Preparing for a Digital Steel Industry: What Challenge for Skills Formation Systems?

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1 Introduction

Since the beginning of industrial society, innovation has always been central to industrial revolutions. What is currently considered to be the 4th industrial revolution (also referred to as Industry 4.0) relies on innovations such as ICT and robotics (bridging the 3rd and 4th revolutions), and recent concepts, such as the Internet of Things, Cyber-Physical Systems, Cloud Computing, Big Data and Artificial Intelligence.

Although Industry 4.0 has a core production dimension, it is also a social phenomenon and is changing the way work is organised, along with how goods and services are produced and supplied. While there is perhaps a consensus within politics, industry and academia that these technological and organisational changes have profound implications for the kind of skills, competencies and qualifications that are needed in the future, there is less agreement about what the future of work is going to look like and how jobs are going to be changed. As Martinaitis and colleagues (2021) pointed out, three scenarios have coexisted in the academic literature: deskilling (Braverman 1974), upskilling (Acemoglu 2002; Goldin and Katz 2008) and polarisation scenarios (Goos et al. 2014; Autor 2015). While the first suggests that segmentation, standardisation and automation of work have gradually caused a deskilling of labour across occupations, the second scenario offers a

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much more optimistic view where technological progress results (almost deterministically) in a higher demand for skills and qualified workers (Skill-Biased Technological Change or SBTC). The third scenario maintains a less monotonic relationship between technology and skills, offering evidence that the mid-skills segment is the one most affected by technological substitution, consequently increasing relative opportunities in the low- and high-skills end.

The divergence in the literature highlights how the exact outcomes of these processes are still uncertain and open to investigation. However, it is largely undisputed that as industries adapt to extensive automation and digitalisation, the composition of jobs will gradually change. With polarisation or upskilling being the most likely effect, workers will be required to possess wider and qualitatively different skillsets from what was the case in the past.

In this chapter, we discuss the implications of such processes for the European steel industry and the response of vocational education and training (VET) systems to emerging skill demands. This chapter draws on the findings of the Erasmus+ project 'Blueprint "New Skills Agenda Steel": Industry-driven sustainable European Steel Skills Agenda and Strategy (ESSA)' (please refer to Chaps. 1 and 2 of this volume for an overview of the project) and on the discussion of institutional models and response types previously elaborated in Antonazzo et al. (2021).

The ESSA project had a Europe-wide focus and primary data were generated through semi-structured interviews and questionnaires in five countries (Germany, Italy, Poland, Spain and the United Kingdom). Overall, we collected 60 responses from steel companies' representatives (HR managers, production managers, training centre managers), VET providers, trade union representatives and steel industry experts. The interviews were conducted between April 2020 and March 2021. Due to the Covid-19 pandemic, the interviews were conducted remotely and usually lasted between one and two hours.

In the remainder of this chapter, we first introduce the concept of institutional models and institutional complementarities (Hall and Soskice 2001; Amable 2009), and then we present our findings on emerging skills needs in the ESSA case study countries. Finally, we look at recent reforms introduced in three of the ESSA case study countries (Germany, Italy and the United Kingdom) to respond to skills challenges. In doing so, we aim to draw attention to the fact that to support the steel industry's transition to 4.0, VET policies need not only to address skills gaps but also to consider the interplay between the reforms newly introduced and pre-existing institutions. This interplay can result in a disconnect between policy expectations and outcomes, as we will try to show.

2 Why Do Institutions Matter in VET?

In the social sciences, an institution is understood as 'a set of behaviours patterned according to one or more variously codified and differentially enforced rules' (Burke 2011, p. 321). Within the Varieties of Capitalism (VoC) framework adopted here (Hall

and Soskice 2001), institutions are described as 'a set of rules, formal or informal, that actors generally follow, whether for normative, cognitive, or material reasons' (Hall and Soskice 2001, p. 9).

Societal institutions are shaped by their historical path. Once considered in their joint combination (this concept is referred to in the literature as 'institutional complementarity'), institutions are deemed to make up coherent models, which can differ deeply from one another. The idea of institutional complementarity entails that, in such coherent models, the presence of a specific set of institutions in one sphere of the economy can raise the returns from corresponding institutions in other spheres (for instance, consider the relationship between labour market regulation, industrial relations and skills formation).

The concept of institutional complementarity is at the core of VoC. Hall and Soskice distinguish between Liberal Market Economies (LMEs) and Coordinated Market Economies (CMEs). The first, exemplified by countries like the United States and the United Kingdom, is characterised by the primary role of market competition in regulating the relations between firms, and in other spheres of the political economy. This is argued to lead to short-termism in economic strategies, investments seeking high returns and short payback and to be associated with low levels of trust between firms (and between firms and other actors). CMEs, usually exemplified by Germany, are characterised instead by a more pervasive regulation and strategic interaction over economic dynamics. Here, firms are strongly linked with one another through sectoral associations and engage in more strategic forms of interaction with social partners. Opposite to LMEs, the institutional setting of CMEs encourages companies to adopt longer-term strategies and to be less dependent on financial markets and their fluctuations.

From a skills perspective, it is maintained that employment protection and coordinated wage bargaining in CMEs tend to encourage workers to commit to a lifelong career and to develop more specialised skills. In LMEs, instead, the absence of such institutions seems to incentivise workers to invest in more general and portable skills to better cope with the risks of market fluctuations and job loss. In parallel with this, it is argued that companies tend to adapt their business strategies to the pool of skills available to maximise their competitive edge (Estevez-Abe et al. 2001). In this way, while firms located in LME would tend to rely less on technology requiring specialised skills, firms in CMEs would engage more in production that requires skilled labour thanks to its availability.

VoC is a dichotomic framework contrasting LME and CME, which presents its limitations when applied, for instance, to Mediterranean or Eastern European countries. Thus, scholars have worked on widening the research on Comparative Capitalism (CC) by proposing more nuanced typologies. One such typology includes indeed Mediterranean capitalism (Amable 2009), exemplified by Italy and Spain, and described as based on more employment protection and less social protection than CMEs (Amable 2009). The Mediterranean model is deemed to rely 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 and Giachi 2018, p. 24). Product market competition is considered to be relatively low here, and the workforce

to possess limited skills and level of education, which does not allow for the implementation of a high-skills/high-wages industrial strategy (Amable 2009). Overall, this institutional model is deemed to provide scarce incentives for upgrading the skills of the workforce, thus hindering potential pathways for innovation.

3 An Overview of Emerging Skills Needs in the Industry

As other chapters in this volume well illustrate, it is becoming evident that the European steel industry is progressively moving towards Industry 4.0 (Estep 2017) with firms starting to employ (although at a different pace) IoT, sensors and big data analytics to improve energy efficiency and resource management, as well as for quality monitoring and defects detection (Murri et al. 2021). Such developments are confirmed by the interviews we collected from the five case study countries (Germany, Italy, Poland, Spain and the UK). A Head of a company training centre in a German steelwork, for instance, underlined the advantage given by extensive generation, storage and analysis of data to act and improve processes or plan a recurring intervention on machinery based on sensor data and computer simulation.

Such developments are reflected in qualifications requirements and expectations regarding workforce skills. While perhaps not at the forefront of Industry 4.0, expectations concerning future competence and skills requirements resurface repeatedly in steel-sector-specific research (e.g. Evans and Stroud 2016; Stroud and Weinel 2020; EC 2020) as they do in our interviews with steel industry representatives. There is, indeed, an expectation that change is both continuous and accelerating, with consequences for vocational education and training:

> Back in the day, apprentices were referred to as *Ausgelernte* which literally means "someone who has completed his/her learning". Nowadays, apprentices are referred to as *Ausgebildete* which means 'someone who has been trained'. The term *ausgelernt* suggests that you are done, finished learning and the rest of your work life is applying what you have learned. Today, an apprenticeship is just your 'initial qualification', one that will be added to throughout your working life (HR manager, Germany).

> Technical progress and process automation require employees to learn and improve their qualifications practically continuously throughout their professional career […] the employer will expect employees to have the skills to continuously improve their professional qualifications (HR officer, Poland).

The data collected allowed us to identify a list of the ten most common skills and competence needs, grouped in three categories, that resurfaced in the five ESSA case study countries, and which can offer an illustration of what industry representatives think needs to be tackled by current (and future) VET programmes (Fig. 1).

Transversal skills appear to be an important concern for the industry as it counts five skills out of the ten most cited. To start, adaptability appears to be critical in the context of a transforming industry:

> This is probably an internal thing; it is about people adapting to change. It's a key thing for us […] the change in the mindset (Training advisor, United Kingdom).

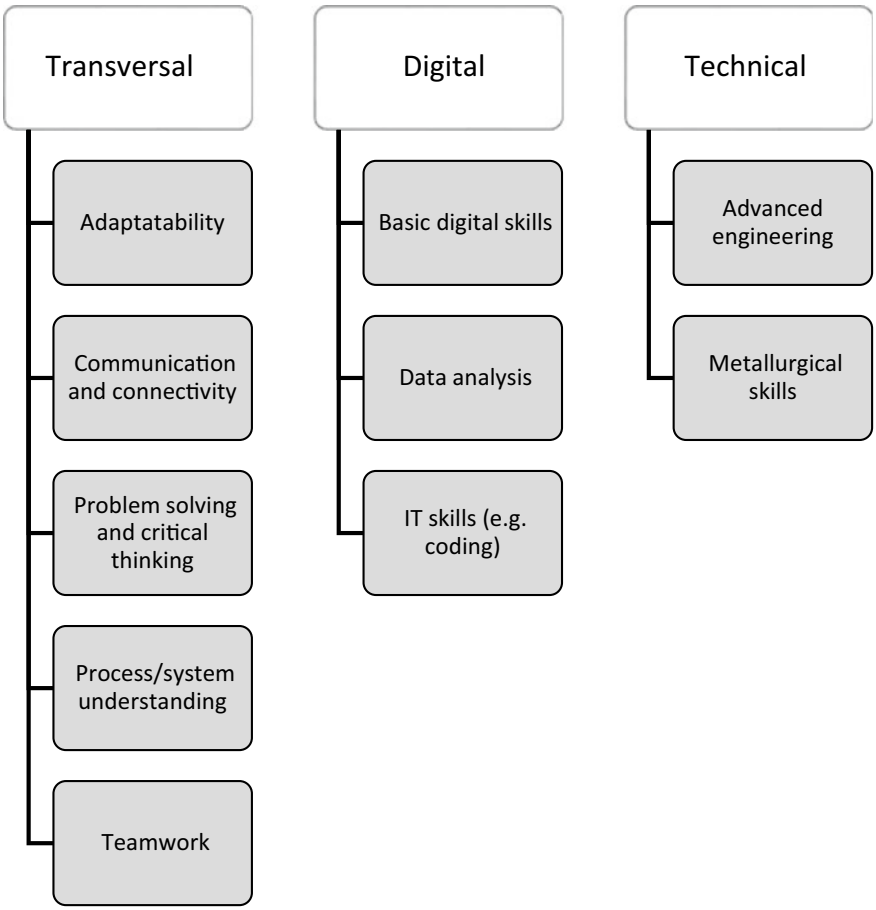

Fig. 1 Ten most cited skills and needs in the ESSA case study countries

There is an increased importance of process and system understanding, which stems from the increasingly integrated character of production processes and the use of digital technologies that render processes less visible and harder to grasp (Zinke 2019). In a more complex and interconnected environment, process and system understanding becomes more important to ensure the smooth running of production processes:

> [they] ensure that apprentices have a contextualised understanding and get the plausibility of what is happening. […] Normally metal workers will not learn PLC [Programmable Logic Controller], 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 to educate them deeply in these areas. Rather, the point is that they have what I call 'overview knowledge' (Training centre manager, Germany).

> They need to acquire general process knowledge, they need to know first of all the overall processes and what are the different outcomes of these before starting to manipulate the real controls of machinery and interface (Training officer, Poland).

The importance of understanding wider processes and how systems operate is crucial also for understanding knock-on effects down the production line:

> [what is important is] 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 to my customer? Because it's a chain at the end of the day (Training advisor, United Kingdom).

The increased importance of personal and social skills is another recurrent theme in the data. Skills such as problem-solving, decision-making, communication and teamwork appear to be highly valued in the modern steel company:

> Decision-making process and problem-solving are always key things for us. And I think the two go sort of coupled. […] Especially with the structures we have now, a lot flatter. The teams are more flexible (Training advisor, United Kingdom).
>
> Technical competencies will be very important […] 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 (Training officer, Poland).

In light of the need for continuous and smooth upskilling of workers, skills such as literacy, numeracy, comprehension and logic, play a crucial role, as they are deemed to provide the grounds for continuous learning:

> But the core, and this is the core of occupational education, is to develop personal and social competencies. Because if we have developed those then people are in a good position to acquire other kinds of competencies, knowledge and skills on their own (Head of training, Germany).

Certainly, digital skills will be of unquestionable importance for metal and machinery workers (Cedefop 2019), and will need to be constantly updated, in parallel with technological advancements. A UK union representative commented on the importance of digital skills for the industry but warned that these need to be built on top of robust foundational skills:

> Digital skills in the UK, you know, the amount of people who do not have basic communication skills, the basic five digital skills,[1] is really concerning actually […] I think that it will be a key barrier to participation in technology in the future […] So, [the problem of] digital 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 and numeracy, how will they then be able to replicate it digitally? (Trade union representative, United Kingdom).

[1] The UK's 'Essential digital skills framework', designed to support providers, organisations and employers who offer training for adults, lists the following five essential digital skills for life and work: communicating, handling information and content, transacting, problem solving, being safe and legal online.

Analytical skills seem also to be of great importance in modern steel companies. In a digitalised environment data are produced continuously and in great volume, and workers at any different level should be able to make sense of them, translate data into real-world situations and act upon them:

> In production, data analysis is fundamental […] In the rolling mill or 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 problems (Trade union representative, Spain).

In addition, and not surprisingly, there is also an increasing demand for more advanced engineering and IT competencies:

> [We need more] highly specialized technicians, mechatronics, with bases of computer, mechanics and electronics that are precious on the market (HR manager, Italy).
>
> 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 (Industry expert, Poland).

While there is much focus on new emerging skills and competencies, this does not mean that traditional job- or occupation-specific technical skills lose their importance:

> And even in 2030, we will educate apprentices in the basics of sawing, filing and welding, and so on. Because, in the end, we need people who can change a pressure roll, who can weld something that needs welding and so on (VET trainer, Germany).
>
> 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 to come from the basics of steelmaking (Training advisor, United Kingdom).

Finally, some amount of on-the-job training is also considered necessary to consolidate and refine the knowledge and skills taught in class or workshops:

> I remember the time when my colleagues were in professional secondary schools, it was like three days teaching in school and two days of real shop floor practising […] And after three years, they were the young professional workers with skills to use a lot of up-to-date machines and technologies. […] the real industry practice is necessary (Industry expert, Poland).
>
> 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 training of the workers (Trade union representative, Spain)

These findings align with those of another recent European project, 'Steel Sector Careers' (EC 2020), which underscored that steel companies would benefit from a more holistic approach to occupational training. There increasingly appears a need to adopt a 'T-shaped' skills approach, including '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' (EC 2020, p. 56).

As requirements like those we described have become more pressing, countries have responded by reforming their VET systems to cope with the new challenges. In the following section, we illustrate recent VET reforms in three of the five ESSA

case study countries (Germany, Italy and the United Kingdom) for clearer contrast, and we discuss them in light of their embeddedness in wider institutional models and their potential implications for the industry.

4 VET Reforms in UK, Germany and Italy

In Europe, VET policies appear to have gone in and out of fashion over time but, increasingly, VET systems have been called upon to address societal challenges stemming from economic and technological transformations. Such challenges have often been tackled by importing 'best practices' from other countries and this is argued to have resulted in some (nominally) common patterns in VET reforms across the EU (Cedefop 2018). Common reforms have consisted of strengthening the links between VET and the labour market, involving employers more in training provision, relaunching apprenticeship schemes, incorporating more elements of transversal skills into the curricula, and extending VET provision at post-secondary and tertiary level.

Turning to our case study countries, the United Kingdom's VET system has been criticised for being fragmented and complex (OECD 2015). The system experiences constant renovation and reform (Pring 2013) and often finds itself at the centre of government rhetoric on skills. Recent VET reforms (also driven by the Industry 4.0 agenda) include England's apprenticeship frameworks being replaced in the period 2018–2020 by new apprenticeship standards developed by sectoral panels of employers. The new standards are occupation-focused, rather than qualification-led, and combine on-the-job training and study. Standards must include a work contract, and at least 20% off-the-job training. The unit-based structure of the previous apprenticeship frameworks has been replaced with a holistic end-point assessment. New standards for metalworkers comprise English and mathematics, subject-related theoretical knowledge (also including environmental and data regulation where relevant) and technical abilities, as well as soft skills such as communication, problem-solving and teamworking.

In addition, the Department for Education rolled out in September 2020 new technical study programmes called 'T levels', aiming to simplify the national VET system and to enhance the credibility of technical qualifications. T Levels are 2-year courses based on the same standards as apprenticeships, designed by employers and approved by the Institute for Apprenticeships and Technical Education. They include compulsory elements such as core theory, concepts and skills for an industrial area, alongside specialist skills and knowledge for an occupation or career. T Levels have been developed to meet the needs of industry and prepare students for entry into skilled employment, further training, or further study. The programme offers a mix of classroom learning and 'on-the-job' training during an industry placement, so meeting employers' demand for earlier work experience. T Levels curricula such as 'Engineering, manufacturing, processing and control', 'Digital production, design

and development', 'Digital support services' seem relevant to the needs of the future steel industry.

Quite different from the UK, the German VET system is well-known for its dual training and the embeddedness of social partners and stakeholders in its governance structure (Clarke and Winch 2006). The German approach to recent VET reforms appears to be rather incremental (or 'adaptive', see Antonazzo et al. 2021). Regarding steel sector vocational qualifications, recent changes were oriented towards filling skill and competence gaps, increasing flexibility within occupational qualification offers and improving the permeability of the system to increase re- and up-skilling opportunities. An example of this type of incremental reform is the updating of the curricula of 11 metalworking and electrical qualifications to meet the new industry and market challenges. The training regulation for qualifications such as 'Mechatronics fitter', 'Production technologist', 'Plant mechanic', 'Electronics technician for devices and systems' have been reviewed and subsequently updated with the involvement of the relevant social partners. In addition, a training 'module' titled 'Digitalisation of work, data protection and information security' (*Digitalisierung der Arbeit, Datenschutz und Informationssicherheit*) has been introduced.

Metalworking occupations have also been updated with training on process integration, system integration, IT-based plant modification and additive manufacturing. Such additional contents were introduced to react flexibly to the different needs of companies and so they are not mandatory for apprentices, but have legally regulated minimal standards that assure quality and transparency across the VET system. More recently, emerging skills gaps related to digitalisation and environmental sustainability have been plugged across all dual apprenticeships by introducing completely new 'standard modules' and by updating and modernising existing modules on labour law and collective bargaining, as well as on occupational health and safety (BMBF 2020).

In Italy, upper-secondary and post-secondary VET programmes were reorganised starting in 2008. As part of a review of the school system, it was decided in 2008 the redefinition and rationalisation of existing curricula. The regulations on the reorganisation of upper secondary schools were subsequently adopted in 2010. Upper secondary technical and vocational schools' curricula were rationalised significantly reducing their number and the overlap between similar ones, and job placements were introduced. Vocational school curricula were further updated in 2017. Curricula such as 'Mechanics, mechatronics and energy', 'Electronics and electrotechnics', 'ICT' and 'Maintenance and technical support', seem to fit well the emerging needs of the steel industry. Technical and vocational schools have also been granted the possibility to customise part of the curricula (20% of the allocated hours) to better tackle the demand of local labour markets.

At the post-secondary level, a new higher technical training programme (*ITS, Istruzione Tecnica Superiore*) was established in 2008. This is collectively organised and run by schools, vocational centres, universities and companies. ITS responds to companies' demand for new and high technical skills to promote innovation. They represent a novelty in the Italian training system as a new strategy connecting education, training and labour policies with industrial policies. This programme

is organised around training areas such as 'Energy efficiency', 'New technologies for made in Italy' and 'ICT', it makes use of I4.0 enabling technologies, and job placement is a mandatory part of the training (at least 30% of the course duration). In addition to this, a 2015 reform established the opportunity for learners to obtain a vocational qualification or a diploma in a dual-training mode (similar to the German dual training) to fill the gap between formal VET and companies and tackle youth unemployment. As regards the vocational qualifications issued at the regional level (*IeFP*, *Istruzione e Formazione Professionale*), the profiles and curricula of these were updated and integrated in 2019 after a two-year review process. This has resulted in strengthening foundational skills across the IeFP curricula and in the addition of new occupational profiles (e.g. 'Digital modelling and production technician' and 'Renewable energy technician'). The Regions also collectively agreed to incorporate personal, social, learning and entrepreneurial competencies into the curricula.

5 Meeting Skill Needs: Different Models, Different Outcomes

To a large extent, the skills and training needs identified within the industry would appear to be addressed by the reforms presented. What we argue, however, is that the outcome of such reforms can only be assessed when considered in their institutional context.

An important debate within the institutional literature concerns the degree of fit between institutions. VoC (Hall and Soskice 2001) assumes that institutions fit tightly and produce coherent and solid economic models (LME and CME). This implies that any reform based on imported institutions (what is referred to in the literature as 'hybridisation') would compromise the stability and coherence of the model and its comparative advantages. While some scholars remark that actual institutional models are more 'slack' than what is maintained by theories like VoC (Amable 2016), there is still agreement on the value of such conceptual lenses in investigating real-world phenomena.

The tripartite arrangement typical of a CME makes it difficult to implement radical changes and adapt quickly to market conditions in Germany. Employers have sometimes expressed concerns on this matter and advocated for some degree of 'hybridisation' of the VET system to enhance its flexibility and better cope with the dynamism of the market. Nevertheless, the German approach is still largely incremental and adaptive. The 'adaptivity' of German VET to industry 4.0, as shown by the example of the metalworking and electrical qualifications, relies on a circular process of reviewing the curricula, identifying changes in processes reflected in occupations, and integrating the contents and skills needed. This type of adaptation can be slower and less flexible but avoids the risk of institutional inconsistencies. The steel companies and the unions' perspectives are brought to convergence through consultation mechanisms that are typical of CMEs, and the regulations for the occupational profiles

have been revised and integrated accordingly. This, we believe, can support long-term upskilling strategies which are critical in light of Industry 4.0 and from which the steel industry and the workforce could both benefit.

Typical of LMEs, the UK is characterised by market-driven VET provision, lack of meaningful trade union involvement, fragmented governance and a tendency to embrace a more radical approach to reforms. Under the pressures created by digitalisation and Industry 4.0, the reforms introduced in the country seem to follow this same pattern. The UK governments have mostly reacted to exogenous pressures when these have become too urgent to be ignored (see Bosch and Charest 2008), often borrowing 'best practices' from other contexts and resulting in institutional hybridisation. This practice has been questioned. For example, some have expressed doubts about the capacity of the new T Levels to engage employers on a larger scale (Williams et al. 2020). This is consequential to the absence of an institutional tripartite arrangement. Where inter-firm relations are characterised more by competition than cooperation, occupational standards defined by a panel of employers might not be widely recognised. Furthermore, as LMEs are associated with a higher heterogeneity of interests, employers' panels are likely to represent the interests of large companies, over those of SMEs.

The new apprenticeship standards in England attempt a shift from qualification- to occupation-based training and to reach some level of coordination between government, employers and VET providers. In this respect, this seems an attempt to shift away from LME's typical market-driven VET. However, the reform lacks the trade union component, which plays an important role in CMEs (see Turbin 2001). This results in an imbalance of employers' influence over VET contents. Such an imbalance could lead to a proliferation of narrow occupational standards, limiting the breadth of learning that would afford protection and resilience to workers (Cedefop 2018). The reforms would require the government to play a more active role in harmonising employers' and workers' expectations, as well as the involvement of trade unions in a tripartite mechanism. Overall, while the reforms described for the UK (particularly England) seem to move in the direction of meeting Industry 4.0 requirements, their actual implementation runs the risk of low engagement both on the side of employers and workers. In turn, this risks undermining the capacity of the UK steel industry to stay on track with the technological changes and cause an imbalance between skills demand and supply.

As regards Italy, the country's approach to VET reforms seems to be mostly incremental with some limited structural changes happening over the last 15 years. The organisation of vocational education and training has not undergone major structural reforms, except for the introduction of the new post-secondary ITS programme in 2008 and the dual training experimentation in 2015. These reforms created some hybridisation since co-delivery and dual training are not typical of the Mediterranean model (where education and training have been tendentially school-based). As regards the review and updating of national standards for the regional IeFP qualifications, this can be considered an example of incremental reform, which has assured that curricula remained fit for purpose and that the IeFP programme maintained its consistency and recognisability within the national VET system.

The fact that ITS courses are more present in the north still reflects a divide in the country. The same geographical asymmetry has been observed for dual apprenticeships (INAPP 2018). Consistently with the Mediterranean model, Italy has long relied on the central and regional governments in regulating and running general education and VET. The introduction of higher technical programmes collectively organised and co-delivered at the regional level by schools, universities, companies and local authorities, brings into the Italian institutional architecture new arrangements. ITS programmes and dual training apprenticeships appear to work better in those regions with a dense industrial population, more established social dialogue and long-standing VET tradition. In other regions, school-based secondary VET remains the most popular choice. Thus, the post-secondary and dual training reforms in Italy appear to serve well the steel industry transition to Industry 4.0 in those northern regions in which the local institutional environment better supports the hybridisation brought in by the new arrangements. This risks widening the divide between the innovation potential of companies located in the north and the centre-south with regard to access to a highly qualified workforce.

6 Conclusions

As the European steel industry faces major transformations, it becomes evident that workers need to possess a wider and more varied skill set. Over the last few years, scholars in different fields have offered consistent insights into the changing nature of manufacturing work due to technological innovation, and how skills and competence needs are changing accordingly (Liu and Grusky 2013; Hecklau et al. 2017; Kazancoglu and Ozkan-Ozen 2018; Spöttl and Windelband 2021). Such insights match with the ones presented in this chapter regarding the European steel industry and they could be summarised in the remark that the mix of technical and soft skills and competencies is changing, with digital and soft skills increasing in their relative importance and catching up with technical and sector-specific ones.

It appears that along with Industry 4.0, a new vision of worker is emerging, which has been labelled and defined in several ways, Human Capital 4.0 (Flores et al. 2020), Operator 4.0 (Romero et al. 2016), Workforce 4.0 (Estep 2017). This scenario reinforces the call for a 'holistic shift' (Flores et al. 2020) in vocational education and training to enhance workers' adaptivity to technological change, as well as companies' innovation potential, sustainability and resilience. Skills formation institutions are expected to keep up with these transformations, resulting in VET reforms like the ones we considered for Germany, Italy and the United Kingdom.

What we aimed to show, however, is that reforms do not happen in a void and nominally similar arrangements (for instance, dual training) might not produce the same outcomes when introduced in a different institutional model. Thus, the way reforms fit in with pre-existing institutions plays an important role in shaping their outcomes. VET is embedded in a wider national institutional architecture, which is characteristic of certain models (e.g., CME, LME, Mediterranean capitalism), as we

have shown. These aspects need to be accounted for by policymakers when they aim to support national industrial strategies by reforming VET provisions. Supporting the steel industry across European countries results in not just a challenge of training for the right skills and competencies, but also of reforming systems in a way that optimises existing institutional complementarities and maximises the return for workers and businesses alike.

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