Country Report

Austria

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1. Introduction

The aim of the current report is to provide a short description of the sector of mechatronics in Austria, including an overview of related qualifications. Another aim is to describe the application of learning outcomes approach in different education sectors as well as assessment procedures focusing on the field of mechatronics.

This report, together with the reports from the other partner countries (France, Germany, Poland and United Kingdom) will provide the basis for the development of a common analysis tool (formerly taxonomy table) including countries' definitions/concepts related to competence understanding, conception of learning outcomes approaches as well as conception and implementation of assessment.

The Mechatronics sector in Austria

According to the classification of economic branches of the Austrian Public Employment Service (AMS), mechatronics is a subfield of electromechanics and electrical machines in electrical engineering, electronics and telecommunications. It covers a broad range of occupations dealing with manufacturing, assembly, repair and servicing in mechatronic systems in the mechanical engineering, plant construction and equipment manufacturing industries.

In Austria, there are several qualifications in the field of mechatronics acquired in different VET pathways. For example, graduates of apprenticeship training who successfully complete the apprenticeship-leave exam, acquire a 'Certificate of Apprenticeship Mechatronics' (ISCED 3b)[1]. The duration of the training is three and a half years. Current data, provided by the Austrian Economic Chambers (WKÖ), shows that in the period between 2004 and 2013 the total number of apprentices in mechatronics increased from 826 to 1,929. Since 2004 the number of women has more than quadrupled, from 32 apprentices in 2004 to 156 apprentices in 2013. Nevertheless, mechatronics is still a male-dominated occupation – this is reflected in the over-representation of male apprentices (table 6).

[1] zeugnisinfo.at.penguin-cloud.at/file_upload/9_tmpphpefLFkz.pdf

	male	female	sum
2004	794	32	826
2005	916	43	959
2006	1027	53	1080
2007	1143	74	1217
2008	1343	93	1436
2009	1463	114	1577
2010	1514	136	1650
2011	1643	147	1790
2012	175	152	1877
2013	1773	156	1929

Table 1: Number of apprentices from 2004 to 2013 (source: Austrian Economic Chambers - WKÖ2)

In addition, the Austrian Economic Chambers provided current data on the apprenticeship-leave exam (table 7).

	No. of applicants		Successful exams	Unsuccessful exams
	Total	Repeaters	Total	Total
mechatronics	693	60	574	119
male	604	51	504	100
female	89	9	70	19

Table 2: Apprenticeship-leave exam in mechatronics in Austria, 2013 (source: Austrian Economic Chambers - WKÖ)

Graduates of specialised VET colleges who successfully complete the final exam (Reife- and Diplomprüfung) acquire a qualification in a specific area of mechatronics such as automation[3] or precision engineering[4] (ISCED 4A). This qualification is a double one as it entitles to practice of a profession and gives an access to higher education. The duration of the study comprises five years.

In relation to continuous vocational education, for people in employment for example, there are foreperson courses in mechatronics. The successful completion of the course including a final exam leads to the acquisition of a certificate 'Abschlussprüfungszeugnis der

[2] WKÖ, Lehrlingszahlen, www.bic.at/berufsinformation.php?beruf=mechatronik-lehrberuf&brfid=88
[3] zeugnisinfo.at.penguin-cloud.at/file_upload/9_datak0003wwwsrv4vhost1phptmpphpsBvkZp.pdf
[4] zeugnisinfo.at.penguin-cloud.at/file_upload/9_datak0003wwwsrv4vhost1phptmpphpoIEKIs.pdf

Werkmeisterschule für Berufstätige für Mechatronik' (ISCED 5A)[5]. The duration of the course is up to four semesters.

Due to reasons of comparability related to qualifications available in the other partner countries (i.e. Germany, Poland and United Kingdom), the country report will focus on the apprenticeship training in mechatronics.

2. The learning outcomes approach

In the Austrian education and training system, the implementation of the learning outcomes approach has been going on for some years and is still not fully implemented. There are several initiatives to strengthen and further develop this approach, many of which closely relate to the development of the National Qualifications Framework (NQF).

School-based VET

In 2004, the Federal Ministry of Education and Women's Affairs (bmbf, formerly known as Ministry of Education, Arts and Culture/bmukk) introduced educational standards in the VET school sector in order to ensure the comparability and quality of training. These standards form a part of the so-called framework curricula, which define the objectives and content of education and training at VET colleges and are regulated by the Ministry of Education. The standards are formulated in terms of learning outcomes; however they do not follow the knowledge/skills/competence model (KSC). They focus on holistic qualifications integrating the following core competences, i.e. a) general-education core competences; b) occupation-related core competences and c) social and personal core competences (cf. BMUKK/BMWF 2011, p. 107).

Since 2007, VET standards have been undergoing comprehensive testing in so-called pilot phases. In June 2010, the Ministry of Education published a "Guide for the design of competence-based and learning outcome-oriented curricula for VET colleges and secondary training colleges" (cf. BMUKK 2010). As a result, some new curricula were developed including also curriculum of VET colleges for Mechatronics. Compared to the old curriculum[6] in the new one occupation-related learning outcomes are clearly specified and social and personal competences are integrated. However, descriptions of learning outcomes do not relate to assessment standards[7].

[5] Abschlussprüfungszeugnis der Werkmeisterschule für Berufstätige für Mechatronik. Internet: zeugnisinfo.at.penguin-cloud.at/file_upload/9_datak0003wwwsrv4vhost1phptmpphp8FR2IK.pdf (accessed 25.04.2014).

[6] BGBl. I Nr. 382/1998. Lehrplan der Höheren Lehranstalt der Mechatronik. Internet: www.htl.at/fileadmin/content/Lehrplan/HTL/HL_MECHATRONIK_Anlage_1.1.6_BGBl._382-98.pdf (accessed 25.04.2014).

[7] Lehrplan der Höheren Lehranstalt der Mechatronik (2012). Internet: www.htl.at/fileadmin/content/Lehrplan/HTL_SV_2011_2012_2013/SV_Lehrplan_HL_Mechatronik_modul_2012.pdf (accessed 25.04.2014).

Apprenticeship training

In general, apprenticeship training in Austria, known also as dual system, consists of a company-based training (which comprises 4/5 of the entire training duration) and a part-time instruction (1/5 of the training) at a vocational school. Company-based training is particularly practice-oriented, i.e. it provides apprentices with job-specific skills and competences. It is within the sphere of competence of the Federal Ministry of Science, Research and Economy (bmwfw), formerly known as the Ministry of Economy, Family and /bmwfj), which elaborates the Vocational Training Act (BAG) and adopts the training regulations for the individual apprenticeship occupations. Of note is that social partners are in charge of decisions about the content of training regulations.[8]

The training regulation consists of an occupational competence profile ("Berufsprofil") with related activities and work descriptions, and a job profile ("Berufsbild") with knowledge and skills to be acquired by apprentices. "Berufsprofil" and "Berufsbild" are both formulated in a largely learning outcomes-oriented manner (table 8).

- ability to read and apply technical documents
- specification of steps, work equipment and working methods
- planning and control of workflows; assessment of final results/the results of work; application of quality management systems
- manufacture, processing and treatment of mechatronic parts; assembly and adjustment of mechatronic subassemblies and components
- assembly, fitting and installation of mechanical, electrical and electronic elements, subassemblies and components
- measurement and testing of parameters related to mechanical engineering as well as of electric variables
- fitting, installation and testing of mechatronic hardware and software components
- establishment and testing of electrical, pneumatic and hydraulic controls
- programming and testing of mechatronic systems
- assembly, fitting, examination, and testing of machinery, plants and installations
- installation, fitting, testing, adjustment, operation and commissioning of enterprisespecific systems in equipment, machinery, and installations
- maintenance and servicing of mechatronic systems
- localisation, diagnosis and clearing of faults, defects and failures of mechatronic systems
- establishment, examination and documentation of protective measures to prevent damage to persons and damage to property

[8] In comparison, the role of social partners in the design of framework curricula for VET colleges is more limited. In so-called curriculum committees, teachers, experts from the Ministry of Education and the economy develop draft curricula for the respective subjects. The social partners receive the drafts and issue statements on them.

- performance of the work taking into consideration relevant safety regulations, standards and relevant environmental standards
- collection and documentation of technical data on workflow and work results
- advisory services for customers on the use, application and servicing of mechatronic systems
- appropriate written and oral command of language and mode of expression as well as use of job-related foreign language

Table 3: Occupational competence profile in mechatronics (source: ibw: Lehrberufsbeschreibungen Deutsch-Englisch. December 2013)

By way of contrast, the school-based element of apprenticeship training focuses on the provision of basic theoretical knowledge and general education. The Ministry of Education is responsible for this part of the training (i.e. elaboration of draft legislation and framework curricula). Up until now curricula of VET schools for apprentices have been predominantly in-put oriented. However, curricula are in the process of being revised, which is an initiative that started in 2011.

The Amendment to the Vocational Training Act (BAG) in 2006 created the possibility for modularising apprenticeships. Since 2010, several apprenticeship occupations (mechatronics is not among them) have been modularised. Modularisation refers to a modular structure of apprenticeship training with several combination and specialisation options. It comprises three "modules": The basic module as a rule lasts for two years and includes the knowledge and skills, which correspond to the basic activities of one or several apprenticeships in a specific occupational area. A main module lasts for at least one year. It comprises the knowledge and skills, which exceed the fundamentals and make up the typical qualifications of an apprenticeship or several apprenticeships in a specific occupational area. There can be several main modules that build on a basic module. And a special module lasts for half a year or a full year and aims to provide additional knowledge and skills that correspond to specific modes of production and services. (cf. Tritscher-Archan 2012, p. 8).

Foreperson courses of mechatronics for employed persons

Curricula of foreperson courses are structured in a similar way as curricula of school-based VET.[9] The profile of skills and competences include technical skills and competences as well as personal and social ones.[10]

Technical skills and competences refer to:

- Planning and design of mechatronic systems

[9] The curricula is available in German at: www.bmukk.gv.at

[10] The translation of the technical and social and personal skills and competences is done by 3s. The original version is available in German at: zeugnisinfo.at.penguin-cloud.at/file_upload/9_datak0003wwwsrv4vhost1phptmpphp8FR2IK.pdf

- Selection of material as well as preparation for production
- Coordination of production and quality assurance
- Use of relevant software and CAD systems
- Knowledge of the relevant rules and procedures

Personal and social competences refer to:

- Accurate and systematic performance of tasks according to technical specifications, standards and legal requirements
- Completion of work orders both independently and in a team with other professionals
- Further training in areas relevant to mechatronics
- Communication with customers and suppliers, drafting of relevant documentation, understanding of technical descriptions and literature.

No further information has been identified regarding the implementation of the learning outcomes or competence orientation in relation to foreperson courses.

Higher education

In higher education the integration of learning outcomes has started together with the implementation of Bachelor-, Master-, and PhD- degree programmes and relates to modularisation of the curricula. According to the Austrian report regarding the Bologna Process implementation 2009-2012, learning outcomes are defined in national steering documents only in connection with the Dublin descriptors, and as prescribed in terms of knowledge, skills and competences in the individual curricula, established under university autonomy. Of note is that, the use of learning outcomes in curricula development and student assessment is a precondition for the accreditation of all study programmes at universities of applied sciences.[11]

3. Examination procedures

School-based VET

From the 2015/16 school year, the standardised, competence-oriented upper secondary school-leaving exam, the "Reife- und Diplomprüfung", will be introduced at VET colleges, and common quality standards will be established. This exam will apply to all candidates and be comprised of diploma projects (subject-specific piece of work including presentation and discussion) and standardised forms of written exams in German, modern foreign languages, and applied mathematics[12].

Apprenticeship training

[11] National Report regarding the Bologna Process implementation 2009-2012 Austria, pp. 1-2, section 4
[12] www.bmukk.gv.at

The apprenticeship-leave exam (LAP) in mechatronics consists of a practical and a theoretical part. The theoretical part of the exam precedes the practical and is in a written form. It consists of three components related to technology, organisation of work and functional analysis. The *technological component* includes test questions from several areas (i.e. mechatronic systems, basics in electrical engineering, testing and measuring techniques, etc.). The time for answering is 90 minutes. *Organisation of work* covers the preparation of a work plan for the installation and assembly of a mechatronic system following specific guidelines. The time given for this task is 150 minutes. The *functional analysis* comprises the description of procedures for preventive maintenance and for minimising errors in a mechatronic system. The time given is 150 minutes[13]. "The theory exam can be waived if the exam candidate can prove successful completion of the final grade of a part-time vocational school" (Tritscher-Archan 2012, p. 20).

The practical part includes a performance check ("Prüfarbeit") on practical know-how and job-related skills of the candidate. It is followed by an expert discussion ("Fachgespräch") between the candidate and a board of examiners (examination committee). The examination committee is made up of a chairperson, who has to be an authorised apprenticeship trainer and legally established stakeholders i.e. employers and employee representatives, who have to be professional experts in mechatronics. The *performance check* relates to the elaboration of a mechatronic sample according to guidelines, formulated in the form of a company contract. Specific tasks include construction, modification or maintenance of a mechatronic system, installation of a control programme, work planning and documentation of work steps. The candidate has 14 hours to complete the task. The *expert discussion* builds on the performance check and proves whether the candidate can demonstrate knowledge of technical terms, whether he/she can offer professional solutions to subject-related problems and establish procedures for their execution. The time given for the discussion is up to 30 minutes.

4. Conclusion

In Austria, vocational education and training includes diversity of pathways, which provides several possibilities for acquiring a qualification in the field of mechatronics. The implementation of the learning-outcomes approach (in relation to curricula design, setting of assessment standards) in VET as well as in the other education sectors is still work in progress and at different stages even within the same education sector. This is illustrated by the apprenticeship training. While the occupational competence profile and the job profile (specified in the training regulations by the Ministry of Economy) are largely formulated in learning-outcomes oriented manner, the curricula for the school-based element of training (regulated by the Ministry of Education) have been predominantly in-put oriented up until now. This poses a challenge for the implementation of the learning outcomes approach as learning contents are described in separate documents, and separate bodies are responsible

[13] BGBl. I Nr.374/2003. Verordnung des Bundesministers für Wirtschaft und Arbeit über die Berufsausbildung im Lehrberuf Mechatronik (Mechatronik-Ausbildungsordnung)

for these.

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