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

Sector Skills Matrix Report

Deliverable D4.3

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Executive Summary

This report serves both as a rationalisation of and a guide to the ESSA Sector Skills Matrix (D.4.4).

The Sector Skills Matrix (SSM) is the outcome of an attempt to systematically identify, evaluate and compare steel-sector relevant occupational qualification programmes in four European countries. The Matrix's intended three main function are 1) to identify steel sector relevant occupational qualification programmes in several (initially five case study) countries; 2) to provide a range of standardised and thus comparable formal information about each identified qualification programme and 3) to provide an assessment of each occupational qualification programme in terms of adequacy of current and future transversal skills provision.

In the authors' view, the Matrix succeeds in two of the three main aims as it identifies steel-sector relevant qualification programmes in four case study countries and provides a range of accompanying information that can help to compare programmes to some extent. It has, however, for practical, 'political' and engagement reasons, not succeeded in producing reliable and trustworthy results with regard to the analysis of current and future skills gaps.

Identifying steel-sector-relevant occupational qualification programmes (OQP) has been relatively straightforward as occupational qualification programmes are – in most European Vocational Education and Training systems (VET) countries at least – standardised enough to be identifiable. The research found that only very few, if any, steel-sector specific OQPs exist, reflecting the increasingly relatively marginalised importance of the sector even in traditionally steel-producing countries. The vast majority of listed OQPs are, however, relevant for a great range of industrial sectors which raises the issue as to whether a sector-specific matrix is useful. The way qualification programmes are organised across most European countries suggests that an 'industrial sector matrix' might be a more appropriate tool.

As VET systems are almost exclusively a domain for national states with very limited influence, coordination or oversight at the EU level, documentation related to the OQPs is non-standardised and therefore hard to compare. For example, some countries specify learning time in hours, while others use months or years as the basic unit. Even when relatively standardised measures such as qualification levels underpinned by the European Qualification Framework are used across European countries, this mostly creates the illusion of compatibility. It is possible, for example, that a supposedly similar Level 3 maintenance qualification is entirely school-based and organised in modular fashion, while in another country, the qualification is non-modular and has strong practical, on-the job learning elements. Thus, while comparability is potentially possible, it requires deep understanding of the various European VET systems to not lead to faulty conclusions.

The third element of the Matrix, the evaluation of current and future skills gap analysis, illumination of the discrepancy between current and future competence requirements and what OQPs currently offer in terms of skills provision, has proved to be the most difficult to establish. The main problem is a lack of industry engagement, without which a industry-led skills gap assessment is simply not possible. There are, however, good sociological reasons for this lack of engagement that continued attempts to establish similar skills gap assessments should take into account. Even with greater or complete industry engagement,

it is still questionable whether a SSM-based skills gap assessment can have the anticipated practical value. The main reason why this is doubtful is related to the 'politics' and organisation of VET systems. Apart from the hyper-fragmented VET system in the UK, which can effectively cater for the specific needs of individual companies, most VET systems across Europe do not allow specific sub-sectors (e.g. the steel sector as a sub-sector of industrial or manufacturing sectors) to exclusively influence the curricula of OQPs as these tend to have relevance for a number of such sub-sectors. While this limits the flexibility for particular sectors to shape VET curricula and thus the usefulness of a sector-specific skills gap assessment, it prevents the fragmentation of VET systems which can have many undesirable effects.

While the Matrix itself is a separate deliverable (D4.4 and uploaded to *steelHub*), this report provides the context required to understand how the Matrix has been constructed, what it can and cannot do and how to use it. Section 1 sets out the rationale for the Matrix in light of the ESSA project proposal and explains some of the terminology used throughout the report. Section 2 clarifies the intended capabilities and functions of Sector Skills Matrix and identifies a range of potential users. Section 3 provides a description of the Matrix structure and content, including an explanation of the overall design choices and definitions of the categories along the horizontal and vertical axes of the Matrix. It also sets out the general approach and the tested methodologies that underpin the attempted skills gap assessment across all included occupational qualification programmes in the four case study countries. Section 4 presents the outcomes of skills gaps analysis related to current and future needs within the steel industries in four case study countries. Section 5 will conclude the report with a number of forward looking recommendations.

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1. Description and Interpretation of Deliverable 4.3

1.1 Overview and rationale

In line with the ESSA Project Proposal, this report constitutes Deliverable 4.3 which takes the form of a Sector Skills Matrix (SSM) Report. The Report will set out:

- Interpretation of Deliverable and related Tasks in light of available VET system information in case study countries
- anticipated functions and users of the SSM
- a descriptive guide for users including methodological guidance
- Findings in the form of a transversal skills gap analysis as well as continental and country-level recommendations

The SSM itself constitutes the separate albeit closely related ESSA Deliverable 4.4 and takes the form of an Excel database, which is uploaded to *steelHub* (the worldsteel, steel university training course repository).

1.2 Interpretation of Deliverables and the related Tasks

The ESSA project proposal prescribes Deliverable 4.3 to take the form of a report and describes the content as being chiefly concerned with the occupation and skills matrix. This Deliverable is linked to a range of sub-tasks that constitute Task 4.3: Development of European sector skills Vocational Education and Training (VET) framework.

Task 4.3 is described as follows: 'The results of Tasks 4.1 and 4.2 will inform the development of an occupation-led skills-set framework for the sector. The framework will be utilised to:

- establish national VET benchmarks for current skills provision for occupations critical to the steel industry;
- utilise data from WP2 and WP3 to strategize for meeting future skill needs through national VET provision and;
- where appropriate correlate occupation skill-sets with cross-European programmes and standards frameworks.'

The ESSA project proposal further prescribes the purposes of the SSM in two sub-tasks:

Task 4.3.1: Develop matrix of occupations and skills cross-tabulated with national VET system provision for identification of current and future skill gaps and needs;

Task 4.3.2: Cross-reference matrix contents with cross-European programmes and standard frameworks for identification of where such programmes can be exploited

The two tasks essentially provide design-prescription and the Matrix design follows these closely. In general terms, the vertical axis of the Matrix will list the most important steel sector-relevant occupational qualification programmes (OQPs), while the horizontal axis affords cross-tabulation with a range of skills categories that are part of these occupational qualification programmes to establish, first, the extent to which OQPs cover certain skills and second, allow to identify gaps.

It is worth clarifying the terminology from the start: we follow the ESCO definition of occupation, which describes an occupation as 'a grouping of jobs involving similar tasks and which require a similar skills set'.[1] By Occupational Qualification Programmes (OQPs) we mean training cycles that allow those who complete them successfully to be formally recognised as being able to perform particular set of jobs and tasks associated with one or a cluster of occupations.[2] Some occupational qualification programmes are highly specific and lead only to one specific occupational qualification. Often, however, occupational qualification programmes are training cycles that can lead to a range or cluster of closely related occupations. For example, the German VET system offers an occupational training programme for 'industrial electronic occupations', yet there is no specific occupation called 'industrial electrician' as such. Instead, there are a range of closely related electrician occupations that share large parts of the training curriculum but differ slightly due to some specialisations (see Figure 1).

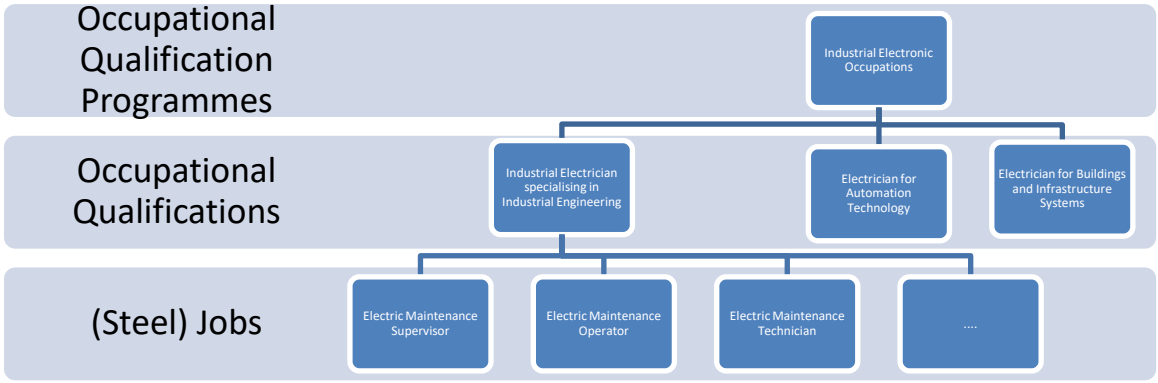


Figure 1: Relationship between OQPs, Occupations and (Steel) Jobs

With regard to 'skills' mentioned in the task description, the ESSA Matrix will limit itself to 'transversal skills' (also commonly referred to as 'soft skills', 'key skills', 'non-occupation specific skills' or 'cross-sectoral skills'). This means that we will not specifically consider or analyse so-called occupation-specific technical skills that tend to make up the bulk of skills and competences transferred in the course of occupational qualification programmes. We have several reasons for this limitation.

First, technical skills/ competences are indeed so numerous across many occupational qualification programmes that their inclusion would risk overloading the Matrix with too much information, effectively making it unusable.

Second, it would have been beyond the capacity and capability of the WP4 team to attempt to obtain full lists of all formally transferred technical skills and competences that are part of OQPs. On the one hand, most training curricula in the five case study countries are only available in the respective national languages. These would have had to be translated before the technical aspects of OQPs could have been analysed and compared. On the other hand, documentation of the technical skills transferred by OQP is not standardised across Europe and various levels of abstraction and completeness exist within case study countries. For example, in Spain various VET-related information repositories provide

[1] See: https://ec.europa.eu/esco/portal/escopedia/Occupation
[2] This focus is what sets ESSA work packages 3 and 4 apart. Both consider their respective units of investigation from a steel industry perspective, but WP3 focuses on 'jobs' while WP4 focuses on national VET systems that, among many other functions, provide the required 'qualifications' for the steel industry workforce.

different accounts as to which learning outcomes have to be met despite referring to the same OQPs.

Third, the literature as well as interview and survey data obtained during the ESSA project suggest that transversal skills become increasingly relevant and important in the context of digitalisation and Industry 4.0 relative to specific technical skills (see ESSA D4.1). This might be slightly counter-intuitive given that both digitalisation and Industry 4.0 are associated with profound technological change, which one might expect to affect and change the technical skills basis of many occupational, but the most profound effects of the technological change associated with digitalisation and Industry 4.0 from a skills perspective are organisational through increased horizontal and vertical integration of processes, resulting in greater interdependence of formerly separate processes. This puts a premium on skills such as team work, process understanding, system knowledge, flexibility, ability to learn and so on (see Antonazzo et al. *forthcoming*)

Fourth, the exclusive focus on transversal skills provision is also aligned with the focus on OQPs: while curricula specifying technical skills provision for the various individual occupations that are part of an OQP tend to differ from each other (due to the different technical specialisations associated with individual occupations), transversal skills provision is usually part of the shared curriculum of OQPs.

'Benchmarking' related to the actual content of VET provisions, whether within a single country or across a continent, is inherently difficult, if not impossible. Even within national VET systems comparisons are often difficult due to a variety of reasons such as a lack of clear documentation of curricula as well as different qualification pathways within a system or due to different regulatory standards. It becomes even more difficult once different didactic approaches to content delivery are taken into account.

When it comes to comparisons across different national VET systems, comparative evaluation becomes even more difficult due to a lack of shared concepts, definitions and terminology. To illustrate this reflexively, the ESSA project makes use of a particular skills classification to organise and structure the SSM which consists of 5 broad categories of transversal skills: digital, environmental, methodological, social and personal. Unfortunately but also unsurprisingly, this particular classification is not used in any of the case study countries.[3] This means that the WP4 team has to translate transversal competence provisions in each case study country into the ESSA terminology on transversal skills to fit them into our classificatory scheme. This already introduces a number of inconsistencies and difficulties (more on this below) but the problems do not stop there: while the translation work done by the ESSA project helps us to compare previously incomparable things, it also means that the 'ESSA language' (i.e. our classification categories and terminology) is not readily understood in the case study countries, thereby limiting the practical impact of work done by the ESSA project.

[3] The classification is based on a McKinsey report on global skills developments (McKinsey Global Institute 2018). The report is methodologically highly questionable and none of the categories in its classification of skills is defined. We use the classification as it had been adopted by other WPs in the ESSA project and no agreement on an alternative classification could be found.

1.3 Evolution of ESSA Sector Skills Matrix

The most significant difference between the current version of the SSM (D4.4_v3) and previous iterations introduced in earlier versions of this report, is a fundamental change of the main organising unit that structures the Matrix from a focus on learning outcomes to one on qualification levels. A second significant deviation from previous versions is that we no longer include the United Kingdom as case study country.

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

Unfortunately, it emerged during the refinement of earlier Matrix versions that there are several problems that render learning outcomes practicably unusable for the purposes of this Matrix. First, complete lists of learning outcomes related to transversal skills of OQPs are often simply not available or obtainable. There is a lack of clear and accessible documentation of learning outcomes across many of the case study countries. Second, even where documentation of learning outcomes is available, it is very difficult to verify whether these represent complete or just partial representations of relevant learning outcomes.[4] Third, VET documentation makes only in very rare cases a clear and explicit distinction between learning outcomes related to technical and transversal competences. One fundamental aspect in this regard is that the acquisition of technical skills is inherently based on and necessarily requires a range of transversal skills, which makes the analytic distinction between difficult.

The practical unsuitability of learning outcomes as principal analytic unit has forced a significant modification of the proposed SSM. On the upside, it has led to a stark simplification of the Matrix which should improve its usability and also make continuous updating easier. The downside is that an important comparative dimension is being lost.

The new design uses the 'qualification level' concept as the main organising unit. All European VET systems use National Qualification Frameworks to distinguish the value of qualifications according to the inherent difficulty in obtaining them. The more is required from a learner – in terms of time, skills, knowledge and responsibility, the higher the level that is attributed to a particular qualification. In recent years, qualification levels have been Europeanised and national qualification levels can be translated into European Qualification Levels which constitute the European Qualification Framework (EQF) (e.g. European Commission 2018). EQF distinguishes like most national frameworks between 8 levels, with 1

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

denoting the lowest and 8 denoting the highest level. The explicit aim of EQF is to afford comparability with regard to the 'value' of qualifications across national VET systems. To some extent, the EQF succeeds as a comparative tool as long it is assumed that the same EQF level signifies broad equivalence between OQP in different European countries with regard to acquired skills, knowledge and competences.

The second major development is that the United Kingdom is no longer represented in the Matrix. The main reason for this 'exclusion' is that the way in which UK VET systems – due to devolution there are actually 4 different systems in England, Northern Ireland, Scotland and Wales – are organised makes it very difficult if not impossible to represent them in the Matrix. The main problem is the hyper-fragmented nature of the UK VET systems. While UK-wide 'National Occupational Standards' exist, they must not be confused with occupational qualification programmes. The former tends to be focused on minimum requirements related to individual skills, particular pieces of knowledge or particular values and attitudes, while the latter are aggregations of a range of skills, knowledge and attitudes which then allow learners to perform particular jobs. Put differently, occupational qualifications can include modules or training units that are based on National Occupational Standards, but there are very limited if any standards that prescribe the make up of whole occupational qualification programmes.[5] Responsibility for the scope and content of qualifications is either a matter of negotiations between employers and education providers or, in case of entirely school-based VET programmes, the responsibility of education providers who tend to be private businesses albeit with a 'charitable status'. This way of organising VET provisions means that the content and scope of OQPs might actually differ from company to company even when they are located in the same nation or region and operate in the same sector. The Matrix, however, requires a certain level of (national or regional) standardisation at the level of occupational qualification programmes and this condition is not fulfilled in the UK.

2. Functions and Prospective Users of the Sector Skills Matrix

In this section of the report, the wider usefulness and functionality of the Sector Skills Matrix is considered. The section starts with a short description of what kind of information the SSM captures. Based on this description, a range of potential uses for and potential user groups of the Matrix can then be anticipated.

2.1 Capabilities of Sector Skills Matrix

While a more thorough and detailed description of the actual information captured in the Matrix will be provided in Section 3 of this report, on a more general level, the Matrix is designed to capture the following information about transversal skills provision in the context of steel-production relevant occupational qualification programmes:

i) the most steel-production relevant formal I-VET and C-VET qualification programmes related to Maintenance, Melt Shop, Rolling Mills (Melt Shop and Rolling

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

Mills rolled into Production), Logistics and Quality Control in each of the five case study countries (four countries in the final analysis)

ii) Direct web-links to curricula and regulations for each occupational qualification programme (subject to availability)

iii) Information related to national VET systems: national labels, classification numbers,

iv) European Dimension: Compatibility/ alignment with/ use of a range of European VET tools: ECVET, Europass, ESCO, EQF)[6]

v) Assessment/ Evaluation of current and future skill/ competence gaps in the form of a RAG (Red-Amber-Green) grading of:
   a. Current TV skills provisions
   b. future proofness of TV skills provision (in close cooperation with representatives of steel companies in the case study countries)

The Matrix is therefore designed to deliver concentrated information on a range of levels that opens up a range of possible functions.

- First, at the most basic level, the Matrix provides detailed information about a range of individual occupational qualification programmes in four different EU countries. Each OQP can be considered individually and key characteristics (see ii, iii, iv in the list above) such as duration, level of qualification, position within national and European VET classification frameworks and transversal content can be viewed in a compact format.
- Second, as the Matrix is a part of the ESSA research project, it is also designed to connect to other work packages. While the previous design tried to provide direct links between occupational qualification programmes and steel-sector specific jobs, this proved to be too ambitious.[7] An indirect link can nonetheless still be made via the five-digit ESCO numbers. Creating such a link can afford wider strategic scope for the ESSA Blueprint when it comes to improving skills provisions. If certain skill requirement are very specific for individual jobs, measures might be taken at the job-level, for example through internal or external specific training measures for certain job holders in steel companies. If skills requirements are of a more systemic nature, measures might be better targeted at the VET system level through improving occupational qualification programmes as these will affect a wide range of steel-sector jobs. The Matrix also creates downstream links with other ESSA work packages. The systematic investigation of transversal skills gaps will feed directly into the overall Blueprint, developed by WP5. The Matrix will hopefully also prove useful for WP6, which is partly concerned with the development of new training tools to address skills gaps through.
- Third, the Matrix also opens up a range of angles for comparing OQPs. Three kinds of comparisons are available within each of the four national case studies.

[6] ECVET is now defunct as a programme, but the principles remain in the encouraging worker mobility across the EU.

[7] The main reason is that job titles tend to be company-specific and roles within individual companies tend to be not easily comparable due to idiosyncratic organisational models. For example, in some companies, specific people with specific qualifications are designated to do specific jobs (e.g. crane operator) while in other companies that utilise a team working approach where all team members are capable of performing a range of jobs, specific jobs (such as operating a crane) can be performed by a range of people with different qualifications.

- Firstly, the assessment of the current adequacy of transversal skills provision in conjunction with an additional assessment of future skills needs, affords a comparisons between current transversal skills provision and future skill needs. This comparison will be build into the Matrix as both RAG (Red-Amber-Green) gradings for current and future adequacy will be displayed side-by-side in the Matrix (vi).
- Secondly, given that OQPs are arranged according to five functional steel-production areas (Maintenance, Melt Shop, Rolling Mill, Logistics, and Quality Control) within each national section (with Melt Shop and Rolling Mill subsequently folded into Production, to give four functional areas), comparisons can be performed within each functional area. In most national VET systems, two or more OQPs have been identified for each functional area. They often have different functional focuses, for example, in the area of maintenance the matrix captures OQPs focused on electrical and on mechanical aspects, but some OQPs also differ due to their education levels reflected in different gradings within national qualification frameworks. In the latter case, comparisons of transversal skills provision can reveal interesting differences between higher and lower level qualification programmes.
- Thirdly, comparisons are also possible between OQPs in different functional areas, for example between production-focused and logistics-focused OQPs. This can be revealing and interesting as differences in transversal skills provision might reflect wider features of the national VET system. For example, in the case of pre-2021 changes that have led to the standardisation of transversal skills provisions in four areas across all OQPs in the German VET system, differences between logistics and melt-shop qualifications reflected the fact that production related qualifications are part of the class of metal and electronics qualification in the German system and have therefore benefitted from an upgrading of transversal skills provision since 2018, while logistics qualifications have only been revised in 2021.

Similar kinds of comparisons can also be performed across the boundaries of the national VET systems. For example, one can perform detailed comparisons concerning the provision of transversal skills for all Level 4 electrical maintenance or all Level 3 logistics qualifications across the four countries, which will reveal significant differences across the four VET systems. By broadening the view across VET system boundaries, potentially interesting gaps and blind-spots related to characteristics of the different national VET systems might become visible. Cross-system learning is also made possible as different ways of approaching transversal skills provision in one system might inspire further development and change in another one.

2.2 Potential Users

The Matrix and its information as part of the ESSA is informed by other work packages but also informs other work packages. Beyond the confines of the ESSA project, however, we anticipate at least potential usefulness of the sector skills matrix for a range of actors operating at three different levels.

- European level

    - EU institutions concerned with skills development, research agendas and VET instrument etc.
    - Other ESSA work packages
    - Other, related EU-level research programmes (e.g. Sectoral Blueprints)
    - Institutions representing social partners at European level
- National level
    - National institutions representing social partners
    - National VET institutions
    - Public and private training providers
- Regional/ Company Level
    - Regional economic development initiatives
    - Regional VET institutions
    - Regional training providers
    - Steel Companies

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

Industry bodies and trade unions operating at national levels in the various steel-producing European countries could use the Matrix to try and influence the direction of national VET systems or to develop additional training programmes in response to identified skills gaps. The Matrix, as well as other instruments developed as part of the ESSA project, can also serve as useful feedback mechanisms to national VET institutions, which in turn might adjust decisions and activities to close identified skills gaps. The Matrix might also prove to be of value to a range of training providers as identified skills gaps offer opportunities to those with the capacity and capability of closing them through the development of training offers.

Finally, at a regional level, the Matrix might prove useful to regional economic development initiatives such the *Initiative Ruhrkreis*[8] in the west of Germany. Given the industry- and sector-transcending nature of transversal skills, the matrix might inform broader regional and local initiatives for cross-sectoral transversal skills development. Also, given the fact that steel companies are often concentrated within particular regions and localities, VET institutions operating at this level might also find the Matrix useful to inform their approaches to training provisions or to underpin wider skills development campaigns. Similarly, local and regional training providers might adjust their offerings in light of skills gaps and future needs recorded in the Matrix. Individual steel companies might also utilise the Matrix findings to adjust

[8] See: https://i-r.de/

2.3 Descriptive guide for users including methodological notes

The usefulness of the Matrix is partly determined by the accuracy and detail of the content and partly by how well information is structured and explained within the Matrix. As the Matrix is a kind of database, there is limited scope to integrate detailed explanations within the Matrix, although the intention is to make labels and categories within the matrix as self-explanatory and intuitive as possible.

One general difficulty afflicting cross-national comparisons concerns language. The Matrix itself is predominantly constructed in English. That means all categories and any text that is part of the Matrix 'scaffolding' is in English. With regards to OQP labels, specific names of occupations and related steel-sector jobs, we try to use both English as well as the respective national language for each case study country.

This section of the report will focus on two aspects of the Matrix design. Firstly, an overall descriptive guide explains the overall structure of the Matrix which should help users to use the Matrix. As the design is replicated for each of the four national VET systems considered in the Matrix, the overall structure can be explained with reference to a single national section. Secondly, where appropriate and required, methodological information and explanations aiming to contextualise information will be provided. This will also include information about the various VET system sources that have been utilised. The section dealing with this aspect of the Matrix takes the form of a Frequently Asked Question documents where a range of relevant methodological questions will be raised and answered.

2.3.1 The 'global layer' of the Sector Skills Matrix

The Sector Skills Matrix is an Excel database that has two 'layers': the 'global layer' summarises in a simplified and highly accessible format the results of the transversal skills gap analysis for the four included countries. The global layer is accompanied by a 'country-specific layer' that goes into greater detail with regard to the actual occupational qualification programmes.

The top or global layer (Figure 2) is a simplified summary of the results of the transversal skills gap evaluation for each of the four case study countries described further above in Section 2.3.1.

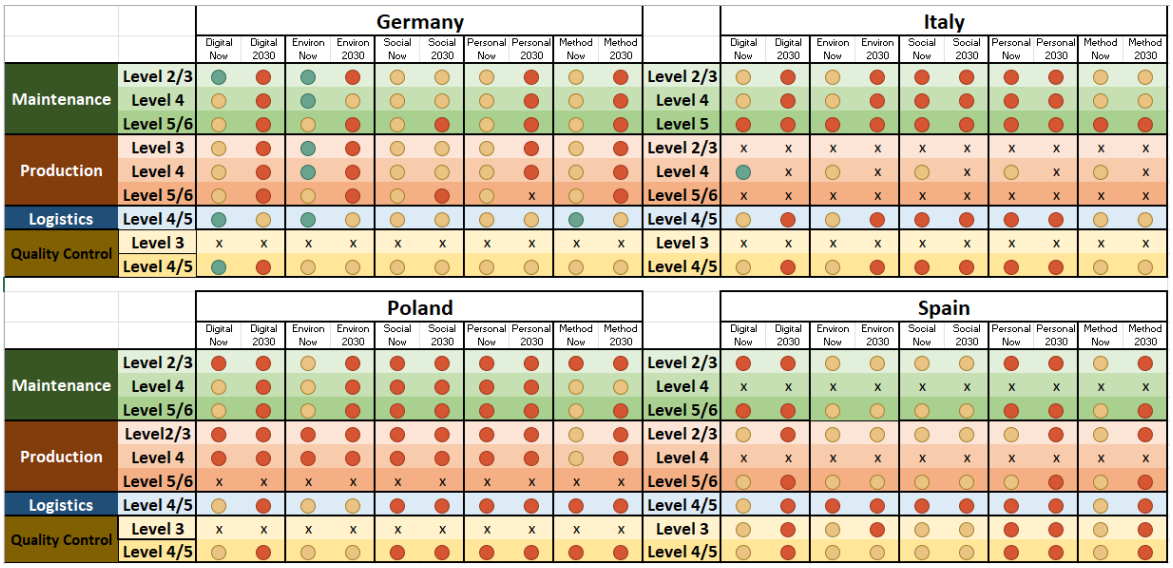


Figure 2: Global Layer of Sector Skills Matrix (June 2023)

The design is simplified because instead of listing all considered occupational qualification programmes (OQPs) in each country-specific matrix, it reduces granularity and restricts itself to displaying qualifications according to their functional areas and qualification levels. This means, for example, that all Level 3 maintenance occupations, which tend to include electrical, mechanical and electromechanical specialisations, are aggregated.[9]

Categories in this section are derived from the skills classification adopted by the ESSA project. This skills classification distinguishes between 5 types of 'transversal skills: digital skills, green skills, social skills, individual or personal skills and methodological. These skill types have been defined in the context of the ESSA project as follows as shown in Table 1:

Table 1: Transversal Skills Categories

Category	Explanation
Digital	Digital skills are broadly defined as the skills needed to use digital devices, communication applications, and networks to access and manage information.
Green	Green skills are those skills needed to adapt products, services and processes to climate change and the related environmental requirements and regulations (such as low carbon emission regulation).
Social	Social skills are defined as a set of individual capacities that can be manifested in consistent patterns of behaviours that enable people to cultivate their relationships at home, school and work and also in the community, and exercise their civic responsibilities.
Individual/ personal	Personal skills refer to the inner abilities or skills of an individual

[9] As explained further above, this is doable because such programmes, despite their different technical foci, tend to share often the exact same transversal elements in their respective curricula.

Methodological	Methodological skills are used in the process of obtaining and understanding new knowledge through thought, reflection, experience, and the senses

In the context of the survey, however, we have refrained from defining the categories in detail as this would have further increased the already extensive task descriptions for respondents. Instead we rely on their common sense understanding of what these categories are likely to refer to in the given context.

To capture both current and future 'grading' of transversal skills provision, each of the five categories has been assigned two columns: one capturing the assessment of skills provision in relation to assessments current skill need (e.g. 'Digital current' or 'Green current', etc.) and one capturing how current skills provision matches up to anticipated skills needs by 2030 (e.g. 'Digital 2030' or 'Green 2030', etc.). Hence a RAG (Red-Amber-Green) grading approach has been utilised to indicate through colour-coding how steel-industry-based VET experts view the current and future depth and breadth of transversal skills provision relative to the needs of the steel industry.

The RAG grading itself is based on the concept of 'sufficiency'. When respondents are asked to make such an assessment, the key question they are asked to consider is whether they consider 'current as well as future transversal skills provisions delivered as part of the formal occupational qualification programme as being sufficient judged by the needs of the company. This means that the colours can be translated in the following way:

- Green dots: transversal skills provision are sufficient
- Amber dots: transversal skills provisions are partly sufficient
- Red dots: transversal skills provisions are insufficient

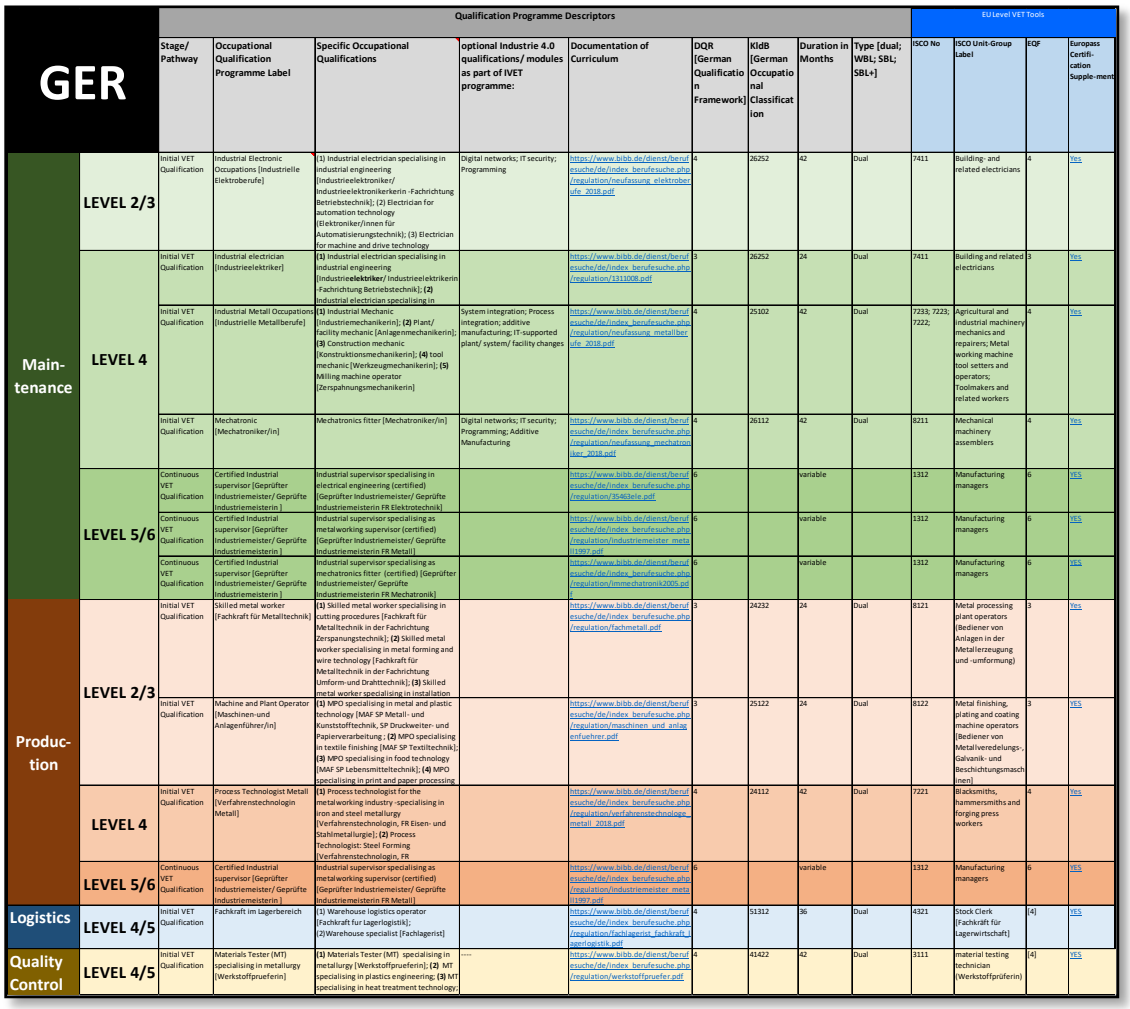
Again, we deliberately did not define the concept of sufficiency and relied on a common sense understanding by respondents. Of course, there might be deeply engrained cultural differences across Europe that might mean that what is considered as sufficient in one country is considered insufficient. The mitigation of this risk would have required long-winded conceptual explanations, which might have reduced response rates further, so on balance it made sense to take the common sense approach in this case.

It is important to understand that the chosen assessment methodology uses the current level of transversal skills provision as the bench-mark for the assessment of current and future skills gap assessments. Put differently, respondents are always asked to judge sufficiency of transversal skills provisions with regard to what OQPs currently deliver. This approach has the advantage that it affords some level of quality control regarding the skills gap assessment performed by industry-based VET experts. Given the widespread consensus that transversal skills provision will increase in importance, this approach suggests that the expert assessment of future (2030) skills gaps should not be more positive than the assessment of current skills gaps. Yet our first chosen survey-based method of measuring transversal skills gaps threw up a range of assessments that judged current skills gaps to be larger than future ones.

The results of the transversal skills gap assessment that is represented in the global layer will be considered and discussed further below in section 4 of this report.

2.3.2 The 'country-specific layer' of the Sector Skills Matrix

The Sector Skills Matrix provides country-specific information on steel-sector relevant occupational qualification programmes (see Figure 3 for the German section of the SSM), which are displayed individually on separate Microsoft Excel worksheets.10



GER		Qualification Programme Descriptors									EU Level VET Tools			
		Stage/ Pathway	Occupational Qualification Programme Label	Specific Occupational Qualifications	optional Industrie 4.0 qualifications/ modules as part of IVET programme:	Documentation of Curriculum	DQR [German Qualification Framework]	KldB [German Occupational Classification	Duration in Months	Type [dual; WBL; SBL; SBL+]	ISCO No	ISCO Unit-Group Label	EQF	Europass Certificate Supplement
Maintenance	LEVEL 2/3	Initial VET Qualification	Industrial Electronic Occupations [Industrielle Elektroberufe]	(1) Industrial electrician specialising in industrial engineering [Industrieelektroniker/ Industrieelektronikerkerin -Fachrichtung Betriebstechnik]; (2) Electrician for automation technology [Elektroniker/innen für Automatisierungstechnik]; (3) Electrician for machine and drive technology	Digital networks; IT security; Programming	https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/neufassung_elektroberufe_2018.pdf	4	26252	42	Dual	7411	Building- and related electricians	4	Yes
	LEVEL 4	Initial VET Qualification	Industrial electrician [Industrieelektriker]	**(1)** Industrial electrician specialising in industrial engineering [Industrie**elektriker**/ Industrieelektrikerin -Fachrichtung Betriebstechnik]; **(2)** Industrial electrician specialising in		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/1311008.pdf	3	26252	24	Dual	7411	Building and related electricians	3	Yes
		Initial VET Qualification	Industrial Metall Occupations [Industrielle Metallberufe]	**(1)** Industrial Mechanic [Industriemechanikerin]; **(2)** Plant/ facility mechanic [Anlagenmechanikerin]; **(3)** Construction mechanic [Konstruktionsmechanikerin]; **(4)** tool mechanic [Werkzeugmechanikerin]; **(5)** Milling machine operator [Zerspahnungsmechanikerin]	System integration; Process integration; additive manufacturing; IT-supported plant/ system/ facility changes	https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/neufassung_metallberufe_2018.pdf	4	25102	42	Dual	7233; 7223; 7222;	Agricultural and industrial machinery mechanics and repairers; Metal working machine tool setters and operators; Toolmakers and related workers	4	Yes
		Initial VET Qualification	Mechatronic [Mechatroniker/in]	Mechatronics fitter [Mechatroniker/in]	Digital networks; IT security; Programming; Additive Manufacturing	https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/neufassung_mechatroniker_2018.pdf	4	26112	42	Dual	8211	Mechanical machinery assemblers	4	Yes
	LEVEL 5/6	Continuous VET Qualification	Certified Industrial supervisor [Geprüfter Industriemeister/ Geprüfte Industriemeisterin]	Industrial supervisor specialising in electrical engineering (certified) [Geprüfter Industriemeister/ Geprüfte Industriemeisterin FR Elektrotechnik]		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/35463ele.pdf	6		variable		1312	Manufacturing managers	6	YES
		Continuous VET Qualification	Certified Industrial supervisor [Geprüfter Industriemeister/ Geprüfte Industriemeisterin]	Industrial supervisor specialising as metalworking supervisor (certified) [Geprüfter Industriemeister/ Geprüfte Industriemeisterin FR Metall]		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/industriemeister_metall1997.pdf	6		variable		1312	Manufacturing managers	6	YES
		Continuous VET Qualification	Certified Industrial supervisor [Geprüfter Industriemeister/ Geprüfte Industriemeisterin]	Industrial supervisor specialising as mechatronics fitter (certified) [Geprüfter Industriemeister/ Geprüfte Industriemeisterin FR Mechatronik]		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/immechatronik2005.pdf	6		variable		1312	Manufacturing managers	6	YES
Production	LEVEL 2/3	Initial VET Qualification	Skilled metal worker [Fachkraft für Metalltechnik]	**(1)** Skilled metal worker specialising in cutting procedures [Fachkraft für Metalltechnik in der Fachrichtung Zerspanungstechnik]; **(2)** Skilled metal worker specialising in metal forming and wire technology [Fachkraft für Metalltechnik in der Fachrichtung Umform-und Drahttechnik]; **(3)** Skilled metal worker specialising in installation		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/fachmetall.pdf	3	24232	24	Dual	8121	Metal processing plant operators (Bediener von Anlagen in der Metallerzeugung und -umformung)	3	Yes
		Initial VET Qualification	Machine and Plant Operator [Maschinen- und Anlagenführer/in]	**(1)** MPO specialising in metal and plastic technology [MAF SP Metall- und Kunststofftechnik, SP Druckweiter- und Papierverarbeitung ; **(2)** MPO specialising in textile finishing [MAF SP Textiltechnik]; **(3)** MPO specialising in food technology [MAF SP Lebensmitteltechnik]; **(4)** MPO specialising in print and paper processing		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/maschinen_und_anlagenfuehrer.pdf	3	25122	24	Dual	8122	Metal finishing, plating and coating machine operators (Bediener von Metallveredelungs-, Galvanik- und Beschichtungsmaschinen)	3	YES
	LEVEL 4	Initial VET Qualification	Process Technologist Metall [Verfahrenstechnologin Metall]	**(1)** Process technologist for the metalworking industry -specialising in iron and steel metallurgy [Verfahrenstechnologin, FR Eisen- und Stahlmetallurgie]; **(2)** Process Technologist: Steel Forming [Verfahrenstechnologin, FR		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/verfahrenstechnologe_metall_2018.pdf	4	24112	42	Dual	7221	Blacksmiths, hammersmiths and forging press workers	4	Yes
	LEVEL 5/6	Continuous VET Qualification	Certified Industrial supervisor [Geprüfter Industriemeister/ Geprüfte Industriemeisterin]	Industrial supervisor specialising as metalworking supervisor (certified) [Geprüfter Industriemeister/ Geprüfte Industriemeisterin FR Metall]		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/industriemeister_metall1997.pdf	6		variable		1312	Manufacturing managers	6	YES
Logistics	LEVEL 4/5	Initial VET Qualification	Fachkraft im Lagerbereich	(1) Warehouse logistics operator [Fachkraft fur Lagerlogistik]; (2)Warehouse specialist [Fachlagerist]		https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/fachlagerist_fachkraft_lagerlogistik.pdf	4	51312	36	Dual	4321	Stock Clerk [Fachkraft für Lagerwirtschaft]	[4]	YES
Quality Control	LEVEL 4/5	Initial VET Qualification	Materials Tester (MT) [Werkstoffprueferin]	**(1)** Materials Tester (MT) specialising in metallurgy [Werkstoffprueferin]; **(2)** MT specialising in plastics engineering; **(3)** MT specialising in heat treatment technology;	----	https://www.bibb.de/dienst/berufesuche/de/index_berufesuche.php/regulation/werkstoffpruefer.pdf	4	41422	42	Dual	3111	material testing technician (Werkstoffprüferin)	[4]	YES

Figure 3: Germany section in the SSM

Each country-specific Matrix follows the same design. To distinguish between them, each country section displays an identifier in the top-left corner (GER = Germany, POL = Poland, ITA = Italy, and ESP = Spain).

The **vertical axis** of the Matrix comprises two columns and is structured according to 1) relevant functional areas in steel plants (Column A) and 2) qualification levels aligned to the European Qualifications Framework (Column B).

The functional areas used for the Matrix are based on those identified in ESSA Work Package 3 (see D3.1), although for the purposes of the Matrix we have merged the function al areas or melt shop and rolling mill into a single 'production' category. Thus, the Matrix concentrates on four critical areas:

[10] For the description that follows, we utilise concepts such as Columns and Rows which are aligned on the structure of the Excel design. This means, Columns are specified by capital letters (A, B, …, Z, AA) while Rows are specified by based on the Excel terminology

(1) Maintenance
(2) Production (Melt Shop + Rolling Mill)
(3) Logistics
(4) Quality Control

The qualification levels are based on the European Qualifications Framework (EQF, see ESSA D4.2 for more details) which distinguishes between 8 qualification levels. According to the European Commission (2018: 5), the "EQF was set up in 2008 as a common reference framework of qualifications, expressed as learning outcomes at increasing levels of proficiency. The framework serves as a translation device between different qualifications systems and their levels." It has been widely implemented across Europe although many nation states continue to use long-established national qualification frameworks alongside the EQF. The EQF distinguishes between 8 qualification levels, with Level 1 denoting the lowest and Level 8 denoting the highest qualification level. As the Matrix concentrates on formal I-VET and C-VET OQPs, the Matrix includes programmes ranging from Level 2 to Level 6.

The **horizontal axis**, comprising of the two top rows of each country-specific Matrix, focuses on two areas.

Qualification Programme Descriptors								
Stage/ Pathway	Occupational Qualification Programme Label	Specific Occupational Qualifications	optional Industrie 4.0 qualifications/ modules as part of IVET	Documentation of Curriculum	National Qualification Framework Identifier	National Occupational Classification Identifier	Duration in Months	Type [dual; WBL; SBL; SBL+]

Figure 4: Qualification Programme Descriptors

The first area contains what we call qualification programme descriptors (see Figure 4). This area comprises nine categories designed to provide enough information to describe each of the listed occupational qualification programmes and its related occupations. In each country-specific sheet, the categories are modified to reflect the names of national instruments. For example, instead of using the label 'national qualification framework', labels such as German Qualification Framework or Polish Qualification Framework etc. are used in the specific sheets.

In Table 2, the nine categories making up the first section of the horizontal axis are explained in more detail.

Table 2: Categories covering national VET-system aspects

Category	Explanation
Stage/ Pathway	'Stage' refers to the distinction between initial (I-VET) and continuous VET (C-VET) programmes, which is an important distinction. To access C-VET programmes, learners usually ought to have completed an I-VET programme, whereas a certificate demonstrating completion of some compulsory school education is usually sufficient to access I-VET programmes. 'Pathway' refers to different forms of VET provision. The category is only applicable to Italy, where a range of VET pathways

	(e.g. school-based vs practice-oriented) are formally distinguished.
'Occupational Qualification Programme Label'	Occupational Qualification Programmes are high-level VET provisions that allow learners to formally acquire one of a related group of occupational qualifications. This field captures the formal or official name of an OQP both in English and in the appropriate national language.
'Specific Occupational Qualifications that are part of the Programme'	Specific Occupational Qualifications are the actual occupational qualifications that learners obtain when they successfully complete a vocational education and training. They are typically part of higher-level occupational qualification programmes and therefore share significant parts of the curriculum. This field therefore captures all individual occupational qualifications that are part of a larger Occupational Qualification Programme.
optional Industrie 4.0 qualifications/ modules as part of IVET programme	In some countries such as Italy and Germany, learners might be given the opportunity to access additional, non-compulsory learning units or modules that have been specifically developed to prepare learners for Industry 4.0. This field indicates which optional units/modules are available to learners.
'Documentation of Curriculum'	This field will contain direct links to Internet-based documents that provide detailed information about the curriculum, usually related to the occupational qualification programme and not to the more specific occupational qualifications. These documents tend to be available in the national language only.
'National Qualification Framework'	Analogous to the European Qualification Framework, all case study countries have their own national system of grading OQPs according to a certain number of levels (usually between 7 and 10). This field records the national level afforded to an OQP.
'National Occupational Classification System'	National VET system tend to have numerical occupational classification systems that helps to clearly identify programmes. This field records the national classification, which is often a number or a combination of letters and numbers.
'Duration'	This field captures the nominal lengths of training in months or hours related to a particular OQP. Not in all cases is the length of programmes fixed and length is not always stated.
'Type of Delivery' [dual; WBL; SBL; SBL+]	This field captures how training is delivered. There tend to be four different types:

	1. Dual: training delivery is roughly split in half between school-based and work-based training 2. work-based learning (WBL): training takes predominantly place within practical working contexts 3. school-based learning (SBL): training predominantly takes place within vocational schools 4. school-based learning plus (SBL+): training takes mainly place in schools but there is a small but significant work-based learning element

The second area of the horizontal axis includes information related to or about European-level VET tools such as European Qualifications Framework levels or Europass documentation (see Figure 5).

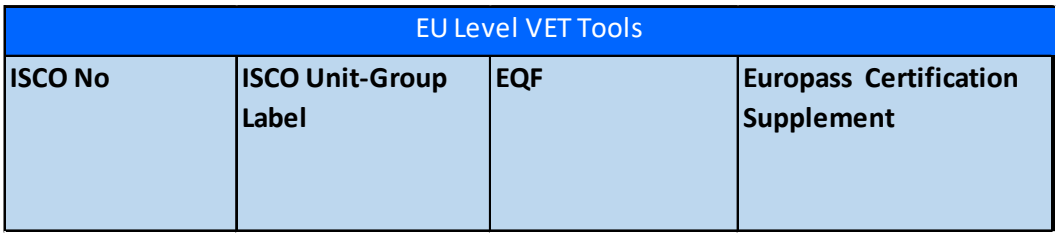


Figure 5: EU-level area of horizontal axis

These categories are explained in Table 3 below.

Table 3: Categories covering EU-Level VET tools

Category	Explanation
ISCO (International Standard Classification of Occupations) Number[11]	The International Standard Classification of Occupations (ISCO) has been devised by the International Labour Organisation (ILO) but it has been adopted by the EU as an important classificatory tool. Captures the four-digit number at ISCO unit group level to establish whether OQPs across case study countries are comparable
ISCO Unit Group Label	This captures the ISCO unit group label associated with the 4 digit number ISCO number
EQF level	Captures the level at which the OQP is classified in case the European Qualification Framework is applied in a case-study country
Europass Certification Supplement	If available, a link to web-based English-language version of the Europass certification

[11] The reference here is to ISCO and not to ESCO, but all the data in this context were obtained via the ESCO database. The reason is that ESCO builds directly on ISCO.

	supplement, that contains core information about occupational qualifications, is provided

3. Methodological information and explanations

This section of the report provides sufficient methodological information to enable others to understand the Matrix and, if desired, to add to it or to expand it independently of the ESSA project.

3.1 Methodological Challenges

There are considerable challenges involved in doing cross-VET-system work in the European context. We can roughly distinguish between challenges inherent in the nature of VET systems that come to the fore when one tries to make cross-national comparisons and challenges that arise out of the ESSA approach to constructing the sector skills matrix. They are considered here in turn.

National VET systems tend to have long and idiosyncratic histories and they do not lend themselves easily to comparisons (see ESSA D4.1). The Matrix tries to enhance comparability by focussing on standardised aspects and features of the OQPs that are relatively similar across the five different systems. Yet difficulties remain.

One significant challenge concerns the range of languages involved. Recent European initiative proves to be very helpful. Thanks to the Europass initiative, most occupational qualification certificates across the case study countries are available in standardised form in English and also in French. Whenever possible, these Europass certificates are used to determine which occupational label to apply. Another helpful tool in this respect is the ESCO database, that provides detailed VET information in many languages, including all official languages in the five case-study countries.

Yet language remains a problem for cross-national comparisons despite EU level initiatives. This is mainly due to a variety of key concepts that are expressed very differently across the continent. The most significant concept in this respect is, to put it as neutral as possible, the 'ability to do stuff' as a result of learning and/or training. In English, the term commonly used in this respect is 'skill', which is a notoriously imprecise word that can pretty much mean knowledge, physical or mental ability, attitudes and even values. Given that English has been the common and collaborative language used by the ESSA project, the skills concept is heavily used by the project. Unfortunately, other European languages do not necessarily use an imprecise but highly adaptive concept such as 'skill'. The German VET system, for example, emphasises the 'ability to act' (*Handlungsfähigkeit*) and generally uses the term 'competences' to describe this. Skills (Fähigkeiten) are just one aspect of the more complex competency concept. Another instructive example is the term 'occupation'. In the context of Germany, the term *Beruf* (occupation) has very specific connotations and the concept is very clearly distinguished from concepts such as tasks or jobs. In many other countries, however, the terms occupation, jobs and tasks seem to be used more or less interchangeably. Indeed, even the ESCO (European Skills, Competences,

Qualifications and Occupations) database, seems to use the term occupation in a way that is not compatible with the German usage.

Another fundamental problem is that even when the same skill terminology is used by national VET systems and by the ESSA project, there are still significant differences in the meaning of the same terms depending on who uses them. There is no easy solution to bridge ingrained differences between different key concepts or between key concepts that are differently used in different locations.

The solution chosen for the ESSA SSM is to operate at a high and abstract enough level of comparisons which turn the country-specific differences in terminology and meaning largely irrelevant. In other words, by avoiding too much detail, the Matrix hopefully succeeds in providing useful comparative and comparable insights into steel-sector relevant occupational qualification programmes.

3.2 Methodological Questions and Answers

This section adopts a format similar to that of a Frequently Asked Question section on a website. The current list of questions has been chosen by the WP4 team but it is likely to expand further due to feedback from ESSA partners and potential user groups.

Why is the vertical axis of the Matrix structured by functional areas?

The concept of 'functional areas' was introduced by WP3 into the ESSA project as part of their way to structure their comprehensive mapping of steel-sector jobs. While WP3 integrated maintenance into each area such as melt-shop and rolling mill, it made sense to disaggregate it for the purpose of the Matrix as maintenance qualifications tend to be cross-sectoral and cross-functional (i.e. there are no steel-sector or rolling-mill specific maintenance qualifications).

While with the benefit of hindsight, it seems absolutely obvious to structure the Matrix using the functional areas, it took us a while to recognise this as the best approach. Originally, the idea was to utilise either the four-digit ISCO numbers of occupations or even start with job titles. Our growing understanding of the variety of VET systems and the variety of preferences with regard to qualifications at the company level, made it clear that such starting points would not work well. The fundamental issue is that there is too much variability across VET systems. For example, in the Spanish system, steel-production operators jobs tend to be associated with ISCO number 8121, which refers to metal processing plant operators in the context of ESCO, while this qualification was not used at all in the German steel sector. Likewise, the great variety of job titles in companies within and across case-study countries, made job titles an unsuitable category to structure the Matrix.

How were relevant OQPs chosen?

The general approach pursued in all case study countries was to combine direct information received from ESSA industrial partners with other publicly available information.

With regard to the former, industrial partners were sent a table containing the five functional areas that the Matrix focuses on with the request to please indicate what kind of occupational qualifications staff working in those areas inside companies typically required. This approach works quite well, though given the great variety of steel producers and the equally great variety of approaches to qualifications, ideally a number of steel companies

ought to be sampled. Ideally, this kind of information would have been obtained while doing fieldwork within steel production companies but due to COVID-19 restrictions, this information gathering exercise was entirely done by using emails or video calls.

Depending in part on the VET system, desk-based approaches to determining relevant OQPs are also doable and complement the direct approach involving steel companies well. In countries with dual apprenticeship system, companies tend to advertise apprenticeship places on their company websites. This approach allows for wide sampling as this information is publicly available and all that is required is to visit the websites of steel companies to see what kind of OQPs close involvement of companies.

In countries where companies are not directly involved in VET provisions, a number of approaches can be applied to gather relevant information. Job adverts from steel producers might give clues as to what sort of qualifications are required to work there. There are also a range of public- and private-sector websites that provide general VET information and/ or career advise that may highlight qualification requirements for particular jobs or sectors. Another approach is to start by checking the ESCO database to find potential steel-related qualifications in a particular country (it is possible – with some degree of caution – to make cross-national inferences, which means if one knows steel-sector relevant qualifications in one country, one can at least check whether a similar qualification in a different system is also steel-sector relevant (the four-digit ISCO numbers utilised by ESCO are very helpful in this regard).

Why are there different quantities of OQPs considered within the different functional areas?

There are numerical differences in the number of OQPs included in each of the five functional areas of steel production. Within maintenance, depending on the country up to six I-VET and three C-VET programmes are considered while there only up to a maximum of two I-VET programmes included in the sections covering Logistics and Quality Control.

These kind of choices have grown relatively unplanned and organically out of the continuous development of the Matrix. The wide spread use of maintenance qualification programmes, for example, is a reaction to information obtained during interviews with steel sector representative because it emerged that different companies have different preferences concerning the skills of their maintenance staff. Some companies rely predominantly on mechatronics due to their versatility, while others value the greater specialisation that comes with employing mechanics and electricians in their maintenance teams. Given that in most VET systems, the three maintenance qualifications are offered, it made sense to include all three into the Matrix. Similarly, it emerged that there tends to be less choice and variety regarding qualifications related to logistics and quality control, which is reflected in the Matrix.

Ideally, quantitative importance of qualification programmes would also be a strong consideration to make decisions about which programmes to include and exclude, but sector-specific statistics in this regard are not easily obtainable across the case-study countries, which means that this consideration has not directly influenced the Matrix design. Wherever possible, however, hints in this regard provided by steel sector interviewees (e.g. ‘we mainly train process technologists for the jobs in the melt-shop’) have been reflected in the Matrix.

Why are no degree-level qualification programmes included ?

The main reason why no degree-level qualification programmes are included in the Matrix is that they tend to be non-standardised, which makes it impossible to draw general conclusions about skill gaps. As shown in D4.1, in the European context universities and colleges tend to have a great deal of autonomy in deciding VET-focussed curricula of study or dual- study programmes.[12] This means that degrees in electrical engineering from two different universities in the same country might be very different in scope and focus. Given that the Matrix requires standardised and generalised information to work, dual study and other degree programmes are not suitable for integration in the Matrix.

Why was 2030 chosen as the year for which to consider future skill needs?

When considering future scenarios for skills requirements, we had to choose some point in the future as an orientation mark. 2030 struck as an adequate time horizon as this is well beyond VET planning cycles in companies, which, depending on the country can take up to 5 or 6 years, but also not too distant in the future which would make it impossible to imagine how technological and organisational developments might play out. It is also important to consider the complexity of the 'supply side' in VET systems. Any significant changes to existing OQPs or the creation of new qualification programmes takes time. Involved stakeholders have to agree on the form and scope of changes. Changes then have to be agreed upon and worked out in detail. They also have to be embedded in laws or regulations. Importantly, training materials but also trainers need to adapt as well. All this tales time, again depending on the system with some being more responsive then others, which justifies a 10 year outlook (the bulk of research activities was taking place in 2020 and 2021).

How were categories on the horizontal axis chosen?

As pointed out in the first section of this report, a lot of the overarching categories included in the horizontal axis of the Matrix are determined by the task-description in the ESSA proposal. Still, an element of freedom of choice has been retained. The current list of categories structuring the horizontal axis of the Matrix are the result of a lengthy matrix development process. Earlier drafts contained a far greater number of categories but they were successively reduced. The main reason for the reduction was that while some information, for example on eligibility requirements or on follow-on C-VET opportunities, were easily and readily available for one or two VET systems, the same information was unavailable in other case study countries.

In general, categories on the horizontal axis were included for three main purposes. One is to provide sufficient information about the characteristics and nature of an OQP that have a bearing on the overall assessment and evaluation of transversal skills provision. Typical examples here are information related to the duration of a OQP and also the type of training, i.e. whether it's a dual programme, school-based and so on. The shorter a programme, the less time to develop competences in depth. Similarly, pure school-based programmes will make it harder to hone skills that are ultimately applied in workplaces.

The second function of horizontal skills categories is to allow for a clear identification of an OQP. Hence the inclusion of categories such as position in national qualification frameworks, numbers or codes related to national and European classification systems. It is worth noting that linking programmes to European frameworks such as ESCO is not always

[12] Legally speaking, Higher Education Institutions tend not to be part of the regulatory system that underpins VET system.

straightforward. For example, there is no direct inherent link between national VET-system information and the ESCO classification of occupations in the case of Germany. In some cases, such as for industrial electricians, linking both national and European level is still easy as ESCO might use the exact terminology resulting in a single four-digit ISCO number that then affords cross-VET-system comparisons. In other cases, it is more complicated. For example, the industrial metal occupations programme consists of five different specialist occupations that can in turn be linked to three different ESCO occupations. In contrast, the Polish national occupational classification system is inherently linked to ISCO, which means that the last four digits in the six-digit Polish classification codes are the four-digit ISCO code, which leaves little room for ambiguities.

Third, given that ESSA is just one of a number of European-level sector blueprints, the Matrix offers an implicit opportunity to at least provide the potential for an expansion beyond the steel-sector. In some sense the current Matrix already goes well beyond the steel-sector most occupations relevant for the steel sector are not steel-sector specific. In fact, steel-sector specific occupations – usually related to melting or rolling of metal are fairly rare across Europe. Given that the Matrix as such is not steel-sector specific, it can be applied to all sorts of sectors and occupations.

Where do the detailed information about OQPs come from?

In all case study countries, detailed information about VET programmes, in particular detailed information concerning the curricula and associated learning outcomes are made publicly available, usually by national or regional regulators or by VET providers.

Germany

The standardised national system makes finding information about programmes, their curricula and learning outcomes relatively easy. For each state-recognised OQP, detailed documentation is provided by the Federal Institute for Vocational Education and Training (BIBB). A dedicated, searchable database is integrated into the public website of the BIBB: https://www.bibb.de/en/40.php.

The specific pages for the occupations provide links to the full documentation of the training regulations and framework curricula. There is usually also a direct link to the certification using the Europass-format. Additionally, the historic genealogical development of the occupational qualification is part of each webpage as is information regarding further future VET options.

Poland

In Poland, detailed information for each formal occupational qualification programme is provided by different institutions. The website of the public employment service (Wortal Publicznych Służb Zatrudnienia: https://psz.praca.gov.pl/) provide compact information sheets for all formal occupational qualifications, including general descriptions and core task related to a variety of occupations Detailed lists of learning outcomes, both technical and transversal, as well as curricula for most occupations are accessible via the website of the Centre for Education (Ośrodek Rozwoju Edukacji: https://www.ore.edu.pl/), which is the main national teacher training institution in Poland, hosts a database that lists all learning outcomes related to the majority of occupational qualifications. Other resources include a database of regulated professions in Poland, which is accessible on a government website: https://www.zawodyregulowane.pl/.

Italy

In Italy, the responsibility for VET is distributed among several actors (Ministries of Education and Employment, Regions and Autonomous Provinces). However, minimum standards and guidelines for IVET are defined at the national level. This makes VET provision highly standardised since minimum standards apply across the whole country. As regards the strictly vocational route (Istruzione e Formazione Professionale), the occupational profiles and standards were defined by the State-Regions standing committee that brought together the Italian Regions and Autonomous Provinces, the Ministry of Employment and the Ministry of Education. As for technically or vocationally oriented high schools (Istituti Tecnici and Istituti Professionali), the guidelines and standards for these are defined by the Ministry of Education. The Ministry of Education website offers an overview of the different routes and their main characteristics https://miur.gov.it/web/guest/scuola-secondaria-di-secondo-grado. Another useful resource to map and retrieve information on VET qualifications (e.g. their composition in terms of skills, knowledge and competence units) is the Atlas of Work and Qualifications https://atlantelavoro.inapp.org/atlante_repertori.php.

Spain

In Spain, the official and state-regulated curricula of qualification programmes, including learning outcomes, are described in great detail in the official state gazette (Boletín Oficial del Estado: https://www.boe.es/) issued by the Ministry of the Presidency, Relations with the Courts and Democratic Remembrance (el Ministerio de la Presidencia, de Relaciones con las Cortes y Memoria Democrática). These bulletins also include specifications such as minimal eligibility requirements and the minimal duration of any VET programme. Additional information on specific programmes can also be found on the websites of the numerous VET schools that operate largely regionally.

3.3 Assessment of current and future transversal skills gaps

The transversal skills gap assessment (TSGA) is the central element of the ESSA SSM and is presented on the global layer of the SSM. The TSGA is essentially an attempt to measure or determine the difference between what the steel industry requires with regard to transversal skills and what occupational qualification programmes are able to deliver.

There are many possible and even more potential methodological approaches to perform such a TSGA. In total we have tried and tested – to very different degrees – three different approaches that we will explain in turn in what follows. They all have their advantages and disadvantages although we can say with hindsight that the first approach is not practical for the task at hand, while the second does not produce trustworthy and robust enough data to base potentially important decisions about the future on them. The third is a blend of the first and second approach, but we did not entirely succeed in testing it. The generated data ought to be far more robust, but the method requires a relatively large amount of preparation and organisation.

3.3.1 General Approach to the Transversal Skills Gap Assessment

The aim of the TSGA is to provide a useful, reliable and trustworthy assessment as to how well transversal skills provided to pupils and apprentices who complete a steel-sector relevant occupational qualification programme match the current and future requirements of the industry in four case study countries.

This aim already determines some aspects of the required approach. Most importantly, it prescribes the expertise of those making the skills gap assessment. They need to have good working knowledge of the following:

- Understand current and future transversal skill needs of steel companies within in a particular country
- Understand depth and breadth of transversal skills provision currently delivered as part of steel-sector relevant occupational qualification programmes
- In countries where OQPs have work-based components, they also need to understand depth and breadth of transversal skills provision currently delivered by companies in the context of work-based parts of qualification programmes

These expertise requirements are quite specific and narrow down the field of those being able to usefully contribute to a TSGA. After consultation with industry partners in the ESSA project, we mainly targeted experienced staff working in steel-company run training centres or academies or staff within HR departments.

Another parameter flowing out of the task affects the instructions given to participants in the TSGA: while OQPs tend to be standardised to some degree, the pupils and apprentices completing them are all different as they have different levels of prior skills and competences and different strength and weaknesses. To create a level playing field in the context of the TSGA, we therefore created a 'standardised pupil/apprentice' that participants should have in mind when contributing to the TSGA. They were therefore instructed to assume that those completing any of the OQPs were school leavers without any prior work experience.

A third aspect of our approach largely determined by the task was that the TSGA had to be country-specific. As VET systems differ from country to country, VET provisions or the outcomes of VET programmes also differ from country to country. Moreover, the expertise of those involved tends to be limited to the country they operate in.

A fourth aspect influencing our approach was forced upon us: following the ESSA research plan, the TSGA started in 2021 which was still heavily affected by the COVID-19 pandemic. This made travel and face-to-face research very difficult and meant that we any specific method we wanted to apply had to be compatible with this context. Specifically, this meant for example that face-to-face workshops or similar methods for gathering the required data that underpin the TSGA were not realistic options and our focus was on approaches that allowed remote participation.

Lastly, we decided to use a 3-point RAG (Red-Amber-Green) assessment for the skills gap analysis. This choice – we could have also opted for a 10-point scale or just about any other assessment scale – was influenced by the consideration that too much granularity will not necessarily lead to useful outcomes. As mentioned above, the skills categories used by the ESSA approach are not used within any of the four case study countries. Asking respondents for a detailed evaluation of skills gaps using, say, a 10-point evaluation scale is unlikely to produce anything more useful than a three-point scale (Red-Amber-Green). As the Matrix itself does merely indicate whether a skills gap exists or not without establishing the exact characteristics of the skills gap (i.e. the Matrix does not tell users which exact skills do or do not match) too much granularity can actually be counter-productive. As it is, the utilised three-point scale is action-oriented: green indicates a sufficient match

between skills requirements and skills provision which requires no immediate action. Assessments resulting in yellow or red, in contrast, signal some need for action. What action is needed, i.e. which exact skills or competences need to be strengthened or added, is beyond the capabilities of the Matrix to determine. As this is likely to differ from country to country and requires further analysis, having greater granularity in the skills gap assessment is of little practical use. In fact, the fuzziness of the results – a three-way assessment of relatively broad and unspecified skills categories – is a strength rather than a weakness.

All research methods have up- and down-sides and the approaches chosen by ESSA to conduct the skills gap assessment is no exception. There is no 'single-best-approach' and choosing an approach is about balancing pros and cons in a such a way that it leads to useful outcomes. In total, we can separate three different methodologies that have ben deployed for the TSGA although one of them, the first, had mainly pilot or test character and has not been seriously considered for wider implications. Taking it into account and reflecting upon it is nonetheless highly instructive.

The three approaches were:

1. Remotely conducted one-to-one TSGA
2. Survey-based TSGA
3. Combined survey- and remote workshop-based TSGA

We will describe and consider each approach in turn.

3.3.2 Remotely conducted one-to-one TSGA

This approach was used to prepare for the survey-based TSGA which was chosen as our main method (more on this in the next section). In order to test whether the survey made sense and whether prospective participants were able to complete their tasks just on the basis of explanations and instructions, a one-to-one remote interview with a German VET expert from a large steel company was conducted. After explaining the context and the general aims of the SSM, the researcher shared the survey document on the screen and gave an additional detailed explanation of the skills categories. This is particularly important as the ESSA skills classification does not match any of the skills or competence classifications used in VET systems of case study countries or, as far as we can tell, in steel companies around Europe. In this particular case, the expert indicated that they would be able to broadly map their input onto the ESSA skills categories.

Researcher and expert then started by considering current skills gap in each of the listed occupational qualification programmes. In practice this meant going through each line in a table that listed all the relevant occupational qualification programmes. At this stage, the VET expert was driving the process by effectively verbalising their thought processes for each OQP. The researcher, in contrast, took a passive role which involved entering the expert assessment into the survey and occasional requests to qualify statements or give more detailed explanations of particular assessments.

The same approach was then repeated for the assessment of future skills gaps which we defined as the gap between what current (i.e. 2021/ 2022) OQPs offered in terms of skills provision and the needs of steel companies by 2030. Again the expert led the process by assessing the future skills gaps programme by programme, while the researcher recorded the assessment and asked additional questions when required.

Overall, this approach had some considerable upsides but also some downsides. The upsides are considerable. First, the face-to-face (albeit remotely) interaction ensures that misunderstandings and inadvertent mistakes are kept to a minimum. The approach can be explained and any specific questions can be immediately answered. Experts can be made aware of the difficulties that come with applying the ESSA skills categories to contexts that utilise different classification systems. Second, the quality and trustworthiness of the expert assessment is very high as experts effectively verbalise their thought processes. This allows researchers to follow their thinking and to probe around potential contradictions or ask for additional reasons and so on. Third, through instant feedback during the exercise, researchers can understand whether the chosen approach and the explanations provided to experts make sense to them, which can help to improve the process. Also, being able to watch an expert practically engaging with the chosen approach can help to uncover potential pitfalls and tacit misunderstandings.

This approach has only very few downsides, although their practical relevance meant that the approach discussed here was just used to test the survey and not rolled out more widely. The main downside of this approach is that it is very hard to implement in practice given limited research resources. The assisted completion of the survey took about 45 mins while we suggested that a skills gap self-assessment via survey would take about 15 mins. While this approach only marginally – in absolute terms – increased the time commitment for steel company employees, asking for a 45 min meeting at a particular date and time instead of say 15 minutes of looking at a survey at a time of their choosing is definitely an additional barrier. The time commitment for researchers, however, increases exponentially with this approach. The exceptional commitment of tkse towards the ESSA project meant that in this case, it only took a few emails to set this pilot meeting up, but this kind of willingness to engage and cooperate with requests to provide input has been rather rare and exceptional than the norm. Unless researchers have already established good personal relations with the right kind of experts in a wide variety of steel companies across the case study countries, trying to secure a commitment to participate in research activities such as contributing to a skills gap analysis is very time-intensive and not necessarily fruitful as many email requests have remained unanswered.

Overall, in an ideal world, this approach would have been used to complete the full skills gap assessment in all the case study countries. But limited time and resources meant that despite the considerable upsides of this method, the practical difficulties of gathering sufficient data across each case study country meant that this approach was not seriously considered as the main method. Table 4 provides a summary of the approach.

Table 1: Summary of One-to-One approach to Skills Gap Assessment

Steps	
- **Identify and approach VET expert in steel company** - **Explain SSM and their role/task in project to secure cooperation** - **Arrange remote video meeting (30-60 mins)** - **Explain task using visual aids (expected Matrix layout, skills classification, RAG definition)** - **Record expert assessment of skills gap for each OQP as it is made**	
Pros	**Cons**
- Trustworthy data	- Time intensive

- Contextualised data (as expert can verbalise judgement, more than pure RAG assessment can be obtained) - Direct expert feedback about SSM and methodology of skills gap assessment	- Difficult to secure cooperation - No collective expert reflections

3.3.3 Survey-based TSGA

A purely survey-based approach was chosen as the main method. During the process, the survey had to be modified as engagement from steel companies was very low. The time commitment – the researchers suggested that a total of 15 minutes was required to complete the survey – appeared to be one of the main obstacles. Other barriers such as general survey fatigue or a general reluctance to engage with external research projects that companies might not be directly participating in, probably also played a role but they were beyond the influence of the research team.

The longer version of the survey starts with an explanation of the aims and objectives of the skills gap analysis and information as to what happens with data provided by participants. This is followed by a section asking for broad information about the company, their attitudes towards training and the relative importance of certain skills categories for the company. This was then followed by the main part of the survey which asked respondents to assess first current and then future skills gap with regard to all identified steel-sector relevant OQPs. In some countries this meant that respondents had to consider 15 to 20 different qualification programmes. This also meant that the accessibility and clarity suffered as respondents had to work their way through two large tables making numerous assessments.

The shorter version aimed to concentrate on the very essentials and this meant to reduce the number of questions and also to reduce complexity. With regard to the survey structure, a much briefer introduction was immediately followed by 2 questions dealing with the current and future skills gap assessment respectively. A fourth question asked for very basic information about the company providing the information. The way to reduce complexity was group individual OQPs together according to their qualification level. Behind this was the realisation based on our original and very detailed research that individual qualifications within a particular VET systems – as long as the VET system is characterised by a modicum of standardisation and centralisation (either at regional or national level) – often share the same transversal content if they lead to the same qualification level. For example, Level 4 maintenance qualifications, which involve electrical, mechanical and electro-mechanical qualifications, tend to share the same or at least similar transversal skills curricula in the form of specific modules (e.g. Poland) or thematic fields (e.g. Germany). This realisation, which also informed the simplification of the SSM, meant that the number of programmes respondents had to work through was significantly reduced – usually to under 10 per case study country, which had positive effects on the expected completion time.

Concerning the approach to reaching respondents, we asked ESSA partners in each case-study country to take ownership of the data collection process in their respective countries. This included the translation of the survey into the respective national languages as

well as organising the distribution of the survey. Three broad approaches to recruit respondents were pursuit in each country:

1. Steel companies that were ESSA partners were directly approached and asked to complete the survey. In some cases, the right experts were personally known through prior engagement in the context of ESSA and these approaches tended to result in completed surveys.
2. Sector associations were asked to distribute the survey amongst their members and to request responses. This approach has led to mixed results. In some countries, sector associations did not engage with our request. In others, this led to modest successes with regard to engagement with the survey.
3. In some cases, steel companies that were not closely engaged with ESSA were directly approached via emails from case-study country organisers with a request to engage with the survey. This is not a very effective approach as it is very difficult if not impossible to identify suitable experts within the companies from the outside. This meant that email requests were sent to generic company email addresses in the hope that they would be redirected to the most suited person within the company.

Practically, however, this approach did not work as well as hoped for. Engagement with the survey, despite the dramatic simplification remained very low, especially with regard to companies that were not part of the ESSA project as a lack of prior contacts within these companies meant that the survey could not be sent to a specific person.. The aforementioned general survey fatigue probably also played a role and the relative complexity of the task, which still required lengthy written explanations most certainly also did contribute to a reluctance to engage with the survey. Additionally, a technical glitch with the survey software meant that some of the limited collected data was lost, although this accidental data loss was not related to the chosen methodological approach.

The biggest problem with the data that was collected through this method was, however, that it was very difficult to gauge whether the data could be trusted. Due to a lack of direct contact with the respondents, the research team had only some limited and indirect means to assess the quality and hence the trustworthiness of the data. In some cases, very short completion times – under 3 minutes – suggested very shallow engagement with the instructions and the task. The best measure of quality was, however, to check whether A) assessments varied at least slightly from OQP to OQP and B) whether future skills gaps were greater than current skills gaps. With regard to A), given the variety of listed OQPs with regard to their functional area, we expected at least some variation between them when it came to current and future skills gap assessments. We found, however, a number of responses that showed zero variation in their assessment which suggests that responses were unlikely to reflect a genuine skills gap assessment; rather responses were entered to get to the end of the survey quickly. With regard to B) given that the approach used current skills provisions as the assessment baseline for current and future skills gaps, it is reasonable to expect that future skills gaps should not be smaller than current skills gaps since the premise of ESSA is that skills gaps arise out of technological and organisational change that is predicted to accelerate over the next 10 years. We found numerous survey responses that showed the unexpected pattern of current skills gaps that are larger than future skills gaps. We suspect that these unexpected patterns were the result of still complex instructions. As respondents were engaging with the survey on their own, no additional explanations or in-process corrections could be provided.

Overall, this approach turned out to be less successful as expected. It had primarily been chosen as the most practical way to collect sufficiently large data sets on current and future skills gaps for this data to be relevant and useful. As such, it seemed the most suitable approach for the purposes of ESSA to gain a European perspective on this by comparing several case study countries. Low engagement even with the much shortened survey and suspected issues with the quality of the responses mean, however, that the method is practically unusable as it fails to generate much data and the data that it manages to collect is unfortunately not trustworthy. Table 5 provides a summary of the is approach.

Table 2: Summary of survey-based TSGA

Steps	
- Translate survey in relevant language - Approach either VET experts in steel companies, steel companies as such or sector organisations to distribute survey	
Pros	**Cons**
- In principle, simple and fast approach for both researchers and company experts - Potential to collect large amounts of data effectively and efficiently	- Low engagement in practice - Low trustworthiness of data - Often low quality data (no variation in responses or smaller future skills gaps)

3.3.4 Survey + Workshop-based TSGA

Our third approach has been developed in response to the short-comings of the purely survey-based method. Apart from the problem of low industry engagement, the biggest flaw of the survey-based approach is that researchers have very limited means to establish whether the actual responses are trustworthy (although, as indicated above, some means exist to identify untrustworthy responses). The idea behind the new approach was to combine the convenience of a survey-based approach with expert workshops where aggregated survey results can be presented and reflectively discussed by industry-based VET experts.

Due to limited time and a confluence of unfortunate circumstances, the suggested approach has not been tested in Spain as anticipated by the research team. We chose Spain as a test site to trial this approach because the Spanish data we had collected before were particularly affected by implausible results due to the apparent misunderstanding of the task by industry experts. Moreover, the number of participants in the first run was very extremely low. In the end, despite much improved industry engagement in this new round of the TSGA, thanks in part to the efforts made by the Spanish steel association and our Spain-based researcher, which led to more and much better survey responses from steel industry experts, finding a suitable date and time for a joint workshop that suited a sufficient number of industry experts proved too difficult.

The whole process as anticipated and planned by the research team would have involved three main steps:

1. **Simplifying and improving the TSGA survey:** The aim was to make the questionnaire clearer, simpler, and shorter in order to reach maximum number of respondents. First of all, the text explaining the survey was shortened to capture and maintain the reader's attention, without overwhelming them at first glance. We assumed at this stage that the respondents already had knowledge about the categorization of skills (green, digital, methodological, etc.). Therefore, we omitted the detailed information about these skill categories. However, the explanation about the meaning of the colours was repeated in both parts of the questionnaire: the first part evaluating the sufficiency of qualification programs for the present and the second part evaluating it for the future. Additionally, the distinction between the two parts was emphasized to clarify what should be evaluated in each case for the reader. Furthermore, more information about the respondents was requested, including their names and email address, so that they could be contacted to participate in the subsequently planned workshop. Finally, a native Spanish speaker working in the industry reviewed the questionnaire as a final step.
2. **Diffusion of the survey:** Industry experts were approached and invited to complete this new, streamlined TSGA survey. The survey also served as recruitment tool for the anticipated 45 minute workshop. The aim was to spread the survey as widely as possible. Firstly, the matrix was sent to three industrial partners of ESSA since they were already informed about the matrix's purpose. Secondly, we reached out to Spanish Steel Association since it encompasses all manufacturers of flat and long steel products in Spain, including carbon, alloyed, or stainless steel. The association also includes producers of steel tubes (seamless and welded), precision strip, cold-finished products, and road restraint systems. The Association forwarded the survey to 46 companies. However, only 6 of them responded. Additionally, we personally tried to reach 6 individuals working in steel plants in Spain who possessed sufficient knowledge to complete the survey. Only 2 of them responded. The respondents were mostly Human Resources and/or Training Managers of the companies. In total, we had nine valid responses.
3. **Conducting Expert Workshop:** After the survey stage, ESSA researchers tried to schedule a 45 minute workshop attended by all those who also completed the survey. We aimed to organize a workshop where we could discuss the respondents' answers jointly and interactively with the aim to reach a consensus on the sufficiency of current and future transversal skills provision for each qualification programme. To achieve this, we contacted each respondent via email and phone and proposed two potential dates. We could not have a positive feedback. Consequently, we had to cancel the workshop option.
   If a joint workshop had taken place, aggregated survey results would have been presented to the participating experts and the latter would have been encouraged to reflexively discuss the aggregated data. Ideally, ESSA researchers could have recorded both the level of agreement or disagreement of participating experts with the aggregated survey findings and also the arguments utilised by experts in the discussions. This rich, qualitative data could have added the required robustness to the survey findings.

If sufficient numbers of participants can be recruited, we believe this approach has very good chances to produce reliable and trustworthy results (see Table 6 for a summary).

Table 6: Summary of Survey + Workshop-based TSGA

Steps	
- Translate survey in relevant language - Approach either VET experts in steel companies, steel companies as such or sector organisations to distribute survey - Include recruitment tools for workshop in survey (e.g. obtain contact details) - Analyse survey data - Organise and conduct interactive workshop to obtain qualitative feedback on survey results with experts who have completed survey - Produce integrated analysis of survey data and data obtained during workshop	
Pros	**Cons**
- In principle, highly reliable and trustworthy results through combination of quantitative and qualitative data - Collective expert reflections - Potential to collect large amounts of data	- High barriers for participants (survey completion + workshop attendance) - Complex organisational task for researchers

4. Results of TSGA

Important

While our approach to the skills gap analysis has produced 'results' **we have to stress that these results are neither representatively reflecting the collective thinking within the four respective national steel sectors nor are they robust and of sufficient quality at this time to be employed with any precision and for practical purposes**. Any results presented here are purely for illustrative purposes.

Despite our best efforts, our attempts to evaluate current and future transversal skills gaps in steel-sector relevant occupational qualification programmes have not produced reliable and therefore usable results. While we managed to obtain some relevant data from the four case study countries, the 'results' are neither representative nor of sufficient quality and should therefore not be used for any practical purposes.

Despite these practical setbacks, it is important to point out that a transversal skills gap assessment as pursued here is in principle possible.[13] The fundamental requirements are (1) high industry engagement at a level that starts to representatively reflect industry views across a country and (2) a TSGA methodology that reliably produces trustworthy data. While possible in principle, the practical hurdles are effectively insurmountable. Industry engagement with external concerns such as research projects or sectoral initiatives tends to be generally low. We suspect, based on anecdotal evidence, that this is mainly to do with low awareness of the potential benefits of external activities and with a lack of capacity within companies to respond to external requests such as participation in research

[13] This is a very different question from the one asked further below: does a Matrix and a systematic evaluation of current and future skills gaps make any practical sense.

activities such as completing surveys. In the case of the TSGA, there is an additional factor that we will reflect more on further below: companies across Europe have very different relationships to the respective national VET systems. In some countries, companies are an integral part of the delivery of occupational qualification programmes (e.g. in Germany) while in other countries, such as Poland, occupational qualifications are delivered almost entirely outside of companies, which can result in a lack of company internal expertise about the VET system.

The methodological difficulties are also hard to overcome. The survey-based approach was mainly chosen for pragmatic reasons of this being the only realistic method that might come close to obtain industry feedback that might come close to being representative. If that had been the case, the sheer quantity of responses should have tempered the disadvantages of surveys. If surveys had returned in large numbers, occasional low quality responses would have hardly affected the average results. But in the low return scenario we faced, the lack of quality control becomes a real issue that effectively makes results unusable.

The (non-)results for the four case study countries can be viewed in ESSA Delivery 4.4. In this report, we just report briefly on the structure of results presentation in the Matrix and we restrict ourselves to one case study country, Spain, as the other follow the exact same design.

4.1 Results

In the absence of meaningful results, we will discuss what we have obtained – effectively non-results – in terms of potentiality. For what follows, we simply assume that the results are meaningful to indicate and illustrate the potential usefulness of meaningful results. We start by looking at a specific country, in this case Spain, and then consider all four case study countries together.

We have two sets of purely survey-based results for Spain. The first set, obtained in 2021, had to be discarded as it the returned data indicated that respondents had largely misunderstood the task.. The second set of results, obtained in 2023 as part of an attempt to run a survey + workshop-based TSGA, is more meaningful. While around 50 surveys have been sent out, only 8 useable returns were obtained. The results of this purely survey-based TSGA are shown in Figure 6.

		Spain									
		Digital Now	Digital 2030	Environ Now	Environ 2030	Social Now	Social 2030	Personal Now	Personal 2030	Method Now	Method 2030
Maintenance	Level 2/3	●	●	●	●	●	●	●	●	●	●
	Level 4	x	x	x	x	x	x	x	x	x	x
	Level 5/6	●	●	●	●	●	●	●	●	●	●
Production	Level 2/3	●	●	●	●	●	●	●	●	●	●
	Level 4	x	x	x	x	x	x	x	x	x	x
	Level 5/6	●	●	●	●	●	●	●	●	●	●
Logistics	Level 4/5	●	●	●	●	●	●	●	●	●	●
Quality Control	Level 3	●	●	●	●	●	●	●	●	●	●
	Level 4/5	●	●	●	●	●	●	●	●	●	●

Figure 6: Survey-based TSGA for Spain 2021

If we were to take the results in Figure 6 at face value, we can observe that Spanish steel companies are not satisfied with the current levels of transversal skills provisions across the five different skills categories as none of current skills provisions have been, on average, rated as sufficient which would have resulted in a green dot. Instead, almost all current transversal skill provisions for all the OQPs are judged to be only partly sufficient with some programmes and skills categories even judged to be insufficient. As mentioned above, the Matrix is not capable of identifying the specific skills that make up each of the categories. All that could be said is that the steel industry views current skills provisions as 'partly insufficient' (yellow dots) across the board of the five transversal skills categories.

Compared to the current skills gap assessment, the future outlook to 2030 suggests that the gap between skills provided today by the VET system and skills required by the steel industry in 2030 is likely to increase over the coming years. Particularly worrying is the skills gap assessment with regard to digital, personal and methodological competences, which are judged to be insufficient by 2030 relative to industry needs.

If these results were translated into VET system focused actions, it might be suggested that there is some need to review the current transversal skills provisions with regard to all skills categories, with a particular urgent need for action in the areas of digital and personal skills. With regard to the outlook to 2030, quite the assessment by industry experts suggests that large-scale revisions to the curriculum are required to align VET provisions with industry requirements. What exactly would be required is beyond the capacity of the SSM to say, but as such reform processes tend to be formally structured and regulated, this is down to the relevant VET stakeholders to work out. The Matrix can, in principle at least, raise awareness for the need to do something in particular areas.

In principle, it is also possible to draw cross-VET system conclusions by comparing the results from different nation states with each other. The phrase 'in principle' needs to be further caveated. To do this soundly, additional research is required that can shed light on the limits of comparability. While the surveys underpinning these results asked the same questions in all case study countries, this does not guarantee that questions are understood

and answered in the same way. For example, expectations with regard to what qualification programmes ought to provide might differ from country to country. In countries with underdeveloped VET provisions, companies' expectations might be very low which might skew the skills gap assessment in particular ways.

Assuming for the moment that results from different countries are broadly aligned and thus comparable, the Matrix should be able to tell us something about the relative strengths and weaknesses concerning transversal skills provisions in the four case study countries (see Figure 7).

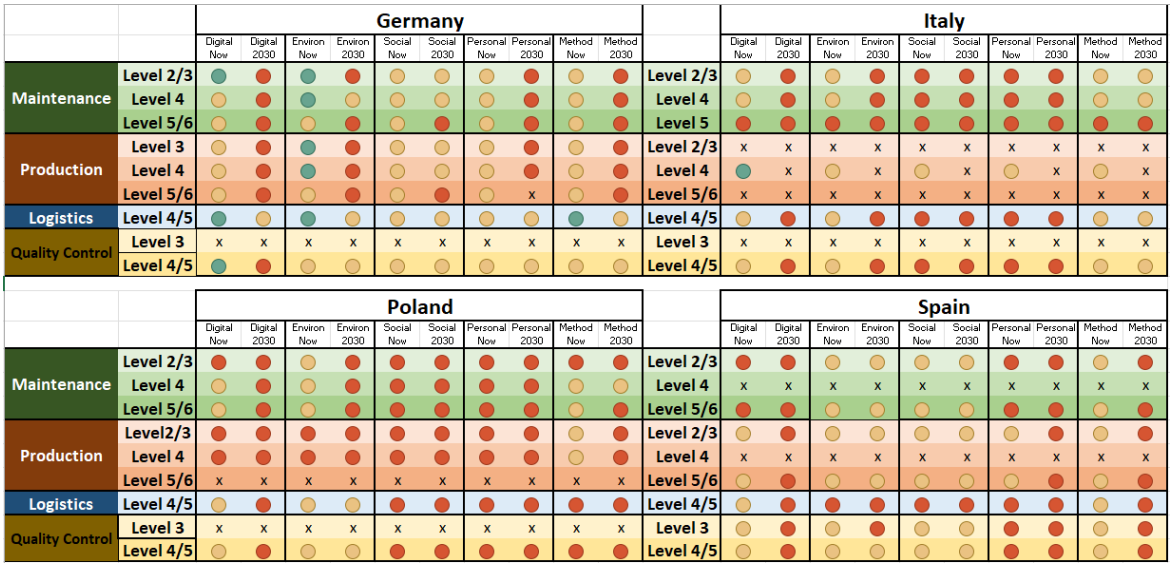


Figure 7: Overview of TSGA for 4 case study countries

If we were to treat the results in Figure 7 as meaningful, we could say that current transversal skills provision looks the most sufficient in Germany, while the gap between current provisions and industry requirements in Spain, Italy and Poland is relatively speaking much greater. In fact, Germany is the only case study country where experts have judged current skill provisions as sufficient with regard to a good number of OQPs and transversal skills categories. As noted elsewhere (ESSA D4.1), transversal skills provisions with regard to environmental skills had been strengthened recently in Germany through the introduction of an environmentally focussed learning field. The German data also highlight, however, how quickly industry experts see requirement change as they regard current provisions of environmental skills to be largely outdated 2030 already.

With regard to future skills gaps, Germany is again best positioned to meet future skills demand as the gap between current provisions and future requirements is the smallest of all case study countries. Nonetheless, a growing gap between skills provisions and industry requirements suggests need for action in in Germany. In relative terms, there is a similar if not a slightly greater need for adjustments in the other three case study countries, particularly in Poland, where skills provisions across the board of categories and OQPs are judged to be insufficient.

4.2 Fundamental Problems of the Matrix Approach

While the depth and quality issues afflicting the Matrix renders the results practically unusable, there are some other, more fundamental issues that are likely to prevent the steel-industry focused Matrix from becoming a practically useful tool. These issues have less to

do with the adequacy or quality of data and are rather social and political in nature. We will illustrate these issues briefly in this section.

4.2.1 Lack of sector-responsiveness of VET systems

The implicit assumption behind the Matrix is that it is possible to adjust VET system provisions such as specific occupational qualification programmes according to sectoral needs. On the face of this, this assumption makes a lot of sense. As many developments and changes in skills requirements are sectoral, making sector-specific adjustments seems plausible and desirable. The fundamental problem in all of the considered case study countries is that national VET systems rarely if ever are sensitive to the particular needs of a specific sector. While this might seem odd from a sector-perspective, this is imminently sensitive from a broader societal perspective. In Germany, for example, there is a broad distinction between qualifications related to crafts, to industry and to commerce. The production and maintenance qualifications in the steel sector are industrial qualifications that enable learners to obtain qualifications which allows them to work in any industrial sector across the whole of Germany. In other words, most of the qualifications that are relevant for the steel sector are also widely used in other industrial sector such as automotive or plant engineering and so on (see ESSA D4.1 for details for each case study country). This has the advantage that those with industrial qualifications can work across all sorts of industry and are not restricted to any specific sector. This makes a national workforce flexible and does not bind workers to specific sectors.

This has further consequences for the politics of shaping forms and contents of occupational qualification programmes. To stay with the example of Germany, forms and contents of qualifications are shaped at national level. Three parties – state, employers and trade unions – are involved in these negotiations. The steel sector is represented in this forum – like other industrial sectors – via the Federal Association of German Industries (Bundesverband der Deutschen Industrie (BDI)). This means that any steel-sector specific wishes regarding the for or content of qualifications might feed into positions taken by the BDI have to be first negotiated amongst industrial sector organisations that are organised within the BDI. Given the relative marginal position of the steel sector within the industrial ecosystem in Germany, it is very unlikely that steel-specific wishes will make it into the negotiation position (unless they are aligned with the demands of other, more powerful sectors such as automotive). Even when it comes to more specific negotiations on particular sub-categories of qualifications, such as metal-related qualifications which are part of a category of Metal and Electronics Qualifications in the German context, the steel sector association is never directly involved in the negotiations around form and content of qualifications that are relevant to the sector. And even if the steel sector was able to put its wishes on the employer agenda, this would just be the agenda of one of three parties in the negotiations around occupational qualification programmes.

Having a Sector Skills Matrix, assuming it contains meaningful and trustworthy data, is unlikely to be able to directly shape VET provisions in the case study countries and beyond. It still has its uses: it can help to inform the skills agenda of national or regional steel sector associations in their indirect dealings with VET systems. It can also inform steel companies where to focus additional training efforts outside of formal VET provisions.

4.2.2 The lacking Europeanisation of VET systems

Despite recent efforts at EU level to harmonise certain VET aspects and to create European VET tools (see ESSA D4.2 for a comprehensive overview and discussion) such as Europass and the European Qualification Framework, VET systems are a matter for member states. While systems across countries are more or less similar, the differences tend to reflect long-standing idiosyncrasies of the nations in which they have developed over long periods (the German VET system, for example, has roots reaching back several hundred years).

The SSM original ambition was to become a European tool to promote cross-country learning and exchanges of best practice as well as mobility of workers. As indicted above, the actual design and content of the Matrix means that these intentions will not be met. The necessarily restricted focus on transversal skills and the impossibility to systematically and comprehensively embed learning outcomes into the Matrix makes cross-country benchmarking and hence cross-country learning very difficult. In a context where VET systems are a matter for national or regional actors and stakeholders, it is doubtful whether the Matrix can contribute to the Europeanisation of VET provisions and whether information about other VET systems are of any benefit to national steel associations or to companies despite the fact that many of the big steel companies operate in a wide variety of European countries.

4.2.3 The local nature of the steel sector workforce

Another social fact is also likely to limit the usefulness of the Matrix for companies, even if they operate in several European countries. This is the fact that new recruits in steel jobs, especially in production-related areas, tend to attract mainly if not entirely local apprentices or already qualified workers. Interviews with steel companies but also analysis done by some steel companies suggests that the vast majority of workers, especially in so-called ‘blue collar jobs' come from the immediate surroundings of the steel plants, usually from within a radius of about 40 or 50km. There is also very little evidence of intra-European migration related to steel jobs, although steel companies located in border regions might employ foreign workers. Language barriers but also barriers related to the often restricted or limited recognition of qualifications seem to be major factors.

While a tool like the SSM might be able to tell local steel companies that there are people with relevant and potentially equivalent qualifications in other European countries, recruitment drives appear to promise more support if they are focussed on the region around a steel plant rather than trying to look to other countries to fill workforce gaps.

5. Concluding Recommendations

Despite intensive efforts to produce a useful and usable tool in the form of a Sector Skills Matrix, we have not been able to produce something of this nature. Despite this setback, we still feel that the time and effort spent on trying to develop such a tool has been worthwhile. Setbacks can be informative and valuable lessons can be learned from this experience.

First, we suggest that systematically understanding and evaluating VET provisions relevant for particular sectors is an important element in an increasingly turbulent economic and

social environment characterised by rapid technological and organisational change, increasing recruitment challenges and the as yet uncertain consequences of climate breakdown.

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

Third, we believe that performing skills gap analyses as an element of wider efforts in skills forecasting and skills requirement predictions is a valuable and important task. Rapid technological and organisational change in the face of Industry 4.0, intensified digitalisation and demographic and educational trends and global climate breakdown will inevitably lead to changes in the skill needs of companies including those operating in the European steel sector. Whether such skills gaps assessments are best made via a tool such as a Matrix or whether other approaches and methods are more accurate and reliable is impossible to tell, because the ESSA Matrix has not (completely) achieved its stated aims in this regard and also because we have not done a comparative study of various skills gap and skills forecasting methods.[14]

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

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

References

Antonazzo, L., Stroud, D., Weinel, M. (forthcoming) Smart manufacturing and tasks automation in the steel industry: Reflecting on routine work and skills in Industry 4.0 *Economic and Industrial Democracy*

Cedefop (2017). *Defining, writing and applying learning outcomes: a European handbook*. Luxembourg: Publications Office. http://dx.doi.org/10.2801/566770

Markowitsch, J. and Plaimauer, C. (2009). Descriptors for competence: towards an international standard classification for skills and competences. *Journal of European Industrial Training*, 33(8/9), 817-837. https://doi.org/10.1108/03090590910993652

McKinsey Global Institute (2018). Skill Shift: Automation and the Future of the Workforce. Discussion Paper, May 2018. [Online access: https://www.mckinsey.com/~/media/mckinsey/industries/public%20and%20social%20sector/our%20insights/skill%20shift%20automation%20and%20the%20future%20of%20the%20workforce/mgi-skill-shift-automation-and-future-of-the-workforce-may-2018.pdf, last accessed: August 2021]