

IMPULS FOUNDATION

The IMPULS Foundation considers itself a think tank for the mechanical engineering sector and VDMA. The foundation focuses primarily on regulatory policy and innovation policy and has supported about 100 projects since its formation. Its most important body is a high-profile board of trustees of industry, science and media representatives and policy makers.

VDMA

VDMA represents more than 3,200 mostly medium-sized companies in the mechanical engineering industry. With around 1.35 million employees and sales of 225 billion euros (2018), the sector is the largest industrial employer in Germany and one of the leading German industrial sectors.

INSTITUT FÜR SOZIALWISSENSCHAFTLICHE FORSCHUNG E.V. — ISF MÜNCHEN

ISF München is one of Germany's leading research institutions for labor and industry sociology. For more than 50 years, it has conducted empirical social research with a comprehensive concept: investigations at companies and public institutions, fundamental research, design, knowledge transfer, and political consulting.

IMPULS



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IMPULS Foundation
for mechanical engineering, plant
engineering, and information technology

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Dated
March 2019

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IMPULS compact

ENGINEERS FOR INDUSTRIE 4.0

IMPULS

DEAR READERS,

Industrie 4.0 is a huge opportunity for mechanical and plant engineering. In production, products, and services, this digital vision is fast becoming industrial reality. The situation is enormously dynamic. Mechanical engineering – Germany's largest industrial employer – is working intensively on new solutions.

But a successful digital transition will not happen automatically – it depends on the people in the companies. Along with qualified specialist staff, engineers play a key role, especially in mechanical and plant engineering as the most important German engineering employer.

New skills and qualifications will be needed, both from the engineers at the companies and as part of engineering training at universities. But what exactly is behind this “new world” often remains vague and difficult for both companies and universities to grasp.

The IMPULS Foundation therefore asked those who are directly affected: managers and engineers from mechanical and plant engineering, and university representatives. Their responses define the “new world” for the first time, shaping a “target profile for engineers 4.0” from the perspective of the mechanical engineering industry.

They also highlight the status of and need for adaptation in engineering training with regard to Industrie 4.0, as well as existing obstacles at universities. A new online tool (www.ingenieure40-online-tool.vdma.org) gives both students and engineers at companies an idea of their own Industrie 4.0 skills.

The digital transformation represents a new era. One thing is clear: If we want to prevent the transformation from forcing us into shape, we need to play a role in shaping it early on. With the “Engineers for Industrie 4.0” study, the key findings of which are presented here, we want to contribute to benefitting both companies and universities. After all, these highly qualified are those who will decide on the success or failure of Industrie 4.0.

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UNIVERSITIES ARE FACING A HUGE PROCESS OF CHANGE

Industrie 4.0 is placing new demands on the training of engineers at universities. New skill and qualification profiles are needed in engineering training. For the first time, there is now a “target profile for engineers 4.0” from the point of view of the mechanical engineering industry, as well as an insider’s view of the situation at universities. The study is based on numerous expert interviews with engineers from the industry and universities. A survey was also conducted among VDMA member companies.

NETWORKING CRUCIAL IN TEACHING

Universities need to keep up with technical progress and adapt their curricula quickly. After all, although the study shows that there are already some productive approaches to adapting engineering training to Industrie 4.0, many universities are only now making a start on the requisite development. Integrating new content into the curricula is a particularly significant challenge, with few structured decision-making processes on which new content to add and which old content to omit. In addition, administrative

obstacles make it difficult to organize study programs across faculties and departments. Many departments and faculties are dominated by subject-related silo thinking. Networking therefore needs to improve, especially in teaching.

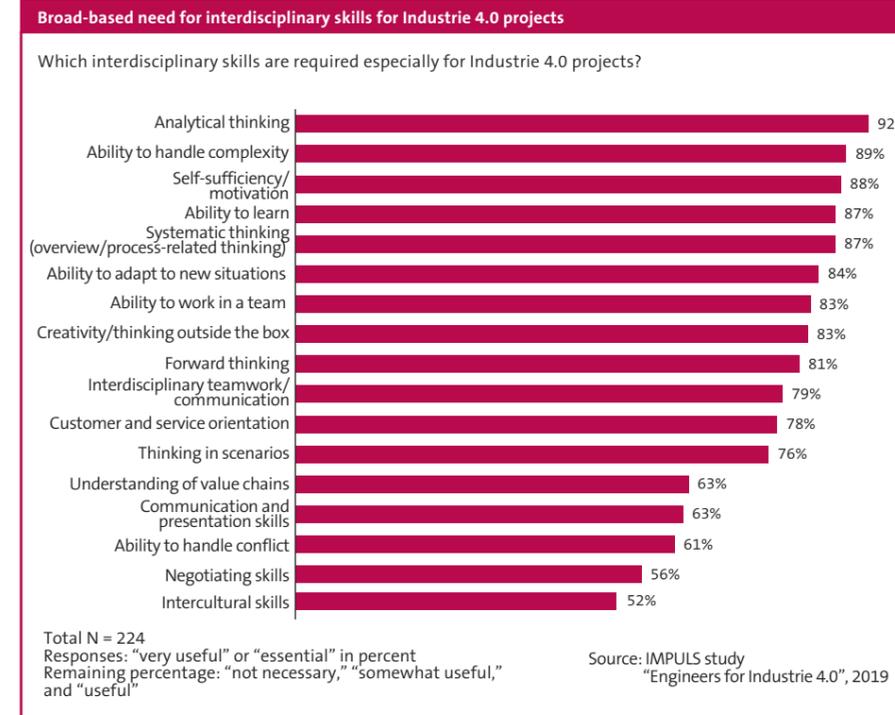
FOCUS: COMPUTER SCIENCES, DATA SCIENCE, AND DATA SECURITY

The specialist requirements in the various engineering disciplines are at the heart of the “target profile for engineers 4.0”, new additions being skills in computer sciences, data science, and data security. Furthermore, engineers 4.0 need to be able to take points of view from other disciplines into account in their own work. Methodological skills, especially process thinking and systems thinking,

and interdisciplinary skills, such as the ability to work both self-sufficiently and within a team, as well as the capabilities to learn and adapt are therefore particularly important. But Industrie 4.0 does not need “super-engineers.” The elements in the target profile cannot simply be added together, but are in a flexible relationship with one another depending on the field of application. The rapid pace of technological change makes this essential – it keeps the target profile flexible and allows it to change over time.

JOINT CORE CURRICULUM IN ENGINEERING SCIENCES

Basic knowledge of computer sciences will be essential in mechanical, electrical, and electronic engineering in future. In return,



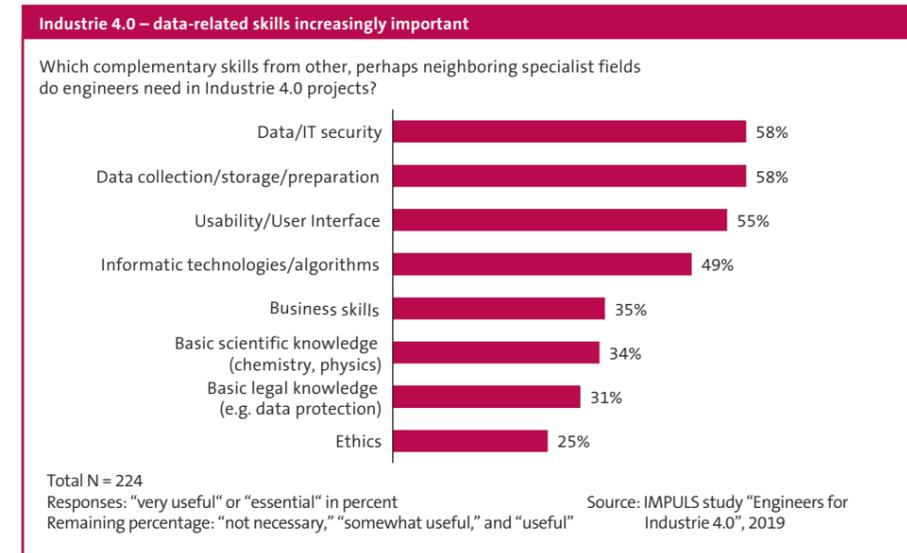
worlds and ways of thinking in engineering sciences from the very start. Another recommendation is to intensify collaboration between companies and universities – something that is already common practice in mechanical engineering. Finally, it is vital to strengthen life-long learning, both by switching between phases of work and education and by learning on the job.

VDMA’S MASCHINENHAUS INITIATIVE

VDMA’s Maschinenhaus initiative will put the results of the study into practice. With the Maschinenhaus, VDMA is helping universities to further develop teaching in engineering training. The reason behind the initiative was the high number of drop-outs from engineering programs. More than 50

consulting projects have been conducted at universities since 2013. A toolbox promotes outstanding examples of good teaching. As the teaching award with the highest prize money in engineering sciences, the “Best Maschinenhaus” honors innovative teaching concepts. In the future, the Maschinenhaus initiative will focus particularly on digitalization and on computer sciences departments and faculties. Drop-out rates in mechanical engineering in particular have fallen significantly in recent years, benefiting students, industry, universities, and university policy.

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- The “target profile for engineers 4.0” has five components:**
- Basic specialist knowledge in an engineering discipline
 - Methodological skills, especially process-related and systems thinking
 - Cross-discipline knowledge such as mechanical, electrical and electronic engineering in connection with Industrie 4.0. This demands a stronger interdisciplinary approach to the content of study programs and improved collaboration between the individual departments and faculties. The study recommends the introduction of a two-semester joint core curriculum in engineering sciences, giving students equal insight into the disciplines of mechanical, electrical, and electronic engineering as well as computer sciences. They would also have a better basis for deciding on a core discipline to concentrate on later. When it comes to developing this core curriculum, companies could contribute the essential practical point of view and introduce the new requirements presented by digitalization. A joint core curriculum, adapted to Industrie 4.0, would connect the
 - Contextual knowledge, i.e. knowledge of conditions, requirements, and perspectives in other divisions and disciplines
 - Interdisciplinary skills, especially the ability to work in a team, self-sufficiency, motivation, problem-solving skills, the ability to learn and adapt, openness, and communication skills

computer sciences also need mechanical, electrical, and electronic engineering in connection with Industrie 4.0. This demands a stronger interdisciplinary approach to the content of study programs and improved collaboration between the individual departments and faculties. The study recommends the introduction of a two-semester joint core curriculum in engineering sciences, giving students equal insight into the disciplines of

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Online Skills Check 4.0

In the course of the study, an “Online Skills Check 4.0” was developed for students, employees, and companies. The online tool provides information on each individual’s own skills for Industrie 4.0. They can gain a general self-assessment in terms of “need for significant qualification,” “need for targeted qualification,” “good outlook” or “excellent outlook”. Furthermore, they can conduct a comparison at the level of detailed skills and qualifications. The “Online Skills Check 4.0” is available at WWW.INGENIEURE40-ONLINE-TOOL.VDMA.ORG

Free download of the extended version of the study at WWW.IMPULS-STIFTUNG.DE/STUDIEN