hands, you weren't a worker, or a steelworker. Digitalisation and automation have been imposed now in the key production positions. Now, as someone says, you spend 8 hours looking at a screen to see if all the parameters are correct”¹⁸³

Automation is also gaining further ground in the sector, and some companies are working on reaching a complete automation of some processes. However, it has also been underlined that automation is not aimed at reducing costs reducing the number of workers, which can be instead employed in other areas of production:

“In the lamination process [...] this will be done using a new machine that is going to be introduced in production in September. If all the steps are done correctly, the human workforce is not going to be present in any part of this process. So, the lamination will be almost completely automatised. And it will be supervised by technical operators there in the line. However, the quality control part of the final product will not be automatised. As I said, we produce high quality special steel, so if we will find some problem in the final part of the product, this is going to be reworked and this part is not going to be automatised, this will still be manual”¹⁸⁴.

As regards the uptake of industry 4.0, an employers' representative has commented that the expectations of employers towards this are generally positive, but that industry 4.0 could also make competition between companies more fierce. However, this process of gradual innovation has been significantly slowed down, in Spain as in many other countries, by the Covid-19 pandemic¹⁸⁵.

Some issues identified in other countries in relation to recruitment apply also to Spain: it has been remarked that qualified workers, particularly for technical roles in maintenance, are generally more difficult to fill:

¹⁸² Interview transcript, HR officer in steel company, Spain.

¹⁸³ Interview transcript, trade union representative, Spain

¹⁸⁴ Interview transcript, HR officer in steel company, Spain.

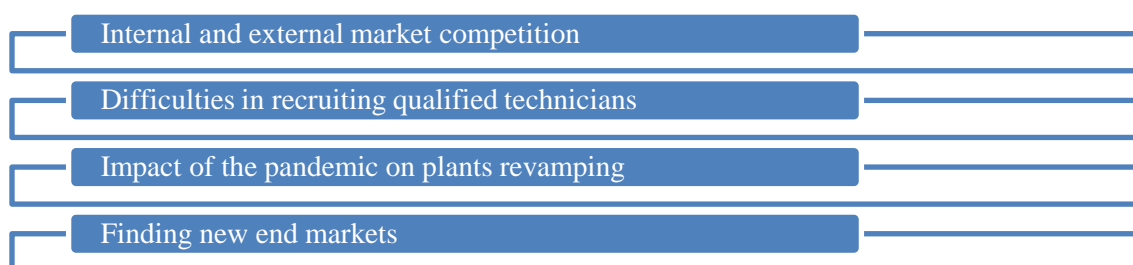
¹⁸⁵ Questionnaire response, employers' representative, Spain.

“The companies systematically tell us that they have difficulties in finding qualified personnel, especially for maintenance. This is a question that all the Human Resources Departments systematically tell us, at the end they use the FP2 as a proof that you have the capacity to learn and train in this area, but you are not prepared to join a steel company, this is what the companies tell us”¹⁸⁶.

Finally, in relation to attractiveness of the sector, it has been commented that the sector is not as unattractive as it might seem, since the contractual conditions could be better than other sectors:

“My opinion is that this is attractive because it is a good sector and we pay a good salary. I come from the distribution sector where salaries are lower. I think the conditions and the salaries are very competitive”¹⁸⁷.

Figure 31 – Challenges faced by Spain’s steel industry as emerged from the fieldwork



4.4.2 Industry perspective on skills gaps

The fieldwork has shown that some companies outsource courses on transversal skills such as communication, teamwork, self-development, conflict management, self-awareness, healthy behaviours, time management, train the trainers, leadership, and personal development¹⁸⁸. This points to a clear need in strengthening these types of soft skills. A general understanding of the production environment and the capacity to communicate broadly across the departments has been remarked as an important need in morn steelworks.

An interesting comment confirms the commitment to soft skills and explains that building these could be more challenging for a steel industry, compared to building hard skills:

“Nowadays we have these challenges...we are working on leadership, we are working on digitalisation, skills related to negotiation...this part is more difficult than the technical one, but we are focusing on them. [...] It is more difficult because it is not so concrete as the hard skills. [...] we are talking of how to develop leadership skills in a group. It depends on how much I believe in these training, how is my behaviour in relation to the others...it’s more complicated for me”¹⁸⁹.

¹⁸⁶ Interview transcript, trade union representative, Spain.

¹⁸⁷ Interview transcript, HR officer in steel company, Spain.

¹⁸⁸ Survey response, organisational development manager in steel company, Spain.

¹⁸⁹ Interview transcript, HR officer in steel company, Spain.

Also in Spain, the importance of previous work experience (particularly for maintenance roles) was underlined as an enabler to effectively use the tools and possibilities offered by digitalisation:

“In production you need work experience to help you use the tools that digitalisation and automation currently provide you with, and that is why maintenance is even more dependent on experience”¹⁹⁰.

In a similar way, work experience was also remarked as a complementary aspect to a formal qualification. Without this, the only formal training could appear as pointless:

“Here in Spain, if you don't have FP2, vocational training, you don't go to work in a steel company. The majority of the business groups no longer hire anyone who does not have this professional training, be it mechanics, electricians, whatever profession it is, but professional training. This professional training is necessary to make the steel industry work and it is necessary to combine it with the knowledge that the veterans can hand over to the new generations. Without this knowledge and professional experience, it is useless to have done 5 years of professional training”.

As for technical (hard) skills, these are certainly important and required by companies, but it not always possible to find in the right combination. Hence, it is assumed that an important part of the professional development normally happens in the company, where the missing competencies are filled and pre-existing competencies are adapted to the company's needs:

“We are asking for several hard skills and knowledge in engineering, lamination process, maintenance...but it's not always possible to find these. It is difficult to find exactly what you want. We are focusing on the 'hard part' of the profile, and afterwards we try to develop the person inside the company”¹⁹¹.

In relation to technical skills, it has been pointed out the need to develop a multiskilled workforce, capable of dealing with the different aspects of production in a flexible way. This is indeed considered a solution to disruptive changes that could derive from technological innovation:

“We are working in the direction of a multiskilled workforce. So, in the production line they are involved in training programmes so that a worker will be able to work in lamination, but also in other parts of the production, and also be able to do some part of the maintenance process”¹⁹².

Another skill that has been defined as crucial for the contemporary steelworker is data analysis:

“In production, data analysis is fundamental [...] in the rolling mill or in the smelting furnace, everything is automated and what the worker has to do is a good analysis of the data. And then, with this data analysis, he has to transfer the solutions to unforeseen events and

¹⁹⁰ Interview transcript, trade union representative, Spain.

¹⁹¹ Interview transcript, HR officer in steel company, Spain.

¹⁹² Interview transcript, HR officer in steel company, Spain.

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problems by modifying these data, these parameters, to how they should produce in practice. For me, good data analysis and the ability to translate the data into real production is fundamental”¹⁹³.

Some consider data analysis as part of a more complex set of skills that workers must possess nowadays, including technical and soft skills:

“The academic centres have to face a radical change. They have to understand that new skills are needed. Communication network and information technology is becoming crucial. All AI related topics and how to collect and deal the data are clear missing points in the VET Centres. [...] There is more need of generalists, we need specialisation but also generalists. [...] Another great opportunity is that people have no soft skills such as teamwork or emotional intelligence”¹⁹⁴.

Another important skill, which could be defined as a meta-skill, is the capacity to learn autonomously and in a self-directed manner. In this respect, digitalisation offers a wide range of opportunities, but workers need to be trained in using the basic tools:

“The most important for me is the ability to learn by your own. And it implies that you need to have several abilities related with the IT tools that can help you to learn by your own. [...] Another area is related with the sharing of knowledge and with the database of knowledge and learning experiences in order to go and see what happened in other cases. And it's necessary to have an idea how to manage databases, how to come into these structures [...] You need to have a clear idea on how to work in teams. When at distance, using the different tools that you have at disposal [...] At all these kinds of things are not a future, but a today need”¹⁹⁵.

Overall, it appears that vocational paths provide good foundations in terms of knowledge and skills, but lack in specialisation and industry4.0 specific contents, as well as in soft skills and analytics:

“They have a good general knowledge but not our desired level of knowledge. More knowledge about industry 4.0 Working with data Training in Soft Skills Training in general management competences. There are certain areas of Engineering lack of knowledge about preventive maintenance”¹⁹⁶

Figure 32 – Skills and knowledge gaps in the industry as emerged from the fieldwork

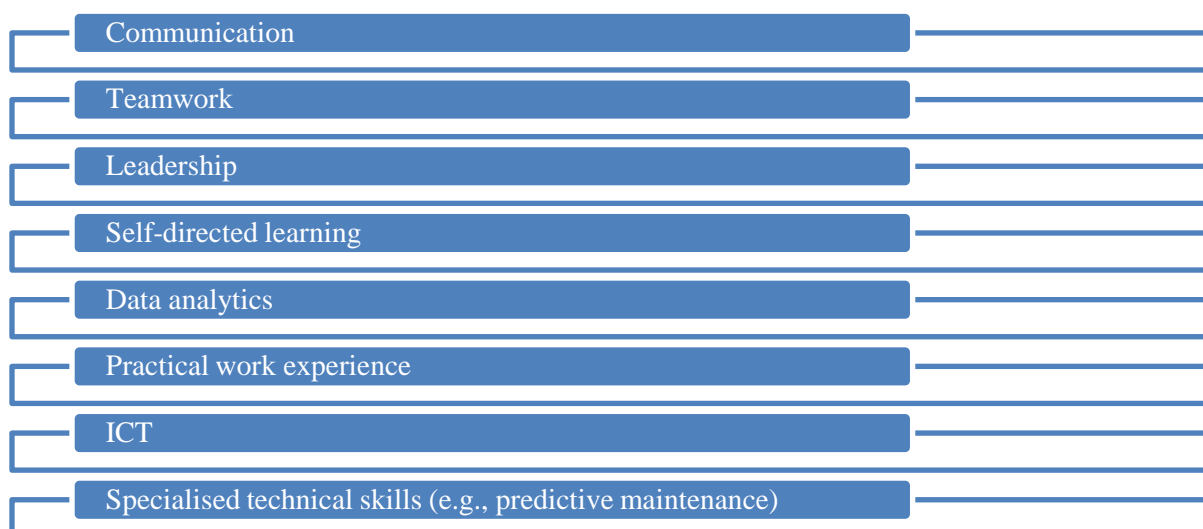
¹⁹³ Interview transcript, trade union representative, Spain.

¹⁹⁴ Interview response, production manager in steel company, Spain.

¹⁹⁵ Interview transcript, Head of training centre, Spain.

¹⁹⁶ Survey response, production manager in steel company, Spain.

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4.4.3 Overview of Spain’s VET system¹⁹⁷

The Spanish VET system entails two different paths, one developed by the education authority and one developed by the labour authority (Cedefop 2016b) (see Table 33).

The ministry of Education and Vocational Training (*Ministerio de Educación y Formación Profesional*) is responsible for establishing the core legislation on IVET, defining standards for quality and setting up formal qualifications and procedures for further implementation and assessment. The 17 autonomous communities (*comunidades autónomas*) oversee further regulation and execution of the IVET principles and guidelines defined at central level.

The ministry of Labour, Migration and Social Security (*Ministerio de Trabajo, Migraciones y Seguridad Social*) is responsible for the definition of VET policies within the employment system. Programmes under the employment authority are normally considered continuing VET, as they are likely to take place after completion of IVET at some level. Specifically, VET for employment in Spain aims at skilling, upskilling or reskilling workers (both employed or unemployed) encouraging a lifelong approach to training. Programmes in VET for employment are of two types, they can be linked to the National Catalogue of Occupational Standards (*Catálogo Nacional de Cualificaciones Profesionales - CNCP*) or can be independent of it.

Table 33 – Governance and main actors in Spain’s VET

Ministry of Education and Vocational Training	Is in charge of setting up the national VET policy: establishing core legislation on initial VET, ensuring equality and equity throughout the state, setting up officially recognised qualifications and their basic curriculum, as well as recognition, validation and approval of foreign studies.
Ministry of Labour, Migration and Social Security	Is responsible for the development of VET policies within the employment system. These programmes tend to be considered as continuous

¹⁹⁷ This paragraph is mainly based on Sancha and Gutiérrez (2019).

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	vocational education and training as they are likely to take place after initial education and training, upon entry or re-entry into working life.
Regional governments	Have executive and administrative competences to manage the education system in their own territory. Regions are also responsible of implementing labour and employment legislation and vocational training for employment in their territory within the framework set at national level.
National Education Council (<i>Consejo Escolar del Estado</i>)	Is the government's main advisory body. All stakeholders within the education sector are represented in this council. It publishes an annual report on the state of the education system, which includes proposals for improvements supported by the council members.
General Council for Vocational Training (<i>Consejo General de la Formación Profesional</i>)	Education and labour authorities that are responsible for VET, at national and regional level, work together in this body with trade unions and employers' associations.
State foundation for training in employment (<i>Fundación Estatal para la Formación en el Empleo – Fundae</i>)	Is a public body comprising the state general administration, the regions and the most representative business and trade unions. It provides technical support to the state public employment service (SEPE), and to the labour ministry in the strategic development of the system of VET for employment. It also works as Cedefop national contact point.
The state public employment service (SEPE)	Publishes reports on the prospecting and detection of training needs, job offers' profiles, labour market evolution and trends, or sectoral prospective studies
The National Institute of Qualifications (Instituto Nacional de Cualificaciones-INCUAL)	Is responsible for the set up and maintenance of the catalogue of national occupational standards (CNCP), which is the backbone of the Spanish VET system. It carries out studies to update the national catalogue of occupational standards in all sectors of the economy.
National Reference Centres (<i>Centros de Referencia Nacional</i>)	Are public training establishments at the service of the professional training system to facilitate its competitiveness and quality, and meet the changing demands for qualifications from productive sectors. They can programme and carry out innovative training activities in the production field they have assigned, serving as reference to the national system for the development of VET.

As explained by one of our interviewees:

“Initial VET for a long time has been not very prestigious. Not many people attending, choosing this option. Different education reforms made it like a second choice for not smart kids, but in the last 10 years these things are changing and now all the policies are trying to strengthen the initial VET system, and they are putting more efforts in it. So, also the educational reforms have been trying to get rid of that image and a new dual VET path has been introduced, to get more connected with the labor market. And in the last years, maybe

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some people argue that it might be because of the crisis and because there were no jobs, more people are enrolling in VET. So, in a way things are improving”¹⁹⁸.

CNCP can be considered the basis of the Spanish VET system. It comprises the most important occupations in the national context, organised in 26 sectoral branches. Currently, the catalogue consists of 668 occupational standards (*Cualificación Profesional*), organised in three progressive levels (based on the degree of complexity, autonomy and responsibility), which are defined and systematically updated by the National Institute of Qualifications (*Instituto Nacional de Cualificaciones* – INCUAL).

School-based VET qualifications are typically composed of a set of occupational standards (*Cualificaciones Profesionales*) included in the CNCP, while qualifications issued by the employment authorities are normally associated to a single professional standard.

Table 34 - Sectoral branches in the Spanish National Catalogue of Occupational Standards

Code	Sectorial Branch (EN)	Sectorial Branch (ES)
ADG	Administration and management	Administración y gestión
AFD	Physical and sports activities	Actividades físicas y deportivas
AGA	Agriculture	Agraria
ARG	Graphic arts	Artes gráficas
ART	Arts and crafts	Artes y artesanías
COM	Trade and marketing	Comercio y marketing
EOC	Construction and civil work	Edificación y obra civil
ELE	Electricity and electronics	Electricidad y electrónica
ENA	Energy and water	Energía y agua
FME	Mechanics production	Fabricación mecánica
HOT	Hospitality and tourism	Hostelería y turismo
IEX	Extraction industry	Industrias extractivas
IFC	Information and communications technology	Informática y comunicaciones
IMA	Installation and maintenance	Instalación y mantenimiento

¹⁹⁸ Interview transcript, VET expert, Spain.

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IMP	Personal image	Imagen personal
IMS	Image and sound	Imagen y sonido
INA	Food industry	Industrias alimentarias
MAM	Wood, furniture and cork	Madera, mueble y corcho
MAP	Maritime and fishing industry	Marítimo pesquera
QUI	Chemistry	Química
SAN	Health	Sanidad
SEA	Security and environment	Seguridad y medio ambiente
SSC	Sociocultural and community services	Servicios socioculturales y a la comunidad
TCP	Textile, clothing industry and leather	Textil, confección y piel
TMV	Transport and vehicles maintenance	Transporte y mantenimiento de vehículos
VIC	Glass and ceramics	Vidrio y cerámica

Source: Sancha and Gutiérrez (2019)

As for initial VET in the education system, compulsory general education ends at age 16, with the completion of lower secondary education (*Educación Secundaria Obligatoria*) that lasts 4 years and the award of the relevant certificate (*título de Educación Secundaria Obligatoria*).

In 2013, a reform of VET paths introduced basic VET programmes (*Formación Profesional Básica*) for those aged 15 who met certain requirements (age, completion of the first cycle of secondary compulsory education, recommendation by teaching staff) and wanted to end the mandatory education with a professional qualification. Basic VET programmes last 2 years, award a relevant certificate (*Título de Formación Profesional Básico*) and give the possibility to move further to intermediate VET (*Formación Profesional de Grado Medio*) or to earn the *Educación Secundaria Obligatoria* certificate and continue in general education at upper secondary level (*bachillerato*).

Bachillerato is a high school programme that lasts usually from 16 to 18 and award successful students with the relevant certificate (*título de Bachiller*). This gives access to higher VET (*Formación Profesional de Grado Superior*) and to university programmes.

Formación Profesional de Grado Medio consists of 2 years training and, after successful completion, awards a technician certificate (*Título de Técnico*). After this programme it is possible to move directly to higher VET and after two years of study and training it is possible to acquire a higher technician diploma (*Título de Técnico Superior*).

All IVET programmes and qualifications are based on the principle of learning outcomes and so are compatible with ECVET guidelines. The three levels of VET are all structured in 2-years courses, for a total amount of 2000 hours of study and training, take place in the same education centres, and entail a compulsory work placement module.

School-based VET diplomas, as stated above, are based on the *Cualificaciones Profesionales* collected in the CNCP and their curricula are structured in a national component (usually between 55% and 65%) and a regional component (between 45% and 35%) in order to adapt them to the local needs without losing in terms of national consistency. Currently, 170 diplomas are available under the VET in education system.

In 2012 dual VET was implemented in order to support youth employment and the acquisition of a formal professional qualification. Essentially dual VET in Spain can follow two different routes, that of training and apprenticeship contracts and dual VET projects under the education system implemented by the regions. In the first case, apprenticeship contracts must be linked to a formal qualification, are usually signed by people aged between 16 and 30 years, and last from 1 and 3 years. In the second case, a training and apprenticeship contract is not mandatory and regional institutions can instead make use of learning agreements to ensure participation of learning institutions and companies in the programmes:

“This is from 2012-2013 and applies to both IVET and CVET, because you can have a dual programme in the IVET system, but you can also have a professional certificate in the dual modality. This is still quite a minority, only a third a 3% of IVET students follow this path for example. Because to be dual you need a company and most of the Spanish companies are very small and for them it's hard to have an apprentice because they don't have the time to care for the apprentice and providing the necessary mentorship. And also for the students it's more work because you are studying and working at the same time. Another problem is pay because this system is very different from one field to another. So you might be hired as an apprentice with a contract, or you just might have a scholarship or a grant. And of course, your role is very different in one or the other, and the responsibilities and rights are very different in one or the other, and the money you can get is also very different. So, there's many issues involved in it, so only 3% in IVET follow these paths”¹⁹⁹.

As for adults, VET in the education system provides basic education for those adults who have not been awarded the *título de Educación Secundaria Obligatoria*. There are also set routes to obtain the *Bachillerato* and to acquire VET qualifications at all the available levels. Thanks to the modular and learning outcomes-oriented nature of Spanish qualifications, partial exemptions of modules included in VET diplomas is possible if requirements are met by the candidate.

Spanish VET providers can be grouped in the three categories:

- public and private institutions recognised by the competent education authority;
- integrated training centres (public) which represent a bridge between the education and the employment VET system, providing both IVET under education VET and further training under employment VET;
- national reference centres (public) specialised in different professional areas, in charge of carrying out innovation and experimentation within vocational training. They serve

¹⁹⁹ Interview transcript, VET expert, Spain.

both the VET in education and in employment with the aim of enhancing the quality and competitiveness of training. National reference centres analyse new training trends, pilot their implementation and establish benchmarks at national level. They are located in each *comunidad autónoma* and cover all the 26 branches in which the Spanish VET is organised.

VET in the employment system is coordinated by the Ministry of Labour, Migration and Social Security (though other ministries can regulate training in their specific area of competence) and is implemented by the regions. Labour authorities, employers and trade unions cooperate, both at local and national level, to define the regulatory framework of the system. The rationale of the system is to provide training programmes for both employed and unemployed workers in order to support their personal development, improve their employability, upskill the workforce, contribute to the competitiveness of the companies.

“The other branch of VET, the continuous vocational training, is more focused on workers and unemployed people. And here is much more connected to company's needs. But the way it is organised through subsidies to companies and VET centres it is becoming quite bureaucratic and partners and employers don't feel quite happy about the way it is working, but they have a very constructive social dialogue”²⁰⁰.

The system was partially reformed in 2015 and 2017 through the Act 30/2015 and the Royal Decree 694/2017. The 2015 act introduced the right to a 20-hours training leave for workers with above a year of seniority.

Some of the funding schemes currently in place under the VET for employment are the following:

- a) training organised by companies (*formación programada por la empresa*) which is funded by discounts on what companies pay to social security;
- b) sectoral and cross-sectoral training programmes for the employed (*planes de formación intersectoriales, sectoriales, autónomos, y economía social*);
- c) training schemes for the unemployed (*planes de formación*);
- d) other training such as individual leaves (*permisos individuales de formación*) and alternance training (*formación en alternancia*).

Spanish employment authorities set targets related to training initiatives on annual basis in order to respond in a timely manner to the challenges set by the labour market. In this perspective, the ministry promoted a call, published in May 2018, to fund training programmes in digital skills for employed workers.

Under the employment system, there are mainly two types of programmes, programmes that are linked to the CNCP and allow the trainee to obtain a formal certificate (*Certificados de Profesionalidad*) and programmes that are not linked to the CNCP, as the training organised by the companies for their own employees (this can be offered by the company itself or by external providers hired by the company), or training provided to employees under agreements signed between companies and trade unions.

²⁰⁰ Interview transcript, VET expert, Spain.

Certificados de Profesionalidad are issued on the basis of common national curricula, they are related to a specific professional standard contained in the CNCP and have a modular structure.

CdP provide evidence of a specific professional profile, associated with a set of skills and competences, that is recognised and valued within the labour market. These certificates are organised in three progressive levels, (based on the complexity of tasks and on autonomy and responsibility necessary to carry out the relevant working activities). Since the reform of 2015, CdP programmes can be delivered in different ways (online-offline), in order to meet the needs of learners. The regulation specifies however, which programmes can be delivered online, the balance of online and face to face teaching, quality standards, and the requirements for the accreditation of e-learning platforms. The certificates are issued by the state public employment service (*Servicio Público de Empleo Estatal – SEPE*) and by regional employment services. Partial certifications can also be issued (units of competence), thanks to the modularity of the Spanish VET system. A CdP can also be earned through a training and apprenticeship contract under the dual VET scheme.

Public and private training centres, as well as organisations created by social partners can offer training programmes leading to the acquisition of CdP but need to be accredited by SEPE or by the regional labour authorities.

As for the programmes not linked to the CNCP, some of these are usually included in the catalogue of training specialities (*buscador de especialidades formativas*) updated by the state public employment service.

Some regulated professions set out specific requirements. Electrical and gas technicians need to hold a certificate of professional competence (*certificado de aptitude profesional*), which can be obtained by accrediting a school-based VET qualification, a CdP or certain units of competence. The certificates of professional competence are issued by regional authorities.

Besides the General Council for Vocational Training (*Consejo General de la Formación Profesional*), other organisations are involved in the VET for employment system. The most relevant are:

- the General Council for the National Employment System (*Consejo General del Sistema Nacional de Empleo*), which is the main consultative body for public authorities;
- the Sectoral conference on Labour Affair (*Conferencia Sectorial de Empleo y Asuntos Laborales*), which provides a coordination structure between the central government and the 17 regions (*comunidades autónomas*);
- the State Foundation for Training in Employment (*Fundación Estatal para la Formación en el Empleo*), which provides technical support to SEPE and to the Ministry of Labour in developing VET for employment;
- the Joint Sectoral Structures (*Comisiones Paritarias Sectoriales*), which are made up of representatives of businesses and unions in each relevant economic sector. They have the specific task to anticipate training needs on the basis of their first hand knowledge of the sectors and propose consequent training.

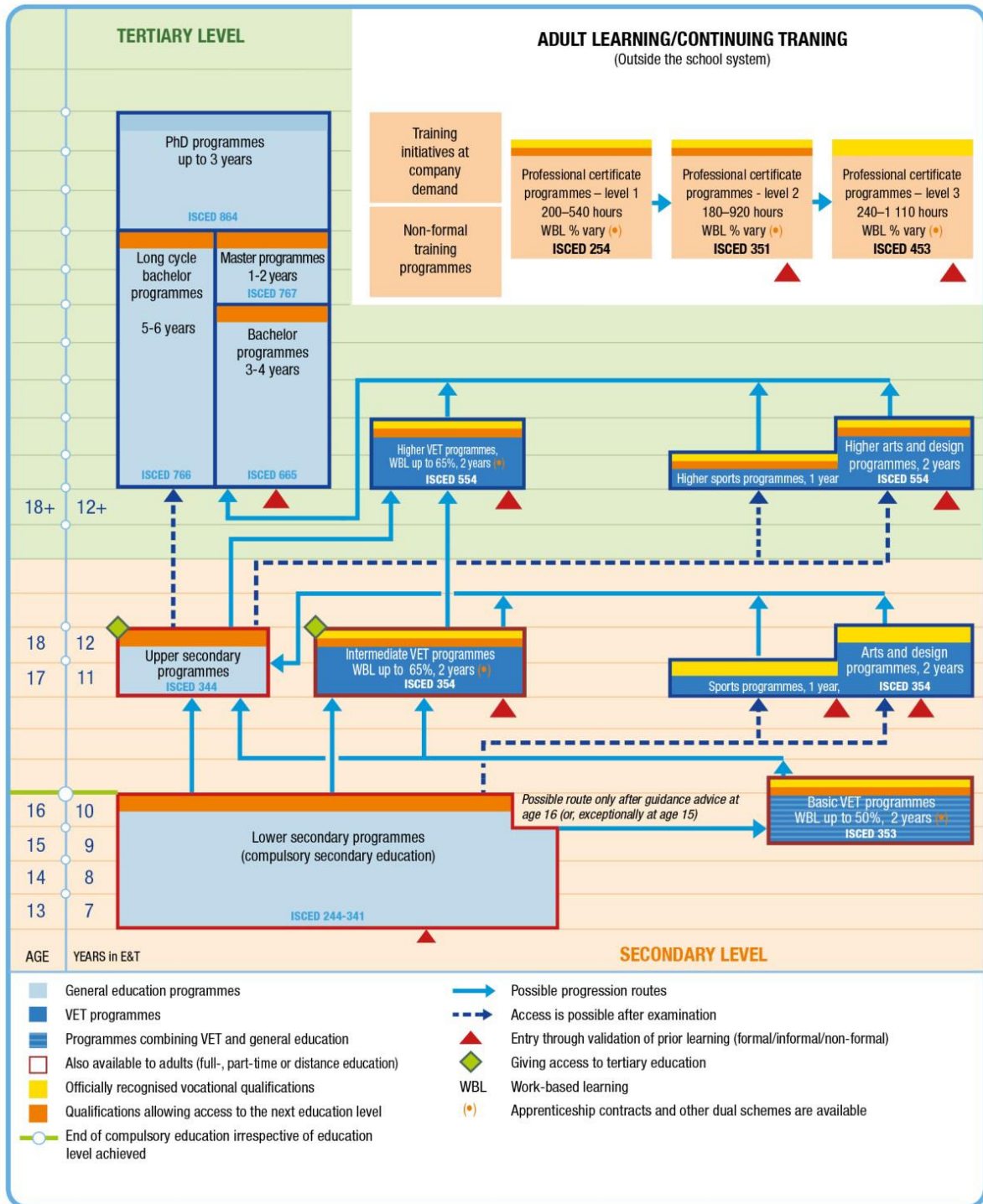
The Spanish VET system has put in place a multilevel strategy for anticipating skill needs, recognised as a crucial competitive advantage. At regional level, graduate tracking measures

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are taken on regular basis by competent employment authorities. At national level, SEPE has established an Observatory of Occupations (*Observatorio de las Ocupaciones*) and the national institute for statistics (*Instituto Nacional de Estadística - INE*) systematically collects data about education and training, and employment. The National Institute of Qualifications (*Instituto Nacional de Qualificaciones – INCUAL*), which is responsible for defining and updating the CNCP, builds in also its own Observatory.

In order to keep the CNCP up to date, INCUAL cooperates actively with stakeholders and collects quantitative and qualitative data through various channels. It is important to note that in this process of developing and updating qualifications some regions have an important role in relation to their specific productive context, as for the case of the Basque Country (*País Vasco*) in metal working. The update of qualifications is an ongoing process that applies to all professional standards older than 5 years.

Figure 33 - General education and VET in Spain



NB: ISCED-P 2011. The Spanish education system is not referenced to EQF levels.

Source: Cedefop and ReferNet Spain.

4.4.4 Programmes and qualifications relevant to the steel industry

Steel industry relevant occupational standards (*calificaciones profesionales*) can be found in the CNCP, particularly in the areas of mechanics production (*fabricación mecánica*) and electricity and electronics (*electricidad y electrónica*). IVET qualifications are usually based on two or more occupational standards. Tables 35 and 36 offer an example of the qualifications available in the area of mechanics and electronics. It has to be noted that the interviews have pointed out that intermediate level is normally the minimum requirement in the Spanish steel industry, with a preference for advanced qualifications where possible.

Table 35 - VET diplomas in mechanics production

Code	Title of the diploma (ES)	Title of the diploma (EN)	Level
FME	Título Profesional Básico en Fabricación de Elementos Metálicos	Basic Professional Diploma in Metal Fabrication	Basic
FME	Título Profesional Básico en Fabricación y Montaje	Basic Professional Diploma in Manufacturing and Assembly	Basic
FME	Título Profesional Básico en Instalaciones Electrotécnicas y Mecánica	Basic Professional Diploma in Electrotechnical and Mechanical Installations	Basic
FME	Técnico en Conformado por Moldeo de Metales y Polímeros	Technician in Forming by Metal and Polymer Moulding	Intermediate
FME	Técnico en Mecanizado	Machinery Technician	Intermediate
FME	Técnico en Montaje de Estructuras e Instalación de Sistemas Aeronáuticos	Technician in Assembly of Structures and Installation of Aeronautical Systems	Intermediate
FME	Técnico en Soldadura y Calderería	Welding and Boiler Technician	Intermediate
FME	Técnico Superior en Construcciones Metálicas	Senior Technician in Metallic Constructions	Advanced
FME	Técnico Superior en Diseño en Fabricación Mecánica	Higher Technician in Mechanical Manufacturing Design	Advanced
FME	Técnico Superior en Programación de la Producción en Fabricación Mecánica	Senior Technician in Production Programming in Mechanical Manufacturing	Advanced
FME	Técnico Superior en Programación de la Producción en Moldeo de Metales y Polímeros	Senior Technician in Production Programming in Metal and Polymer Moulding	Advanced

Table 36 – VET diplomas in electrics and electronics

Code	Title of the diploma (ES)	Title of the diploma (EN)	Level
ELE	Título Profesional Básico en Electricidad y Electrónica	Basic Professional Diploma in Electricity and Electronics	Basic
ELE	Título Profesional Básico en Fabricación de Elementos Metálicos	Basic Professional Diploma in Manufacture of Metallic Elements	Basic
ELE	Título Profesional Básico en Instalaciones Electrotécnicas y Mecánica	Basic Professional Diploma in Electrotechnical and Mechanical Installations	Basic
ELE	Técnico en Instalaciones Eléctricas y Automáticas	Technician in Electrical and Automatic Installations	Intermediate
ELE	Técnico en Instalaciones de Telecomunicaciones	Technician in Telecommunications Installations	Intermediate
ELE	Técnico Superior en Automatización y Robótica Industrial	Superior Technician in Automation and Industrial Robotics	Advanced
ELE	Técnico Superior en Mantenimiento Electrónico	Senior Technician in Electronic Maintenance	Advanced
ELE	Técnico Superior en Sistemas Electrotécnicos y Automatizados	Superior Technician in Electrotechnical and Automated Systems	Advanced
ELE	Técnico Superior en Sistemas de Telecomunicaciones e Informáticos	Superior Technician in Telecommunications and Computer Systems	Advanced

Source: <http://www.todofp.es/que-como-y-donde-estudiar/que-estudiar/ciclos.html>

As regards training programmes related to Industry 4.0 and digitalisation, it has been remarked that there is still missing a VET diploma specific for these subjects (see also comments in section 4.4.5), however some steps in that direction have been taken with specialisation courses, which could add a third year to the standard 2-years VET diplomas:

No at full VET degree level, but there has been a focus on digitalisation terms in the specialisation year (the 3rd years): Cybersecurity in industry, Cybersecurity at network level, Digital maintenance, Artificial Intelligence... At the beginning, this 3rd year experience was only executed in the Basque Country, but the Spanish Government is exporting this good practice into the rest of the regions. Some of these programs are consolidated whereas some are being yet tested. The drawbacks for having difficulties when implementing these programmes are the limitations of/with teachers and the difficulty of transforming into practical terms the abstract parts of industry 4.0

Along with training in the employment system, which can be considered as CVET, another relevant part of continuing training in Spain is subsidised training. These are training schemes funded by public calls, and could be sectoral or cross-sectoral, for employed or unemployed. Some of the most popular courses (by number of participants) activated within subsidised training calls in 2018 are listed in Table 37. Subsidised training courses can be linked (although it is not mandatory) to the national occupational standards set in the CNCP.

Table 37 – Examples of subsidised trainings in 2018

<ul style="list-style-type: none">• Design and maintenance of photovoltaic solar energy installations• Driving forklift trucks• Computer assisted design with Autocad• 6 Sigma, safety, efficiency and productivity tools• Robotics fundamentals• Autocad 3D• Tig welding• Programmable automation• Advanced PLC [Programmable Logic Controller]• Electrical components in machinery

Source: Fundae

As regards company training, the top ten courses (by number of participants) are listed in Table 38.

Table 38 - Ten most relevant training in companies in 2019

<ul style="list-style-type: none">• Prevention of occupational risks• Languages• Human resources management• User Computing / Office• Quality• Storage, Stocks and Shipping• Lifeguard and First Aid• Machinery Operation. Building• Security and vigilance• Welding

Source: Fundae

4.4.5 Remarks on VET

In Spain, as in other case study countries, a recurring remark regarded the lack of steelmaking specific knowledge offered in vocational courses. Some also commented on the relatively basic level of the technical knowledge offered in vocational programmes, although it has not been clarified the level of the programmes the respondents referred to:

“They have competencies, but the level of mastery or development of them is relatively general with respect to what companies want, which is much more specific”²⁰¹.

“There are no specific subjects for the sector...electricity or electronics do not prepare you specifically for the sector, but there has been significant progress in requiring you to do work experience in the workplace”²⁰².

In this perspective, some argued for a stronger collaboration between companies and VET providers and for a better alignment of the different stakeholders similarly to the German system.

However, another interviewee considered the training offered in vocational programmes adequate in relation to technical skills. While soft skills and company-specific technical skills will always be developed internally:

“Related to the hard skills, I think we are talking about an engineer, this part for me will be almost ok, it is ok, the other part, how to manage in a production process like this one, how to work in a company under total quality management principles [...], you can only understand this part when you start working in a company. So, this part related to the soft skills, the relational skills, is something that you have to learn here. But for the hard skills I think that the schools are ok. It is true that there is a gap related to metallurgy, when we are talking about engineers, in the old days there was an engineering degree related to steelmaking or metallurgy”²⁰³

A production manager also considered VET training still relatively far from business needs and from the actual work on the shopfloor, and the contents taught were considered not up to date. However, some generalist mechatronic qualifications were considered a welcome development. Also, it was seen as a positive aspect the raising awareness that in-company placements are needed²⁰⁴.

Another aspect that was commented on is the need to ensure through vocational contents a better understanding of the integration of different technological concepts and processes. This is again a recurring theme, related to the need for a more solid process and system knowledge:

“[T]he iteration between all systems should be taken into account; we usually teach CNC [Computerised Numerical Control] and do not focus among the commutation of this CNC with its environment and surroundings, when this fact is gaining importance”²⁰⁵.

²⁰¹ Questionnaire response, employers' association representative, Spain.

²⁰² Interview transcript, trade union representative, Spain.

²⁰³ Interview transcript, HR officer in steel company, Spain.

²⁰⁴ Survey response, production manager in steel company, Spain.

²⁰⁵ Questionnaire response, VET provider, Spain.

As for the flexibility of training paths, the third-year specialisation mentioned above is considered a good way to ensure that IVET remains fit for purpose and flexible enough to meet a range of needs²⁰⁶.

Contents related to digitalisation have started being incorporated in the curricula, but besides the need to improve this integration, it appears also to be a need to strengthen teachers and trainers' training on this:

“[D]igitalisation related ones must be incorporated (and are being incorporated already) in subject syllabuses. But the need to be satisfied system-wise is the training of the lecturers themselves, the teachers themselves”²⁰⁷

A Head of training commented on workers possessing the right digital skills in order to be able to use the available technological devices that can support their daily tasks:

“[F]rom the point of view of vocational education and training it's necessary to update the way in which they are trained. It's necessary to give them all the basic and advanced concepts of hydraulics, mechanics pneumatics etc, but in the companies you need that this people could work with this knowledge and with the new technologies that allow them to be effective. If you have a doubt, you could have an expert that immediately you can connect with him or not. But at least you need to know how to work with it, with these technologies. [...] today it's not in the programmes. Maybe it is in the programmes of people that are studying something related with IT or similar, but not in other areas of education and training like metallurgy or mechanical maintenance”²⁰⁸.

A way forward for the relaunch of sectorial training, as well as a relaunch for the industry itself, was seen by a trade union representative in the re-establishment of apprenticeship schools in the companies:

“Anyone also from other sectors, like automotive and shipbuilding, will tell you that we need to recover what used to be called apprenticeship schools in Spain. Basically, these worked as if companies assumed the FP2 training of the workers that they subsequently incorporated into their companies [...] For example, ArcelorMittal had a very important centre for apprentices in the Asturias, and it is already being recovered [...], because this is the path that many companies consider should be taken to qualify and train their workers in the steel sector, the companies themselves to assume the formal training of their workers”²⁰⁹.

In this respect, the introduction of dual training options is viewed as welcome development in the training path, capable of re-joining the world of work and the world of education. At the same time, there appears to be some scope for improvement, especially for companies to better advertise themselves and career opportunities in vocational schools:

“F]inally the dual system is joining the two worlds, the training one, universities and schools, and the industry and business, so for me is the right direction. We can improve

²⁰⁶ Questionnaire response, VET provider, Spain.

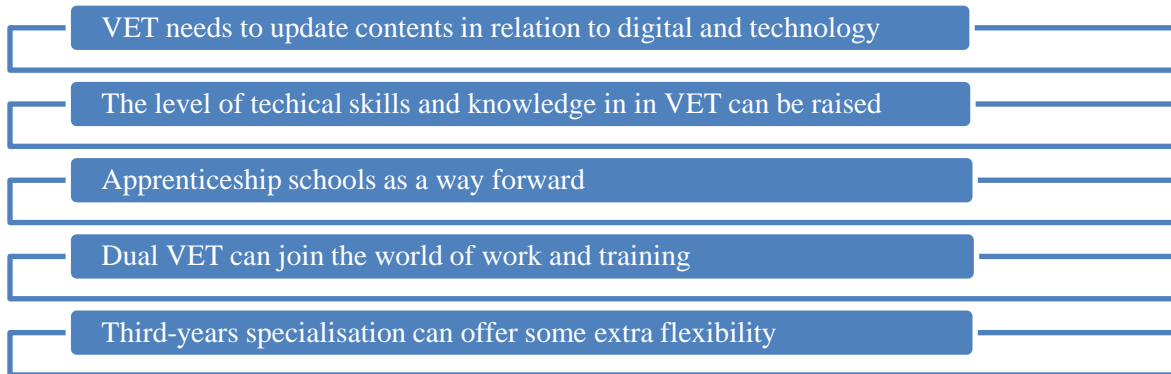
²⁰⁷ Questionnaire response, VET provider, Spain.

²⁰⁸ Interview transcript, Head of training centre in steel company, Spain.

²⁰⁹ Interview transcript, trade union representative, Spain.

some things, but the direction is the right one. [...] We should be there [in schools] explaining... we should invest time, money... finally when you build a company and you have 1500 people... finally you think 'I don't have exactly what I want', related to skills, and you have to ask yourself another question, 'if I want to improve this situation what should I do? I should join the other part that is providing me the candidates'"²¹⁰.

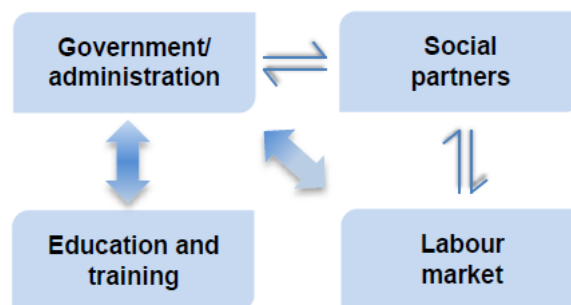
Figure 34 – Remarks on Spain’s VET as emerged from the fieldwork



4.4.6 Feedback mechanisms

As regards formal feedback mechanisms, Spain relies on what has been labelled a “participatory model of feedback mechanism” (Cedefop 2013; Markowitsch and Hefler 2018). What distinguishes this model from the Statist one is a more formalised influence of social partners. Although countries grouped under this type may also be characterised as statist, the degree to which social partners influence VET justifies a distinction between ‘statist’ (lower influence) and ‘participatory’ (higher influence of social partners) (Cedefop 2013). In this way, organised interests could partake in the governance of the VET sector with specific proposals. However, their role and influence remain limited when compared to that of social partners in coordinated countries like Germany.

Figure 35 – Participatory feedback mechanism model



Source: Cedefop (2013)

²¹⁰ Interview transcript, HR officer in steel company, Spain.

Although the Ministry of Education and Vocational Training, and the Ministry of Labour, Migration and Social Security are responsible for proposing and setting up VET policies and core legislation at the national level, and Regions are responsible for implementation at the local level, social partners play a relevant role in several advisory bodies. Under the education system, the government's main advisory body is the National Education Council (*Consejo Escolar del Estado*), which brings together all the stakeholders in the sector, including employers and unions. Another important body is the General Council for Vocational Training (*Consejo General de la Formación Profesional*) where social partners work together with representatives of VET in education and employment. Within the employment system, the State Foundation for Training in Employment (*Fundación Estatal para la Formación en el Empleo – Fundae*), which provides technical support to SEPE (the state public employment service) includes also the most representative business and workers' organisations. Finally, joint sectoral structures, which bring together employers' representatives and trade unions, have an advisory role in identifying training needs.

4.4.7 Good practices

The Spanish VET system offers well-established routes for the recognition of non-formal and informal learning since 2009 which are shared between the education and the labour authorities. The general framework for the validation procedure is outlined in the CNCP, including quality standards requirements. The ministries of education and employment publish (jointly or not) yearly public calls for validation of informal and non-formal learnings, which are implemented at regional level. The calls make clear which specific units of learning outcomes can be validated, and which formal qualifications and economic sectors are involved.

“If you have experience and you've been going through much training, but you haven't a recognised qualification, there are different systems so you can achieve that recognition. The main thing is the public calls for recognition. The system works in a way that most of the competencies are devolved to the region. So, each region can place these public calls and say ‘anybody who wants to get the recognition about the skills on’ and then they list the modules and the professional standards, the professional certificates associated for example with waiters, welders, electricians etc. So in that public call you say ‘well I have experience, so I can apply for these set of modules’, which might be a full qualification like one of these professional standards. Then you have to prove that you have certain experience and that you have at least certain training. You have to pass three stages. One is like a counsellor who goes through your documentation to check if you fulfil the requirements in terms of experience and training. Then you pass an exam, which could be an applied exam. And then the third is when you are given the certification [...] So far they have been a regional. But they are recognised everywhere, because the system is the same. The qualification of the occupational standard is everywhere. So there are guidelines which are followed by everybody. So if you pass the examination in Valencia, that module is recognised in Galicia or Andalusia, etc”²¹¹.

The procedure usually entails a phase of advisory, in which candidates are helped to assess their own skills and to put together a portfolio of their professional experience. After this, candidates' experiences are assessed on the basis of the evidences shown and through practical examinations, and finally they receive a certification for each unite of competence they have been successful in. Candidates must be able to prove at least three years of work experience relevant to

²¹¹ Interview transcript, VET expert, Spain.

the specific unit of competence they are applying for recognition, with a minimum of 2000 working hours in the ten previous years, or, in case of non-formal training, they must prove that they have received at least 300 hours of training in the ten previous years.

4.4.8 System trend

As a concluding remark, for what concerns recent trends, Spain has made some efforts to strengthen the VET system in a context that was historically characterised (and still continues to be characterised) by a preference for general education (Cedefop 2020). Recent data on enrolments (Sancha and Gutierrez 2019) show that in the academic year 2017/2018 there were still more students who opted for general upper secondary education than for the VET path: 66.59% in general upper secondary (*Bachillerato*) compared to 33.40% in vocational upper secondary (intermediate VET) cycle. However, it should be noticed that from 2009 to 2018 the overall number of students enrolled in IVET has increased by 65.23%. This renewed interest in VET paths could be partially explained as a consequence of the 2008 economic crisis. In particular, from 2014 to 2018, the number of students has increased more in basic and advanced programmes, while intermediate programmes (*grado medio*) have seen a slight decrease in enrolments (*Ibidem*). Cedefop (2020) points to such trends as evidence of a vocational drift, along with reforms, such as the introduction of dual VET, aimed at strengthening the ties between VET providers and employers and encouraging a greater involvement of students in the labour market. However, it has to be noted that the participation of students in dual programmes still represents a small part of the overall enrolments.

4.5 Poland

4.5.1 Polish Steel Sector

The Polish steel sector is one of the largest in the EU. In 2019, Poland among European producers was classified in 5th place with the production of crude steel 9.0 million tons – 5.7% share in EU (27) crude steel production²¹²– Figure 36. In the last few years, this production has changed from the lowest level of 8.5 million tonnes in 2014 to the highest - 10.3 million tonnes in 2017. Currently (2019) 24,700 people work in the Polish steel sector. Steel production in Poland at the integrated steel mill ArcelorMittal Poland in two locations in the south of Poland (Kraków and Dąbrowa Górnicza) accounts for 54.9% of crude steel production²¹³. The remaining part of steel is produced in 6 steel mills in the EAF process. Electric steel mills are mainly located in Silesia (south of Poland), and three also in central Poland – the Polish Steel Region consists of Silesia – Malopolska - Opolskie Province – Mazowsze - Świętokrzyskie Province - Podkarpackie Province. In addition, the steel sector in Poland consists of 12 metallurgical enterprises that deal with metallurgical processing based on external batch (so called re-rollers).

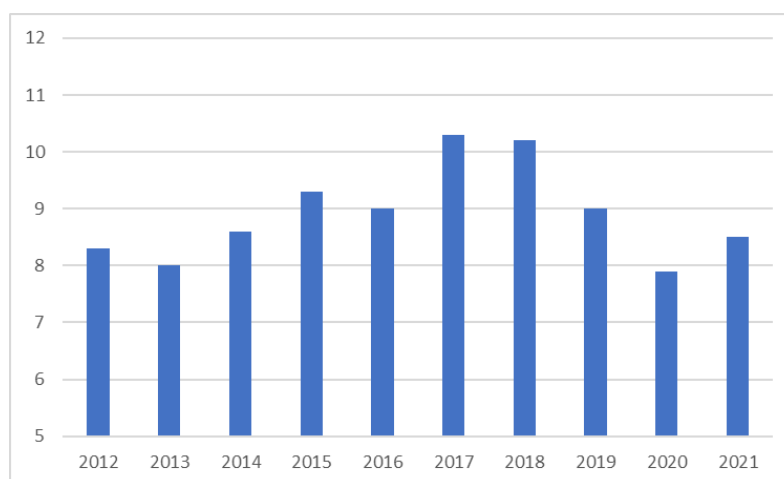
²¹² Eurofer: European Steel in Figures 2020, <http://www.eurofer.eu/assets/Uploads/European-Steel-in-Figures-2020>

²¹³ Worldsteel Association, World Steel in Figures 2020, <http://www.worldsteel.org/steel-by-topic/statistics/World-Steel-in-Figures.html>

In the years 2003–2006, the steel industry in Poland was deeply restructured in consultation with the EC to match European standards. As part of this process, employment in metallurgy was reduced, production capacity (over capacity) was reduced, and mechanisms preventing the use of forbidden state aid were introduced. All steel mills subjected to restructuring met the requirements of the viability test used by the EC to assess the effectiveness of restructuring processes.

In Poland, the steel industry belongs to the top ten largest industrial sectors. The value of sold production of this sector in 2018 amounted to PLN 37.5 billion (about € 0.85 billion), which represents 3% of industrial production. Sales production dynamics did not grow as fast as GDP - it amounted to 2.8%, while GDP growth in 2018 amounted to 5.1%²¹⁴ [4].

Figure 36 – Poland total crude steel production (all qualities) in metric tonnes



Source: Eurofer

The industry is currently facing uncertain economic prospects, mainly because of the repercussions of the Covid-19 pandemic:

“now we really have a problem with Coronavirus of course, but let's say three months ago, the situation of these companies was quite good [...] they were in a good condition and they kept hiring people [...] but the industry is really small at the moment”²¹⁵.

The analysis of the conducted interviews and survey responses offer a summary of the main challenges that the Polish steel industry is facing - Figure 37. A crucial challenge is that of greening the industry, which is coupled with a broader systemic transition in the production of energy. Poland is still highly dependent on fossil energy sources, especially coal, which makes the cost of electricity for Polish company particularly expansive.

²¹⁴ Polish Steel Industry 2020, Polish Steel Association, www.hiph.org/ANALIZY_RAPORTY/pps_eng.php

²¹⁵ Interview transcript, Steel industry expert, Poland.

ESSA: Identification of National (Sector) VET Qualification and Skills (Regulatory) Frameworks for Steel (Deliverable 4.1 – Version 3)

“I think the biggest challenge in Poland is ecological. I mean, the cost of the utilisation of the environment. And the problems with our power plants because, as you probably know, we are based on coal, and this is a really big problem for the whole country, and especially for the companies which are 50% dependent on power, they consume a lot of power generated by the coal fuelled power plants. This is because of the costs, because of the of the prices of the carbon dioxide”²¹⁶.

Furthermore, the need to green the steel production requires significant investment in greening technologies, as well as workers who possess the right skills to cope with new processes. The issue of reducing CO₂ emissions was cited as the primary challenge by workers’ representatives, employers’ representatives as well as industry experts:

“There are still new laws and indexes that we must meet. The huge problem is emission of CO₂, of course. For example, in this year we had a better score, something lower than a year ago, but it was only because the production in our integrated industry was lower than one year ago. It's very tough to change this. It requires many huge investments”²¹⁷

Other issues that the industry is facing relate to the lack of skilled workers and the unattractiveness of the sector:

“[T]he lack of skilled workers, and I mean at the lowest academic level. But this is a really big issue because we used to have a lot of technical secondary schools which educated steelworkers, foundrymen, etc. Nowadays is completely unpopular”²¹⁸.

When it comes to skilled workforce, a concern that has been expressed several times regards the existence of better options for skilled workers, both in terms of other industries and abroad, and the competitive salaries offered by other companies:

“[I]n the case of my employees, the situation on the market is bad because the market does not have people with appropriate permissions and qualifications to work on my section. If we find such an employee on the market, we are not in the current HR and payroll policy to ensure competition in terms of remuneration and usually employees choose to work in neighbouring companies”²¹⁹.

It has been pointed out that the lack of skilled workers risks further deteriorating the image of the industry since skilled workers might be required doing more overtime²²⁰. Also, an ageing workforce in the Polish steel industry is reported to be struggling more with innovation and digitalisation²²¹.

²¹⁶ Interview transcript, Steel industry expert, Poland.

²¹⁷ Interview transcript, employers’ association, Poland.

²¹⁸ Interview transcript, steel industry expert, Poland.

²¹⁹ Survey response, Line Manager in steel company, Poland.

²²⁰ Interview notes, Trade Union representative, Poland.

²²¹ Survey response, Line Manager in steel company, Poland

Figure 37 – Challenges faced by the industry as emerged from the fieldwork



4.5.2 Industry perspective on skills gaps

As we have argued earlier, the skills landscape at the national level will depend also on the penetration of a range of technologies in the sector. The collected data suggests that the 4.0 transition in Poland is particularly non-homogeneous and often not state of the art, except for a few international companies:

“There is still a gap and between our level and the international, but as I said, international companies in Poland they are not worse than the same somewhere else. But this is the group of the top”²²².

“In some melting shops I saw really excellent installations not only to measure, to do some typical stuff, but even with kind of artificial intelligence, with kind of sampling and some predictive methods, not only like a reaction to the problem but prediction [...] But I would say, we are at the beginning of that in the steel plants in Poland. In many plants the managers are not really thinking about 4.0”²²³.

Some interviewees however had a different perspective and did not see a big divide between international companies and SMEs in terms of technological standards. Overall, the general technological level of the sector appears to be medium-low, especially when it comes to developing new products or new technologies:

“I think we have huge expenditures on innovation and many and new patents granted. But I think this is much more in the area of environmental protection and production efficiency, not in new products and new technologies, from my point of view. The share of enterprises that have innovative projects is about 36% in Poland. I also have data about enterprises

²²² Interview transcript, steel industry expert, Poland.

²²³ Interview transcript, steel industry expert, Poland.

ESSA: Identification of National (Sector) VET Qualification and Skills (Regulatory) Frameworks
for Steel (Deliverable 4.1 – Version 3)

which have introduced new or improved products and that is only 23%. So, I classify our sector as medium-low technology²²⁴.

This seems to go along with a relatively scarce appreciation of the idea of Industry 4.0 at the time of the research:

“The concept of Industry 4.0 is just very abstract. Some people say that it is right now. Of course not. Some other are not aware of how soon it will be on the table. I don’t think that there is a very serious thinking about how to be prepared for it. For example, in steel companies those people doing a very hard work don’t think about this. And the managers are busy with the current problems and they don’t think about progress and how to be prepared for it²²⁵.”

However, it has been suggested that education could be a driver, where companies are not particularly interested in modernising plants, pointing to some normative mechanisms (DiMaggio and Powell, 1983) that could favour the uptake of new paradigms:

“At universities there are people thinking about 4.0, doing PhDs on this. And it is an initial thinking. And when this people will go to work in the companies, then it could be the moment in which these things are treated more seriously²²⁶.”

In a future perspective, the uptake of Industry 4.0 is expected to bring more automation and predictive maintenance, modern measurements and inspections (drones, vibration amplification, etc.), tracking data and parameters of the current operation of devices, reliability centred maintenance, minimisation of physical work²²⁷. Also, the creation of large databases including all data from each stage of the production process, and the creation of algorithms to predict and manage the parameters and quality of the final product. Minimizing the impact on the human error process through the supervision of remote computer systems, access to systems and databases from mobile devices providing online access to the process²²⁸.

Certainly, such changes are expected to bring important transformations both in terms of organisation and skills needs:

“In organisational matters, the implementation of more advanced automation systems will force a change in the organisation in the form of employing fewer service employees, which will also involve employees specialised in servicing modern devices and control systems²²⁹.”

²²⁴ Interview transcript, Employers’ association, Poland.

²²⁵ Interview transcript, steel industry expert, Poland.

²²⁶ Interview transcript, Steel industry expert, Poland.

²²⁷ Questionnaire response, Support Manager, steel company, Poland.

²²⁸ Survey response, Line Manager, steel company, Poland.

²²⁹ Questionnaire response, Support Manager, steel company, Poland.

The loss of jobs based on routine and manual tasks is expected to be replaced gradually by jobs in different areas requiring a different skillset:

“The work in the steel company is usually very hard, especially those areas where you have a contact with processing metal, and all these computers and digitalisation is just to facilitate the work and even do something instead of humans. In these terms of course it could lead to reducing the numbers of people physically working in those areas. But there will be also new jobs because all these computers must be maintained, must be updated, you need new software, and so on. So, this is changing, and very simple work is being replaced, by value-added work”²³⁰.

This new skillset is expected to include a higher degree of IT skills – Figure 38, as well as higher technical competencies related to engineering and foundry processes, all consolidated through practical experience. At the same time, a general process knowledge is required, a remark that has been recurrent in all the researched countries. These are indeed the areas in which the current skills gaps seem to be:

“IT people, for instance, I think we don’t have enough skills there, because even nowadays it is difficult to find good IT people, and they earn a lot of money, because they are in shortage. High educated people with these skills can go anywhere in the world, close to Poland they can move to Germany and they would find very well-paid jobs”²³¹.

“Every year we ask our colleagues from the industry, about the skills that are most valuable for them [...] And most of them claim that they are looking for specialists, but not only focused on one very strict discipline [...] they need in an engineer in let's say material science, metallurgy, foundry engineering, not only generally material science engineering”²³².

Some have commented on the how technological transformation will impact differently on different roles. Technicians and engineers are expected to possess a more diversified set of skills compared with operators:

“I would say metallurgy, computer skills, but useful computer skills, and language to combine these together to have the skills to cooperate with the international environment [...] This as regards engineers, but for the shop floor workers I think English is less important, computer skills are less important...I would say for the shop floor workers, the most important thing is practice”²³³.

However also operators will need to be able to deal with at least basic digital devices and possess some basic analytical skills to make sense of the increasing amount of data collected during

²³⁰ Interview transcript, Steel industry expert, Poland.

²³¹ Interview transcript, steel industry expert, Poland.

²³² Interview transcript, steel industry expert, Poland.

²³³ Interview transcript, steel industry expert, Poland.

steelmaking processes. This implies a general upskilling on the workforce at all levels of education:

“[T]he machine operator, any machine, it must be somebody with technical skills, but it is not like only doing some simple thing, you must coordinate a lot of things, and you must even use a computer, because almost every modern machine has a computer in it, some touchpad or some screen to use, or some data to input, to capture, to analyse on site. So, I will say even workforce nowadays must be much more developed and educated, not only basic skills”²³⁴.

Workers at all levels need also to be provided with the knowledge to understand and make sense, in a more holistic way, of the overall process of steelmaking:

“[T]hey need to acquire a general process-knowledge, they need to know first of all how the overall processes and what are the different outcomes of these before starting to manipulate the real controls of machinery and interfaces”²³⁵.

Another problem is related with workforce ageing and the risk of losing skills acquired through experience since the VET system is judged so far as not adequate in terms of offering hands-on experience.

“I think advanced engineering skills are missing, because older workers are retiring constantly and this is a technical skills problem and also in advanced techniques”²³⁶.

The focus in Poland seems to be mostly on technical and manual skills. From the point of view of some workers’ representatives, companies struggle also to recruit machine operators, although this has been reported as a shrinking occupational group. Some interviewees reported more concerns in relation to the mid-low segment of occupational profiles (semi-skilled workers), rather than to higher occupations (Interview notes, Trade Union representative, Poland). This could link back to the issue of the scarce technological penetration and non-homogenous standards in the sector. This sort of statements can also be explained considering the limited popularity of vocational training in the country, which might cause shortages also in some low-skills profiles, probably depending on the geographical location of the plants:

“Vocational schools are not very popular from the point of view of learners. Most of students want to move forward to the university, rather than getting into vocational programmes, so the overall number of pupils in vocational programmes is not very high”²³⁷.

Many interviewees agreed that the undergoing technological transformation will require upskilling and workers with higher level initial qualifications. This is consistent with prior re-

²³⁴ Interview transcript, steel industry expert, Poland.

²³⁵ Interview notes, Training Officer in steel company, Poland.

²³⁶ Interview transcript, employers’ association, Poland.

²³⁷ Interview notes, Training Officer in steel industry, Poland.

search in the country (see for instance, Stroud and Fairbrother 2006). As reported by an interviewee, “enterprises are providing some training to rise the ICT skills, but I think it's still not enough to cover the needs”²³⁸. Language skills are also reported to be often lacking.

More in general, qualifications are required to be more oriented towards new technologies and the operation of digital devices. Employees also need to be fully aware of the risks associated with working with fully automated production processes. The organisation of work should be more focused on the supervision of the process and devices than on their operation as it was in the past²³⁹.

Soft skills are gradually gaining importance in the sector, although they do not appear to be as prominent as in other countries. While skills and knowledge related to physical, chemical and mechanical processes, will still be the most important focus for companies, highlighting to some extent the need for companies to complement school-based training also in these core areas, in some cases the need to integrate soft skills is also appearing and being translated into internal training:

“Technical competences will be very important, since the physical, chemical and mechanical processes won't change. So, we need to train well our workers on that. But also we realised in our company that we need to offer some training on soft skills, such as communication, problem solving, team-working, because they work in a team and well-managed interaction is very important to work properly. These courses should start for the first time in September 2020, but due to the Covid-19 we don't know if we will be able to start them this year”²⁴⁰.

Others have also remarked that soft skills will become more important to organise companies' work, in particular in relation to communication and collaboration.

Finally, a commitment to lifelong learning is also becoming more important: technical progress and process automation require employees to learn and improve their qualifications practically continuously throughout their professional career. It seems that the process will accelerate even more in the future. Thus, the employer will expect employees to have the skills to continuously improve their professional qualifications²⁴¹.

In perspective, although Industry 4.0 doesn't yet appear to be a fully established concept in Poland, it is becoming clearer that it will require, once fully established, “an interdisciplinary and inter-departmental approach, as well as combining knowledge and skills from several areas. Remedying this situation requires far-reaching interventions at the state level - it would require understanding that IT competences will become necessary in many areas, and the solution

²³⁸ Interview transcript, employers' association, Poland.

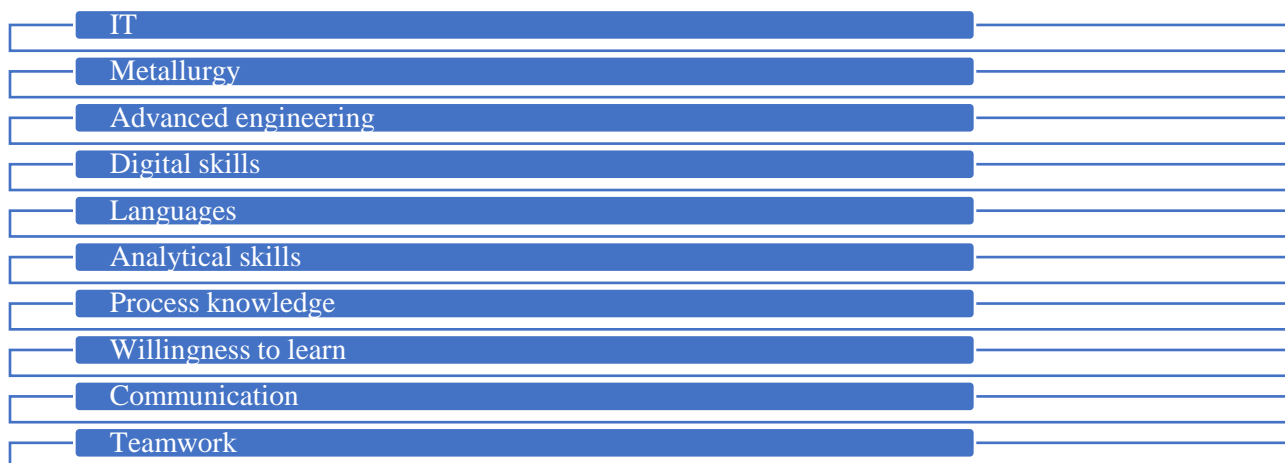
²³⁹ Survey response, Support Manager in steel company, Poland.

²⁴⁰ Interview notes, Training Officer in steel company, Poland.

²⁴¹ Survey response, HR Officer, steel company, Poland.

would be to include skills in the field of IT infrastructure design, UX programming (User Experience), electronic measurement and control, or programming for the needs of data processing science”²⁴².

Figure 38 – Skills and knowledge gaps in the industry as emerged from the fieldwork



4.5.3 Overview of Poland's VET system

The vocational education system, after the devastation of World War II, was systematically built and developed in Poland until the end of the 1980s, i.e. until the end of the period of communist rule. After the political transformation, the national education system, including the VET system, was reformed several times. A good summary of changes in the education system in Poland, including the VET system, are presented in the study²⁴³ by discussing changes in VET systems in Visegrad countries. The most important elements of this summary are presented below:

- As in other countries of the eastern bloc, Poland's VET regressed with the transition from a centrally planned to a market economy. Large State-owned enterprises were closed or privatised, and new owners refused to support VET schools previously linked to them. The direct links between enterprises and VET schools were disrupted. This was due, on the one hand, to lack of money, and on the other, to the popular belief at the time that vocational education was too expensive, held no future for Poland's economy, and to the preference for higher education. Polish employers at that time neither saw a need to invest in training their employees nor to contribute to the VET system.
- A strong increase in the salaries of those with higher education and the rising unemployment of those with basic vocational education contributed to this development of

²⁴² Survey response, VET provider, Poland.

²⁴³ Cedefop (2020). Vocational education and training in Europe, 1995-2035: scenarios for European vocational education and training in the 21st century. Luxembourg: Publications Office of the European Union. Cedefop reference series; No 114. <http://data.europa.eu/doi/10.2801/794471>

‘de-professionalization’ of the Polish education system. VET was not the object of reform actions during the entire transition period.

- Only recently has VET become a new national policy priority as reflected in various national and regional strategic documents and actions, among them the implementation of learning outcomes-based curricula and assessment, investment in infrastructure, and measures to improve the image of vocational education.
- A recent study shows that also the attitudes of employers have changed. They are now more willing to support the VET system (such as by taking learners for practical training or contributing to sector councils or advisory boards), although they are still reluctant as regards more operational tasks (such as developing curricula or participating in exams).
- The V4 countries do show remarkable similarities. They all have strong school-based VET systems which have shown steady erosion within the past three decades. They have a similar conception of IVET and also of CVET (conceived as job-related formal and non-formal education), and in all four countries we see a clear trend towards combined general and vocational education (dual qualifications providing access to higher education and a technical/professional qualification) at the expense of more practical VET at lower ISCED levels in the past two decades.
- In Poland the share of students in vocational education has decreased from 78% to 58% over the past three decades (1990-2017). The data show a steady decline without any major breaks.

In conclusion, it should be said that the initial reforms of the VET system were unsuccessful and led to its gradual decline. Only the reform of 2016, taking into account the growing demand in the economy for employees with secondary education in disappearing professions, provided for the creation of a vocational education system, which - while maintaining some well-functioning types of schools (e.g. technology), was based on two-stage branch schools, enabling the acquisition of not only theoretical but also practical knowledge (dual system). This system is currently being implemented (see Table 39). It is too early to assess its effectiveness - the first graduates of second-cycle industry schools will appear on the labour market in 2023.

Table 39 – Governance and main actors in Poland’s VET

Ministry of Education	Is in charge of VET policies at secondary level, with the support of other Ministries for particular occupations.
Ministry of Science and Higher Education	Is responsible for higher VET (post-secondary and tertiary level)
Counties (<i>Powiaty</i>)	Are responsible for upper secondary schools, including vocational schools
Regions (<i>Wojewodztwa</i>)	Are responsible for schools of regional and trans-regional significance, e.g., vocational schools that are strategic for the regional economy.
IBE - Educational Research Institute	Conducts interdisciplinary research concerning the functioning and effectiveness of the education system in Poland. The Institute participates in national and international research projects, prepares reports, expert

	opinions and carries out advisory functions. It is also the national contact point for Cedefop.
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The education system in Poland has undergone structural changes. In December 2016, the education ministry introduced reforms aimed at prolonging the time children spend within one educational programme and to develop a vocational education system that is responsive to the needs of a modern economy. In November 2018, an act introducing significant changes in VET was signed into law. The new law complements the recent structural reform of the education system initiated in 2016. The main aim is to restore the prestige of vocational education by improving its quality and effectiveness. Special emphasis is placed on strengthening the mechanisms of involving employers in the development of VET in all its stages, particularly in practical vocational training and on the systematic adaptation of VET to labour-market needs by forecasting the demand for professions and skills. Figure 39 shows actual governance of Poland's VET.

The current VET system in Poland is based on initiatives undertaken by the Ministry of National Education:

- The Act on the Integrated Qualifications System (2016) has brought together the qualifications framework, register of qualifications that can be attained, quality assurance and validation principles. General and higher education level qualifications were included in the register. Non-statutory qualifications linked to CVET have been registered based on the initiative of VET providers or other stakeholders;
- The government has revised the incentive system to increase VET participation, develop the vocational guidance system, and expand the implementation of work-based learning in VET by promoting cooperation between schools and employers;
- The Ministry of National Education, together with the Centre for Education Development (ORE), continue work on the development of new core curricula to be introduced in 2019;
- New sectoral skills councils are being established under the umbrella of the Polish Enterprise Development Agency, giving voice to sectoral stakeholders regarding the demand for competences at sectoral level to improve education and labour market matching.

According to the assumptions, the target structure of schools includes: 8-year primary school, 4-year general high school, 5-year vocational upper secondary school, 3-year first stage sectoral school, 3-year special job-training school, 2-year second stage sectoral school, postsecondary school.

In November 2018, an act introducing significant changes in VET was signed into law. The new law complements the recent structural reform of the education system initiated in 2016. Most changes will take effect at the beginning of the school year (2019/20)²⁴⁴.

The main aim is to restore the prestige of vocational education by improving its quality and effectiveness. Special emphasis is placed on strengthening the mechanisms of involving employers in the development of VET in all its stages, particularly in practical vocational training and on the systematic adaptation of VET to labour-market needs by forecasting the demand for professions and skills.

The new law:

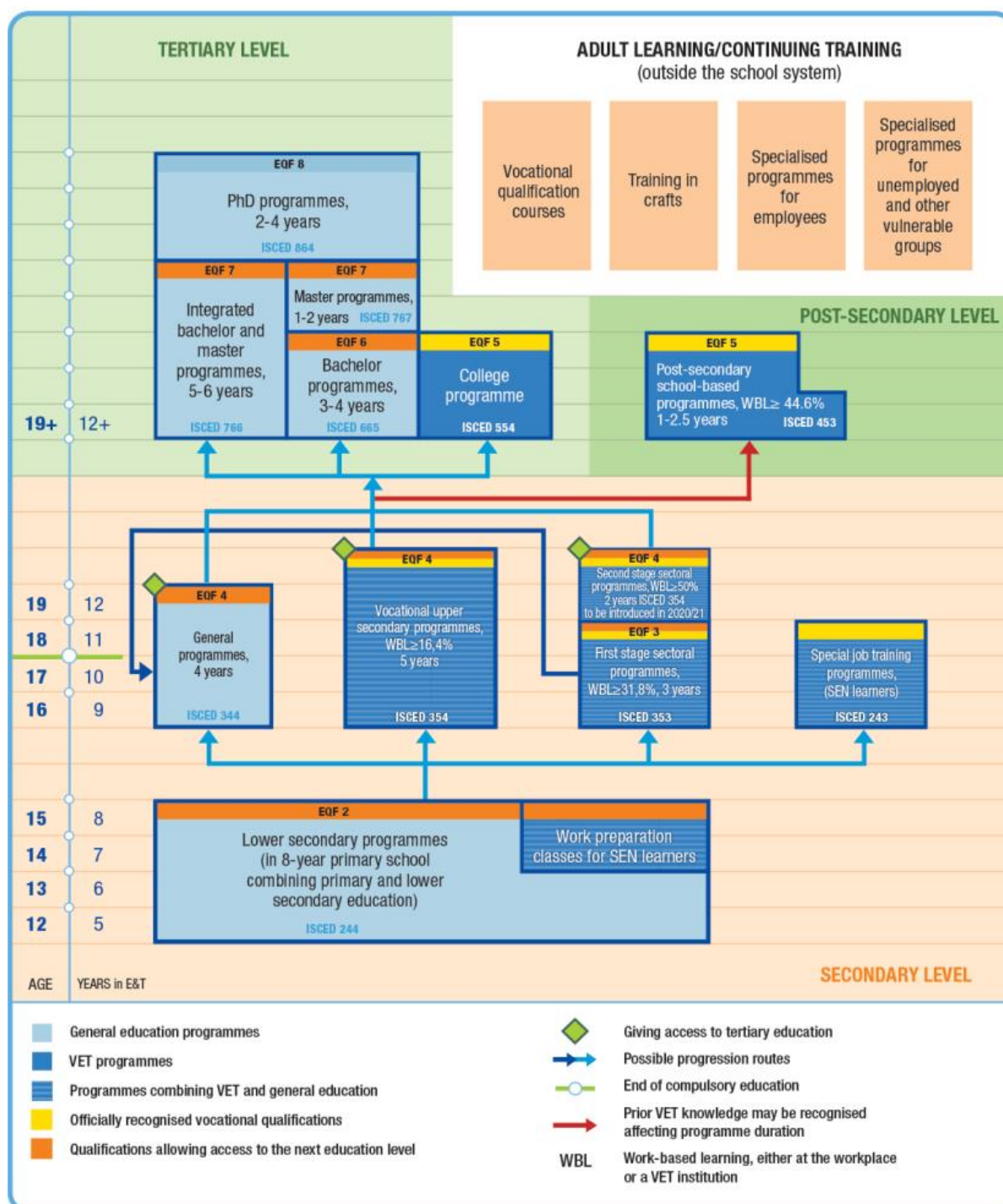
- makes it mandatory for VET learners to pass a State vocational examination or a journeyman's examination to graduate from secondary education; it also changes the form of exams, the process of preparing examination tasks, and the requirements set for examiners;
- introduces, in cooperation with employers, apprenticeship as a new form of vocational learning for learners in upper secondary VET and first-stage sectoral programmes, who are not juvenile workers;
- introduces new options for VET learners to obtain additional vocational skills or qualifications beyond the core curriculum;
- allows VET schools to organise short-cycle vocational courses for adults;
- makes it mandatory for schools to cooperate with employers when launching new programmes; this cooperation may include patronage classes, the organisation of practical training, teacher training, participation in the organisation of vocational examinations, providing schools with certain equipment and participation in teachers' council meetings;
- introduces obligatory professional training for VET teachers in companies;
- introduces a labour-market-needs forecast mechanism; forecasts will take into account various data sources, including data from Statistics Poland, education information system, social insurance data and opinions of skills councils;
- increases state subsidies to local governments for VET schools educating in higher demand occupations and to employers involved in training VET students in higher demand occupations;
- introduces the functioning regulation of the newly-established second-stage sectoral programmes;
- introduces changes in the accreditation system for institutions providing continuing education in out-of-school forms, aimed at greater quality control.

²⁴⁴ <https://www.cedefop.europa.eu/en/news-and-press/news/poland-vet-reform-continues>

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According to the new law, the introduction of a new occupation in the classification of occupations will simultaneously determine its core curriculum, speeding-up the reaction to labour market developments. Changes in the occupational classification structure will be also introduced.

Figure 39 - VET in Poland's education and training system after reform started in 2016



The Polish schooling system is presented on Figure 39. Education is compulsory up to 18 years of age, while full-time school education is compulsory up to age 15. Full-time compulsory education lasts 9 years (the last year of pre-school education and 8 years of primary school education). Compulsory education for 15 to 18 year olds can take place as part-time education, both in and out of school, e.g. in the form of short qualifications courses or vocational training for juvenile workers.

Upper secondary education can be provided by different types of schools and take the form of a general upper secondary four-year programme (*licea ogólnokształcące*), a vocational upper secondary five-year technical programme (*technika*) or a three-year first stage branch / sectoral programme (*branżowa szkoła pierwszego stopnia*), which can be followed by a two-year second stage branch / sectoral programme. Upper secondary education is typically available to primary school graduates (usually 15 year-olds), apart from the second stage sectoral programme, which will be available to graduates of the first stage programmes (18 year-olds).

Post-secondary non-tertiary programmes are provided by post-secondary schools (*szkoły policealne*) and can be attained in one- to two-and-a-half years. They are available to graduates of general and vocational upper secondary programmes, as well as in the future – of second stage sectoral programmes (usually 19 to 20 year-olds).

Completing any type of VET programme and obtaining a school leaving certificate is not the same as attaining a vocational qualification. Learners in the formal VET system can be awarded two types of documents confirming attained learning outcomes:

- Vocational Certificates (certificate of a vocational qualification in an occupation); and
- Vocational Diplomas (vocational qualifications diploma).

Learners can be awarded a vocational diploma only by obtaining both the qualifications distinguished in an occupation (vocational certificate/s) and a school leaving certificate. Vocational qualifications can only be confirmed by passing an external State vocational examination documented by a vocational diploma.

Each qualification includes specific sets of learning outcomes defined in the core curricula for vocational education. Learning outcomes are grouped in units, which typically contain from several to over a dozen learning outcomes and reflect specific professional tasks. The core curriculum for general education determines the learning outcomes related to the general education component and key competences provided by VET programmes.

Adults aged 18 and older can be awarded a vocational certificate after passing the State vocational examination extramurally. By taking extramural exams, adults may also acquire certificates of completion of general education schools.

Formal VET leads to four qualification levels (2 to 5) that correspond to the European qualifications framework (EQF). The VET system comprises initial and continuing education. It can be offered as:

- school-based programmes with obligatory work-based learning (WBL differing in scope and form, also including dual training/alternate training),
- juvenile employment (apprenticeship scheme – with practical training with employer and theoretical training in school or in out-of-school forms, based on a contract between the learner and the employer),

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- out-of-school forms – different types of courses based on the core curricula.

VET has three governance levels: national (ministries), regional (school superintendents, mainly in pedagogical supervision) and county (powiat – managing schools). The education ministry is in charge of VET policies at secondary level, supported by other ministries responsible for particular occupations. The Ministry of Science and Higher Education is responsible for higher VET. Social partners advise policy makers on necessary changes in VET.

The majority of public education institutions in Poland are managed by local government units. Counties (*powiaty*) are responsible for upper secondary schools, including vocational schools, and schools for children with special needs; the regions (*województwa*) are responsible for schools of regional and trans-regional significance (e.g. groups of schools or vocational schools important for the regional economy).

Central government units (usually ministries) often manage vocational and fine arts schools. All types of schools can also be established and managed by non-public institutions, such as religious and social associations. Generally, in Poland, the higher the education level, the higher the share of non-public institutions.

The decision to provide education for a particular occupation listed in the classification of occupations for vocational education is made at local level by the school principal in agreement with local authorities (county level) and after asking the regional labour market councils (advisory bodies) for their opinion concerning compliance with labour market needs. Teaching programmes can be developed individually by schools.

The vocational education and training system in Poland allows the following levels of qualifications, as defined in the European Qualification Framework (EQF), to be achieved within public education:

- EQF 3 – Ist stage branch / sectoral schools,
- EQF 4 – IInd stage branch / sectoral schools, vocational upper secondary programme,
- EQF 5 – does not exist besides colleges of social work (*kolegia pracowników służb społecznych*); these colleges provide three-year programmes for the occupation of social worker,
- EQF 6 – Ist stage academic / university studies,
- EQF 7 - IIst stage academic/university studies.

Three-year first stage branch/sectoral programme (*branżowe szkoły I stopnia – BSI, EQF 3*) introduced in 2017 are part of the formal education and training system. This programme is available to primary school graduates (usually 15 year-olds), that is those who received the primary school leaving certificate (this also applies to lower secondary school graduates during the transitional period). The first stage sectoral programme combines general and vocational education and leads to a vocational qualifications diploma for a single-qualification occupation (after passing the State vocational examination). The school director decides on the share of

work-based learning. However, it cannot be less than 60% of the hours foreseen for vocational education (which combines both theoretical and practical training). Completion of this programme provides access to further education: at the two-year second stage sectoral programme. This is a school-based programme, but apart from schools, there are also qualifying vocational courses. After graduating from the first stage branch / sectoral school and passing the exam in one qualification, the graduate will obtain a diploma confirming qualifications in the profession, and will also receive basic industry education. Examples of occupations obtained at this stage of education are: mechanic, electrician, locksmith, machine operator, etc.

Two-year second stage branch / sectoral programme (*branżowe szkoły II stopnia – BSII, EQF 4*) started to operate in the 2020/21 school year. This second stage sectoral programme aims at further developing the professional skills attained in the first stage sectoral programme. Upon completion of the second level sector programme, the graduate will obtain a vocational diploma from a secondary school and, after passing a vocational examination, a diploma certifying two vocational qualifications at EQF4. General education in this programme is planned to be limited, with the main focus placed on the vocational training to be conducted in the form of vocational qualification courses. The school director decides on the share of work-based learning, however it cannot be less than 50% of the hours foreseen for vocational education (which combines both theoretical and practical training). The two-year second-degree sector program is available to graduates of first-degree sector programs - usually 18-year-olds, but also to adults. Depending on the profession taught, education in a sector second degree program may be delivered as a full-time or extramural.

Graduates of industry-oriented second-level programs will be able to continue their studies in higher education after passing the baccalaureate exam (*matura*), separate from the qualifying exam.

Five-year vocational upper secondary programme (*technika, EQF 4*) are part of the formal education and training system. This programme is available to primary school graduates, usually 15 year olds (i.e. those who received the primary school leaving certificate). The vocational upper secondary programme combines general and vocational education and leads to a vocational qualifications diploma for occupations consisting of two qualifications after passing the State vocational examination. The school director decides on the share of work-based learning, however it cannot be less than 50% of the hours foreseen for vocational education (which combines both practical and theoretical training). Graduates of these programmes, after passing the secondary school leaving examination (*matura*), are eligible to continue to tertiary education. Education in the vocational upper secondary programme can be carried out as full-time, stationary, extramural studies. The completion of the programme allows to obtain a professional diploma in the profession taught at the technician level, after passing the vocational exam in a given profession, e.g. Electrician Technician 311303, Mechanical Technician 311504.

VET core curricula at EQF 3 and EQF 4 levels are formalised in the Regulation of the Minister of National Education of May 16, 2019 on the core curriculum for vocational training in sectoral

education and additional professional skills in selected occupations in sectoral education (Journal of Laws 2019, item 991)²⁴⁵. For each occupation core curricula describe precisely the number of hours for technical skills but for transversal skills you can find only remark: “Teachers of all compulsory educational activities in the field of vocational education should create conditions for students to acquire personal and social competences”.

Graduates of these programmes, after passing the secondary school leaving examination (*matura*), are eligible to continue to tertiary education.

The higher education system includes:

- Post-secondary school-based programmes (*szkoła policealna*, EQF 5),
- First cycle tertiary education (bachelor or engineer, EQF 6),

Second cycle tertiary education (master's degree, EQF 7) or a unified master's degree (EQF 7). Graduates are awarded the professional title of master engineer.

4.5.4 Programmes and qualifications relevant to the steel industry

The education in occupations assigned to the metal industry includes the following occupations and qualifications:

- - **Foundry pattern maker**; Qualification: making and repairing foundry tooling, vocational school I st. EQF 3; 721104
- - **Foundry machine and equipment operator**: Qualification: Operation of foundry machinery and equipment: vocational school I st. EQF 3; 812107
- - **Metallurgical machinery and equipment operator**: Qualification: Operation of machinery and equipment of the metallurgical industry: vocational school I st. EQF 3, 812122
- - **Foundry technician**: Qualification: Making and repairing foundry tooling, Organizing and supervising the foundry process; secondary technical school or vocational school II st. EQF 4; 311705
- - **Metallurgical technician**; Qualifications: Operation of machinery and equipment of metallurgical industry, Organization and operation of metallurgical processes; secondary technical school or vocational school II st. EQF 4; 311708

There are only two occupations that are strictly specific to the steel sector: Metallurgical Machinery and Equipment Operator and Metallurgical Technician.

Graduates educated in these professions can be employed in all so called "metallurgical" positions (e.g. operators of all machines in metallurgical departments like sintering, blast furnace,

²⁴⁵ <https://www.ore.edu.pl/2019/08/podstawa-programowa-ksztalcenia-w-zawodach-2019>

steel melting, rolling etc. equipment). These are occupations related exclusively to the steel industry.

In addition, the steel industry employs specialists in dozens of professions who can work in many other industries, not only in the steel sector. They are educated in first and second level sectoral schools and secondary technical schools and have obtained various qualifications at EQF 3 and EQF 4. From this occupational group the following occupations are particularly sought after in the steel industry:

- Electrician (*Elektryk*); Qualification: Installation, putting into operation and maintenance of electrical installations, machines and equipment; vocational school I st. EQF 3; 741103,
- Electric Technician (*Technik Elektryk*) Qualification: Installation, commissioning and maintenance of electrical installations, machinery and equipment, Operation of electrical machinery, equipment and installations; secondary technical school or vocational school II st. EQF 4; 311303,
- Mechanic/fitter of machines and devices (*Mechanik-monter maszyn i urządzeń*); Qualification: Installation and maintenance of machines and devices; vocational school I st. EQF 3; 723310,
- Mechanic Technician (*Technik Mechanik*) Qualification: Assembly and operation of machinery and equipment, Organization and supervision of production processes of machinery and equipment; secondary technical school or vocational school II st. EQF 4; 311504

The education system in all of the above professions (metallurgical and others) is based on similar principles. Obtaining the qualification requires passing a vocational exam in the field of the qualification identified in the profession.

Workers interested in improving their skills can take advantage of the Continuing Vocational Education and Training (CVET) system.

In the area of CVET, support is organised mainly through the employment services and financed from the Labour Fund), as well as from the European Social Fund (ESF).

This support includes the following activities²⁴⁶:

- vocational training;
- loans for financing of the cost of training;
- training vouchers;
- vocational practice vouchers;
- scholarships for youth from low income families for the period of education;
- financial support for examination fees and vocational licence fees;

²⁴⁶ Cedefop; Educational Research Institute (2019). Vocational education and training in Europe: Poland [From Cedefop; ReferNet. Vocational education and training in Europe database]. <https://www.cedefop.europa.eu/en/tools/vet-in-europe/systems/poland>

- statutory training leave for employees.

The CVET system makes it possible to broaden professional skills and acquire higher qualifications for workers in all occupations, including steel-specific occupations:

- Second stage sectoral programme leading to EQF 4, (*branżowa szkoła II stopnia*),
- Post-secondary school-based programmes leading to EQF 5 (*szkoła policealna*),
- Tertiary education including: first degree (Bachelor's degree - EQF 6), second degree (Master's degree EQF 7) or unified Master's degree (EQF 7). Graduates are awarded the professional title of engineer.

Undergraduate (bachelor's) studies usually last three years. The studies take place in full-time and part-time (distance learning) modes. A specific profession related to steel production is **metallurgical engineer**. Steel-related professions include mechatronics engineer or electronics and telecommunications engineer. .

Vocational education and training system in Poland allows learners and employees to acquire and upgrade their qualifications (vocational certificates) through validation of non-formal education and informal learning.

Persons can take extramural State vocational examinations conducted by regional examination boards if they are over 18 years old, have completed a lower secondary programme or an eight-year primary programme and have at least two years of learning or work in an occupation relating to the targeted qualification. If they do not have two years of learning or work experience, they can enrol in a vocational qualifications course. Completion of a vocational qualification course entitles learners to take the State vocational examination. After successfully passing the State vocational examination, learners obtain the same vocational certificate as regular VET students.

4.5.5 Remarks on VET

Despite the shift towards a German-type dual training, which has been positively commented on by several interviewees (although it has been noticed that it is not yet a popular option), some concerns have been expressed in relation to the new reform, particularly regarding the lack of sectoral coverage as in specialistic profiles, and the scarce provision of digital and IT skills:

“with this reform we have only curricula for two occupations for the metallurgical sector. This is the metallurgical devices operator and metallurgical technician. And in the curric-

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ula, you can find only elements of mechatronic and automation, not much additional computer knowledge or competencies. Maybe it is just for now, but there is no element of the future for this people”²⁴⁷.

Some criticism has also been expressed on the VET system in general, as for the quality of some schools and the competence of some teachers. Also, a recurring criticism addresses the limited practical orientation of school-based VET in the country and their disconnection from the world of production, an issue that should be now overcome by the new reform.

“I do not believe that the VET system in Poland is able to provide and support a qualified workforce that the steel industry needs. In the current system, there is a lack of directional schools, as well as directional [branch] training and practical preparation for workers employed in blue-collar positions in the steel industry. Employees employed in blue-collar positions acquire the necessary knowledge and practice only while working at production plants”²⁴⁸.

“The quality of schools changes from school to school, we had a very good one in Krakow, but others were not that good. The major problem is with teachers, which sometimes are not well-trained to be teachers”²⁴⁹

“vocational and technical schools are not able to provide the so-called "practitioners" who are able to take a tool in their hand and do something with it, as well as practical knowledge and a practical approach are at a very low level”²⁵⁰.

Interviewees have commented on the loss of connection between steel works and vocational training infrastructure from 1990 – Figure 40. Currently, few of steel works have internal vocational centres. Besides internal training centres, the problem seems also to be the lack of strong links with schools. Also, companies themselves not always engage with schools at upper secondary level (like technical and vocational schools). Since metallurgy relies heavily on practice and experience the loss of connection between training and workplaces is a problem that still needs to be addressed (Interview notes, Trade Union representative, Poland). In contrast, the pre-1990 set-up of VET, deeply embedded in the production system, was praised as success factor of the past and something it is trying to rebuild, although through very different means.

“I remember the time when my colleagues were in the professional secondary schools, it was like three days teaching in school and two days the real shop floor practicing [...] and after three years, it was the young professional worker with skills to use a lot of up-to-date

²⁴⁷ Interview transcript, steel industry expert, Poland

²⁴⁸ Survey response, Support Manager in steel company, Poland.

²⁴⁹ Interview notes, Training Officer in steel industry, Poland.

²⁵⁰ Survey response, Line Manager in steel company, Poland.

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machines and technologies. [...] I know the German system quite well and they have something like that, even for engineers, the real industry practice or apprenticeship is necessary”²⁵¹.

This, however, requires facing now a different type of problems, since, as it has been noted, the costs for offering in-company training can be very high and companies fear the risk of poaching and losing their investment.

“Some of the companies, they started with this and they launched again similar activities, but is very expensive. And it is a big responsibility because these are still youngsters. You know, the law, and the rules, and the documents: this is a 16 years-old person, so you must give him additional equipment, must be only the day shift, specific conditions, etc, etc.’ A lot of rules and requirements. And the companies when they start counting the cost and the possible benefits, because they are not sure that after they spent a lot of money to train the young people, they will start the job”²⁵²

One of the most important challenges that the new reform needs to tackle is the low popularity VET has acquired during the years:

“The general feeling is that the level of education in fields related to industry is constantly lowered. Vocational schools are not popular, the problem is the lack of candidates and their usefulness. Universities and technical secondary schools are in a slightly better position”²⁵³.

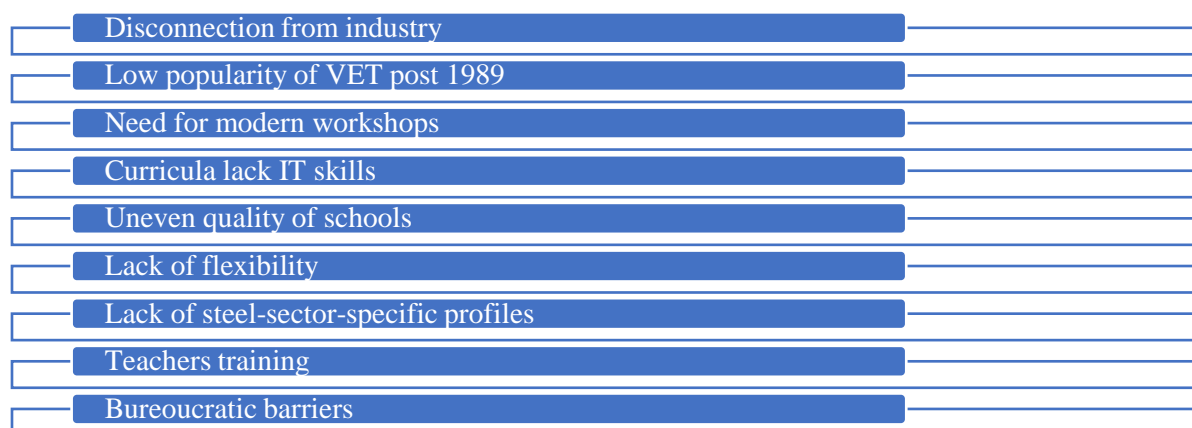
Some VET providers have stressed the idea that, in order to meet the expectations of both learners and companies, a better management of VET networks will be required, and also the participation of employers, in various bodies, e.g. chambers and councils. The strategy should consist in the cooperation of vocational training institutions with employers, consisting in retrofitting the former with modern equipment, professional internships for teachers (for familiarisation with the latest technologies used in industry), apprenticeships and placements for students (Survey response, VET providers, Poland). Another important point, stressed by some interviewees, is the need for more flexibility and timely adaptation of programmes and curricula to the technological advancement and the labour market demand, in so underlining some rigidity due to strict regulations. Furthermore, it has been remarked on the need to adopt system solutions that would help employers in dealing with placements and apprenticeships: “ready-made documentation that can be used, as opposed to the current situation where system solutions oblige the employer to prepare documentation, organise and finance vocational training of young people” (Survey response, HR Officer in steel company, Poland).

²⁵¹ Interview transcript, steel industry expert, Poland.

²⁵² Interview transcript, steel industry expert, Poland.

²⁵³ Survey response, Support Manager in steel company, Poland.

Figure 40 – Remarks on Poland’s VET as emerged from the fieldwork



4.5.6 Feedback mechanisms

Overall, the Polish system can also be considered as based on a “statist” feedback mechanism model, similarly to the Italian one. At a lower level of abstraction, some specific programmes are listed below.

The system of sector skills councils, launched in 2016, covers knowledge about current needs in various sectors and enable the demand for competences and qualifications to be anticipated:

- The Programme Council on Competences (*Rada Programowa ds. Kompetencji – RPK*) consists of representatives of ministries, training institutions, social partners, universities, non-governmental agencies, as well as labour market stakeholders. The RPK mainly focuses on building cooperation between the education community and entrepreneurs; it also encourages the development of sector councils and implements recommendations in the areas of science and education.
- The Sector Skills Councils are the central part of the system. Currently, there are seven active councils in the following sectors: health and social care; construction; finances; tourism; motorisation and electromobility; fashion and innovative textiles; ICT. Their main aims are:
 - to collect information from various labour market stakeholders and recommend systemic solutions and changes in the area of education;
 - to stimulate cooperation between education providers and employers;
 - to provide support in identifying and anticipating competency needs in a given sector.

Deficit and Surplus Occupation Monitoring

Since 2005, the Deficit and Surplus Occupation Monitoring survey (MZDiN) has been conducted by county and regional labour offices as well as the labour ministry. In 2015, a new methodology was applied – the survey is based mainly on the IT systems’ data of employment offices (on unemployed persons, reported vacancies, providers offering professional activation services), studies of online job offers, information obtained from employers in a questionnaire

study, data from the Statistics Poland and the School Information System. Since 2015, the ‘Occupational barometer’, previously implemented in the Małopolska region, also started to be implemented in the whole country, conducted by the regional labour offices. It is a qualitative short-term (annual) forecast providing information on deficit and surplus occupations.

The annual forecast of the demand for employees

The forecast of the demand for employees in vocational education occupations was introduced in 2018 as a new tool to help shape the vocational education and training offer. Starting with 2019, this forecast will be developed annually and published in the form of an announcement by the Ministry of National Education. The forecast will be based on analyses conducted by the Educational Research Institute using various data sources. The forecast will impact VET financing.

Developing occupations within the classification of occupations

The introduction of new occupations to the classification is regulated by the Education Law. The classification of occupations is determined by the education minister in cooperation with the relevant ministers responsible for a given sector of the economy, who can submit their requests to include particular occupations in the classification. To anticipate labour market needs, representatives of employers and employees are consulted during the development stage of the classification. Professional associations, organisations of employers, sector skills councils, social partners and other stakeholders’ organisations can submit their proposals to the relevant minister to establish a new occupation; in this way they shape the educational offer of the formal VET system. After the proposal has been approved, the education minister includes the occupation into the classification and appoints a working group to design the core curriculum for vocational education for that occupation.

Designing the core curriculum for vocational education

The education minister appoints a working group to design the core curriculum for vocational education for new occupation. The working group contacts the institution which submitted the proposal for the new occupation to determine the learning outcomes, and then undertakes consultations with other experts in the field. At this stage, occupational standards, which are developed by the labour ministry, are considered. The decision on the occupations offered by a given VET school is made by the school principal in agreement with local authorities (at the county level of government) and after asking the regional labour market councils (advisory bodies) for their opinion concerning compliance with labour market needs. Regional labour market councils shall take into the account the forecast of the demand for employees in vocational education occupations.

Modernising VET curricula

In order to improve the labour market relevance of VET education, the education ministry together with the Education Development Centre, has implemented an ESF co-funded project ‘Partnership for VET’ focusing on developing partnerships in vocational education and training in cooperation with employers and other social partners. In the first phase of the project, a social partner forum was established - 25 sectoral teams of social partners were set up to better adjust VET to labour market needs, and particularly to recommend changes in the vocational core curricula and classification of occupations. In the following years, stakeholders prepared changes in numerous VET curricula and developed new curricula. Numerous teaching plans and programmes, career development paths together with diplomas and qualification supplements in Polish and English were also designed. By February 2018, 1,048 employers actively participated in the project.

4.5.7 Good practices

The Voluntary Labour Corps (*Ochotnicze Hufce Pracy – OHP*) is an organisation specialising in supporting youth at risk of social exclusion and unemployed under 25 years old, overseen by the labour ministry. The organisation offers young people over 15 years old without lower secondary education, the possibility to attain vocational qualifications and/or to supplement their education. Currently it has over 214 Corps agencies (2019) providing young people with the opportunity to complete their education and acquire professional qualifications before entering adult life. The Voluntary Labour Corps provide training in 64 professions, both in their own workshops or as on-the-job training with an employer. All students with low/no income receive free meals and accommodation during the education period. Students also receive guidance and pedagogical support. Each year, over 800,000 young people receive various forms of help from Corps agencies including individual psychological support, group workshops for active job-seeking, vocational courses, vocational courses offering certified qualifications, language courses, European Computer Driving Licence (ECDL) course, driving course, entrepreneurship course, assistance in finding jobs and organising traineeships, as well as traineeships offered by employers.

The University Study-Oriented System (called USOS) is a student management information system used in 70 Polish universities, technical universities, higher vocational institutions, university schools of physical education and other types of high education institutions. Among these schools are top public universities in Poland, like the University of Warsaw, Jagiellonian University from Kraków, Adam Mickiewicz University from Poznań, and Nicolaus Copernicus University from Toruń.

From the functional point of view USOS is a software information system supporting management of higher education at university level. What makes it unique is the, unification of services at country level and integration achieved from effective cooperation between universities who jointly develop and deploy the system on a scale hardly to be found anywhere in the EU. It is the only system of that kind in Poland, being built by universities for universities, with a business model acceptable to even the smallest institutions.

This cooperation creates new quality in administration of education, since existing processes, rules and documents are discussed, changed, unified, before getting computer system support. System development is driven by user needs reported daily to system developers. Lobby of universities can influence existing law, as some examples demonstrate. Such cooperation has an impact not only on administration of education, but on education itself, mainly by supporting transparency and comparability. These aspects can be regarded as good practices to notice and disseminate.

Building and deploying the university information system is a lifetime project, which never ends. New needs arise every day, law changes, priorities are re-evaluated, development of information technologies creates new possibilities. The project of that kind should always be regarded as work in progress.

“Some good practices are starting to be established, like an online platform between vocational schools and companies to exchange information. This, if implemented fully, should provide a good basis for relaunching the collaboration between companies and vocational schools”²⁵⁴.

4.5.8 System trend

In summary, as regards VET trends, Poland’s VET system appears to have made a U-turn in recent years. The system has experienced a progressive and continuous academic drift starting from the early Nineties, with the transition to a market economy. The former cornerstone of the Polish VET system, namely the direct links between enterprises and VET schools, were disrupted” (Cedefop 2020, p. 87) since employers did not see a need to invest in vocational training, nor to support the system anymore. This drift produced a number of consequences: the vocational offer became inadequate to the needs of the labour market, curricula became outdated, and training facilities poorly equipped. This produced even more depreciation of VET in the general public, leading to falling numbers in enrolments (from 78% in 1990 to 58% in 2017) (Cedefop 2020). However, in recent years, employers’ attitudes towards VET appear to have changed and there seems to be a greater will to support the system (Ibidem), as also our interviews have shown. The reforms started in 2016 and still ongoing point to a change in the trajectory, with a stronger emphasis on dual training and collaboration between VET providers and businesses. In this sense, the Polish VET system might experience in the coming years a counter-drift towards vocationalisation, although it is too early to make final claims.

²⁵⁴ Interview notes, Training Officer in steel industry, Poland.

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SECTION V – Concluding remarks

5.1 Where are national VET policies heading?

As a summary and conclusion of this report, we list the main trends identifiable from a comparative overview of the VET systems under study. The insights summarised in this section are reviewed and further discussed in Deliverable 4.5, *Sector Skill Framework*, which serves as an executive summary of all the deliverables produced under WP4 and lists several recommendations for the industry in relation to vocational education and training.

In a recent study, Cedefop (2018d) observed a certain degree of convergence in VET reforms across the EU over the last two decades. The most common reform packages have consisted of strengthening the ties between VET and the labour market (through involving employers more in the design of the qualifications), relaunching apprenticeships as a way to anchor training to actual jobs (some form of ‘duality’), broadening courses contents to equip learners with more transversal skills, and extending and strengthening VET provision at post-secondary and tertiary level (also establishing routes for continuation into academic degrees). These trends re-surface to some degree in recent VET system reforms in our five case study countries, although there are country-specific differences, mainly depending on the ‘starting position’ of the respective VET systems. Persisting differences between systems reduces the likelihood that complete harmonisation is possible in relation to the addressing of skill needs. Particularly, differences between the UK and elsewhere in Europe, but also differences between other case study countries are notable. Such differences have long been noted within the academic literature (e.g., Busemeyer and Vossiek 2016) and result in quite different patterns of skill formation and the way skills needs might be addressed.

Most commonly, reforms consisted in the following:

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

Some comments on the trends observed are summarised in the following points:

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- The problem of skills mismatches has been addressed in all the case study countries through a more direct engagement of social partners (especially employers) in VET provision as well as in the existing feedback mechanisms. This does not apply to Germany where a solid and long-lasting cooperation has already been in place in VET.
- Systematic reviews of vocational qualifications are needed to ensure that contents are up-to-date and vocational profiles are still relevant for the labour market. This is particularly relevant in light of the accelerating pace of technological change. In Germany, for instance, the screening of occupational curricula for metalworking and electrical qualifications led to the introduction of a specific learning module on digitalisation of work, data protection and information security (*Digitalisierung der Arbeit, Datenschutz und Informationssicherheit*). It also led to additional content on environmental sustainability, occupational safety and labour law. In Italy, the review of vocational profiles completed in 2019 produced a more nuanced catalogue of national profiles with more adequate technical requirements (e.g., automation, production line programming etc.), and strengthened the transversal skills component.
- The gap between formal training and work experience was a shortcoming of Mediterranean countries' VET systems. Also in Poland, the recent economic developments have broken the link between companies and VET providers. Recent reforms in all these countries have introduced dual apprenticeship schemes, with the aim of shortening the distance between formal training and workplace-relevant skills acquired directly on the shop floor. This results in an attempt to shift the whole system towards a more collective type of skills formation. In the case study countries, dual options are often available from upper-secondary to tertiary education. However, in some countries such options are still marginal (e.g. Italy and Spain).
- The competence of VET trainers is considered another strategic leverage to relaunch the attractiveness of vocational education and training. In different systems new programmes and curricula have been introduced (like “ITS” in Italy, “T levels” in England) which require the participation of professionals from the specific sector as trainers and a relevant on-the-job training component. The importance of training the trainers was stressed also in the 2016 reform of the Polish education and training system.
- Permeability and flexibility of the paths have been enhanced through better connecting IVET with higher-level programmes and higher education (though these routes are still not particularly popular). This aims to avoid dead ends and to reduce the divide between different programmes, allowing for more flexible and adaptive paths (also in consideration of an increasing need for re-training mechanisms).
- All the considered countries have developed their own National Qualifications Repertoires and have undergone the process of referencing it to the EQF (except Spain). This increases transparency and cross-national comparability of qualifications through referring them to common and understandable descriptors.

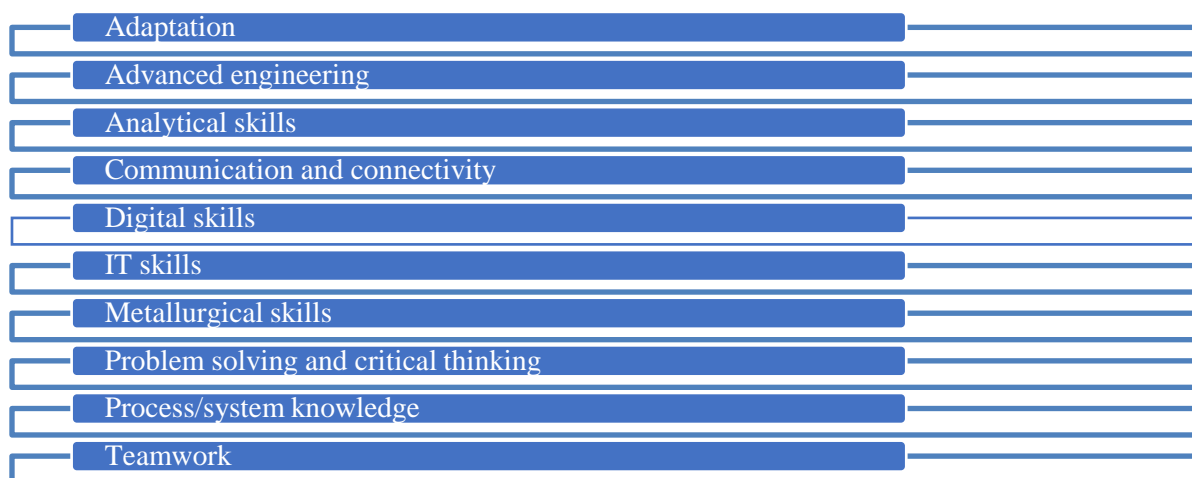
- Rapidly changing industrial landscapes and labour markets require not just timely but coherent and strategic responses. The VET system comparative analysis shows a latent tension between fast responses and mid- to long-term incremental adaptation. This appears to be exemplified by the cases of the United Kingdom and Germany. While fast responses might lack coherence and do not point to a long-term strategy (and could result in undermining trust in, and value of, VET), too rigid (and unidirectional) vocational paths have shortcomings in meeting the flexibility required by labour markets.
- This tension is reflected also in a different vision of occupational standards. In liberal market contexts, such as the United Kingdom, employers increasing importance in updating and designing new qualifications might lead to a proliferation of narrow-defined occupational standards. This, in turn, might undermine the capacity of the system to deliver what ESCO defines as skills with higher degree of reusability, so limiting workers as well as businesses' resilience. The German concept of “vocational action competence” (*Handlungskompetenz*) and vocational principle (*Berufsprinzip*), instead, seem to point towards a more holistic vision of the occupation and its associated competencies.
- Another criticality concerns the degree of fragmentation of a VET system. Where governance is complex and localised, the consistency of the whole system and its capacity to align with a national (long-term) strategy might be undermined. Where the system is more fragmented, policy structures are both more complex and more unstable (e.g., the constant renewal the UK VET), and this can inhibit employers and learners' engagement and trust. In countries as the UK, the needs of different groups of learners are met through a highly diversified offer. Part-time and distance learning options are also available. Though considering a wider training offer as a positive feature, the overlapping of many qualifications in a highly fragmented system, may cause confusion among learners.

5.2 Overarching insights emerging from the fieldwork

To conclude this section, we offer some reflections on the insights emerged from the fieldwork. Figure 41 below shows the ten most mentioned skills and knowledge needs in the steel sector in the ESSA case study countries. While certain sector specific skills and knowledge remain important gaps to address (metallurgical skills, advanced engineering), most of the common needs and gaps appear to be located in the area of transversal skills and to emerge directly from the digitalised, interconnected and lean processes that characterise Industry 4.0.

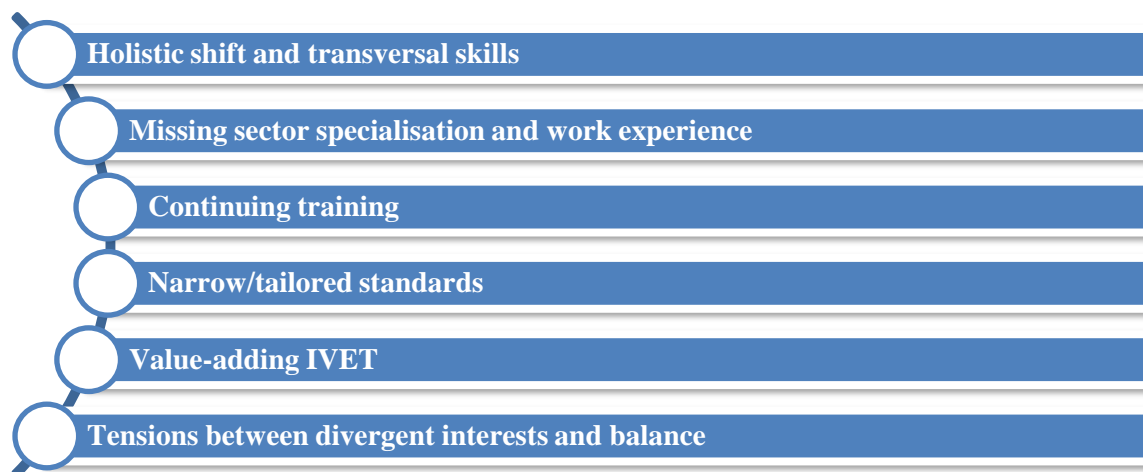
Communication and analytical skills appear to be particularly relevant. Communication skills allow for that “connectivity” between different roles and departments that is an important requirement of smart companies and that allows to go beyond traditional occupational boundaries and understand different professional views and jargon. Analytical skills seem also to be of great importance since in a digitalised environment data are produced continuously and workers (at different levels) need to make sense of them in relation to the processes they are involved in. Also, problem solving skills and adaptation are likely to be more and more required in the future as a direct consequence of technological innovation and organisational transformations.

Figure 41 – Ten most mentioned skills and knowledge needs emerging from fieldwork



As regards more general reflections on VET and its functions in relation to the sector, these are summarised in Figure 42. Each point is addressed below and could be considered as a possible starting point for further discussion on the relation between VET systems and industrial sectors.

Figure 42 – Insights emerged from the fieldwork



- a. Technological development is producing more complex and integrated (both horizontally and vertically) workplaces. The need for a stronger process and system knowledge was indeed one of the most common remarks coming from the respondents. There is an urgent need to overcome the parceling out of competencies and embrace a more holistic approach to occupational training. The German concepts of *Berufsprinzip* and *Handlungskompetenz* seem to go in this direction. The need for a holistic approach to training is consistent with the main finding of the fieldwork in relation to skills needs, namely the increasing importance of transversal skills outlined above. It appears more and more important that these skills are integrated in vocational curricula in a T-shaped structure, and complement the technical competencies in an organic manner.

- b. Vocational qualifications at any level are strengthened when coupled with actual work experience. This need was again remarked by companies' representatives as well as unions' representatives. In-company training, in the form of placements or dual apprenticeships, can help to tailor skills and competencies to the industrial environment that is specific of a sector or a company, remedying to scarce sector customisation at the IVET level.
- c. Completing IVET and obtaining a vocational qualification cannot be considered anymore the final goal, rather the first step in a lifelong commitment to learning. The pace and width of change in the workplaces require systematic upskilling (or re-skilling). In this respect, IVET acquires the status of foundational training, on which everyone could build more specialised and up-to-date competencies. Being foundational, IVET needs to be broad in its scope and balance technical and transversal skills.
- d. Although employers' participation in the design of vocational standards for qualifications is important, allowing employers to have a central role in this respect without including also the workers' representatives could lead to a proliferation of narrower occupational standards. This would limit the breadth of learning that would afford both protection and resilience to workers. This is in contrast with the foundational understanding of IVET as in point c.
- e. In addition to the previous points, some noted that the goal of IVET is to provide a cultural advantage. The role of schools and VET centres was considered that of producing knowledge and competencies, and to foster ideas. Although in-company experience is recognised as important, where curricula are too much tailored to sector or company needs, this might cause a diminishment of the innovative potential of prospective workers. These considerations apply particularly to technical roles, involved in departments that thrive on innovation, but have also wider implications. It was remarked the importance for companies to build an internal social fabric, including all level of workers, that could resonate with technological concepts and innovation to allow major transformations.
- f. To conclude, the points listed above show that there are somewhat divergent interests that VET needs to recompose. This produces a tension between company needs, workers', and governments' ambitions reflected in VET. Companies often remarked the need for more specialised training in metallurgy and steelmaking. However, the IVET as a societal institution is expected produce knowledge, skills and competencies needed to act in different domains of society. Finding the right balance through a better coordination of all parts could be the key challenge in the coming years. Offering workers and employers' vocational qualifications that are solid and incorporate a balanced diet of technical and transversal skills, and a reasonable time to spend in company in order to adapt their skills to companies' requirements is the goal that national VET systems will have to reach.

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