Future of manufacturing

Modernisation of dual apprenticeship training at ABB – Germany

Company initiatives to align apprenticeships to advanced manufacturing

Disclaimer: This working paper has not been subject to the full Eurofound evaluation, editorial and publication process.
Introduction

Scope of the research

This case study report is part of the study ‘Policy developments and practices of apprenticeships in selected EU Member States and world competing regions’ carried out in five EU (Denmark, Germany, France, Ireland and Italy) and two non-EU countries (Australia and USA). The study is conducted in the frame of the Pilot Project ‘The Future of Manufacturing in Europe’ (FOME), proposed by the European Parliament and delegated to Eurofound by the European Commission (DG Internal Market, Industry, Entrepreneurship and SMEs).

One of the objectives of this study is to provide an analytical overview of apprenticeship systems in the selected countries and to review changes to the current systems following labour market shifts, changes in employment, career and mobility patterns and technological and structural change. Particular emphasis is placed on the impact of new technologies and the need for a high skilled and adaptable workforce in manufacturing and advanced manufacturing. This research is carried out in response to the increasing interest in apprenticeships among policy makers to tackle skills mismatches but also to integrate young people into the labour market. The appeal of apprenticeships is also growing particularly in a context where new technologies are transforming work organisation and production processes across all sectors, particularly manufacturing. The findings from this research will feed the policy discussions around the role of apprenticeships for the future of manufacturing and inform policy making in the context of current or planned reform of apprenticeship systems and the necessary links to be established between education/training and industrial policies.

The case study report builds on the information contained in the national report on apprenticeships in the advanced manufacturing industry in Germany that was elaborated during the first phase of the study (Voss/Schöneberg 2017).

The case at a glance

This case study focuses on the modernisation of dual apprenticeship programmes at ABB in Germany. The focus is on the introduction of new forms of teaching and learning as well as the development of further qualification modules that reflect new needs as emerging from Industry 4.0 and advanced manufacturing technologies and processes. Rather than focussing on a specific occupational programme, the case study sheds a light on innovative projects within dual apprenticeship training at ABB. These are: the modernisation of the ABB Training Centre in Berlin; the development of a programme "Supplementary Qualification for Digital Competences in Initial and Further Training", and the new trainee programme "Digital Industry Trainee HR".

As regards the four different forms of adaptation of apprenticeship that are addressed by the research¹, the case concerns the types (b) creation of new occupations/emerging occupations and c) creation of company apprenticeship/training programmes as well as d) organisation of apprenticeships/training in (regional) clusters.

¹ These are: (a) modernisation of a specific occupation; (b) creation of new occupations/emerging occupations; (c) creation of a company apprenticeship / training programme; and (d) organisation of apprenticeships/training in (regional) clusters.

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Structure of the report
The report basically falls in three parts: a general part with background information (including context factors); a descriptive part which outlines the set-up and implementation process; and an evaluative part which deals with outcomes and impact. In a final section, the programme is viewed in a broader perspective and in relation to the continued development of apprenticeships in the advanced manufacturing sector, and relevant conclusions are drawn – also in the light of subsequent developments.
Context factors

Regional/sectoral and/or company-specific set-up

ABB is a Swedish-Swiss multinational corporation headquartered in Zürich, Switzerland, operating mainly in robotics, heavy electrical equipment, and automation technology areas, power grids and corporate services. The company is structured in four divisions: electrification products, robotics and motion, industrial automation and power grids.

ABB is one of the largest engineering companies serving customers in utilities, industry, transport and infrastructure, operating in around 100 countries globally, with approximately 135,000 employees in December 2017.

ABB Germany is one of the most important global sites of the ABB corporate group. In 2016 the different ABB sites in Germany had a turnover of 3.28 billion and employed 10,540 staff in around 40 local sites across the country, of which 20 are also production locations. However, nearly half of all ABB employees are working in the Rhine-Neckar region in Southern Germany, while the headquarters of ABB Germany is located in Mannheim.

ABB Germany has a number of subsidiaries, including companies such as ABB Stotz-Kontakt GmbH with around 1,400 employees in Heidelberg that develops, manufactures and sells products for the electrical equipment and automation of buildings, machines and production sites. Another subsidiary company is Busch-Jaeger Elektro GmbH, a company specializing in electrical installation technology for buildings and homes. The company is located in the Ruhr area of North-Rhine Westphalia and employs around 1,300 people.

It should be noted that overall employment of ABB Germany during the last years has been quite stable. This has not always been the case in the past. The company went through a significant crisis situation in the 1990s and experienced several periods of restructuring and change. However, more recently, ABB certainly has profited from being both an applicant and a producer of advanced manufacturing technologies and applications.

This in particular relates to the success of the ABB divisions of robotics as well as industrial automation. The ABB robotics business offers robots, controllers, software systems, as well as complete robot automation solutions and a range of services for automotive, as well as for the general industry. ABB is a leading supplier of industrial robots and robotic software as well as application equipment and complete manufacturing solutions. By the end of 2016, ABB has installed more than 300,000 robots worldwide and offers services to clients on the basis of a network that is the most comprehensive one in the automation industry.

To complement its robotics business, ABB has established its own robotics training centres and there are more than 50 of them under the umbrella of ABB University worldwide. The training courses include standard robot training modules, process and applications courses and systems training. Customized training can also be provided to students on site, in an external training facility, or through e learnings and webinars.

The industrial automation segment develops and sells control and plant optimization systems, automation products and solutions, including instrumentation, as well as industry-specific application knowledge and services for a broad range of industries.

Apart from automation technology and hardware, ABB today is also a major supplier for software platforms supporting the industrial internet and the digitalisation of manufacturing processes. The ABB Ability platform is an integrated industrial internet platform and cloud infrastructure (based on Microsoft Azure) to help industrial customers create new value with digital solutions.
The platform enables customers to securely integrate and aggregate their data, combine with wider industry data, apply big data and predictive analytics, and generate insights that can help them drive performance and productivity improvements.

As regards big data, ABB has also established a strategic collaboration with IBM focusing on harnessing artificial intelligence for advanced industrial technologies. The idea is to create new business fields where customers will benefit from ABB’s competence on digital technology solutions combined with IBM’s expertise in artificial intelligence and machine learning (IBM Watson).

There are two further context factors that should be highlighted here as they also are important for the adjustment of ABB Germany in the light of advanced manufacturing technologies, namely as regards to its implications on work, personnel development and VET:

First, ABB Germany is characterised – as other large manufacturing companies – by a strong participation of workers interest representation as well as co-determination at all levels. There are local works councils at all local sites and above that there are works council representatives at group (Gesamtbetriebsrat) and corporate group (Konzernbetriebsrat) level. Works councils have strong consultation and co-determination rights in the field of personnel planning, vocational education and training practice. Together with the management there are also many agreements (Betriebsvereinbarungen) that regulate employment and social aspects such as working time, time-off for training, data security or further qualification rights. It should also be mentioned that according to the German industrial relations act (Betriebsverfassungsgesetz), there is a special body that represents the interests of young workers and apprentices at the company level (Jugend- und Ausbildungsvertretung, JAV) that plays quite a strong role as regards to involvement in apprenticeship matters at ABB Germany as well as the general interest representation of the younger generation.

Apart from these structures of interest representation, German ABB workers are represented in the supervisory board of ABB Germany, thus have a say on general business strategies and decisions. Furthermore, workers representatives are involved prominently (including as current President) in the ABB Employee Council Europe (EWC).

A second important context factor of ABB Germany as regards to advanced manufacturing is the active involvement of company representatives – both from the management and workers – in public policy debates about Industrie 4.0, digitalisation of work and the discussion about vocational education and training. For example, the member of the ABB corporate group works council and President of the ABB EWC is a member of a working group (on work, education and training) of the ‘Platform Industrie 4.0’, a multi-stakeholder expert group and cooperation platform that develops recommendations for all stakeholders as regards to the future of industry in Germany.

The platform is organised by the Federal Ministry for Economic Affairs and Energy and the Federal Ministry of Education and Research. The platform aims to identify all relevant trends and developments in the manufacturing sector and to combine them to produce a common overall understanding of Industrie 4.0. With participants from more than 100 organisations, the Platform currently is the largest and most diverse Industrie 4.0 network worldwide. The ‘Plattform Industrie 4.0’ was established in 2016 and already has been a model for other countries – in 2017 cooperation agreements have been signed with the governments of France and Italy.

Furthermore, in the field of apprenticeship training and VET, ABB is engaged in a number of projects with federal as well as regional research and policy institutions. Representatives of ABB training centres are involved in publicly funded research projects and company specific projects serve as pilots for initiatives in the field of VET. This is illustrated later in this report in more detail in the context of the development of a model project “Supplementary Qualification for
Digital Competences in Initial and Further Training”. It should also be noted that ABB management representatives are actively involved in the modernisation of existing occupational profiles in the metalworking sector.

Relevance of dual apprenticeship
Dual apprenticeship plays a key role for initial vocational education and training at ABB Germany. It is the most important route for a career in the company for labour market entrants, both in the field of production as well as in commercial and administrative occupations.

ABB offers dual apprenticeship training in a broad range of occupations that require a formal, generally acknowledged and regulated apprenticeship training. There are around 20 different production occupations and six commercial occupational programmes in which ABB Germany offer apprenticeships (see table below).

Table 1: Apprenticeship in Training Occupations offered by ABB

| Production and technology occupations (requiring formal training) | • Plant mechanic  
| • Electronics technician for automation technology; Electronics technician for industrial engineering; Electronics technician for building and infrastructure systems; Electronics technician for devices and systems; Electronics technician for motors and drive technology  
| • Precision machinist; Production mechanic; Industrial mechanic; Construction mechanic  
| • Machine and plant operator  
| • Mechatronics fitter; Mechatronics engineer for refrigeration technology  
| • Surface coater  
| • Paper technologist  
| • Technical product designer  
| • Process mechanic for coating technology; Mechanic in plastics and rubber processing  
| • Tool mechanic  
| • Milling machine operator  
| Commercial occupations (requiring formal training) | • Warehouse logistics operator  
| • Warehouse operator  
| • Industrial clerk  
| • Office manager  
| • Patent assistant  
| • Event manager  

Source: ABB

Most of the dual apprenticeship programmes have a duration of 3.5 years, whereby 70% of the training takes place in the company and around 30% in vocational schools. There are a few occupational programmes that only last for two years because the qualification is less complex (e.g. machine and system operator or warehouse specialist). The apprenticeship courses at ABB

2 The project manager of the ABB training centre in Berlin is involved in the current revision of occupational profiles in the metal and electronics sector. A new, more ‘agile’ process (Agiles Verfahren) is going to be implemented by summer 2018.
are reflecting dual apprenticeship as regulated by the VET act in Germany in general (for further details see Voss/Schöneberg 2017).

Most of those who enrol for an apprenticeship at ABB have obtained a secondary education degree (ISCED 2 or 3a, Realschule) with medium to high grades. Most apprentices in the commercial programmes have a university-entrance diploma (Abitur).

In the first and second year of training, apprentices are trained in the two ABB Training Centers in Heidelberg and Berlin (ATC) and in local vocational schools. This phase is completed with part 1 of the final exam, which equals 40 percent of the final score of the occupational degree.

To ensure the best possible vocational training, industrial-technical apprentices are continuously trained in the ATC. They are trained for example in pneumatics, CNC and electrical engineering as well as in computer aided design. In addition, ABB (on initiative of the youth and apprenticeship representation, JAV) offers the opportunity for all apprentices – including those who do not necessarily work with computers at their workplace - to obtain a ‘European Computer Driving License’ (ECDL). This initiative has been motivated by the aim to spread at least basic digital skills to all apprentices and leave nobody behind.

In the third year of apprenticeship, the apprentices switch between practical phases in the respective departments of the company and theoretical phases in the vocational school. At the end of the training part 2 the final examination will be completed in the form of a project that is implemented at the company level. There is also the possible to conduct a central practical examination (so-called 'PAL examination'). This contributes the remaining 60 percent to the final score.

As other large companies in Germany that employ highly qualified staff, also ABB Germany offers dual study courses for young people entering the labour market that are interested in combining bachelor study courses with practical training. Though in Germany this is not regarded as 'higher apprenticeship' (because it is linked to the tertiary/academic education path and not to the VET path; for further details see Voss/Schöneberg 2017).

ABB Germany offers dual study courses in engineering as well as in business administration and management. All courses are set up according to the German dual system offering theoretical learning and practical work phases. The students graduate with the diploma BA, BEng or BSc.

All dual students have a trainee contract with ABB and receive a monthly salary. Students start with a two/three-month preparatory course at the ABB training centre in Heidelberg. The remaining three-year courses are evenly divided between theoretical learning (at the Baden-Württemberg Cooperative State University) and practical work phases within ABB.

Currently, ABB Germany is offering dual study courses in the following fields:

- **Bachelor of Engineering**: General Mechatronics; Electro-Mobility; Electronics Technology; Mechanical Engineering, Project Engineering, Industrial Engineering
- **Bachelor of Arts – Industry** (Business Administration, Management)
- **Bachelor of Science**: Business Informatics; Information Technology

In 2017, ABB Germany had a total of 732 apprentices (including dual students with an employment contract) of which about one quarter were female apprentices (most of them in PAL examinations are organised at the local Chamber of Industry and Commerce and are carried out at the same time and with identical content throughout Germany. So comparable standards in the examinations are ensured.

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commercial apprenticeship occupations). According to interviews with ABB's HR and training departments, the numbers of apprentices in IVET and dual students have been relatively stable over the last years.

With an 'apprenticeship rate'\(^4\) of 7%, the ABB Germany figure is higher than the national average (around 5% in 2015) and significantly higher than in the average of larger companies (around 4% in 2015, see BIBB 2017a).

As regards occupational fields and apprenticeship programmes, the following shares emerge:

- 51% of all carried out a dual apprenticeship in technical occupations;
- around 13% of all carried out an apprenticeship training in commercial occupations;
- 36% of all apprentices were dual students at the Dual University of Applied Science or Master Students; most of dual students were in courses that lead to a Bachelor of Engineering.

The following figure shows the top-10 apprenticeship programmes at ABB Germany. It also illustrates the current skills and qualification demands of the company: In the field of initial dual VET, the mechatronic occupational programme is the most important, followed by electrician in industrial maintenance and industrial mechanics. However, there also is a significant demand for dual students in engineering electronics technology and in the Bachelor of Arts in Industry.

**Figure 1: Top 10 apprenticeship occupations at ABB Germany**

<table>
<thead>
<tr>
<th>Programme</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor of Engineering Electrical Engineering</td>
<td>94</td>
</tr>
<tr>
<td>Mechatronics</td>
<td>91</td>
</tr>
<tr>
<td>Electrician for industrial maintenance</td>
<td>53</td>
</tr>
<tr>
<td>Industrial mechanics</td>
<td>49</td>
</tr>
<tr>
<td>Bachelor of Arts Industry</td>
<td>40</td>
</tr>
<tr>
<td>Specialist for office management</td>
<td>36</td>
</tr>
<tr>
<td>Electrician for machines and drives</td>
<td>31</td>
</tr>
<tr>
<td>Bachelor of Engineering Industrial Engineering</td>
<td>28</td>
</tr>
<tr>
<td>Bachelor of Engineering Mechatronics</td>
<td>26</td>
</tr>
<tr>
<td>Tool mechanics</td>
<td>26</td>
</tr>
</tbody>
</table>

*Source: ABB*

According to the company level stakeholders at ABB, the share of dual students has increased during the last years. However, in particular HR and training planning personnel also stressed that this does not mean that dual apprentices in initial VET become less relevant or even substituted by employees with an academic qualification.

\(^4\) The share of apprentices, including IVET and dual students in all employees of the company.
Needs and challenges related to manufacturing and advanced manufacturing

According to all stakeholders interviewed in the context of this case study, advanced manufacturing and digitalisation already has resulted in significant changes in production processes that require significant adjustments that have resulted for example in the revision of occupational programmes in the field of electronics and IT already in 2003/2004. According to the head of HR interviewed in the context of the case study, ABB Germany both as a driver of advanced manufacturing technologies and processes as well as an applicant of such technologies and processes is facing the need to adjust corporate practices in five broad fields of action:

- Competences
- Initial and further education and training
- Working environment
- Working time and places of work
- Leadership

According to the head of HR, it is important to address all these strategic fields of practice in an integrated and not in an isolated way. Therefore, activities of awareness building amongst management and executive staff at all levels as regards ‘digitalisation’ and ‘industry 4.0’ have been an important focus of HR activities in recent years. Awareness workshops, implementing agile methods, knowledge transfer about advanced technologies and the development of analytical tools for identifying new requirements at the individual workplace/working environment have been carried out throughout the company. This is based on the idea that it will hardly be possible to involve employees and develop their competences and skills in response to technological and process change if the awareness about the need, the motivation to adapt is not in place. Furthermore, change processes require an adjustment of framework conditions, including decision making structures, new models of working time and regulation regarding totally new aspects (e.g. integration of smart assisting systems such as VR (‘virtual reality’) glasses or smart cloths in the working environment). In particular regarding the adjustment of framework conditions, the works councils and employee representations play an important role, namely by the (re-) negotiation of company specific agreements on topics such as working time flexibility or IT mobile work.

As regards initial and further training contents and other aspects, interview partners have highlighted the following needs and requirements regarding adjustments:

- Occupational profiles have to be examined and adjusted continuously – here, also general/national revisions of profiles are important (see textbox);
- Advanced manufacturing, digitalisation and industry 4.0 imply that competences become more and more important
- Not only the company-based training and education but also the VET school parts of apprenticeship training need to be adjusted – this implies also the qualification of VET school teachers.
General information on the case

Background and reasons of initiating the practice

ABB Germany currently is carrying out several projects and activities that aim at adjusting and making initial as well as further vocational education and training “fit for digital” change and advanced manufacturing.

For the purpose this case study, three practices have been selected as they illustrate the various new requirements that are emerging from advanced manufacturing technologies as well as innovative solutions and practices developed by ABB Germany in the field of initial and further VET training.

The first practice is the modernisation of in-company VET training in the two ABB training centres in Heidelberg and Berlin, whereby the focus will be on Berlin as this has been visited in the context of the study and interviews have been carried out there. The second practice is the development of a concept for supplementary qualifications for digital competences in initial and further training that has been developed at ABB. The third example is the development of a new trainee programme ‘Digital Industry’.

General and detailed objectives and expected results

As a highly diversified company in terms of products as well as in regard to more than 30 locations across Germany, ABB Germany has established two regional training centres where apprentices are trained: the ABB Training Centre (ATC) in Heidelberg and the Vocational Training Centre Berlin (AZB).

ATC Heidelberg is the largest training centre of ABB in Germany with around 590 apprentices, including around 250 dual students in fields such as electronic technology, machine engineering and business engineering. As regards apprentices in dual occupational programmes the most important ones are mechatronics, electricians, industrial mechanics, construction mechanics, tool makers and apprentices in commercial occupations. The ATC not only trains ABB apprentices but also around 80 apprentices from 18 regional partner companies. These companies are often SMEs and linked to ABB as suppliers or cooperation partners.

The recently modernized and refurbished ABB Training Centre in Berlin has grown significantly during recent years as the following figure shows, illustrating also the attractiveness of the collaborative training approach (Verbundausbildung). Currently, only 5% of a total of 800 apprentices that visit the AZB are employed by ABB. 95% are working in around 140 cooperating firms, most of them located in the Berlin/Brandenburg region.
Figure 2: ABB Training Centre Berlin – Network companies

Source: ABB

The network approach of the ABB training centres, has significant added value, according to the ATC and AZB management. It allows establishing complex learning environments and engage highly qualified trainers. Furthermore, it enables apprentices from smaller companies to obtain skills and competences in fields related to advanced manufacturing that so far are not implemented in their own company. It should be noted that apart from providing the training, the training centres are also responsible for the screening and selection of apprenticeship candidates. Furthermore, the training centres have cooperation agreements with regional schools and regularly organise information events and practice days in order to promote occupational programmes and pathways. These administrative and promotional activities are highly attractive for smaller companies that do not have the resources for own promotional activities like that.

As regards technical equipment and specialization in advanced technologies, the AZB current has

- 29 different training areas
- Around 50 turning and milling machines
- 4 numerical turning machines
- 3 robot units

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• As regards advanced manufacturing technologies the training centre offers training on 3-D measurement processes, a fully automated production unit with the ABB collaborative robot YuMi\(^5\), 3-D printing technology as well as smart-home applications/technologies.

The AZB offers apprenticeships in 24 different training occupations - nine electronic and 11 metal-working training occupations, three other training occupations (technical product designer, technical system planner, qualified IT specialist) and two dual study courses (Bachelor of Engineering in Industrial Electronic Technology and Bachelor of Engineering in Design and Manufacturing). As of 1\(^{st}\) September 2016, the most popular training occupations were mechatronics (226 apprentices), electricians in various functional fields (150) and industrial and tool mechanics (133).

The Training Center in Berlin has a full-time staff of around 30. Apart from trainers and instructors and administrative staff, there is also a full-time project manager engaged in scientific and other project works.

ABB HR and also the Training Centre in Berlin are engaged in different projects that are addressing important challenges as well as contribute to the further development of initial and further education and training. In particular the following projects that have been completed in 2017 or are still ongoing have been highlighted by the interview partners as particularly relevant for the field of initial and further VET:

• Internal project “Education Quality” that has been completed in 2017 and focused on an internal inventory of requirements and needs as regards training in relation to digitalisation and industry 4.0 at ABB.

• Project “Supplementary Qualifications for Digital Competences in Initial and Further Training”: Development of a cross-occupational further qualification module, including methodical and pedagogical concept, pilot project and implementation of the further qualification by administration regulations of regional chambers.

• Development of a new programme “Digital Industry Trainee”.

• Development and implementation as a pilot (2017) of a workshop series on “Digital Awareness” for executive employees and managers as a low-threshold method to become aware about the topic.

• Not only dual students but also all apprentices in technical and commercial training occupations are going to be equipped with laptops and will get access to ABB networks in order to participate in new forms of communication and digital training offers.

• Introduction of a digital version of the reporting card/booklet for apprentices (‘blok’) in order to train apprentices as well as training personnel for working with electronic devices, increase mobility and stimulate reflection on the potential of digital devices.

• Simulation game/exercise 3-D Printing – competence development and learning to use this new technologies and related tools in the context of a project week with mixed groups of IVET apprentices from various ABB sites.

• Development of webinars on the topic of “Digitalisation for training personnel – Basics and Digital Competences”.

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\(^5\) YuMi (“You and Me”) is a flagship model of ABB robotics: a twin-arm collaborative robot for assembling small-scale parts. The robot was developed for a new era of automation, where humans and robots work hand in hand on a task, such as small parts assembly.
“Reverse Monitoring” – Executives learn from “digital natives”: The aim of this (planned) project is to enable managers and employees with executive functions to learn from younger colleagues about the use of modern technologies. This should contribute to organisational learning at ABB and to the integration of the younger generation values into the organisation.

Planning of a “Learning Factory 4.0” in Berlin focusing on Industry 4.0 technologies and processes, including the development of methodical and pedagogical concepts and implementation. It is planned to construct the building of the factory 4.0 in 2018 and open it in 2019.

In the following, we focus on some the projects mentioned above, namely the project on ‘Digital Competences’ and the ‘Digital Industry Trainee’ programme.

Linkages to national programmes and initiatives
The project “Supplementary Digital Competences in Initial and further Training” is implemented as a model project in the context of the strategic programme “Work 4.0 made in Berlin” that is co-funded by the City Government of Berlin.

Similar policies and programmes currently are carried out in nearly all German federal states (Länder) as well as at national government level in the context of the activities focussing on adjustments of initial and further vocational training and education.

The Berlin project is implemented by the ABB Training Centre in cooperation with k.o.s. GmbH. It is monitored by a steering committee as well as an expert group that consist of all relevant stakeholders: politics and administration, chambers of commerce, craft trade organisations, trade unions, vocational schools, employer organisations and the federal institute for vocational training (BIBB).

As highlighted above and also stressed by ABB stakeholders in the context of interviews carried out in this study, the project on digital competences is closely linked to a broad range of internal change projects and initiatives within ABB Germany.

Scope of the programme/initiative
Aiming at the development of supplementary digital competences that are important for all employees irrespective of the specific occupation, the project covers three different occupational fields and a variety of specific occupations: Metalworking and electronics (Mechatronic), craft trades (System Mechanic) and services (Insurance/Finance Salesperson).

The project started in March 2016 and was completed by a first pilot implementation of the supplementary qualification module and the teaching and training concept at the end of September 2017.

There will be follow-up pilots before the supplementary qualification module should be certified/regulated by regional VET institutions (Chambers of Commerce and Industry) and thus will become available for all regional companies.
Project design, planning and implementation

Needs assessment and type of change implemented
The project 'Supplementary Qualifications for Digital Competences in Education and Training' takes into account the requirements of the changed working world of the future, namely induced change resulting from digitalisation and advanced manufacturing technologies which cannot yet be determined precisely. It is based on two considerations:
First, further qualification can close gaps in training regulations and be used for skills and competence development of employees already in work. Secondly, because the adaptation of training regulations can only be realized at longer intervals, further qualifications offer scope for a short-term adjustment of education and training.

Involvement of different actors
As highlighted above, all relevant actors are involved in the development and implementation of pilot of the digital competences project: apart from ABB personnel (project manager at the training centre in Berlin, national HR, representatives of the Berlin City State Government in the field of employment, education and training, the main trade unions at cross-sectoral and sectoral level (DGB and IG Metall), employer organisations, business chambers, VET schools and the main German VET research institution (BIBB) are involved in the steering committee of the project as well as in form of a scientific expert group.
This broad stakeholder approach mirrors the German approach of adjusting, modernising and further developing VET policies in general. As the recent example of initiatives focusing on modernising occupational profiles and apprenticeship programmes in the metal and electronics sector illustrates, in particular social partners play a key role.

Financing
The project "Supplementary Qualifications for Digital Competences in Education and Training" is financed mainly (around 75%) by City Government of Berlin (Senate Administration of Integration, Labour and Social Affairs).
As regards the financing of the modernisation of the ABB Training Centre in Berlin, the City Government of Berlin and public funding was also the major source, contributing about 90% of the costs related to infrastructure and refurbishing investments. With view on the running costs of training it has to be noted that according to the German apprenticeship regulation, the on-the-job component of dual apprenticeship training has to be covered by the training company (the VET school component is financed by public funds). Thus, the companies that use the ABB Training Centre for practical vocational training for their apprentices, pay a fee to the training centre. It should be noted that this fee is co-financed by public funds: In situations where the company is not able to deliver all the training obligatory training contents that are foreseen at the company level or in cases where a collaborative training ('Verbundausbildung') would provide a higher apprenticeship quality, companies might receive a subsidiary. This subsidiary in Berlin in 2017 was €40 per training day and €7,500 per year as a maximum for a 3.5 year duration. The following figure is illustrating the partnership approach of the ABB Training Centre.
All other projects and initiatives related to vocational education and training adjustments at ABB described in this report are financed from own funds.

As highlighted by company level stakeholders, investments in initial as well as further vocational education and training are regarded as an important factor contributing to a highly qualified and motivated workforce and to the sustainability of innovation and competitiveness potentials of the company.

In the context of adjusting both initial as well as further training and education in the light of advanced manufacturing and managing digitalisation processes, different kinds of investments and costs have been highlighted by interview partners. Apart from recent investments and running costs in the context of the modernisation of the two training centres, also other activities that were mentioned above (section 2.2) are directly related to such adjustment processes.

Apart from that, ABB Germany also has increased its engagement in promotion events in order to attract young people for starting a career at ABB as an apprentice. The company for example is organising open door events, so-called holiday camps for school pupils, specific activities to attract more young women into technical occupational training (‘girlsatec.de’) and other activities (cooperation with schools and universities, social activities, funding of sports events, etc.).

Other forms of local, regional and/or national support and expertise

ABB Germany is embedded generally in local, regional and national networks that are highly relevant for education and training practices. Worth mentioning here are for example trade union and employer organisations at various level, secondary and VET schools, universities and research institutions.

It should also be mentioned that ABB Germany itself is actively involved as an important actor in relevant networks and initiatives that focus on the broad topic of digitalisation and its impact on work. The following networks at national and regional level were highlighted by the HR Country Manager:
Modernisation of dual apprenticeship training at ABB – Germany

- Participation in a working group of the 'Platform Industry 4.0' initiative of the Federal Ministry for Economic Affairs and Energy and the Federal Ministry of Education and Research
- Providing expertise to joint metalworking and electronics sector social partners initiative for a partly revision of industrial metal and electronics occupational profiles (so-called 'Agile Procedure', 'Agiles Verfahren')
- Participation in the 'HR Denkfabrik 4.0' (a future lab of human resources) of the regional metalworking employer organisation in South West Germany
- Participation in various research projects on the future of work, industry 4.0 or leadership in digital transformation

Implementing the programme/initiative

Supplementary qualification for digital competences

In the context of a pilot project, the elaboration of the supplementary qualification for digital competences was implemented by the ABB Training Centre in cooperation with an external cooperation partner on behalf of the City Government of Berlin (Senate Administration of Integration, Labour and Social Affairs). The project started in 2016 will be completed at the end of 2018. The aim is to develop a supplementary qualification concept on transversal ‘digital competences’ that can be used in IVET as well as further training and that will result in a certified examination.

The project started with the identification of transversal competence requirements that are triggered by digitalisation of production processes, irrespective of the specific occupation or sector. This was done on the basis of three different occupations, including mechatronics. As a result of this process 36 knowledge and competence items were identified that seem to be highly relevant. These items then were clustered into a model that consists of five modules (see table below).

*Table 2: Five items of supplementary qualification for digital competences*

<table>
<thead>
<tr>
<th>Basics competences as regards digitalisation</th>
<th>Learning and working in the digital world</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Technical drivers</td>
<td>• Learning with digital media</td>
</tr>
<tr>
<td>• Digital society</td>
<td>• Digital driven knowledge management</td>
</tr>
<tr>
<td></td>
<td>• Knowledge transfer</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>ICT Competence</th>
<th>Handling Data</th>
<th>Systems &amp; Processes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hardware</td>
<td>• Data security</td>
<td>• Work processes</td>
</tr>
<tr>
<td>• Software</td>
<td>• Data protection</td>
<td>• Added-value</td>
</tr>
<tr>
<td></td>
<td>• Data analysis and evaluation</td>
<td>• Cross-company processes / networking</td>
</tr>
</tbody>
</table>

*Source: ABB Training Center Berlin/www.kompetenzen-digital.de.*

It should be noted that each module contains a description of required knowledges, skills and personal competences that correspond to the systematics of the German Qualification Framework as well as the EQF.

The model was developed in close cooperation with a broad range of stakeholders that were involved in an expert committee as well as steering group, namely representatives of the Federal Governments of Berlin and Brandenburg, Chambers of Commerce and Industry, Craft
organisations, trade unions, employer organisations, VET schools, the federal VET research institute BIBB, educational institutions as well as single companies.

The ABB Training Centre in Berlin and its partner have also developed an approach regarding the provision of ‘digital competences’ that focuses on a ‘blended learning’ approach, that is a strong focus on self-organised personal competence development and the creation of ‘learning architectures’ and ‘enabling frameworks’ that foster self-organised learning and competence developments.6

The educational concept for supplementary transversal digital competences is based on the following considerations:

- Self-organized competence development of the future will take place with the support as well as within the internet;
- Competence goals have to be defined for each learner individually;
- Competency goals are formulated individually.
- The focus is on ‘enabling didactics’ instead of ‘teaching didactics’: Knowledge accumulation, qualification and competence development are shifted towards self-responsibility of the learners;
- Educational institutions must focus on designing a learning architecture as an ‘enabling framework’;
- When assessing learning achievements, it no longer matters to know a lot, but to be able to use knowledge methodically and meaningfully to solve challenges.

The supplementary qualification so far (May 2017) has been tested in pilots with apprentices in IVET that are in the second or third year of training. In total 26 apprentices from 13 different companies and 11 different occupations participated in the pilots.

Learners work on their own practice projects (e.g. 3-D printing) and use a common learning platform. Learning and competence development take place in practice and in the network (learning platform). Two apprentices form a tandem and exchange information about their practical projects in a binding and regular manner. Several tandems form a learning group and handle additional tasks in the group. The learners are accompanied by learning coaches and supported if necessary. There are only a few face-to-face appointments with the entire group.

In a one-month pilot phase in 2017, the supplementary competences provision and the learning arrangement were subject to a practical test with ABB apprentices, mentors/trainers, vocational school teachers and project staff. The project focused on 3-D printing and carrying out a task jointly by various tandems of trainees that also worked on a transnational basis. Apart from electronic communication between tandems and participants, physical meeting took place at the beginning and at the end of the pilot. Based on the insights gained, ABB has adapted the concept for piloting with apprentices: the learning project now extends over two months; there will be an additional face-to-face meeting. The extent (presence and self-learning shares) is calculated to be 50 to 74 hours. The piloting will be evaluated and the model adjusted according to the results.

With a view to the implementation of the model, it is planned that by the end of 2018 the final supplementary qualification arrangement should be ready and certified by the chamber of commerce and industry by the end of 2018 so that it can be applied within ABB as well as other companies. The supplementary qualifications for digital competences in education and further

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6 As regards the development of a new educational/didactical concept the project team was supported by a renowned expert of blended learning.

Disclaimer: This working paper has not been subject to the full Eurofound evaluation, editorial and publication process.
training should be then available as a nationally recognized additional qualification, certified by the relevant chambers after passing an examination.

It should be noted that apprentices are not the only target group of the supplementary qualification for digital competences. Further targets that will be addressed after the piloting phase are qualified workers as well as in-company trainers and mentors and VET teachers.

**Trainee programme Digital Industry**

The second practice example that was highlighted by interviewees of ABB Germany is the trainee programme 'Digital Industry' that was launched at the Hannover technology fair in spring 2017 (the largest metalworking and technology fair in the world).

In addition to the already existing trainee programmes that exist at ABB, the programme 'Digital Industry' addresses academics who have already obtained a Master degree (either as a dual student at ABB or entering the company from other routes) focusses on developing competences linked to advanced manufacturing technologies and processes that are required for future management personnel.

There are three different sub-programmes that are offered to young talents in the fields of digital business development (focusing very much on the new digital platform ABB Ability that links customers directly with the company7), digital process management and production.

During the 24-month programme (the 'normal' trainee programme of ABB lasts 18 months), trainees will get to know different locations and production sites of the Group in Germany and abroad. At the research center in Ladenburg, for example, they have the opportunity to support the development of new digital solutions. In addition, a stay abroad of 3 – 6 months provides the trainee(s) with the opportunity to gain additional competences and intercultural experience. As regards locations, the trainee is free to visit any ABB site around the globe, depending on her/his interests. Normally the location chosen is related to the respective department and specialisation the trainee is engaged in. Of course, the stay at a ABB site abroad will be selected and prepared in close cooperation with the mentor of the trainee who assists the trainee during the whole two-year period of the traineeship.

**Quality assurance mechanisms**

As highlighted in a recent publication (BIBB 2017b), so far, the various elements of quality assurance in vocational education and training in Germany are not perceived as an overall concept. They are based on traditional processes, procedures and regulations that are laid down in several laws and documents. They can only be partially represented by the EQAVET quality framework. For instance, national regulations tend to define regulatory regulations, legal bases or nationally applicable standards rather than instruments of quality assurance.

However, it is undisputed that the training quality must be reliably secured. At the legal level, the Vocational Training Act (BBiG) and the Craft Trade Regulation (HwO) have established quality assurance mechanisms governing both the development of training regulations and the organization of their training and their supervision by the chambers. With the amendment of the BBiG in 2005, the Vocational Training Committees of the Chambers and the Regional Vocational Education Committees were obliged to work towards the continuous development of the quality of VET. The instruments created in this way anchor the quality assurance and development of VET as a permanent task in the dual system.

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7 [https://new.abb.com/abb-ability](https://new.abb.com/abb-ability)
For the understanding of the quality assurance of vocational training, three general principles are important: the dual principle, the professional principle and the consensus principle. The dual principle combines learning in the work process with learning at the vocational school and at the same time enables the acquisition of professional experience. On the basis of a nationally binding and recognized certificate, the professional principle opens up the possibility of exercising a variety of professional activities. The principle of consensus guarantees labour market closeness, transparency and acceptance of training occupations through the involvement of social partners, the federal and state governments in the development of national training standards. Laws, ordinances and recommendations set binding minimum standards for company education nationwide.

It has to be stressed that involvement of social partners relates to all levels of VET governance, implementation and monitoring. At the company level for example, the works councils, youth and apprenticeship representation bodies and employee representatives at the company supervisory board play an important role. Apart from involvement in company level committees and institutions, works councils also negotiate if necessary company level agreements with the management (Betriebsvereinbarung).

Interviews with works councils and apprenticeship representatives at ABB have shown that these representation bodies play a very active role. For example, the group works council has recently initiated and negotiated a company agreement on mobile work and home-work, it also has agreed regulations on e-learning frameworks (each employee should have the opportunity for e-learning, per week a certain amount of working time should be available). Furthermore, the ABB works council has agreed with the management a ‘takeover guarantee’ for apprentices. This means that each apprentice knows that after the successful completion of the training he/she receives a direct employment contract with the company.

The apprenticeship and youth representation at ABB Germany (JAV) consists of nearly 50 representatives from all parts of the company, including also dual student representatives. The representation body meets at least two times per year and is closely cooperating with the works councils.

**Skills of involved training and mentoring personnel**

As already mentioned above, the regular updating and further qualification of the training personnel at VET schools as well as within the companies is a key task of the quality assurance mechanisms of the German VET system.

At the ABB Training Centre in Berlin as well as in Heidelberg, training and mentoring personnel are mainly qualified staff from the company that have decided to become a trainer.

According to the HR Manager of the German ABB, ‘our two training centers in Heidelberg and Berlin are state-of-the-art and our trainers are continuously trained in order to provide the trainees and students of the dual university with the necessary digital skills. Thus, the extension of our trainee offer by the new Digital Industry programme is a logical step in our Digitization strategy.’

As already highlighted above, skills and competence development of in-company training and mentoring personnel will also be carried out in the future in the context of the supplementary qualification for digital skills.

Off-the-job training is provided by teachers of local/regional VET schools. There is a close and continuous cooperation between ABB HR and training departments and the VET schools. It should be noted that the ABB Training Centre in Berlin offers the opportunities for VET school teachers to visit the Centre for a short-term internship in order to develop further technical as well as didactical knowledges and competences.
Difficulties and challenges during implementation

A challenge according to a representative of the ABB youth and apprenticeship representation body is that some VET schools are lagging behind as regards quality and technical infrastructures.

The implementation of new training contents and new forms of learning in particular in the production are facing the challenge that due to specific requirements across different production departments one fits all solutions are not suitable. There is a need for department-specific approaches of skills development that are integrated in a structured framework and combines with self-organised learning. It also had to be taken into account that parts of the production areas still are not connected to the internet. As regards to these challenges, the ‘supplementary qualification for digital competences’ (that also targets workers in production) as well as other measures (e.g. the decision taken in 2017 to equip all apprentices with a tablet computer and not only dual students or the ‘computer driving license’) should be regarded as answers.
Outcomes, impact and lessons learned

Major outcomes and impacts on company and region

Outcomes and impacts on the company. The case study has analysed the examples of modernisation of dual apprenticeship training at ABB Germany – the modernisation of the ABB Training Centre in Berlin that provides training not only for ABB apprentices but also for those of regional SMEs, the development of a programme ‘Supplementary Qualification for Digital Competences in Initial and Further Training’ and the new trainee programme ‘Digital Industry Trainee HR’. Due to the recent character of changes it is too early to identify concrete outcomes and impacts on the company. However, at least the modernisation of the training centre in Berlin already has had a positive outcome on the company insofar as it has contributed positively to the image of the company as a forerunner of advanced manufacturing technology teaching and dual VET training innovation in the light of digitalisation of manufacturing and industry 4.0. This is illustrated by the attractiveness of the training centre for regional companies and in particular SMEs and the plan to extend the training centre by a new campus. And though the ABB programme of a supplementary qualification for digital competences still is at the pilot phase it also has contributed positively to the image of the company. Both practices also have a positive impact on the Berlin-Brandenburg region because more than 90% of the apprentices being trained at the centre are not ABB apprentices but from other companies.

Progression to ‘higher apprenticeship’, professional mobility and career progression for the individual. The new trainee programme "Digital Industry" complements the already existing higher VET programmes at ABB as well as the existing dual study programmes that provide for young people having completed an initial apprenticeship at the company to progress further to a Bachelor or Master degree and enter a pathway in management and leading positions within the company.

Impact on the local labour market. The impact of the practices at ABB is likely to address future skills gaps and a lack of highly skilled workers in manufacturing by providing young people with the skills and competences that will become increasingly relevant in the future. In this context it should also be mentioned that the ABB training centre runs several projects and initiatives to attract young people already at school age for a dual apprenticeship, including young women (‘girlsatec.de’, ‘ABB Girls Camp’).

Increased attractiveness of the entire region or sector and spill-over effects on other companies in the region. By the cooperative approach of ABB training centre that provides also apprenticeship training in advanced manufacturing and all relevant metalworking occupational programmes for apprentices of regional companies, namely SMEs, the centre has a clear spill-over effect on other companies in the region.

Attractiveness and capability of apprenticeship

To start an initial apprenticeship or a dual study programme at ABB is highly attractive for young people because of the positive image of the company as well as the high quality of training provided in the training centres of the company. Apprentices of ABB as well as of companies collaborating with the Training Centre are also regarded as highly capable. As highlighted in the interview with the representative of the Centre drop-out rates of ABB apprentices are between 6 - 8% and below 10% as regards apprentices from other companies visiting the Training Centre. This contrasts to an national average drop-out rate of 25 - 35% of apprentices in production related IVET programmes in Germany.

Here it should also be highlighted that the employee representation body at ABB (works council) has agreed with the management on a guarantee to offer apprenticeship a regular employment
contract after the successful completion of the apprenticeship (‘Übernahmegarantie’). Since 2017 such a guarantee also exists for dual students. This certainly has further contributed to the attractiveness of beginning an apprenticeship at ABB.

**Key success factors and lessons learned**

Key success factors that have contributed positively to the practices described here and the absence of particular difficulties can be highlighted as follows:

- **Strong commitment of the ABB top management to invest in VET training and apprenticeship**: The practices described here would not have been possible without the firm commitment of the ABB management to modernise and adjust initial training as well as further qualification at the company in order to become 'best in class' as regards advanced manufacturing and digitalisation of industry. The modernisation of the training centre and the two programmes described here are related with quite a significant investment in VET and qualification, including also the creation of new posts within the company (for example a project manager at the training centre in Berlin).

- **Development of new and innovative concepts of VET provision and ‘learning architectures’**: As highlighted in the context of the development of the supplementary qualification for digital competences, new and innovative approaches of learning and teaching have been developed as an integral part of the supplementary qualification programme. The development of new a ‘learning architectures’ and an ‘enabling learning framework’ that measures learning performance and outcomes not so much on the basis of quantitative knowledge but on the basis of the practical application of such knowledge for solving concrete problems and challenges.

- **Active involvement of employee representatives and apprentices**: It is important to highlight the active involvement of employee as well as apprentice representatives in the practices described here. This has created/increased the feeling of ownership. It should also be mentioned that VET training and apprenticeship is a matter not only of information and consultation but also co-determination according to the German labour code.

- **Collaboration with regional education and training institutions, companies and VET research**: Long-lasting and trust-based cooperation with primary and secondary schools, VET research institutions, technical colleges as well as top research institutions in the field of industry 4.0 as well as other stakeholders (employer organisations, chambers and trade unions) are further important success factors. Furthermore, the cooperative approach of the training centre, i.e. not only providing training for internal apprentices and workers but also for regional companies has been an important success factor.

- **Existing public funds for innovative practices and programmes**: Finally, also the existence of both national/federal as well as regional funding programmes (often also with the involvement of the ESF) aiming at the promotion of VET and the modernisation of qualifications, industry 4.0 or the digital transformation of the economy are important external framework conditions of innovative practices as described in this case study.
Commentary and conclusion

Adjusting dual apprenticeship in the light of advanced manufacturing

The ABB case illustrates a number of important aspects of adjusting dual apprenticeship in the light of advanced manufacturing:

First, adjustment processes in the field of initial dual VET training programmes are not made by 'inventing' totally new occupations but rather by adjusting already existing ones by adding new contents and – equally important – change the way of learning and teaching. This is strongly illustrated by the development of the supplementary qualification programme for digital competences as well as the modernisation of the VET training centre in Berlin.

Secondly, and with view on guaranteeing an effective implementation as well as acceptance within the company, adjustment process should be implemented with the active involvement of management as well as workers representatives. Here, the various measures of awareness building and the key role of the national HR Director were important elements of support.

Thirdly, the ABB case illustrates that adjustment processes of dual apprenticeship should be developed and implemented not in an isolated way but as part of a broader transition and change process. This implies that not only initial dual VET but also VET teaching and mentoring techniques, learning methods, further qualification and skills development as well as dual study courses are adjusted and modernised accordingly. This is illustrated by the various practices that have been implemented at ABB simultaneously.

Policy implications and transferability

According to the management representatives of ABB Germany, the recent economic success of the company that not only applies by also successfully develops advanced manufacturing technologies would not have been possible without the highly skilled and qualified workforce and high-quality apprenticeship training.

This means that any industrial policy that aims at promoting and fostering advanced manufacturing processes should have as an integral part also a VET and qualification component.

A further important implication of the ABB case is that modernising and adjusting VET programmes and dual apprenticeship courses should not stop with adjusting curricula or development new contents: also the way of learning and teaching has to be modernised and adjusted in order to reflect new needs and new competence requirements.

A further policy implication is related to the relationship between companies and VET policy: The ABB case illustrates that policy and VET research rather have a supporting and facilitating character, whereas specific initiatives, objectives and goals as well as implementation processes are largely driven by company level actors (including employee representation bodies) in close cooperation with the social partners, i.e. trade unions and employer organisations at sectoral level.

This strong role of companies and social partners for VET policy is an important element of the German dual VET system that cannot easily been transferred to other countries without a more or less significant reform of the whole system.
References

All Eurofound publications are available at www.eurofound.europa.eu


## Annex

### A.1 List of interviewees

<table>
<thead>
<tr>
<th>Type of organisation</th>
<th>Organisation</th>
<th>Interviewee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>ABB</td>
<td>ABB Germany HR Country Manager</td>
</tr>
<tr>
<td>Employee representation</td>
<td>ABB</td>
<td>Member of the ABB group works council, ABB supervisory board and ABB European Works Council</td>
</tr>
<tr>
<td>Apprenticeship representation</td>
<td>ABB</td>
<td>7 members of the ABB youth and apprenticeship representation (apprentices and dual students)</td>
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<tr>
<td>VET provider</td>
<td>ABB Training Centre Berlin</td>
<td>Project manager</td>
</tr>
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<td>ABB Training Centre Berlin</td>
<td>Director</td>
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<td>VET research</td>
<td>BIBB</td>
<td>Head of department, responsible for Industry 4.0 and adjustment of apprenticeship</td>
</tr>
<tr>
<td>Employer organisation</td>
<td>Gesamtmetall</td>
<td>Head of education and VET department</td>
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