

# Identifying Future Skills for the Digital Transformation in the Steel Industry: An Ecosystem Analysis in the German Rhein/Ruhr Area



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## 1 Introduction

The impact of the increased use of digital technology on the world of work has become an important and controversial topic in public and political debate. Although a variety of factors, such as globalisation, demographic change or climate change, have an impact on work and human capital, much attention is paid in academic discourse to digitalisation in particular as a driver of change. It is expected that the digital transformation has and will have far-reaching consequences for employment and will lead to traditional job profiles changing, also affecting skills, with new demands for workers emerging (Gonzalez Vazquez et al. 2019: 10; Kirchherr et al. 2019: 2).

Thus, this chapter aims at examining the question of how digitalisation affects the skill demands of employees and managers. Especially with regard to the skills required of employees in the future, there is a great deal of need for discussion and a lack of clarity. This chapter thereby aims to make well-founded analyses of skill requirements. The topic of future skill demands is explored in the steel sector of the Rhein/Ruhr region, with a focus on the Düsseldorf administrative district in Germany. In order to categorise future skills, the skill classification of the BEYOND 4.0 project<sup>1</sup> will be used. This chapter thereby focuses on the categorised transversal skills, i.e. digital, personal, social and methodological skills needed for the digital transformation. Accordingly, it is expected that not only digital skills, but also non-digital skills will gain in importance in connection with a changed organisational structure, the increasingly fast pace of the working world and a related change in

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work culture. In the context of this chapter, skills shall be understood as “the stock of human capabilities that allow human beings to perform tasks” (Fernández-Macías et al. 2016: 30) and underpin the execution of tasks.

This chapter will show the results of a qualitative study conducted within the BEYOND 4.0 project with various company representatives and other stakeholders of the steel industry in the Düsseldorf administrative district. It approaches the question of which skills employees and managers need for digital transformation. Despite supra-regional corporate strategies, the administrative district level is a suitable unit of analysis when focusing on skill needs and skill supply. We thereby refer to the concept of entrepreneurial ecosystems, assuming that not only companies and start-ups but also other actors, processes and institutions such as universities and research institutions, the public sector in the form of business development and political actors, as well as educational institutions, banks and associations play a crucial role in the development of a sector within a region (Brown and Mason 2017: 15; Stam 2015).

Such close links between actors from different sectors of society (e.g. economy, public, research, civil society) could indeed be identified in the steel sector of the Düsseldorf administrative district. Following an ecosystem approach, steel-related stakeholders in the region, including company representatives, experts from the federal employment agency and regional employment agencies, business development agencies, chambers of industry and commerce as well as various research and educational institutions, were interviewed to share their expert knowledge on which skill demands for employees will arise as a result of digitalisation in the steel ecosystem. In total, 8 interviews were conducted and evaluated. In this way, concrete assessments of the questions were obtained from different perspectives in order to be able to qualitatively describe the effects of digitalisation on skill demands from a regional perspective.

## 2 BEYOND 4.0's Categorisation of Future Skills

The determination of skill demands is fundamental in order to design skills supply appropriately and to teach the right skills, avoiding skill mismatches and operating on a common understanding of skill requirements among different stakeholder groups. The BEYOND 4.0 research project<sup>2</sup> offers an orientation in that matter. Within the framework of the project, a systematic literature research on future skills was carried out, on the basis of which a skill categorisation was developed. The literature reviewed did not necessarily refer to individual sectors, as the skill categorisation aims to present skills that apply to all sectors, and thus to the digital world of work in general. This categorisation serves as the basis for the empirical results of this chapter and structures the findings.

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One finding with regard to the categorisation of future skills of the digital transformation was that not only digital, but also non-digital skills, in the form of personal (e.g. required personal traits, e.g. adaptability to technological changes), social (e.g. communication/collaboration) and methodological skills (e.g. problem-solving) gain importance in the course of the digital transformation while job-specific skills (including work experience) remain important (see explanations of the categories below; Kohlgrüber et al. 2021: 2). Within BEYOND 4.0's skills framework, primarily those non-digital skills were considered that tend to gain in importance across different professions in all sectors due to the influence of digitalisation (Kohlgrüber et al. 2021: 20).

The central role of *digital skills* is recognised in all the studies examined (e.g. Gonzalez Vazquez et al. 2019; Bughin et al. 2018; Kohlgrüber et al. 2021: 35). In this analysis, a distinction will be made between basic, moderate and advanced digital skills. It is a common result of different broader studies that basic digital skills are already important in most occupations and at all skill levels and will become even more important in the coming years (Kohlgrüber et al. 2021: 35; see also Cedefop 2020; Gonzalez Vazquez et al. 2019). Basic digital skills thereby mean basic computer skills like handling a mouse or scrolling up and down on screens and creating and reading digital documents. While moderate digital skills are mainly important in medium-skilled jobs and especially in jobs with administrative tasks, literature shows that advanced digital skills are particularly required for jobs of higher-skilled workers and are closely linked to job-specific skill demands. Moderate digital skills thereby refer to word-processing or creating documents and/or spreadsheets, while advanced digital skills refer to rather sophisticated tasks like programming (cf. Kohlgrüber et al. 2021: 35). Digital skills also include, among others, the use of digital devices, cybersecurity, the secure handling of data, including their analysis and interpretation, as well as the use of complex digital communication tools (Kohlgrüber et al. 2021: 33).

In the context of BEYOND 4.0, *personal skills* are understood as skills or rather personal traits that people need in order to fulfil their working tasks and to succeed in the modern world of work (Kohlgrüber et al. 2021: 35). Such personal skills include self-reflection, integrity, sense of responsibility, motivation, willingness to take risks and personal attitude, for example in the form of openness or values (cf. Abel 2018: 28). In close connection with openness, adapt to change is one of the most important personal skills in the context of the digital transformation, as is the ability to learn new skills. The basic assumption here is that further education and lifelong learning are becoming enormously important in the course of digitalisation (Janis and Alias 2018).

*Social skills* include all skills related to interpersonal interaction. They include basic communication skills such as the exchange of information as well as more complex social interaction skills such as skills for teamwork or other types of cooperation, intercultural skills, the coordination of social networks, conflict resolution strategies, teaching, mediating, negotiating and persuading as well as the knowledge of how to appear polite and friendly (Kohlgrüber et al. 2021: 36). Social skills are gaining in importance in the course of digitalisation, also due to a change in the

organisation of work. At the same time, it is assumed that the demand for social skills will increase in the future, as these are skills that are difficult to automate from a technological point of view (Cedefop 2019 and Eurofound 2018). It is also expected that especially skills related to leadership and management, negotiation skills as well as interpersonal skills and empathy will gain in importance in the coming years (Bughin et al. 2018; DRIVES 2020).

Advanced *methodological skills* are needed to find strategic solutions to achieve a defined goal (Kohlgrüber et al. 2021, p. 36). For such a systematic approach, problems need to be analysed and understood before creative solutions can be found and prioritised. Problem-solving skills as well as creative and analytical thinking are required in this context (Abel 2018; OECD 2019). In addition, basic methodological skills such as literacy and numeracy are seen as important prerequisites for the acquisition of digital skills and form another category of methodological skills. Such basic methodological skills include also basic language skills and cognitive skills. They form the basis for lifelong learning (OECD 2019). In addition, basic methodological skills are crucial for individuals to benefit from the digital transformation. This is not least because these skills are essential for employability and make an important contribution to the inclusion of people in digitalised work processes (Kohlgrüber et al. 2021: 36).

Job-specific skills form another category with regard to future skills and are also part of the BEYOND 4.0 skills classification, even though they are not in the focus of this chapter. Such job-specific skills relate to the specific field of work, domain or occupation in question. In this way, job-specific skills form a counterpart to general or transversal skills, as they refer to the use of specific knowledge. However, the exact consideration of so-called job-specific skills, which are assigned to individual fields of activity, is difficult in the empirical analysis. Since there are myriads of different jobs and occupations, it seems difficult to gain an overview of the skills required for them. For this reason, in this chapter, job-specific skills are not considered in the empirical analysis.

### 3 Focusing on Steel in the Rhein/Ruhr Area

The Ruhr region and Düsseldorf administrative district are of particular importance as a steel location for various reasons: Even though the steel sector is now heading in a climate neutral direction with the aim of replacing coal with hydrogen, in the past (and to this day), coal played a significant role for steel production. The Ruhr region and the city of Duisburg have thereby always benefited from rich coal deposits in the region. Furthermore, Duisburg's location directly at the river Rhein makes it an ideal location for the production of steel (Röhl 2019: 49) and the import of more coal from other regions and countries. After all, the river can be used to transport bulk goods such as iron ore, which are also needed for steel production—the city's

steelworks still obtain ores from Rotterdam via the Rhein.<sup>3</sup> The Ruhr region itself, which today is one of the most densely populated, largest conurbations in Europe, grew “around industry”, so to speak (Hahn 2011: 43). Thus, the expansion of the transport infrastructure in the form of a rail and road network connecting the various locations preceded the population growth and urbanisation in the region.<sup>4</sup> The Ruhr area has developed over the decades into the largest steel region in Europe and the Ruhr region has established itself strongly in the metal industry.

Over the years, steel production in the Ruhr region and in general has changed drastically, even before digitalisation and decarbonisation. German steel companies are producing more and more efficiently. Labour productivity, measured in terms of crude steel production per employee, has almost tripled in the last 30 years (Küster-Simic et al. 2017: 19). Also, employment figures of the steel ecosystem show that there have been enormous staff cuts in recent decades: while the Duisburg coal and steel industry of the 1960s employed around 160,000 people, today this figure is around 21,000 (Berger 2007: 5). Despite this enormous decline in employment, the steel sector is still by far the largest employer in the city of Duisburg (Bundesagentur für Arbeit 2020). In addition to the depth of added value of the steel product, the high indirect employment of the sector, which is not included in the statistics, should be emphasised. If suppliers and other service providers are included, experts assume that a total of around 40,000 people are employed in the steel sector in the city of Duisburg.<sup>5</sup>

The city of Duisburg generally occupies a special position in the analysis of the ecosystem. However, the capital of North Rhine-Westphalia and eponym for the administrative district of Düsseldorf also plays an important role in the ecosystem. After all, for a long time, the administrative headquarters of numerous iron and steel producing companies as well as steel associations were located in the state capital Düsseldorf.

## 4 Empirical Findings on Skill Demands in the Steel Ecosystem

In the following, the empirical results on skill demands and changes in skill demands due to digitalisation from the qualitative interviews are summarised. The thematic focus is on skill demands in the steel ecosystem, the structuring element being the transversal skill categories defined in the BEYOND 4.0 project, which gain importance across different jobs and occupations. The results are divided into digital, personal, social and methodological skills.

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<sup>3</sup> Expert intermediary, 08\_12\_2020.

<sup>4</sup> Expert intermediary, 08\_12\_2020.

<sup>5</sup> Expert intermediary, 08\_12\_2020.

## *Digital Skills*

Overall, new tasks appear to be emerging at all skill levels in the steel industry as part of the digital transformation, which are accompanied by changed skill demands.<sup>6</sup> The focus should now first lie on those skill demands that relate directly to the use of digital technologies or technologies in general.

Based on the expectation of the experts surveyed, it appears that medium-skilled workers in various occupations and fields are confronted with new software and digital systems. The intensity and the question of whether basic, moderate or advanced digital skills are needed, varies depending on the occupational field. Changes affect office workers as well as skilled workers in production.<sup>7</sup> Digital skills will particularly be demanded at the level of production management and quality assurance, as complex tools are already being used in this area.<sup>8</sup> Skilled workers, accordingly, need an understanding of the function, operation and use of such technologies: “You cannot always use such technologies if you do not fulfil certain prerequisites. For this, of course, you have to understand how these technologies work and what you have to pay attention to. The demands on the employees on site then also increase”.<sup>9</sup>

The steel experts interviewed expect high-skilled workers to have the highest requirements compared to other skill levels, while some interview partners assume that the demands for low-skilled jobs will not change dramatically in the near future.<sup>10</sup> One reason for this is that, from a companies’ point of view, digital systems ought to be easy to use, especially for the low-skilled. As it can be deduced from statements of the expert of one of the research institutes of the ecosystem, which has specialised in the development of digital solutions for steel companies,<sup>11</sup> in many cases companies place high demands on the user-friendliness of digital technologies: “if [...] we come up with really great modern solutions, then the [steel plants] say, yes, that’s all great, but then the simple man at the plant (...) must also be able to understand and operate them. That is why we (...) try to design the solutions in such a way that they are as simple as necessary and possible for the end user”.<sup>12</sup> The aim is thereby to reduce the need for complex training courses on digital knowledge at the low-skilled level.<sup>13</sup>

One example for a digitalisation process that kept digital skill demand rather low are control terminals in steel plants and in the logistics halls of steel producers and steel processors that function similarly to smartphones, so that only basic digital skills are needed to use these devices by the operators.<sup>14</sup> For example, mobile terminals,

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<sup>6</sup> Expert employee representative, 01\_09\_2020.

<sup>7</sup> Expert research, 27\_04\_2020.

<sup>8</sup> Expert research, 27\_04\_2020.

<sup>9</sup> Expert research, 27\_04\_2020, item 82a.

<sup>10</sup> Expert research, 27\_04\_2020; expert intermediary, 10\_12\_2020; expert company, 15\_12\_2020.

<sup>11</sup> Expert research, 27\_04\_2020.

<sup>12</sup> Expert research, 27\_04\_2020, item 82b.

<sup>13</sup> Expert employee representative, 01\_09\_2020.

<sup>14</sup> Expert company, 02\_11\_2020.

which are partly used in manufacturing by steel processors in the ecosystem, have Android interfaces. These types of interfaces are familiar to a large proportion of workers from everyday smartphone use. Yet, applications important in the work context differ from those on private smartphones, so their operation is still trained in the companies, but in a quick and easy way. Nevertheless, the focus here is on a user-friendly application and the attempt to reduce errors in dealing with new systems.<sup>15</sup>

Accordingly, low-skilled employees are primarily required to have basic digital skills. However, such basic skills are not only a prerequisite for low-skilled workers, but for all skill levels for working with digital technologies. Basic digital skills include the use of end devices such as tablets, smartphones, laptops and computers or basic knowledge of Microsoft Office.<sup>16</sup> The training of these basic skills is one of the most important tasks of various actors in the ecosystem, such as the employment agency, who has a mediating role between companies and training providers. Our respondents mentioned some challenges of providing basic digital skills as they are closely related to other basic skills. For example, methodological skills such as literacy and numeracy are essential for the acquisition of digital skills. In particular, language skills play a decisive role, so that teaching basic digital skills to migrants who do not have a certain level of German language skills is sometimes difficult: “We also have a large group of applicants with a migration background. We notice that digital skills would be important. But there is a step before that, namely the language component, which is also an issue for us [...]. We would have potential and the means to qualify people, but oftentimes this is not possible due to the lack of language skills. Because of the language barrier, skilled people sometimes end up in unskilled jobs”.<sup>17</sup> Here, the clear demand for language courses becomes obvious. Local employment agencies have increased the number of offered paid German courses for unemployed as a result.

Although digital systems are playing an increasingly important role in almost all areas, advanced digital skills are a prerequisite especially for highly qualified jobs. Thus, not only IT specialists, but also other occupational groups such as engineers are increasingly required to set up and to have an in-depth understanding of digital programmes, according to some experts.<sup>18</sup> Highly qualified as well as medium-skilled workers in the steel ecosystem are also increasingly confronted with new technologies in work systems, which leads to new skill demands, for example with regard to programming and the secure handling of data and data protection. Consequently, the share of jobs with a stronger focus on IT systems and programming is increasing in general.<sup>19</sup>

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<sup>15</sup> Expert company, 02\_11\_2020.

<sup>16</sup> Expert intermediary, 10\_12\_2020.

<sup>17</sup> Expert intermediary, 10\_12\_2020, item 30.

<sup>18</sup> Employee representative, 01\_09\_2020; expert intermediary, 10\_12\_2020.

<sup>19</sup> Expert employee representative, 01\_09\_2020.

## *Personal Skills*

Changes are taking place at a rapid pace in the digital transformation. According to the interviewed experts, employees are regularly confronted with new software, so that further education and ongoing training on new technologies are of great importance, especially at middle and higher skill levels. Lifelong learning is therefore becoming indispensable in the context of digitalisation, as programmes and digital systems are constantly being further developed and new digital elements are being integrated into companies at regular intervals. However, this statement does not only refer to the steel ecosystem, as this impression also seems to arise in other sectors: “We notice in the entire labour market that changes that used to take place within 15 years now happen within months”.<sup>20</sup>

As a prerequisite for the development of the necessary learning skills, employees are required to be open towards new technologies and willing to learn and to change.<sup>21</sup> At the same time, this also requires determination, courage and trust on the part of employees as well as managers. The more these qualities are present in organisations in the steel ecosystem, the better digitisation can be implemented as a major transformation topic, according to the experience of one of the company experts interviewed.<sup>22</sup> Accordingly, employees are required more than ever to recognise their own skill gaps and training needs. On the part of the employees, this requires a high degree of honesty and self-reflection in addition to proactivity and independence. This assessment of the interviewed experts was also confirmed by an in-house survey at one of the leading steel manufacturers in the ecosystem.<sup>23</sup> Overall, the experts share the assessment that further qualification and training, respectively lifelong learning along all skill levels of the steel ecosystem are gaining in importance due to the influence of digitalisation. Accordingly, personal skills, which enable lifelong learning, are becoming fundamentally important for all employees.<sup>24</sup>

At the same time, the leading companies in the steel ecosystem are characterised by low staff turnover. As a result, employees, even in the low-skilled spectrum, normally have a high retention rate in steel-producing and steel-processing companies, which in turn has a positive effect on the willingness of companies to provide further training.<sup>25</sup> The fact that employees stay longer in the company makes the investment in their further qualification “worthwhile” from the company’s point of view. In many cases, regional steel companies consequently rely on in-house further education and training, so that the requirements for potential applicants are manageable. An interviewee from a local steel SME states that a completed apprenticeship on low and partly also lower medium job profiles is therefore not necessarily a prerequisite for a worker in the company. However, certain basic characteristics are required in

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<sup>20</sup> Expert intermediary, 10\_12\_2020, pos. 40.

<sup>21</sup> Expert company, 15\_12\_2020.

<sup>22</sup> Expert company, 15\_12\_2020.

<sup>23</sup> Expert network, 01\_10\_2020, expert intermediary, 10\_12\_2020.

<sup>24</sup> Expert intermediary, 10\_12\_2020.

<sup>25</sup> Expert company, 15\_12\_2020.



this context, which can also be described as personal skills, or rather, personal traits, including punctuality, diligence and reliability: “[T]he people we need have to be punctual, hard-working and reliable, and we teach them the rest”,<sup>26</sup> as the company expert puts it. These prerequisites may sound self-evident, but various statements show how essential these qualities are and how difficult it seems to be, especially for smaller companies in the ecosystem, to recruit appropriate workers<sup>27</sup>.

Accordingly, personal skills such as the ability and willingness to adapt to change can be seen as a prerequisite to acquire digital skills related to the operation of technologies, programmes and systems. It is precisely these personal skills that play a decisive role not only in high- and medium-skilled jobs, but also in the low-skilled end. Although basic digital skills are currently mostly sufficient for low-skilled jobs, employees at this skills level may also be expected to constantly familiarise themselves with new digital tools, so that further training and education is likely to become an issue for low-skilled workers in the future<sup>28</sup>.

## ***Social Skills***

Social skills have not only been important since the emergence of the terms Industry 4.0, Industry 5.0 and digitalisation. Nevertheless, the digital transformation means that social skills are gaining in importance. Reasons for this include the changed organisation of work, which certainly does not affect all areas equally, but is nevertheless noticeable in many companies and departments. For example, topics related to digitalisation are often dealt with in interdisciplinary teams. The focus is thereby on project work, so that employees from different departments come together for a certain period of time to solve specific, internal company problems as is the case of one of the companies of our study<sup>29</sup>. This exchange between different professional groups has increased the demands on interdisciplinary teamwork. After all, the working methods and communication cultures of different professions are not always compatible, even within the company—employees from marketing, for example, have different thematic focuses, work content and technical jargon than engineers or IT specialists. Accordingly, interdisciplinary cooperation comes with various challenges. At the same time, digitalisation is also shaping contact with national and international customers. Through communication tools, web conferences can be held across national and continental borders. As a result, especially more highly qualified employees increasingly have contact with people from different cultural backgrounds.<sup>30</sup> Other drivers also play a role, such as globalisation. In the steel ecosystem and in the steel industry in general, company takeovers and mergers are

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<sup>26</sup> Expert company, 02\_11\_2020, item 18.

<sup>27</sup> Expert company, 02\_11\_2020.

<sup>28</sup> Expert intermediary, 10\_12\_2020.

<sup>29</sup> Expert company, 15\_12\_2020.

<sup>30</sup> Expert intermediary, 01\_09\_2020.

not uncommon, with the strongest competitors in the industry coming from China, so that employees are also confronted with other cultures and ways of working.<sup>31</sup>

In addition, the importance of intensive customer contact is increasing in various sectors, including mechanical engineering. This is a development that has been ongoing for years and is accelerated by the use and possibilities of digital technologies, ultimately enabling the customer in the steel industry to intervene more and more in the design processes. As a result, the work pressure for employees increases, but also the communication requirements, as more and more people are involved in processes.<sup>32</sup> The interviewed company experts confirm that the end customer plays an increasingly important role in development processes and is optimally integrated into production and design processes. Communication and cooperation are thus becoming more important aspects of the modern working world for more workers than before.<sup>33</sup>

Social skills also include management skills. This point is also related to a changed organisation of work. Ultimately, forms of agile work are currently increasingly required, in which flat hierarchies are of great importance. According to the experts, the trend in companies with a high level of digital technologies is moving away from hierarchical structures towards cross-functional, cross-hierarchical work: “For many managers, it is a challenge how they should lead their team. Namely, via a technology that they sometimes have much less knowledge of than their team members. And if you are now in a culture where the boss always does everything best and if everyone believes that, then of course it is a problem. But our managers should also see their role more in coaching their team to success instead of being the one who brings solutions”.<sup>34</sup> In this context, interviewed company experts emphasise that digitalisation should always be understood as a joint project, as various areas are important in the digital transformation. Accordingly, experts in technologies, for business aspects and for work organisation are also found in project teams. Ultimately, managers have the primary task of bringing these different roles together and promoting successful cooperation.<sup>35</sup> A high degree of empathy and sensitivity is thereby required on the side of managers. Nowadays, managers also have more and more the task of supporting the development of their employees, recognising needs and, if necessary, pointing out appropriate further training opportunities. Such a non-authoritarian leadership style seems to have already been implemented at least in the large steel plants of the Rhein/Ruhr ecosystem in the areas where digitalisation plays a role.<sup>36</sup>

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<sup>31</sup> Expert intermediary, 10\_12\_2020.

<sup>32</sup> Expert employee representative, 01\_09\_2020.

<sup>33</sup> Expert company, 15\_12\_2020.

<sup>34</sup> Expert company, 15\_12\_2020, item 43.

<sup>35</sup> Expert company, 15\_12\_2020.

<sup>36</sup> Expert company, 15\_12\_2020; expert employee representative, 01\_09\_2020.

## *Methodological Skills*

Methodological skills include basic skills such as logical thinking, numeracy and literacy as well as advanced methodological skills such as complex thinking, problem solving skills and creativity. Interviewed experts confirm that these skills are indispensable for the acquisition of digital skills and the handling of digital technologies.<sup>37</sup> These skills also play a role independently of digital skills, as they contain the prerequisites for the acquisition of further knowledge. Finally, as already mentioned, the in-house training of unskilled workers plays an important role in many cases, especially in the regional steel industry.<sup>38</sup> So-called lifelong learning is of great importance, which in turn requires methodical learning skills. If these prerequisites are met, even unskilled workers in steel companies have the opportunity to undergo training and further their professional development.<sup>39</sup> This impression is not only created by statements of interviewed experts from two companies, but also by assessments of other, company-external actors in the ecosystem. One of the company experts formulates it as follows: “We are a company that has almost no fluctuation. This is [...] good, because we have an infinite amount of time to develop our people. That means that when we hire people, it’s partly not a question of what they can do, but what they are capable of learning. We can train the people, so there are hardly any bad investments. It’s different when the average length of stay of the employees is 3 years, of course you have to ask yourself whether it’s worth investing”.<sup>40</sup>

The methodological learning skills that are essential for lifelong learning are becoming more important in the course of the digital transformation. Work content is changing at a rapid pace due to the influence of digitalisation. As it is difficult under such pressure of change to impart concrete digital knowledge on the long term, for example related to the function of a particular system, employees are more than ever required to develop methods that enable lifelong learning.<sup>41</sup> In this context, experts observe that learning skills are more likely to be present in employees who have completed a degree or training and that it is therefore easier for them to familiarise themselves with new systems and structures at these levels: “The higher my skills are, and also my human capital, the higher the possibilities are to prepare myself for other things and to be retrained”.<sup>42</sup> This also has an impact on recruitment processes in the steel ecosystem, as it is assumed in this context that disadvantaged labour market groups such as unemployed and unqualified workers lack learning skills and that the acquisition of digital skills as well as dealing with change will therefore be all the more difficult for them.<sup>43</sup> The increasing demand for skilled workers in the steel ecosystem therefore can also be explained by the fact that completed training has

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<sup>37</sup> Expert intermediary, 10\_12\_2020.

<sup>38</sup> Expert company, 02\_11\_2020.

<sup>39</sup> Expert company, 15\_12\_2020.

<sup>40</sup> Expert company, 15\_12\_2020, item 17.

<sup>41</sup> Expert intermediary, 10\_12\_2020.

<sup>42</sup> Expert intermediary, 10\_12\_2020, item 11.

<sup>43</sup> Expert intermediary, 10\_12\_2020.

become more important against the backdrop of these developments, as it is expected “that someone with a completed training is also able to acquire company-specific knowledge more easily”.<sup>44</sup>

Learning skills are closely related to flexibility and the ability to adapt to new circumstances and respond to change. In this context, analytical skills are also important, which are required in various areas, especially at higher skill levels.<sup>45</sup> For low-skilled employees, the pressure for education and further training is lower in comparison. However, it is evident that influences such as digitalisation, globalisation and internationalisation of markets lead to changes in forms of work and the labour market, so that skills will also require regular updates in the low-skilled end, at least with regard to future prospects, and therefore, methodological skills as well as lifelong learning play a role at all skill levels.<sup>46</sup>

As digitalisation is accompanied in many places by changed processes and a changed organisation of work, the demands on the self-organisation of employees are increasing. Ultimately, digitalisation is also associated with new autonomy and more flexibility on the part of employees, which in turn leads to new demands on employees’ skills to organise themselves. Employees are required to recognise training and further education needs as well as weaknesses and deficits on their own. “Thinking outside the box” and developing an understanding for one’s own work are thereby demanded.<sup>47</sup>

The use of digital technologies in various areas can reduce complexity and lead to simpler work processes; however, paradoxically, it becomes particularly complicated when problems arise in situations that do not correspond to routine work processes. In these cases, methodological skills such as problem-solving skills, understanding of systems, expertise and experience are particularly in demand.<sup>48</sup>

## 5 Conclusion

The empirical material of BEYOND 4.0 project, in which steel industry experts of the Rhein/Ruhr area were interviewed, illustrates the importance of non-digital skills in connection with digital skills. Digital skills, at least in basic form, are playing an increasingly important role at all qualification and skill levels. However, it is above all the requirements for the continuous learning of new skills in dealing with digital systems and software that play a special role. Personal skills, such as willingness to change and adaptability, as well as intrinsic motivation to increase one’s own level of digital skills are particularly important. In this respect, different skill categories are interacting with each other. Many of the non-digital skills can be seen as a

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<sup>44</sup> Expert intermediary, 10\_12\_2020, item 15.

<sup>45</sup> Expert intermediary, 10\_12\_2020.

<sup>46</sup> Expert intermediary, 10\_12\_2020.

<sup>47</sup> Expert employee representative, 01\_09\_2020.

<sup>48</sup> Expert employee representative, 01\_09\_2020.

prerequisite for the learning of digital skills. This becomes particularly clear with the methodological skills numeracy and literacy, without which it is difficult to learn digital skills.

A central finding with regard to the skill demands in the steel ecosystem are the challenges that arise from the fast pace of digitisation. This fast-moving nature means that it is difficult to impart specific knowledge, especially in dealing with digital technologies, because the software and tools used change at regular intervals.<sup>49</sup> As a result, non-digital skills are particularly in demand. The fast pace of digitisation has an effect above all on methodological and personal skill demands. Here, in addition to openness, the motivation and willingness to learn seems to be important for employees at all skill levels. At the same time, requirements for skills that enable lifelong learning, such as personal skills, are also increasing.<sup>50</sup> Some of the experts interviewed emphasise that skilled workers and highly qualified people in particular are more likely to be trusted with these personal and methodological skills. In this context, the training or university degree is seen as evidence that the respective persons have the necessary learning skills and the necessary adaptability to better cope with change.<sup>51</sup> This could indicate that formal educational qualifications will become even more important against the backdrop of digitalisation and increase the disadvantage of the low-skilled on the labour market or that some form of certification of being an apt learner might be needed.

The degree to which digital skills are needed varies greatly depending on the skill level of the employee. For example, more digital skills are needed for higher skilled employees, while the challenges are less at lower skill levels. Experts in the steel ecosystem report that especially in the low-skilled sector a lot of value is placed on a high level of user-friendliness of digital solutions.<sup>52</sup> It is questionable to what extent this development is also evident at other skill levels. Ultimately, in some cases this could lead to a loss of importance of skilled work, especially in the medium-skilled sector, not necessarily with regard to formal educational qualifications, but with regard to the actual work tasks. In a second step, this could of course also have an impact on job advertisements and thus ultimately on formal qualification requirements. The described user-friendliness speaks rather against an “upgrading” of low-skilled jobs caused by digitalisation at this moment in time, but rather for the fact that employees at this level are not confronted with demands for advanced or even moderate digital skills despite the increasing use of digital technologies. In contrast, according to the experts, the demands for advanced digital skills are increasing for highly qualified employees.<sup>53</sup> With the next waves of digitalisation this situation might change, as still more aspects of the production process get digitalised and ask for appropriate digital skills, also on the shop floor.

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<sup>49</sup> E.g. expert intermediary, 10\_12\_2020.

<sup>50</sup> Expert intermediary, 10\_12\_2020.

<sup>51</sup> Expert intermediary, 10\_12\_2020.

<sup>52</sup> E.g. expert research, 27\_04\_2020.

<sup>53</sup> E.g. expert employee representative 01\_09\_2020.

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