



Digitalising the economy: The future of employment and qualification in Germany

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The new complex and intelligent digitalisation poses a significant challenge to the economies and the labour markets. In this context, the underlying article discusses the future of employment and changes in qualification requirements as well as policies for vocational and further training, social security and the coordination of flexibility. We provide a view on the development in Germany as a large Continental economy.

Everyone has been talking about digitalisation and “Industry 4.0” for a few years now. Even though it may be something of a hype, we can expect some profound changes in the labour world brought about by intelligent, interconnected digitalisation. After the previous industrial revolutions, this current process now involves interconnecting the virtual-digital and physical worlds as well as machine learning in production. The objective is that the value chain can be controlled entirely by digital means or that it can control itself in a self-organised way, also beyond company borders. The result shall be a more efficient, flexible, and individual production.

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From a business point of view, we can therefore identify two main concerns: On the one hand, a new way of organising and dividing labour in production, also between humans and machines. On the other hand, however, it is also about developing new ideas and creating new value from the possibilities offered by digitalisation and the use of large amounts of data. What it all amounts to is therefore new business models on the market side of the companies.

Strengths and weaknesses of Germany 4.0

What is the outlook of a continental economy like Germany in particular in light of digitalisation? On the one hand, Germany is economically well-equipped; on the other hand, however, a range of completely novel challenges awaits, as the author of this article argues in a [recent article on industry 4.0](#). German companies are particularly well-represented in interconnected mechanical and plant engineering as well as sensor technology. Those sectors play to the typical strengths of the investment goods and export industry. In cloud technology and big data, however, there are other leaders; first and foremost, the U.S. But it is these latter fields which could form the core of intelligent control and communication. In that respect, Germany could quickly find itself in the position of an extended workbench of a modern digital economy if there is too much of a focus on traditional strengths such as mechanical engineering. Germany's unchallengeable strength in the export of high-end industrial goods, particularly in the last decade, could then no longer be guaranteed.

Its second strength, which could also be turned into a weakness, lies in the structure of the German economy: While the news are dominated by the major corporations, as usual, a large majority of workers is employed with small and medium-sized companies. In the past, there was no need to worry about the innovation capacity of the German SMEs. However, 4.0 Digitalisation is happening on a whole new level of abstraction, complexity, and interconnection, and handling it is by no means a matter of course within the limited structures of smaller companies.

Moreover, the German system is facing a number of internal challenges as well. Production, knowledge, sales, and development activities are growing ever closer together. This means that the typical German dividing line between tasks is blurring. At the same time, hierarchies become flatter. The importance of formal authority is increasingly replaced by topic-specific networks and streams of information. The strengths of many German companies, oriented towards productivity and quality, must be developed further towards flexibility. Particular emphasis should be placed on reconciling the companies' need for flexibility with that of their employees. Demands are growing, especially with regard to short- and long-term working

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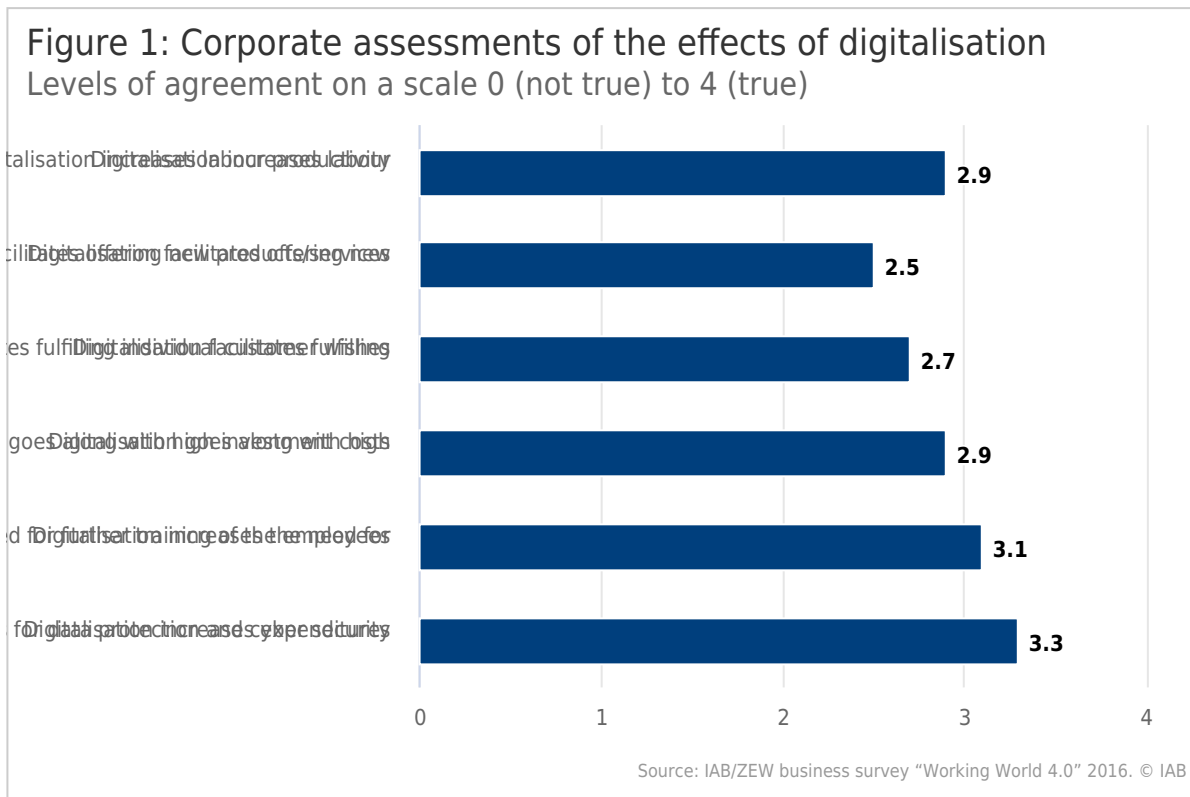
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hour arrangements, in part also due to a shift in the perception of social roles. In some areas, this means that entirely new technical possibilities will arise for such a connection, but the organisational implementation remains a challenge.

Employment: No decline, but major changes

Even if 4.0 Digitalisation is heavily implemented in Germany, the effects on the labour market in particular will be ambivalent. When observing digitalisation from a technological perspective, the typical result is a high degree of substitution of human work by machines. The actual effects on the labour market, however, require a comprehensive economic assessment while taking into account a variety of effects: Jobs disappear, new jobs are created, demands and activities change, production becomes more efficient, new products are created, income is generated and introduced into the economic cycle, labour supply and demand as well as wages and prices are adapted. The results of current assessments differ immensely, as for instance some discussion from Carl Frey and Michael Osborne in 2013 or David Autor in 2015 shows. On the one hand, there are fears of massive job losses as contemporary occupations are rendered superfluous by robots, and on the other hand, there are hopes for large-scale employment and innovation gains.

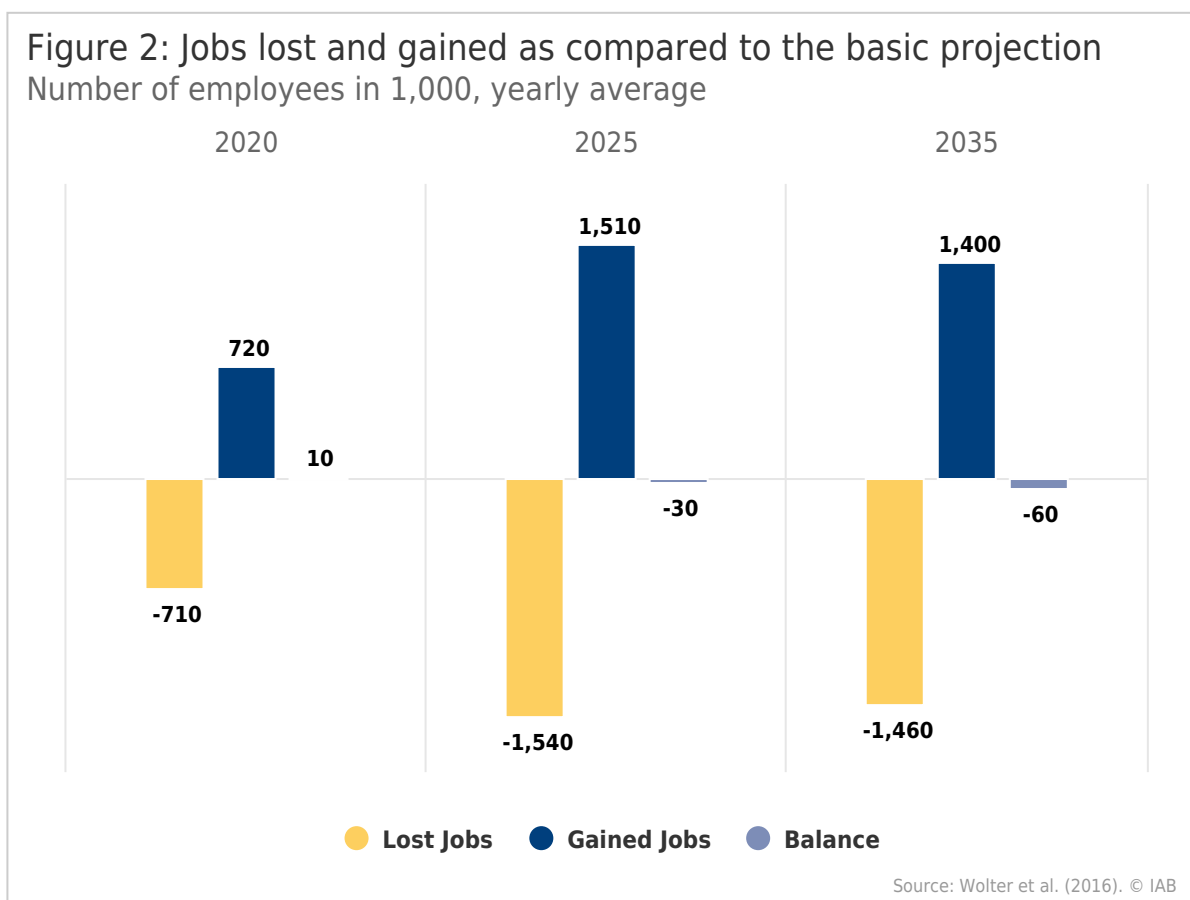
This ambivalence is also reflected in company survey results. Figure 1 shows, for example, that respondents believe that digitalisation will increase labour productivity. This means that the same value can be created with less employment of labour. However, companies also expect additional effects on new products, investments, further education, and data privacy, among others. If all these services were performed, it would come with additional employment.



A [study comprehensively analysing the effects of 4.0 digitalisation on the economy and the labour market](#) was recently presented by the Institute for Employment Research (IAB), the Federal Institute for Vocational Training, and the Institute of Economic Structures Research. Compared to the [predecessor study, "Industry 4.0"](#), the perspective is broadened and the implementation of "Economy 4.0" including digitalisation in the services sector is considered. While the keyword for Industry 4.0 is often a "factory devoid of humans," the services include, among other things, "autonomous driving" or fully automated logistics.

The study takes the current labour market projection from the [QuBe project](#) as the "basic scenario" and compares it to an "Economy 4.0 scenario". The latter is specified along the lines of a comprehensive set of assumptions that cover the implementation of 4.0 digitalisation in Germany. This scenario shows an increase in value creation by approx. EUR 80 billion (almost 3% of current GDP) within the span of ten years beyond the basic scenario. In light of increasing productivity and higher demands posed to employees, this results in higher wage sums on the one hand and on the other hand in higher profits, given more efficiency and revenue for new products. The employment level does not show any significant changes. This result justifies neither the fear of high job losses nor the hope for

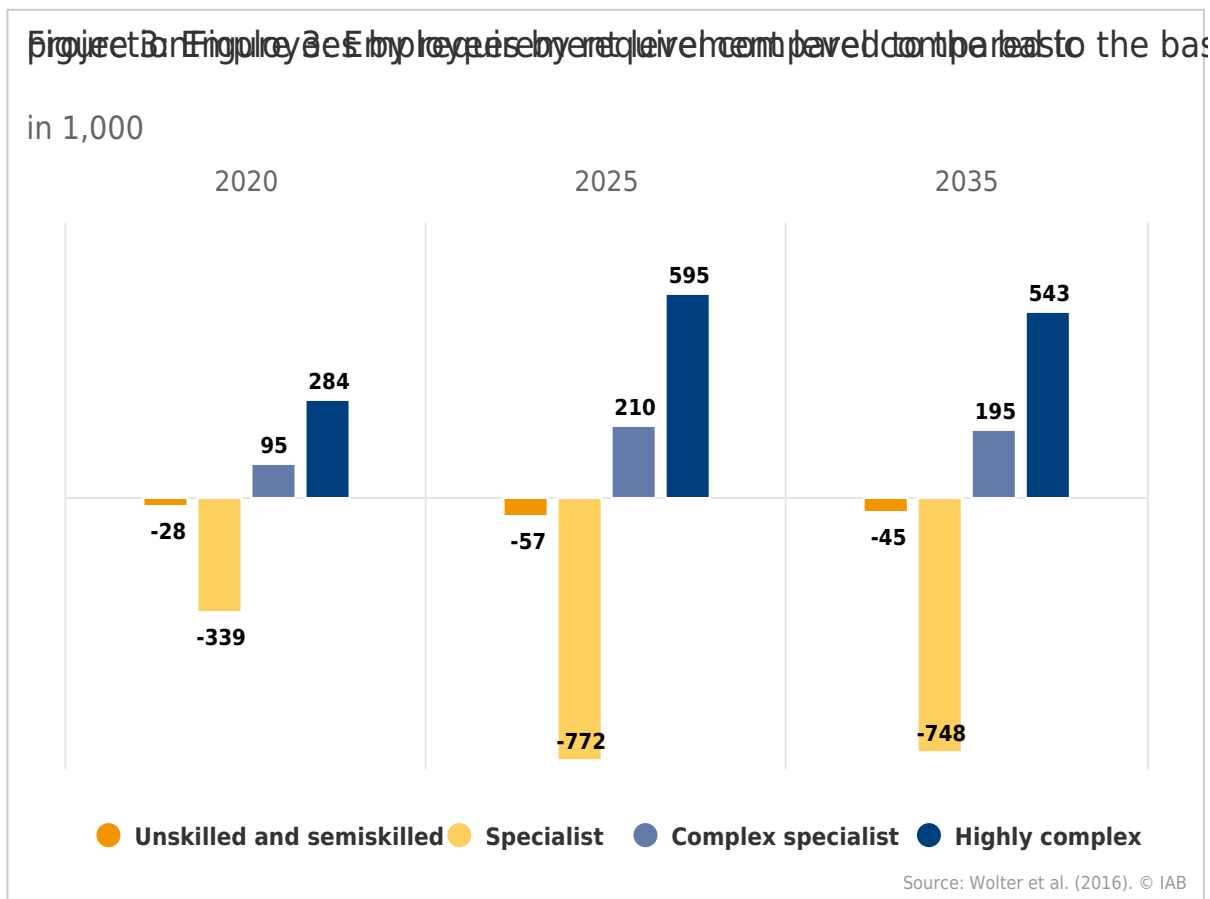
high job gains. Behind that, however, there are considerable changes: A large-scale introduction of Economy 4.0 in the year 2025 would result in the loss of approx. 1.5 million jobs which were still there in the basic scenario, but also in the creation of 1.5 million additional jobs in other areas (s. Figure 2). The tendency of these results is confirmed by [a study of Anja Warning and the author of this article](#), who examine the present employment dynamics subject to company-level digitalisation trends: In total, no negative employment effects can be identified, but companies with a trend towards digitalisation show a higher rate of both hiring and dismissal rates.



In particular typical professions in the manufacturing area decline, such as machine- and facility-controlling and maintaining professions. Damping effects can also be found in electronics, chemical, and synthetic materials professions. But also office and commercial services professions are affected. The strongest repercussions are felt in the occupational areas of finance, accounting, and book-keeping. By contrast, IT and scientific as well as teaching professions (which benefit from the need for further training) are on the rise. In

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terms of requirement levels, the demand for complex and highly complex activities is rising by approx. 800,000 while it declines for unskilled (-60,000) and particularly specialist activities (-770,000) (s. Figure 3). Expressed in qualification stages, this is reflected in gains in the academic area as well as losses in the vocational and unskilled area. This shows that the development towards Economy 4.0 will also affect the medium-skill range of the labour market, which is particularly strong in Germany. But one must not interpret these effects as a mechanical process: Specialists can also benefit from a rise in complex activities if they develop their own competences accordingly. Even today, many employees with vocational training do not work at the specialist level but at the complex specialist level—but many others hold jobs in the unskilled area.



When looking at the industries, we can see that employment in the manufacturing sector in particular is affected negatively, in spite of sales increases. The industries which benefit most from that scenario are information and communication, education, and activities of households as employers of domestic staff. While the positive effects on the two former

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industries can be explained by a greater need for consultation and further education as a side effect of digitalisation, the increase in employment in the households sector is less obvious. Here we see the effects of a rising income and demand level whereas the jobs in question can be automated to only a relatively limited extent. 4.0 Digitalisation therefore also creates jobs in areas which are not even directly connected to it. That is a general characteristic of employment reactions to technological change, and its overall effects can therefore only be illustrated in a comprehensive approach.

As a whole, the effects of Economy 4.0 might even lead to some kind of compensation of the emerging imbalances: Shortages in the medium-skill jobs based on vocational training are mitigated. In contrast, additional demand is generated for the strongly increasing supply in the academic field. For an effects analysis of the labour market development we must thus also consider the development of the labour supply in addition to the changes in labour demand dominating the debate.

The new digitalisation affects not only low-skilled jobs

However, this seemingly elegant result does not constitute an all-clear. According to the results, the difficult labour market situation of low-qualified persons will even deteriorate by trend. Even though impulses are possible in this area, e.g. the use of assistance systems such as data goggles and mental/ergonomic relief through human-machine collaboration, the way humans process information in the concrete working environment must be taken into consideration. Therefore, even with digital support, the most important factors will still be transparency, task-oriented design, openness towards human intervention, and qualification. Moreover, tasks could come up for low-skilled workers if structural changes emerge in jobs at the medium-skill level, leading to a redistribution of individual, hard-to-automate tasks such as short cleaning or maintenance activities, which have hitherto been covered in these jobs. But all the while, it is conceivable that labour market policy measures for improvements in the low-skill sector will become even more important. The overall macroeconomic effects of the phenomenon of Economy 4.0 entail major challenges on a political and company level. After all, major shifts and changes of workplaces are foreseeable.

Vocational training for a digitalised economy

Education and further education play an important role. To what extent Economy 4.0 will push back or even eliminate entire professions remains to be seen—the automation of tasks does not equal the automation of entire jobs which combine tasks with interaction, flexibility, problem solving, adaptability, and common knowledge. In any case, professional

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requirements will change, and the effect strongly depends on the areas in which this change is best received.

The Economy 4.0 process, which creates new task profiles through digitalisation, must be addressed according to one's own strengths in international competition. As right as it may be to place an obvious emphasis on university training, the clear specific strengths of the German system lie in the vocational training system and its interlocking of theory and practice. Then again, vocational training content is often oriented towards rather narrowly defined job profiles and a specific working environment, which can limit one's capacity to adapt and evolve in professional life, as Eric Hanushek and co-authors show in a 2017 article. Moreover, in a report from 2015 Katharina Dengler and Britta Matthes demonstrated that there is a high number of routine activities, especially in many jobs at the vocational training level, which are comparatively easily programmable.

Policy must therefore be active rather than simply reactive, focussing on the further development of strengths in order to train people who have the potential to shape the implementation of Economy 4.0. As production, knowledge, and development activities grow closer together and hierarchic control is receding, creative leeway is created which may also include the vocational training area. In the context of the implementation of 4.0 Digitalisation, high-quality employment becomes a business model precisely when staff is available who can take on new and responsible tasks. It stands to reason that digital content should be integrated more strongly into vocational training. But it is at least as important to teach competences such as conceptual and creative thinking as well as abstraction and communication skills for these new possibilities to be used in the most effective way. In the German system, the (secondary) master craftsman qualification provides a corresponding starting point. A "master tenure track" system, i.e. an integrated vocational training path towards a master craftsman qualification, might be a good idea to make this vocational training track more attractive. This qualification could be strengthened with other competences, including value creation-oriented process understanding, innovative thinking, and basic skills in the handling of scientific results.

Further education should be on par with initial training

Due to changing and increasing requirements, further training after initial training will become decisive to continuously further develop competences. Based on the IAB Job Vacancy Survey, Anja Warning and Enzo Weber find, for example, that especially companies with a trend towards digitalisation increasingly expect new staff to have additional skills acquired through courses. The findings of the IAB/ZEW business survey "Working World 4.0" also

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indicate a significantly increased demand for further training with regard to digitalisation (s. figure 1). Educational policy is mainly concerned with initial training; labour market policy, by contrast, with the unemployed. But the technological change must be mastered by the currently employed. Therefore we need a policy of further training.

In this regard, we need to adjust to new developments. The risk of dismissal is currently at an all-time low, which is particularly conducive to a booming labour market. According to the above-mentioned scenario results, however, labour market dynamics will increase significantly, which also means increased inflows into unemployment. If the structural and occupational change increases, consulting in the fields of further and new qualification will become essential. It must be decided soundly and as early as possible whether placement in the current field of action, further development, or reorientation is the right way. But one should be forewarned: During the structural change in and after the 1970s, which marked a departure from conventional factory work, the labour market failed to prevent the build-up and hysteresis of unemployment of low-skilled workers in particular.

In light of that, in a [2017 article](#) the author of this article argues that it is not very likely for a labour market policy awaiting job losses and inflows into unemployment to be able to master the critical effects of the digital change on its own. After all, as soon as unemployment occurs, labour market policy is completely out on its own (plus the collaboration of the unemployed), i.e. it can only resort to its own resources and measures. If one starts before that, though, there are cooperation options regarding corporate further training initiatives. Companies have information on the concrete needs from a production and market perspective and are therefore central players on the further training stage.

Public politics, however, should undertake the support and funding for further training activities in forms such as qualification consulting for companies and employees or a share in the costs of measures and work loss. After all, further training not only helps the employees and the company, it is also an important macroeconomic factor: Investments in further training contribute to the fact that the digital change can be mastered, i.e., that high-quality employment is developed on a broad base as the core of a digital business model.

In order to achieve this, further training must be on par with initial training. This also means that the advantages of formal qualification, highly visible in Germany, are combined with the flexible acquisition of skills. The establishment of further training could be strengthened by a legal system on an institutional level where competence standards are developed which are universal (and also digital) and additional qualifying achievements are formally recognised under those standards. With the right modularisation, this could even lead to fully valid qualifications, such as explained by Thomas Kruppe in a 2012 expertise. General competence

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standards would improve information and orientation, make quality assurance easier, and increase the relevance of further training for professional development in the labour market, especially if formally recognised.

The traditional strengths of the German *Mittelstand* could be endangered, should individual companies' capacity for conquering new digital business models not be sufficient. The same is true for further training, a field where particularly small companies should receive political support—also and especially in the form of consultation competence and network creation. Further training policy is not only labour market policy but also serves a second goal: strengthening companies' ability to adapt and evolve.

It must be borne in mind, however, that political activity must not push aside the companies' commitment to further training. It is all about support and collaboration, not a taking over. Financial aid from political sources is especially advisable for further training which nurtures general knowledge and skills and not so much for specific measures tailored to a specific company with specific activities. Appropriate certification should be a prerequisite, as it would facilitate the recognition of qualifications and achievements at the same time.

A purely personal further training policy involving, for example, personalised education accounts would run the risk of increasing the companies' uncertainties regarding staff availability and of taking from them some of their own competence and responsibility of [human resources](#) development. But it is precisely this further training competence which must be effectively used on the political side. However, not all companies and groups have the same further training options. The same is true for shorter employment relationships. Similarly, the need for professional reorientation regularly goes beyond the current job. So if the existing further training options are not sufficient, or if the desired measures are not situated at the corporate level in a way that makes sense, support should be provided also independently from the corporate context. That way, the advantages of cooperation with corporate further training initiative could be combined with individual development support.

Flexibility and labour market institutions

Digital tasks can typically be completed in a flexible manner. Using 4.0 technologies, activities which used to be location- or environment-specific can also be switched to a digital basis. This opens up new activity options outside of the usual standard employment relationships, e.g. for self-employed individuals. But also here assessments should stay realistic: Economy 4.0 not only brings new possibilities but also new complexities and higher demands of the staff. In order to meet those demands, companies will also require a very

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well-qualified core workforce with company-specific knowledge. And still—even if jobs will not dissolve into complete flexibility, social security for a more flexibly working [labour force](#) must be refined. After all, they are just as much in need of security in case of unemployment, old age, and nursing care dependency as if they worked in a traditional employment relationship subject to social security contributions. By the same token, it must be made sure that it is not the tax payers who end up acting as de-facto insurers, covering for the costs incurred. Extending compulsory social security contributions to include all forms of employment—also self-employment—is recommended as the logical consequence; the rules of on-demand compulsory insurance would have to be adapted. This will surely require a special unbureaucratic—and digital—procedure for small and short-term jobs. But also apart from the question of social security, the market for flexible digital services will have to take organisational shape—up to the definition of standards or employee special interest groups.

Moreover, it is becoming more and more essential to reconcile the growing flexibility needs of both companies and employees. Anja Warning and the author of this article find that newly hired personnel in companies with a trend towards digitalisation is more often facing varying work content, but sometimes also tight schedules, overtime, and varying working hours. Faster product life cycles and globally connected economic activities are opposed to changed family lifestyles and individualised employee requirements. While new digital technology can create additional room for that, there is also the risk of professional requirements seeping into private life. Legal protection from overloading must remain in place, but great importance should also be placed on coordination processes both on the company level and among the social partners to make sure that the multitude of possible constellations can be sufficiently catered to. Flexibility and protection can be agreed under the principle that employees' concessions have to be balanced by the employer's side. Thus, it could be guaranteed to make appropriate comprehensive packages in terms of worker protection in case of increased flexibility; packages which might also include holiday provisions, release from duty for further training, or measures for corporate health management.

Conclusion

The advent of smart, interconnected digitalisation comes with great challenges. But the effects on the labour market will mainly take place in the well-known field of tension of economic adaptability to technological change and structural problems. It is necessary to take measures in economic, educational, and labour market policy which are fit to support and advance a digital economic and labour market model especially in Germany. The further development of vocational training, comprehensive strengthening of further training, and the organisation of social security and corporate flexibility are the most deciding factors in this

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