
Country Report

Germany

Content

1. Introduction.....	1
2. The learning outcomes approach.....	2
3. Examination Procedures.....	4
4. Conclusion.....	5

1. Introduction

The report provides an overview of the sector mechatronics with its different qualifications. With a focus on the apprenticeship “mechatronics” in the dual system it describes the status quo of learning outcomes orientation and competence assessment procedures.

Mechatronics in Germany

Relating to the Classification of Occupations 2010¹ of the Federal Institute for Vocational Education and Research (BIBB) mechatronics covers a range of occupations such as mechatronic fitter, mechatronics for refrigeration technology and motor vehicle mechatronics technician. According to the classification it is also a subcategory of electrical engineering occupations, such as industrial electrician, micro technology, information system technician etc.

The profession of a mechatronic fitter covers a broad range of occupational fields. It can be found in the electrical industry, in machine and plant construction, the automotive industry, the steel industry as well as crafts. Mechatronic fitters are dealing with the assembly and maintenance of mechatronic components and systems from manufacturers in plant and machinery, with the operators of the systems and in service areas and service providers in different industries and sectors. In Germany, there are several qualifications in the field of mechatronics linked to several VET-pathways:

- In Germany, the access path most people choose to the occupational field mechatronics is achieved through dual vocational education. The training occupations “mechatronics fitter (crafts)” and “mechatronics fitter (industry)” are *recognized training occupations* according to the Vocational Training Act. Its duration is 3 1/2-years. Due to the relevance of the qualification in the dual system the report will focus on this training occupation. Current data issued by the Federal Institute for Vocational Education and Research² shows that – despite a decrease from 2012 to 2013 – the number of new training contracts is still on a high level. It is still a male dominated training occupation (table 4).
- *Further training qualifications* such as “Meister (master craftsman)” and “Techniker (technician)” are offered for people in employment. Entry requirement is usually the final examination and professional experience in a recognized training occupation relevant for the objective of the field of continuous training. The qualifications are regulated under federal law.
- In *undergraduate courses* both training integrated courses and practice integrating courses are possible. A study of mechatronics can be combined for example with training in recognized training occupation mechatronics/mechatronics or

¹ www.bibb.de/de/66262.htm.

² www.bibb.de/de/65907.htm.

electronics/electronics technician for automation technology (industry). The undergraduate course ends with the degree Bachelor of Engineering.

Training occupation	New training contracts			
	2012		2013	
	male	female	male	female
Mechatronik Fitter (Crafts)	195	9	177	3
Mechatronik Fitter (Industry)	7263	531	6891	498

Table 1: Number of new training contracts (source: own illustration, data from BIBB, www.bibb.de/de/65907.htm)

2. The learning outcomes approach

In the German vocational education and training system the outcome orientation of curricula and training regulations is still ongoing. There are several initiatives to further develop this approach and its implementation in regulatory instruments. The following principles serve as a conceptual framework for the development:

- *Orientation to competences:* The training regulations determine the competences, which apprentices need to acquire. This competence-oriented description includes the professional, methodical, social and personal dimension.
- *Learning-outcome oriented description of competences:* The competences are described in terms of learning outcomes. These terms lay down what trainees know, understand and are able to do after finishing a learning process.
- *Orientation to working and business processes:* The competences which must be acquired by the trainees are oriented on the working and business process.

Dual training “mechatronics fitter”: Training in a recognized training occupation – such as mechatronic fitter – is to impart “Berufliche Handlungsfähigkeit”, which is the professional ability to act responsible in private, social and vocational situations and provide the necessary professional experience. This is mainly achieved by company-based training (three or four days per week) and part-time teaching in vocational schools (one or two days a week). Training in the company is based on training regulations the Federal Government issues for recognized training occupations. This ensures a comparable level of training throughout a specific occupation. It is within the sphere of the Standing Conference of the Ministers of Education and Cultural Affairs (KMK) to issue framework curricula in accordance to each training regulation, structured along learning fields. Training regulations and curricula are the basis for training in the dual system.

The training regulation contains the duration of apprenticeship and guidance times, examination requirements and skills, knowledge and competences to be acquired by the

trainee. The latter are summarized in a training profile and – in more detail – in the general training plan (table 5):

No. and Part of the training occupation profile	Skills, knowledge and competences to be imparted	Guidance times in weeks in the training year		
		1	2	3
20: Maintain mechatronic systems (§ 3 Paragraph 2 No. 20)	<ul style="list-style-type: none"> a) Inspect mechatronic systems, check function of safety systems and protocol checks b) Maintain mechatronic systems in accordance with maintenance and repair plans, exchange parts subject to wear and tear as part of preventative maintenance c) Dismantle devices and sub-assemblies noting their function and label parts with regard to position and functional alignment d) Rectify malfunctions by conducting remedial procedures and exchanging parts and sub-assemblies e) Rectify software errors f) Compare system parameters with stipulated values and adjust g) Repair mechatronic systems according due consideration to company processes h) Adapt mechatronic systems to altered operational conditions i) Use diagnostic and maintenance systems 			13

Table 2: Part of the general training plan for mechatronic fitters (source: www2.bibb.de/tools/aab/ao/mechatroniker_ao_rlp_engl.pdf)

The school-based element of dual training focuses on theoretical and practical knowledge related to the occupation, general subjects such as economic and social studies and foreign languages. Since 1996 curricula for vocational schools are defined in units of learning outcomes (so-called fields of learning). Fields of learning are formulated in a competence-oriented manner. At the level of the KMK framework curricula the competences are defined in largely general terms in order to take into account regional and sectoral developments. They must be concretized in so-called educational program conferences at the respective individual school.

In the Committee on Innovation in Vocational Education and Training (IKBB)

representatives and experts from Federal Government and the Länder, companies, schools and industry associations agreed upon the “the reorientation of the training regulations towards competence descriptions” (Bundesministerium für Bildung und Forschung 2007, p. 18). Currently the “concept to design competence-based training regulations” is developed and tested in two occupations (mechatronics is not among them). A working group of the Federal Institute for Vocational Education and Training will discuss requirements for future training regulations on the basis of the results of this project. Other initiatives aim at the unification of training regulations: The project “EDGE” (Development of models to allow credit to be given for learning achievements between different training courses in the twin-track training system on the basis of ECVET) identified learning units for the mechatronic training, specifying the corresponding competences and training duration. However, the unification and modularization of training regulations is still discussed controversially in Germany.

3. Examination Procedures

The examination system is regulated consistently in the Vocational Training Act (“Berufsbildungsgesetz”, Bundesministerium für Bildung und Forschung 2012, p. 30). With the revision of the training regulation of the apprenticeship mechatronic fitter in 2011 a new examination structure was introduced. The so-called extended final examination (“*Gestreckte Abschlussprüfung*”) consists of two parts at two different times and replaces the traditional form that consisted of an interim and a final examination. Whereas the former interim examination was used to assess a trainee's progress only and did not play a role in the grade issued for the final examination, the new structure foresees that the results of both parts count into the final grade. Both parts consist of a practical part, expert discussions (“*Fachgespräch*”) and written assignments.

Final examination: Part 1

The final examination Part 1 takes place 18 months into training and has a weighting of 40 percent onto the final result. The trainee is given a *work task* in the field *work on a mechatronic subsystem*. The task also includes situational *expert discussions* and written assignments³. The time given for this task is 8 hours, including expert discussions and written assignments.

³ berufenet.arbeitsagentur.de/berufe/berufld.do?_pgnt_act=goToAnyPage&_pgnt_pn=0&_pgnt_id=resultShort&status=A08

Final examination: Part 2

The final examination Part 2 takes place at the end of training and has a weighting of 60 percent onto the final result. It consists of 4 areas of assessment related to a work assignment, organization of work, functional analysis and economic and social studies. The *work assignment* covers the section “assembly or maintenance and commissioning of a mechatronic system”. It proves whether the candidate is able to analyze and plan work tasks, obtain, evaluate alternative solutions taking into account operational procedures and responsibilities on site etc. Within the area the company has the option to choose between a company assignment (option 1) or a work task (option 2): Option 1 requires the candidate to conduct of a company assignment in 20 hours and document the results. The expert discussion builds on the documentation and lasts no more than 30 minutes. Option 2 covers the preparation, conduction, postprocessing and documentation of a work task in 14 hours (6 hours for conduction the task) and ends with a situational expert discussion of no more than 20 minutes.

The areas *organization of work*, *functional analysis* and *economic and social studies* are assessed in written assignments. The test time in the areas of organization of work and functional analysis is 105 minutes each, in the field of economic and social Studies 60 minutes. The written part can be complemented in certain assessment areas by an oral examination, if this is crucial to passing the exam. It proves whether the candidate can demonstrate that she/he is in a position to plan a work task, choose the necessary mechanic and electric components, software, tools and devices, plan measures for maintenance or commissioning taking into account operational processes and whether she/he can demonstrate knowledge of general economic and social context.

The final examination is taken by examination boards of the competent authorities (chambers), consisting of at least three members (representatives of employers, employees and part-time vocational schools). The members must be knowledgeable about the examination areas and suitable to participate in the examination system (cf. Bundesministerium für Bildung und Forschung 2012, p. 31).

The fact that examination methods and tasks are as close as possible to the real working and business processes is an indicator that examinations are largely competence oriented. However, little research has been done on the implementation of this approach. Currently, there are several initiatives to further develop competence based assessment and its implementation in examination procedures (cf. Lorig et al. 2012).

4. Conclusion

In Germany, the learning outcomes approach is closely connected to the concept of the professional ability to act. Its implementation (regarding the reorganization of trainings

regulations and curricula, competence oriented assessment) is still an ongoing process. There are several initiatives to further develop this approach and its implementation in regulatory instruments and assessment procedures, including qualifications in the field of mechatronics. One result of these initiatives is the recently published recommendation of the Board of the Federal Institute for Vocational Education and Training (BIBB). This recommendation states that training regulations, beginning with the application process in 2015, should be described in a competence-oriented manner and according to typical work and business processes in fields of action⁴.

References

Bundesministerium für Bildung und Forschung (Ed.): 10 Leitlinien zur Modernisierung der beruflichen Bildung – Ergebnisse des Innovationskreis Berufliche Bildung 2007. Bonn 2007. Internet: www.bmbf.de/pub/IKBB-Broschuere-10_Leitlinien.pdf (accessed 28.08.2014)

Bundesministerium für Bildung und Forschung: German EQF Referencing Report. Bonn, 2012: Internet: www.nok.si/cms/files/nok/userfiles/Dokumenti%20EOK/German%20referencing%20report.pdf (accessed 28.08.2014)

Lorig et al.: Kompetenzbasierte Prüfungen im dualen System – Bestandsaufnahme und Gestaltungsperspektiven. Bonn 2012. Internet: www.bibb.de/de/wlk54485.htm (accessed 28.08.2014)

⁴ www.bibb.de/de/11703.php