

Skills for Industrie 4.0

Training Requirements and Solutions

acatech (Ed.)



The competitiveness and sustainability of German industry and its ability to add value will depend on whether it can successfully complete the transformation to Industrie 4.0 in the coming years. Technologies that connect things, data and processes offer the prospect of more efficient industrial processes. They could also have a disruptive impact through the development of new business models, revolutionising not only products and manufacturing but also the way that industry adds value. Industrie 4.0 promises to benefit both large corporations as well as small and medium-sized enterprises (SMEs).

At the same time, Industrie 4.0 is bringing lasting changes in the workplace. Increasingly interconnected, flexible and complex processes are leading to new requirements in terms of the skills that companies possess and the training of their workforce. Industrie 4.0 is also transforming companies' structure, organisation, and the nature of people's jobs.

Nevertheless, the course of this digital transformation is not predetermined – it is something that we can and must shape ourselves. The various possible scenarios are influenced by interactions between technology, people and organisations depending on the decisions taken at an operational business strategy and employment policy level, as well as by the prevailing overall conditions. Skills development for Industrie 4.0 will have an important role to play, since new skills will be required at every level in order to design and adapt products and processes, but also to develop new business models and transform work and process organisation. The main focus of this acatech POSITION PAPER is on identifying the skills

required by businesses to increase the efficiency of industrial processes, with particular emphasis on the needs of SMEs.

At a glance

- Industrie 4.0 is bringing lasting changes in the workplace. Technologies that connect things, data, and processes are placing new demands on employees and management, especially in industry.
- Workplace training for Industrie 4.0 is thus the key to the success of industrial enterprises. The implementation of the digital transformation possesses particular challenges for SMEs.
- At the same time, however, Industrie 4.0 is making new, digital continuing professional development formats available that allow training content to be precisely tailored to the knowledge and needs of staff and management.
- The constantly changing list of skills required for Industrie 4.0 must be regularly updated so that the relevant adjustments in the education system can be made. In the future, the focus will be on interdisciplinary thinking and acting, cross-functional process know-how, and IT skills involving both specialised and more general application knowledge.
- The goal should be to prevent a twofold digital divide between large and small industrial enterprises and between high-skilled and low-skilled workers. SMEs should receive special support to help them develop the skills needed for Industrie 4.0.



One of the principal goals of skills development for Industrie 4.0 is to prevent a twofold digital divide between large companies and SMEs and between high-skilled and low-skilled workers. The keys to achieve this include on the one hand the framework for training and professional development in schools, universities, other higher education institutions and companies, on the other hand the support provided to companies in order to help them implementing the transformation and modification of the content, methods, and business models used by education providers and education institutions. The speed and dynamic nature of this new industrial revolution imply that the adopted approaches will need to be continuously reviewed and developed.

The importance of training to the success of Industrie 4.0

Although companies in Germany see Industrie 4.0 primarily as an opportunity, there are still a lot of questions regarding its implementation. Small and medium-sized enterprises in particular are far less bullish about the opportunities of the fourth industrial revolution compared to large corporations. SMEs trail behind in terms of both – the implementation of Industrie 4.0 and the training of their employees.

As well as data evaluation and analysis, cross-functional process know-how and management, and interdisciplinary thinking and acting, the key skills' development themes for companies of all sizes also include customer relationship management and leadership. In addition, companies attach a similar degree of importance to the strengthening of integrated, interdisciplinary IT skills throughout the workforce.

There are, however, some differences in the priorities of large corporations and SMEs as far as Industrie 4.0 training is concerned. Large companies tend to focus more on technology- and data-oriented skills in areas such as artificial intelligence. SMEs, on the other hand, place particular emphasis on process- and customer-oriented skills (e.g. the ability to coordinate work processes), as well as skills relating to infrastructure and organisation, for example social and communication skills.

If employees successfully acquire skills that will stand them in good stead for the future, it is important to ensure the conceptual coherence of existing training and professional development provision and to develop its content in line with the requirements of Industrie 4.0. Increased use of innovative teaching and learning solutions can offer new ways to tailor and personalise

how content is taught and provide staff with targeted support while they work. It is therefore crucial to raise awareness of Industrie 4.0 among SMEs in particular and to create training and professional development solutions that meet their specific needs. It is also essential to ensure that skills development focuses on companies' work processes, to enable flexible solutions that can be rapidly implemented and to allow both businesses and education providers the freedom to experiment.

To ensure that companies' workforces develop the skills needed to successfully implement Industrie 4.0, it will be necessary to harness and integrate existing approaches as well as pooling current initiatives and resources. It will further be important to systematise the outcomes of different projects and initiatives and create an overview of existing solutions. However, training for Industrie 4.0 should not be confined to the dual vocational training system and continuing professional development in the workplace. Moreover adapting and developing training pathways, curricula and content in schools, universities and other higher education institutions, as well as in the realm of occupational training and professional development will be necessary.

A skills development model

Successful skills development for Industrie 4.0 cannot be delivered solely through "traditional" training and professional development formats such as face-to-face learning. It increasingly requires the use of new digital formats targeted at specific employee groups and needs. Managers and decision-makers should be informed about the fundamental principles and benefits of Industrie 4.0 enabling them to make informed decisions on the relevant issues going forward. This might be done, for instance, using short learning units on a specific topic (knowledge nuggets) delivered via mobile devices. Meanwhile, knowledge nuggets for operational staff can be made available through the company's IT systems, providing them with targeted access to the required information, operating instructions, or decision-making support while they work.

As part of the "Industrie 4.0 Skills Development Study" project, a model was developed for the target group-specific learning pathways and educational media approaches described above, in the shape of an open, expandable online demonstration solution. This model serves to illustrate different approaches to the concrete implementation of Industrie 4.0 content, assistance systems, flexible learning methods in workplace training, and professional development.



Recommendations for business, policymakers and society

Three groups of actors are called on to promote and successfully implement skills development for Industrie 4.0: businesses, policymakers and associations, and education providers. The following recommendations for these groups were formulated by acatech:

Recommendations for business

- **Raise awareness of and implement strategies for Industrie 4.0:** Decision-makers within companies should gain an understanding of the disruptive changes that Industrie 4.0 entails. It is therefore of significant importance that companies infer strategies and measures for the skills development of the employees, the implementation of new products, efficient processes, and innovative business models. Managers' leadership skills thus play a key role.
- **Strengthen employee training and change management:** The workplace education as well as further education has to be adjusted to Industrie 4.0 and qualification has to be made a priority. New digital methods for learning and training provide an effective starting point. Moreover a customisation of work- and process-organisation and also the creation of appropriate framework conditions are important. Change management should be considered from the beginning.

Recommendations for policymakers and associations

- **Create the conditions to facilitate the required training:** An in-depth analysis of educational and skill levels by schools, universities and other education institutions should provide the basis for precisely defining the key media and digitalisation skills and developing successful training strategies. All the relevant actors at every level – national, regional, and company – should be included from an early stage. The establishment of an institutionalised professional development system will create the conditions for personalised, open, and lifelong learning pathways. Training and professional development should focus on companies' work processes, while flexible solutions and the freedom to experiment will also be important. Moreover, training for Industrie 4.0 should not be confined to the realm of occupational training and professional development – also universities and other higher education institutions ought to be involved.

- **Adapt the education system to future requirements:** Schools and higher education institutions have to teach media and digitalisation skills in order to ensure that schoolchildren and students are properly equipped for Industrie 4.0. The training provided at vocational colleges and in companies under the dual training system should reflect the latest technological changes. This will require targeted training and professional development of teaching staff as well as the modification of study courses. Training and professional development for Industrie 4.0 should in general focus on the operational level.
- **Provide information for companies and their employees and facilitate communication between them:** It is important to raise awareness of the far-reaching changes that Industrie 4.0 is bringing, especially among SMEs. Communication between companies should therefore be facilitated through a central platform that provides relevant information and themed learning spaces. In order to provide graduates and employees with guidance and reliable information, it is recommended that a neutral education platform with specific training solutions should be developed and implemented.

Recommendations for education providers

- **Use digital media to teach Industrie 4.0 skills:** Digital learning formats and methods provide a valuable means of raising awareness about the opportunities and challenges of Industrie 4.0 among businesses and their employees. They can and indeed should be selectively combined with traditional ways of learning (such as seminars, workshops, and tutorials) as part of a blended learning approach. It will be important to develop need-based, self-guided, informal and formal solutions. Innovative teaching and learning solutions can deliver new forms of targeted, personalised skills development, as well as supporting employees in the workplace via assistance systems. Training and professional development provision should be flexibly adapted to reflect the different stages of the lives and the learning process in which employees are located.
- **Develop new business models for education providers:** New consultancy services, personalised and situation-specific solutions, continuing professional development relating to specific products, and skills and gap analysis services can all offer education providers new ways of making money and adding value for their customers.



acatech Industrie 4.0 Skills Development Study

This acatech POSITION PAPER is based on an empirical survey of companies' views on skills development for Industrie 4.0 that was carried out in September/October 2015 and December 2015/January 2016. The survey investigated the status quo with regard to the implementation of Industrie 4.0 among German businesses, as well as the associated skills requirements. Its focus was on small and medium-sized enterprises (SMEs). During the course of the study, 345 companies were asked to complete an online survey and interviews were conducted with 38 experts from academia and business.

In addition, a second empirical survey was conducted on behalf of acatech in May/June 2016 by the Centre for European Economic Research (ZEW). This survey was incorporated as an additional training and professional development module into an IAB/ZEW workplace 4.0 survey of German businesses. This representative survey asked 2,032 companies about the implementation of Industrie 4.0 and how their employees' work and the demands on them are changing as a result of the fourth industrial revolution.

The findings of these surveys formed the basis for the formulation of recommendations for policymakers, businesses, associations and education institutions, as well as for the development of the demonstration solution.

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