



WHITEPAPER

2018

**QUALITY AT THE CORE OF A
GLOBAL QUALIFICATION SYSTEM**

EUROPEAN FEDERATION FOR WELDING, JOINING AND CUTTING

WWW.EWF.BE



"We live in a most remarkable time: a time which is an age of discovery; a time in which we are seeing changes in our understanding of the world, of the planet, and of each other in ways which are really quite fundamental. This happened in the original Renaissance 500 years ago, and we celebrate the discoveries of that time today. The Renaissance is regarded as the period of the most extraordinary progress, and our time is also a period of the most extraordinary progress".

Prof. Ian Goldin,

Author, "Age of Discovery; Navigating the Risks and Rewards of our Second Renaissance"

By 2030, 210 million people around the world are expected to change occupation. That's equivalent to the current population of Brazil, or 40% of the European Union. Why is this happening? Labour disruption, which is caused by a number of forces including industrialization, globalization, digitization and automation. Up to 800 million workers worldwide are at risk of labour disruption between now and 2030. Previous industrial revolutions were very slow in their global spread, in that there are still parts of the world that have yet to be touched by the first industrial revolution. But even where people are still doing very traditional and (apparently) immutable tasks, they now have a mobile phone in their hands which, even if apparently less significant, is a profound change, creating huge opportunities, amongst other, for financial services.

This fourth industrial revolution, as stated in Professors' Ian Goldin and Chris Cutarna book *Age of Discovery*, **is part of a broader movement, a new renaissance**. This renaissance is different in the speed, in its breadth and depth, and it is not confined to industry, but it is broader in scope. As the first renaissance, **it implies a broad access to knowledge**, which is no longer confined to books, but easily accessible to everyone. No sector is left unchallenged and manufacturing is no exception, with companies quickly merging into both digital and manufacturing centers, creating new challenges and opportunities. **Existing skills and competences are quickly becoming obsolescent**, as this change requires new ones from professionals in all areas.

The answer to these challenges is strongly dependent on the ability of traditional education and **Vocational Education and Training systems** to cope with the demand for new curriculums and methodologies to address the need to get the **workforce up-to-speed** with the new business requirements and technologies being deployed. The broadest possible **recognition of the acquired knowledge** is a critical component of this reality.

Also, education systems need to become more agile. What was once an established and effective learning method is quickly changing, and the issues faced by professionals and companies alike range from the need to quickly adapt to change, streamline retraining and reskilling, ensure transferability between traditional education systems and technical education and, finally, to integrate modularity on existing qualifications systems.

Qualifications need to be harmonized so that they can be used for training and accepted regardless of the location where the training is held, reducing overhead for companies who want to find the best professionals to meet their needs as quickly as possible. In cases where this harmonization has yet to happen, it is up to each country to adjust its courses to national requirements and regulations, with the ensuing possibility of creating further disconnect and gaps between industries in each country.

In order to provide this consistency, at least at the European level, it is of paramount importance to connect the International Sectoral Qualifications with the European Qualifications Framework, leveraging the developments of EU tools and policies aiming at fostering transnational cooperation in education and training. This will become a cornerstone of recognition, both inside and beyond European borders, creating a more mobile and fluid workforce, recognized in education and training systems and able to withstand and respond to evolving requirements, be they of industry or region.

EWF harmonised qualification system addresses these challenges for professionals in joining technologies by constantly updating current courses and launching new ones for leading-edge technologies such as additive manufacturing and laser welding, keeping abreast of the evolving technological adoption landscape

EWF's system Education, Training, Qualification and Certification of Personnel has been recognized as a best practice for international sectorial harmonisation of qualifications by Cedefop - The European Centre for the Development of Vocational Training.

As these challenges are inherently global, qualifications need to have the same level of quality throughout the ecosystem, with ironclad consistency. For that, EWF has developed a quality system that complies and extends the requirements of ISO/IEC 17065 to ensure that qualifications requirements are met consistently throughout the entire ecosystem using EWF harmonised qualification system. As a result, companies and countries can focus their efforts on improving overall competitiveness through technology adoption, with the certainty that they can rely on the workforce capabilities they will need to operate them.

2. What are the challenges for manufacturing businesses?

The ongoing transformation touches all industries, manufacturing being no exception. Developments in previously disjointed fields such as artificial intelligence and machine learning, robotics, nanotechnology, 3D printing and genetics and biotechnology are all building on and amplifying one another. It is expected that smart systems—homes, factories, farms, grids or entire cities—will drive the response to problems ranging from supply chain management to climate change. This is the time of Industry 4.0. But this is far from just a technology initiative. It's the future of manufacturing as we know it.

The nine technologies transforming industrial production are:

- Big Data and analytics
- Autonomous robots
- Simulation
- Augmented reality
- Additive Manufacturing
- The Cloud
- Cybersecurity
- The Industrial Internet of Things
- Horizontal and Vertical system integration

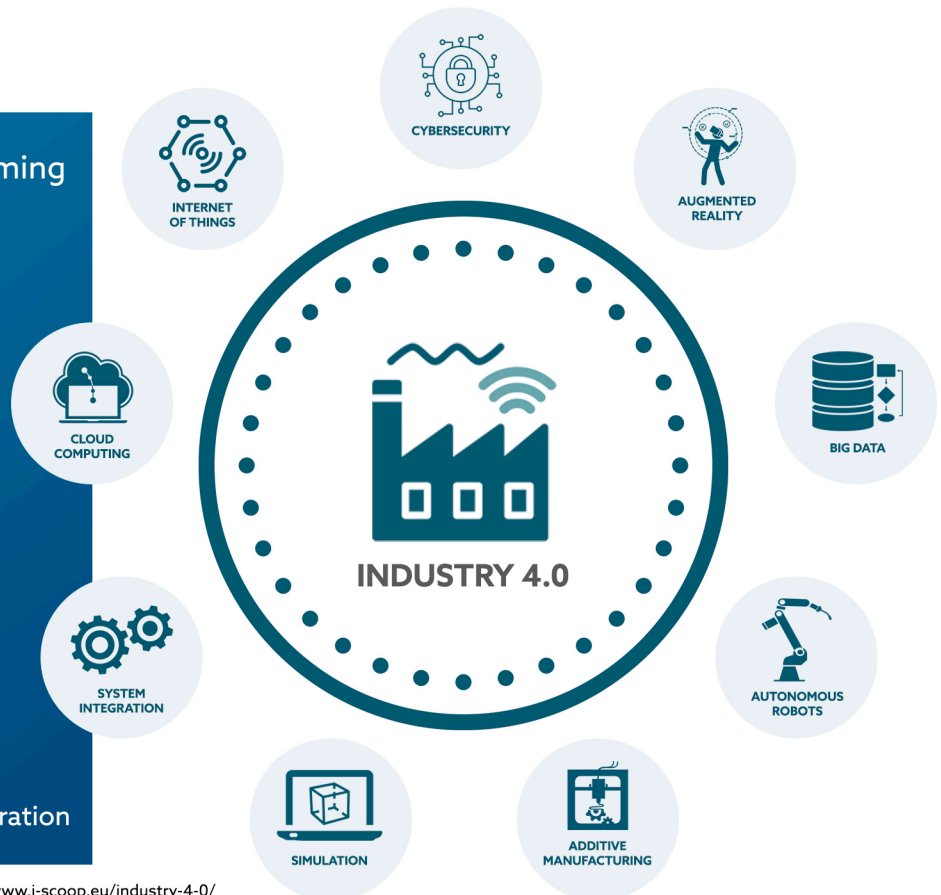


Figure - Industry 4.0 - Digital Transformation. Source: <https://www.i-scoop.eu/industry-4-0/>

The ultimate goal is the "smart factory" with cyber-physical systems capable of autonomously exchanging information, triggering actions, and controlling each other independently. This facilitates fundamental improvements to the industrial processes involved in manufacturing, engineering, material usage, asset performance and management, and supply chain and lifecycle management. Manufacturers are reinventing their business models to focus on value-added services, and/or entering new geographic markets or adjacent market segments.

The challenges they face range from changing customer preferences, cost and capital pressures, shorter product lifecycles, new sources of disruptive competition and an quickening pace of business and demand that are forcing manufacturers to rethink and transform their operating and business models. Today's Industry 4.0-outfitted factories are empowered to drive productivity and keep costs down while ensuring quality and consistency across manufacturing processes globally.

These technologies can address current issues faced by those manufacturers. Investments into robotics and machine-to-machine communication do help improve operational productivity. Better analytics can enable improved insights into customer preferences and product usage. Digital twinning can assess and simulate systems to improve design and performance.

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INTERNET OF THINGS (IOT) CONNECTED DEVICES INSTALLED BASE WORLDWIDE FROM 2015 TO 2025 (IN BILLIONS)

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The market's opportunity is incredible. Analysts suggest that the Industry 4.0 market will be massive. Based on the growing of the consumer segmentation who is the targets user of connected things, Gartner believes that the Internet of Things (IoT) market will be worth almost US\$3 trillion by 2020¹. And IDC thinks that the virtual and augmented reality market, of great importance for designing and prototyping, will achieve a five-year compound annual growth rate (CAGR) on the period 2017-2021 of 98.8%². This change is putting a strong pressure on organizations and their leaders, forcing them to quickly adapt.

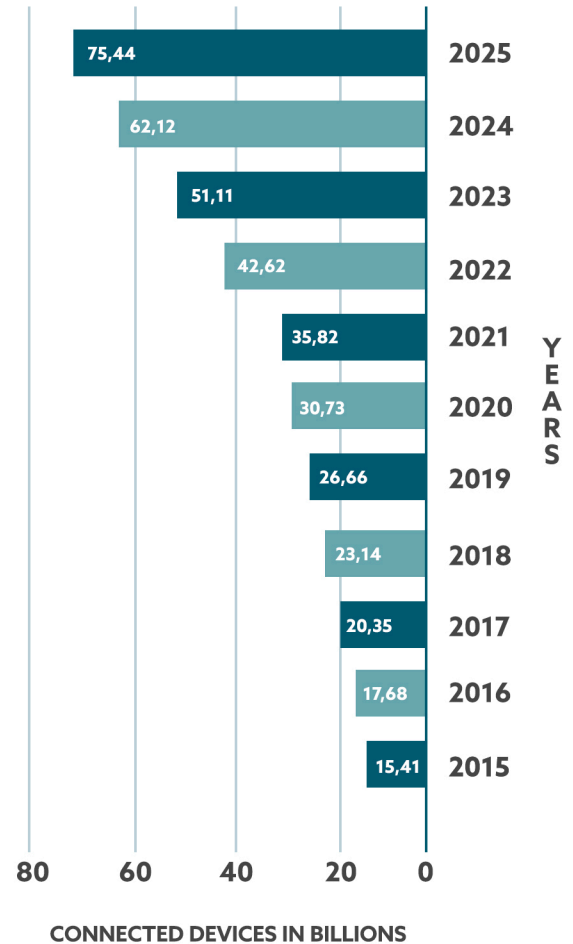


Figure - Internet of Things (IoT) connected devices installed base worldwide from 2015-2025

WORLDWIDE AR/VR HEADSET FORECAST, 2017Q4

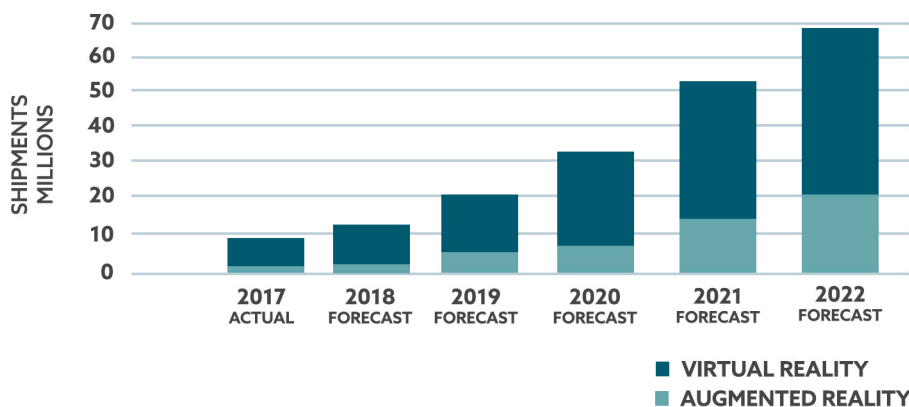


Figure - IDC Forecasts Increasing Demand for Augmented Reality/Virtual Reality Headsets Over the Next 5 Year

In order to assess organizations and leaders readiness to embrace this revolution, Deloitte runs a yearly survey of C-level Executives to understand how leaders are ready to harness the full potential of industry 4.0 to the benefit of their customers, their people, their organization, their community and societies overall.

The ensuing report³ highlights that only 14% of CXOs are highly confident that they are capable of leveraging Industry 4.0. This research also found that while CXOs see new business or delivery models as the biggest threat to their organizations, they are largely using these new technologies as a tool to make existing operations more efficient and cost-effective.

¹ <https://www.gartner.com/newsroom/id/3598917>

² <https://www.idc.com/getdoc.jsp?containerId=prUS43248817>

³ https://www2.deloitte.com/content/dam/insights/us/articles/4364_Industry4-0_Are-you-ready/4364_Industry4-0_Are-you-ready_Report.pdf

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Also relevant, only a quarter of the CXOs that have participated on the survey think that they have the right workforce composition and skill sets needed for the future, although a large majority of them (84%) are doing everything they can to create a workforce for Industry 4.0

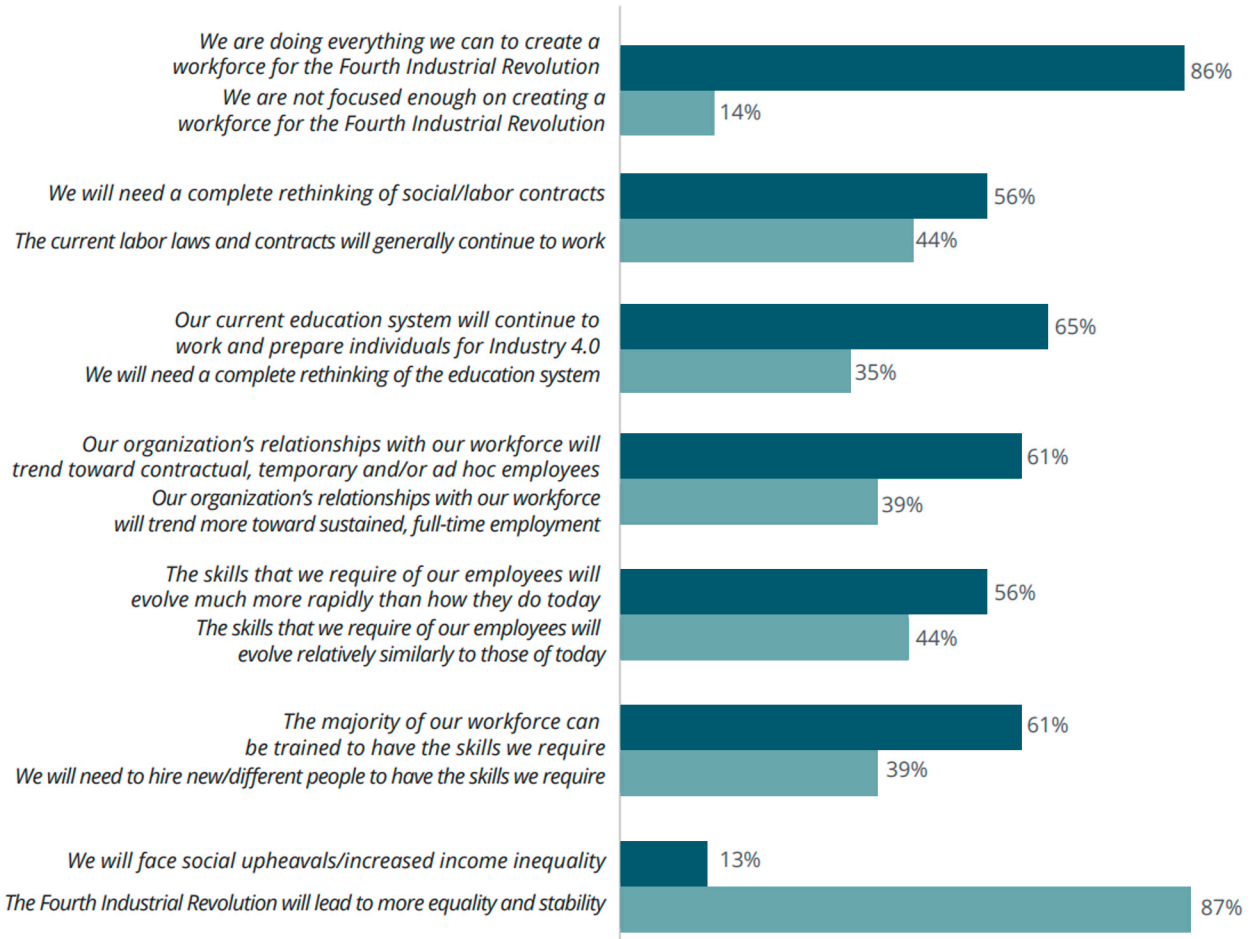


Figure - CXOs answers to the question: Which of the following statements about the Fourth Industrial Revolution's? Source: Deloitte Insights - The Fourth Industrial Revolution is here - are you ready?

As whole industries adjust and new ones are born, many occupations will undergo a fundamental transformation. Together, technological, socio-economic, geopolitical and demographic developments and the interactions between them will generate new categories of jobs and occupations while partly or wholly displacing others. They will change the skill sets required in both old and new occupations in most industries and transform how and where people work, leading to new management and regulatory challenges.

Application of technology has already changed when and where work is done in practically every industry as workplaces of the industrial age give way to work practices of the digital age, including remote, flexible and on-demand work. And there is a growing need for further specialized knowledge, coupled with a need for knowledge on other fields of expertise to complement the core ones.

Leveraging the results of a recent survey on the implementation of digital technologies in Germany, a project was undertaken to assess how overall employment, unemployment and wages are responding to digitalisation in the country⁴. Based on their findings, the project team of ZEW - Centre for European Economic Research -, was able to demonstrate that the diffusion of digital technologies in German businesses has created more employment overall, but has led to other changes, most significantly in the employment structure. These new technologies from Industry 4.0 have led to a one per cent increase in employment levels between 2011 and 2016, which is equivalent to an increase of 0.2 per cent each year.

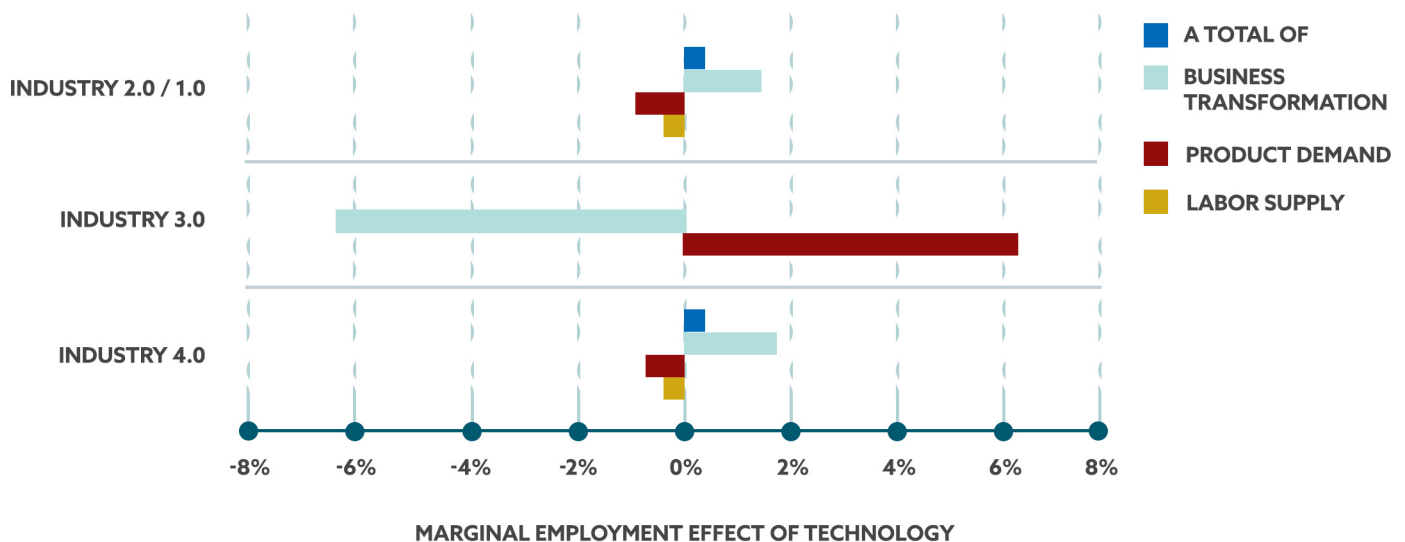


Figure - Marginal employment effect of technology

According to their findings, around half of German establishments are already using technologies characteristic of Industry 4.0, combining traditional industrial production techniques with modern information and communication technologies (ICT). Though these technologies currently only make up around five per cent of these establishments' means of production and just eight per cent of their office and communications equipment, the trend over the recent years clearly indicates that digital technologies are playing an increasingly important role in everyday business practices. As a result, primarily jobs that involve routine tasks are starting to dwindle in significance as a result of digital processes, while analytical jobs such as software development or programming and interactive jobs are experiencing considerable growth.

If need be, the results of this study strengthen the case for education as the key tool to manage the challenges ahead, since the economies of the future will be knowledge-driven and the ability to increase function-specific and complementary knowledge becomes the norm.

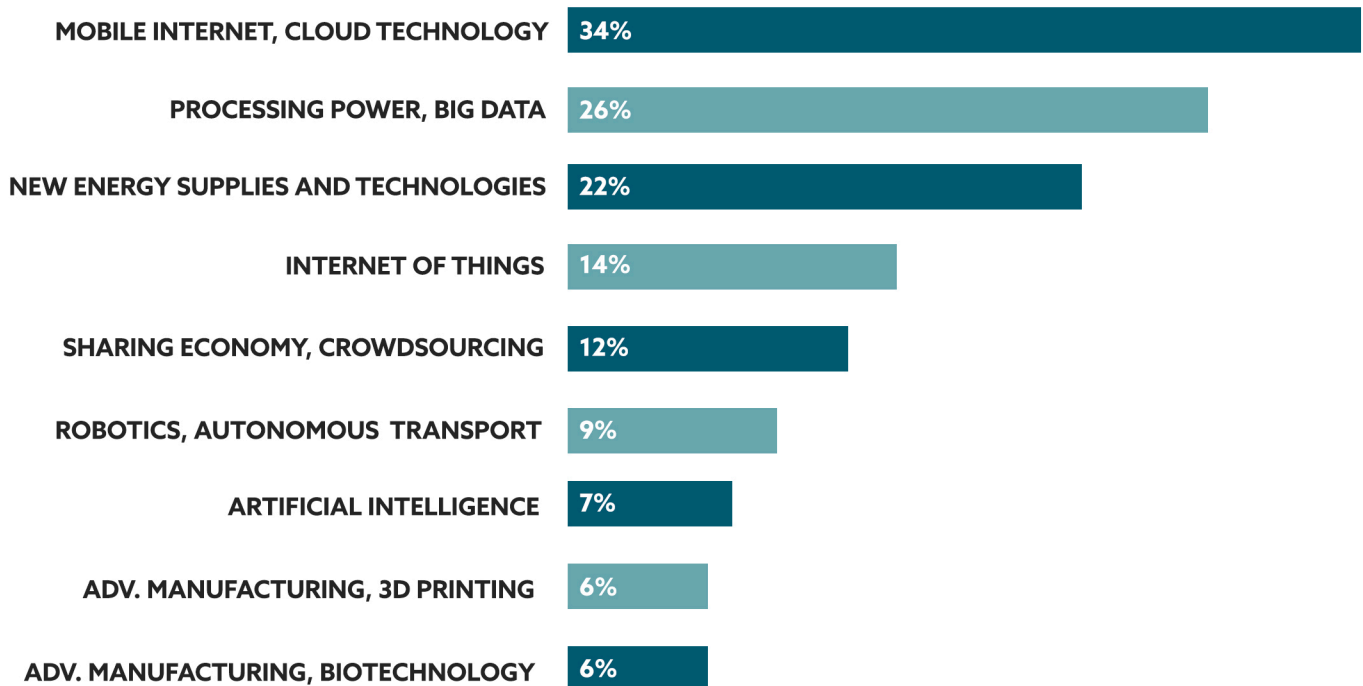
⁴<http://www.zew.de/en/presse/pressearchiv/die-digitalisierung-schafft-jobs-braucht-aber-gezielte-foerderung/?cHash=24bcfa23d7f966b6ad617f6a4a3793b3>

According to Prof. Goldin, the current requirements of deep expertise and broad knowledge will mean more and more specialisation because the amount of knowledge is growing all the time. The answer to this challenge might be to achieve a T- shape in an individual's knowledge structure – combining very deep learning, with a very broad set of interests and abilities. Today resources (Youtube videos, blogs, discussion forums and networks, books) are available to cultivate curiosity and acquire knowledge in many different fields. As a result of all these forces working together, there is a near-simultaneous impact on employment and need for new skill sets.

This means that **it is fundamental for Education to also change, as most education systems were built for the needs of prior employment opportunities.** If today's students are to be prepared for the fourth industrial revolution, a disruption is needed to ensure that they have the skills that our economies need.

The **World Economic Forum report on the Future of Jobs⁵** highlights the challenges facing manufacturing and production roles, as these new technologies become mainstream on the shopfloor, and the increased manufacturing demand for advanced materials and comparatively favourable expectations around robotics, will lead to new labour opportunities. On the other hand, 3D printing, resource-efficient sustainable production and robotics are all seen as strong drivers of employment, in light of a continued and fast-growing need for skilled technicians and specialists to create and manage advanced and automated production systems. This is expected to lead to a transformation of manufacturing into a highly sophisticated sector where high-skilled professionals are in strong demand.

TECHNOLOGY



SOURCE: FUTURE OF JOBS SURVEY, WORLD ECONOMIC FORUM

Figure - Technological drivers of employment

⁵<http://www.zew.de/en/presse/pressearchiv/die-digitalisierung-schafft-jobs-braucht-aber-gezielte-foerderung/?cHash=24bcfa23d7f966b6ad617f6a4a3793b3>

As economies become increasingly open and companies operate complex value chains of vast geographic scope, harmonized qualifications play a pivotal role in ensuring that organizations can work consistently in any location and can leverage the best resources for optimal results.

To make knowledge acquisition and recognition more effective, it is needed to establish a connection between its two existing pillars, which are the traditional education systems used at Universities and the technical training given for specific jobs. The disconnect between them implies that a qualified technician will not have its qualifications recognised in the traditional education system, which basically means that transferability of knowledge is not effectively being applied, hinders industry's growth by slowing the adoption of newer technologies and creating unnecessary barriers to the improvement of workforce qualification.

Also, learning profiles are quickly evolving, and the issues faced by professionals and companies alike range from the need to quickly adapt, streamline retraining and reskilling, ensure transferability between traditional education systems and technical education and, lastly, to integrate modularity on existing qualifications systems. To respond to these challenges by the development of national qualification systems is highly time-consuming and does not allow for the qualified professionals to work in other countries, as it is not recognized outside the original country. Joining is one area where this need is being felt, since more sophisticated and advanced production and joining processes frequently require the ability to assemble products coming from diverse locations (that are required to abide by the same standards of production quality), be highly knowledgeable about materials and their characteristics, as well as how to operate complex tools and machinery, ones where digital is tightly interwoven into the processes.

To address the aforementioned challenges, the member countries of EU where welding courses were offered started in 1992 a process of harmonisation of the content of education and the implementation in terms of courses' syllabus and hours of training allocated to each module. The system started by addressing welding personnel and has since then extended its scope to include a wide range of related technologies, e.g. adhesive bonding, plastic welding, thermal spraying and others.

One key issue addressed by the system from the start was the requirement of recognition. Ensuring required qualifications were accepted in each country would, as a result, eliminate the need for national qualification systems, that would eventually be incompatible among each other. Recognizing the long-term vision and strategy of EWF's International System for Education, Training, Qualification and Certification of Personnel, Cedefop – The European Center for the Development of Vocational Training – has considered that it should be seen as a best practice for international sectorial harmonisation of qualifications.

The other issue that needed to be addressed was the quality system. To ensure this, EWF has made its quality system compliant with ISO/IEC 17065, guaranteeing that the resulting qualifications had the same uncompromised quality, regardless of the country where the course was taken.

The uniqueness of EWF's system is two-fold. First, it is based on its ability to leverage a single syllabus for each level of the training course and a harmonised system for examinations resulting in the same qualification potentially being awarded in any country, coupled with its unique quality assurance system.

The cornerstones underlying the long-term vision and strategy of EWF are the following:

- Ensure that the training and qualification System is updated to comply with technical innovation and industrial demand;
- Develop new qualifications in line with technological and industrial advances;
- Provide a pathway for continuous professional development for professionals in manufacturing;
- Create flexible pathways for continuous professional development;
- Ensure the quality of the EWF diplomas, by running a rigorous quality assurance system in the countries worldwide that are using the EWF System.

4. Quality system breaks the barriers to widespread adoption of international qualifications

EWF's qualification system has been evolving to address the most recent trends, such as modular training. The modular approach will address workforce mobility, life-long learning requirements and flexible pathways for continuous professional development, all of which are basic requirements for today's and future professionals. It allows professionals to pick and choose the most appropriate qualifications to achieve the required certification, thus enabling further flexibility of the workforce in response to changing industry's requirements.

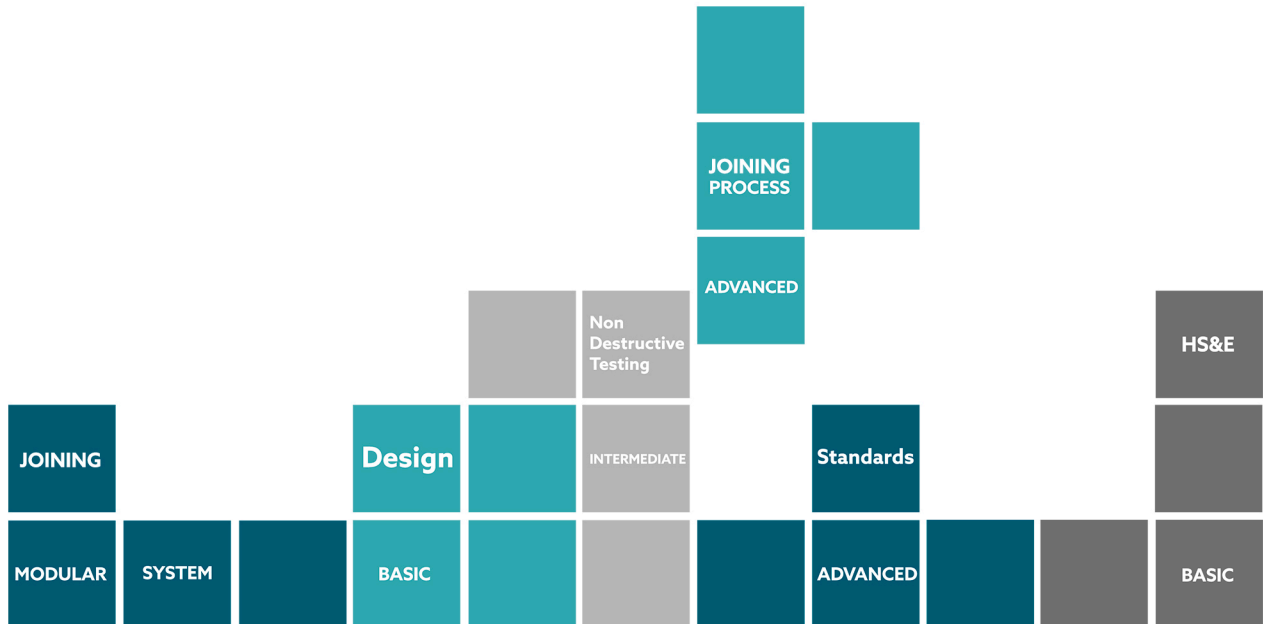


Figure - Modular approach of EWF Qualification system

The modular approach unique benefits include curriculum flexibility, short-term assessment goals and engagement of students in the process. A modular curriculum offers students more flexibility and variety than traditional forms of curricular organisation, empowering them to manage their courses as they progress. It also allows students to choose the path and modules that fit their professional needs and ambitions while at the same time balancing all elements comprising the curriculum and not just those that form part of examination syllabuses.

As part of this push to bring training and learning methodologies up to the current standards for digital natives, EWF and its members are looking at the development of an innovative ICT training solutions potentially including Welding Simulators, Game Based Learning, and Serious Gaming. These are new and innovative teaching methods that allow learners to explore playfully different parts of a scenario.

Games are typically designed for different ability levels and with the goal of helping the players to retain the information that they learn and apply it to other problem-solving situations, as well as a means of collaboration between learners and educators.

EWF has had a lasting success story but it is indeed not resting on its laurels, constantly looking for ways to innovate and lead in learning methodologies. EWF harmonized qualification system is constantly updating current courses and launching new ones for technologies such as additive manufacturing and laser welding. This creates a virtuous cycle, enabling quick adoption of new technologies and paving the way for its quick evolution.



Figure - Overview of the current EWF Harmonised Qualification and Quality System

5. The uniqueness of a proven quality system

Ensuring the quality of the training, regardless of location, the unique qualification system of EWF relies on a robust and transparent quality system, one that is widely accepted by the complete chain of stakeholders involved, from training institutions to national certification bodies, companies, trainers and trainees. Once the system was set and established, and after a partnership was forged with the International Institute of Welding (IIW), non-European countries were added. The rigorous quality assurance ensures that the required standards are met uniformly throughout the world in an impartial and non-discriminatory way.

The quality system includes the ecosystem of members, other relevant stakeholders and the training centers. The members are responsible for the identification of the most appropriate Authorised Nominated Body, who manages EWF's system in the country and are responsible for ensuring that the standards of implementation of the EWF education, examination, qualification systems and/or personnel certifications schemes are maintained.



Figure - The three pillars of EWF Quality Assurance System

To ensure that EWF quality system rules are strictly followed by training centres, an Assessment structure has been put forth, one that ensures that, regardless of location and entity, the results are consistent. This structure comprises Lead Assessors, Peer Assessors and Distance Learning Assessors. They are charged with the auditing of the required compliance with EWF's quality system rules.

The training centres, in order to be recognized as such, need to comply with rules and procedures which are audited by EWF auditors. This are evaluated in order to ensure full compliance with the stringent requirements from EWF in order to deploy and teach the EWF/IIW Qualification courses, combining both supporting knowledge and application experience, in a close relation with industry and their needs.

This straightforward yet secure process is the guarantee that each professional is indeed capable of performing according to the capabilities defined for each qualification.

This process provides the critical mass of professionals required to quickly advance and respond to changes in technologies and ensuring their swift adoption, creating a virtuous cycle for technologies, shortening the cycle from availability to broad utilization, which is a critical issue facing organizations today.

Ensuring that job opportunities are met by a diversified and mobile workforce and, as a result, provide additional competitiveness to European companies, EWF has been actively pursuing the alignment of the Welding Qualification System to the European Qualification Framework (EQF), through the National Qualifications Framework of each individual country. One expected outcome of this close alignment is its use as a benchmark with other areas from the manufacturing sector.

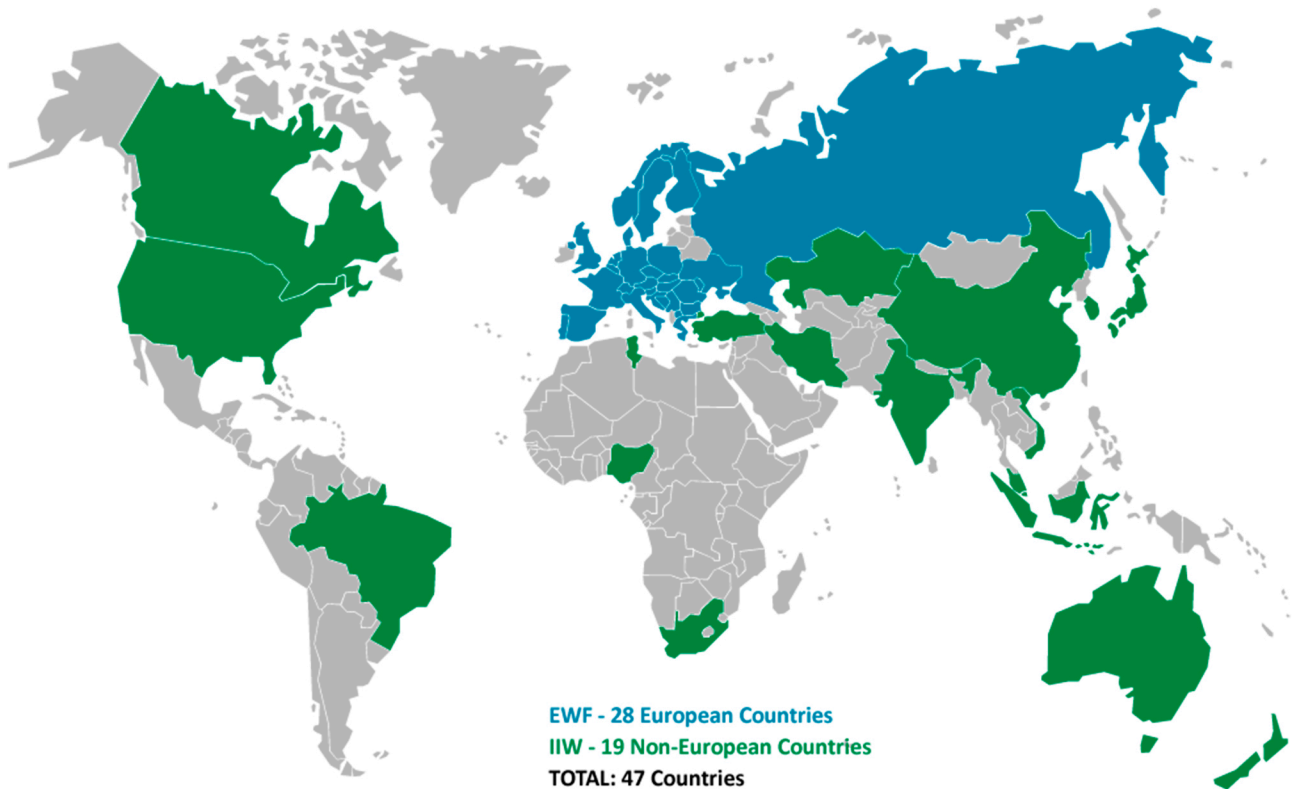


Figure - Global implementation of EWF Harmonised Qualification and Quality System

In summary, the uniqueness of EWF's harmonized qualification and quality systems create a swift pathway for the recognition of qualifications in the countries that are already engaged with the system. Currently, this ecosystem comprises 46 countries and 683 ATBs (Authorised Training Bodies). The network also includes 55,000 companies worldwide.

All in all, this long-term vision and continuous updates and improvements ensure that the system will keep pushing forward well into the next decade.

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"Building on 25 years of successful cooperation between the world's most significant welding institutes, EWF continues to be as fast-paced and innovative as the industry it serves. Leading the way in harmonization of vocational education, EWF has professionalized the workforce and provided mobility of skills and transparency of qualifications that is only dreamed of in other sectors."

EUR ING Chris Eady CEng FWeldI, President of the European Federation for Welding, Joining and Cutting



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