



Identification of sector-related qualifications according to common demands of being employed by enterprises of the European Aeronautic and Space Industry

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Executive Summary

- The AEROVET project piloted the elements of the ECVET technical specifications in the context of transnational mobility using the example of technical occupations in the aeronautics sector in France, Germany, Spain and the United Kingdom.
- Given the fact that the formal structures of the curricula and training regulations in the four countries are highly diverse, as is the concrete organisation of the training process, the common professional work tasks (PWT) were taken as the common ground, in terms of content, for the learning outcomes to be acquired at the other learning venues (hosting institutions).
- One result of the project is a workable, comprehensive description of the potential for learning in the sector in the shape of the learning units (LU) and sub-units derived from the professional work tasks according to the ECVET technical specifications. This product is available as a mobility certificate, which has been legitimated by the competent institutions involved, validated by the participation of educational experts from colleges and the industry, and tested during a piloting phase at Europe's largest aircraft manufacturer AIRBUS.
- In addition, a user-friendly guide was prepared, which explains the application of the instrument and which is not aeronautics-specific, i.e. it can also be used in other industrial sectors in which training objectives are described in terms of professional work tasks.
- The results of the piloting phase were rated so positively by the training departments at AIRBUS that the mobility certificates will continue to be used after the funding period of the project.
- The requirements of the European Aviation Safety Agency (EASA) with regard to work on flight hardware could be integrated into the learning units in such a way that the German Federal Aviation Authority (Luftfahrtbundesamt, LBA) expressed its interest to allow for a certification of the occupational profiles to be reorganised on the basis of the learning units (instead of a certification of training providers).
- With reference to the sector of technology-related occupations in aeronautics it was possible to identify the strengths and weaknesses of the single elements of the ECVET Recommendation. These findings can make a valuable contribution to the revision, due in 2014, of the ECVET Recommendation.

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1. Project Objectives

Like all projects funded within the priority programme “Projects for the piloting and development of the European Credit System for Vocational Education and Training” (EACEA/14/08), the AEROVET project is testing the various elements of the ECVET technical specifications in the context of transnational European mobility of VET students. The selected sector of technical occupations in aeronautics is particularly appropriate for such testing because of two aspects:

1. In the field of manufacturing the sector is dominated by one large transnational enterprise.
2. In the field of maintenance the European Aviation Safety Agency (EASA) has already enacted, at a Europe-wide scale, compulsory modules as standard requirements for the certification of skilled workers in aircraft maintenance.

The following milestones have been achieved:

- Establishing the professional work tasks identified in the previous AERONET project as the basis for the formulation of learning units, taking into account the ECVET technical specifications (see annexes 1-4).
- Investigation of the relation of the learning units to the relevant [national] qualifications in the participating countries (see annex 8/9).
- Formulation of the units which are part of a potential transnational “core occupation” and integration of the requirements formulated by the European Aviation Safety Agency (EASA) for the licence to work on flight hardware into these units (see annex 25/26).
- Formulation of sub-units:
Sub-units were formulated that are integral parts of the professional work task in question. The decision as to whether a learner has successfully completed a sub-unit is made by the tutor in charge on a qualitative performance-oriented scale on the basis of observations and interviews (see annexes 18-20).
- Testing and establishment of the procedures and instruments in the exchange of trainees between the AIRBUS locations (see annexes 28-31).
- Preparation of a user guide for the application of the instruments as well as a joint memorandum on the elements of the ECVET technical specifications (see annexes 43-50).
- Consideration of the project results in the process of reorganising the sector-related occupational profiles in Germany (see annexes 10-12).
- Dissemination of project results through conferences and publications (see annexes 32-42).

2. Project Approach

In terms of **methodology** the project approach consists of a close connection of the three interrelated aspects of the **development**, **validation** and **legitimization** the learning units and other materials by means of consultations and meetings. Each single step of developing and testing the instruments on the basis of the professional work tasks (explicit description of the knowledge, skills and competences, integration of the EASA modules, relation to national occupations, reference to NQFs and the EQF, exemplary allocation of credit points to the units, testing, evaluation) takes place in an **iterative process** involving a close consultation of the partners with national experts.

In terms of **content** the approach emerged from a preliminary analysis of the national curricula in France, Germany, Spain and the United Kingdom; these curricula cannot be used as the basis for common learning units. For instance, Spain does not have a specific occupational profile in aircraft manufacturing. The work is carried out by workers from related occupations (e.g. car mechatronic) who have been familiarised with the manufacturing tasks through on-the-job training. As regards the area of maintenance, Spain is training only higher-level technicians (EQF level 5). In Germany, on the other hand, skilled workers for the sector are trained, inter alia, in two recognised occupations with a training period of 3.5 years each. The occupational profile of electronics technician for aviation systems belongs to the group of electrical engineering occupations, and the profile of aircraft mechanic, being a self-contained occupation, is divided into the three specialisations of maintenance, manufacturing and engines. Not surprisingly the professional work tasks, i.e. the competence areas of skilled workers, are quite similar in spite of the different qualification approaches. No matter whether a flap is fitted at Airbus Bremen (DE) or Airbus Broughton (UK), or whether the check and, if necessary, repair of an onboard communication system takes place at a French or a Spanish airport, the contents and processes, manuals and documentations are identical or at least of the same kind. Accordingly it was possible in the course of **expert worker workshops** and **work process analyses** to formulate a total of 22 learning units that cover the main professional work tasks of electronics technicians as well as mechanics in the sector and which can – potentially – be learned in a mobility phase.

3. Project Outcomes & Results

The first milestone achieved was the definition and publication of all learning units:

1. Production of metallic components for aircraft or ground support equipment
2. Production of components of plastics or composite materials for aircraft or ground support equipment
3. Operating and monitoring of automated systems in the aircraft production
4. Joining and dissolving of structure components and aircraft airframes
5. Assembly and disassembly of equipment and systems in/at the aircraft airframe
6. Functional checks and tuning at the aircraft
7. Maintenance and inspection of the aircraft
8. Analysis and reconditioning of malfunctions at system components
9. Analysis and reconditioning of damage on structure components
10. Reconditioning of accessory equipment
11. Independent quality inspections
12. Production of bunched circuits for aircraft systems
13. Production or modification of electric devices
14. Passing bunched circuits in aircraft systems
15. Assembly and disassembly of subsystems and devices at aircraft systems
16. Modification of aircraft systems
17. Functional checks and system audit of supply units and control systems
18. Functional checks and system audit of information and communication systems
19. Analysis and repair of malfunctions at bunched circuits in aircraft systems
20. Analysis and repair of malfunctions at supply units and control systems
21. Analysis and repair of malfunctions at information and communication systems
22. Maintenance and inspection of aircraft systems

Fig. 1: The 22 learning units (for detailed descriptions see annexes 1-4)

The high degree of overlap between the essential professional work tasks from the four participating countries (Germany, Spain, France, United Kingdom) in the aeronautics and space industry is **not** reflected in the training contents (see annexes 8 and 9). Apart from the systemic differences in vocational education and training (dual v. school-based and professionalism v. fragmentation) the training programmes in the sector are also characterised by a different organisation of the educational content (e.g. France applies a horizontal diversification: following the 2-year CAP qualification there is the option to add one more year (formerly two more years) to complete the Bac Pro. Spain, on the other hand, does not have a qualification at the skilled workers' level; specific skills in manufacturing are 'only' trained on the job while in maintenance the qualification starts straight away at the level of technicians).

The second milestone achieved was the referencing to the existing national qualifications in the sector (see annexes 8 and 9).

| Summary | | | | |
|---|--|---------------------------|--|--|
| Name of qualification | LU covered completely or to a large extent | NQF/EQF level | Approximate coverage of curricula by the LU in % | Duration |
| Germany | | | | |
| Fluggerätmechaniker FR Fertigung & Instandhaltung | 1-11 | NQF: 4 EQF: possibly 4 | 80 % | standard: 42 months, optional: 36 months |
| Elektroniker für luftfahrt-technische Systeme | 11-22 | NQF: 4 EQF: possibly 4 | 80 % | standard: 42 months, optional: 36 months |
| France | | | | |
| (Bac Pro Mécanicien Système cellules) | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 | NQF: 4 EQF: 4 | 80 % | 3 years, including 22 weeks in the workplace |
| (Bac Pro Technicien Aérostructure) | 1, 2, 3, 4, 5, 6, 7, 9, 10, 11 | NQF: 4 EQF: 4 | 80 % | 3 years, including 22 weeks in the workplace |
| (Bac Pro Mécanicien Système Avionique) | 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 | NQF: 4 EQF: 4 | 80 % | 3 years, including 22 weeks in the workplace |
| (CAP Electricien Système d'aéronefs) | 12, 13, 14, 19 | NQF: 5 EQF: 3 | 80 % | 2 years |
| CAP mécanicien cellules d'aéronefs | 1, 2, 3, 4 | NQF: 5 EQF: 3 | 80 % | 2 years |
| United Kingdom | | | | |
| Aeronautical engineering level 3; aircraft manufacture mechanical pathway | 1 2 4 | NQF 3 EQF 3 | 30% | 24 – 36 months within a 48-month programme |
| Aeronautical engineering level 3; aircraft manufacture electrical pathway | 12 13 14 | NQF 3 EQF 3 | 30% | 24 – 36 months within a 48-month programme |
| Aeronautical engineering level 3; aircraft maintenance pathway | 3 5 6 7 8 9 10 15 16 17 18 19 20 21 22 | NQF 3 EQF 3 | 75% | 24 – 36 months within a 48-month programme |
| Spain | | | | |
| Higher-level technician for maintenance in the area of aircraft machinery | 6, 7, 8, 9 10, 11, 17, 19, | NQF 3 EQF 5 | 30% | Minimum: 2000 h |
| Higher-level technician for maintenance in the area of avionics | 10, 11, 16, 17, 18, 19, 20, 21, 22 | NQF 3 EQF 5 | 30% | Minimum: 2000 h |

Fig. 2: Overview: Results of work package 3 (see annexes 8 and 9)

This agreement concerning the core of professionalism in the respective areas was a necessary prerequisite for the second phase, in which the differentiation into sub-units took place, as did the investigation of the compatibility with the modularised approaches of tertiary education and of the EASA (European Aviation Safety Agency). The third milestone consisted of a concrete mobility certificate taking into account the ECVET technical specifications, and a memorandum of understanding concerning the modalities of recognition. Due to the complexity of the learning units in relation to the short duration of the mobility periods it has to be expected that an entire learning unit can be completed in a single mobility phase only in exceptional cases. In order to make it possible that the learning outcomes can be certified, recognised and accu-

mulated in spite of this, so-called mobility units were developed, which are an integral part of the learning units and constitute coherent sets of knowledge, skills and competences. A four-level qualitative performance-oriented scale was developed and approved for the assessment of the learning outcomes acquired. The German National Agency at the BIBB adopted this assessment approach in 2009 for their priority programme “Leonardo da Vinci – Mobility”.

| Lerneinheit 4: Fügen und Lösen von Strukturbauteilen und Luftfahrzeugzellen | | | | | | | |
|--|------------|-------------------------------|---------------------------|--------------------------|---------|-------|--------------|
| Bemerkungen | | | | | | | |
| Mobilitätseinheit | Bewertung | | | | Lernort | Datum | Unterschrift |
| | Beobachtet | Unter Anleitung mitgearbeitet | Unter Aufsicht gearbeitet | Selbstständig gearbeitet | | | |
| Einzelteile zur Montage vorbereiten | | | | | | | |
| Bohrer nach Material auswählen und mit entsprechender Drehzahl bohren | | | | | | | |
| Einzelteile und Baugruppen durch Nieten, Schrauben, Kleben verbinden und sichern | | | | | | | |

Fig. 3a) Sheet of an apprentice' mobility pass (DE), (see attachment 13-20)

| Unité 4 Joiner et déposer des éléments de la structure et de la cellule de l'aéronef | | | | | | | |
|---|-------------------|---------------------------------|----------------------------------|------------------------------------|-----------|------|------------------------|
| Remarques : | | | | | | | |
| L'unité de mobilité | Evaluation | | | | Lieu | Date | Signature |
| | A été co-réalisée | A été réalisée sous instruction | A été réalisée sous surveillance | A été réalisée de manière autonome | | | |
| Préparer les pièces détachées pour le montage | | | X | | 611-11211 | | D. GAYRAUD TO 14433 |
| Choisir les mèches selon les matériaux et percer avec la vitesse de rotation adaptée | | | | | | | |
| Assembler et sécuriser les pièces détachées et les modules par rivetage, vissage et collage | | X | | | 611-11211 | | D. GAYRAUD TO 14433 |

Fig. 3b) Sheet filled in by the French colleagues (FR) (see attachment 28-31)

This iterative approach to including the ECVET technical specifications made sure that the outcome was not an artefact unfit for practice. In the third and final phase, the testing and optimisation of the instruments, the consortium benefited from the fact that there is already an established practice at AIRBUS concerning the transnational exchange of apprentices so that there was no need to set it up from scratch in the course of the project. The experiences of the practical phase were again discussed in consultations with all partners and sectoral experts, and in the end we achieved not only a final version of the materials, but also a joint recommendation of all actors involved. According to practitioners the added value of the selected approach consists in the fact that the apprentices as well as the trainers and tutors at the home and hosting institutions can agree on the units to be covered by the mobility phase *before* the beginning of the phase in question. (Even though in practice there is no even distribution of the 22 units, the freedom of choice is of crucial importance for the application in the company.) *During* the mobility phase it is especially the easy handling which is an advantage; there was hardly any response we heard more often than “please no more paperwork”. *After* the mobility phase the completed matrices document which mobility units a learner worked on (due to operational conditions the learning agreement cannot always be strictly fulfilled) and how well he or she performed, i.e. which knowledge and skills may now be presupposed by the teachers at the home institution (see annexes 28-31).

Another important result is the successful demonstration that the core learning units 5, 6, 7, 9, 11, 15, 16, 22 as well as an additional unit of engine maintenance incorporate the requirements of the European Aviation Safety Agency (EASA) for the licence to work on flight hardware (see annexes 26 and 27).

This evidence convinced the social partners in Germany to use the AEROVET learning units as the basis (in terms of structure and content) for their position concerning the reorganisation of the occupational profiles in the aeronautics sector:

“Common qualifications defining the occupational profile

1. Joining and dissolving of structure components and aircraft airframes
2. Functional checks and tuning at the aircraft
3. Maintenance and inspection of the aircraft
4. Analysis and reconditioning of damage on structure components
5. Analysis and reconditioning of malfunctions at the engine
6. Independent quality inspections
7. Assembly and disassembly of subsystems and devices at aircraft systems
8. Modification of aircraft systems
9. Maintenance and inspection of aircraft systems
10. Quality inspections
11. Human Factors
12. Air law

These qualifications include all requirements for the awarding of the institutional release rights following EASA-regulation part 66 CAT A.“

Source: Position paper by the Kuratorium der deutschen Wirtschaft für Berufsbildung (26.04.12, see annex 12, own translation)

The project results concerning the various elements of the ECVET technical specifications are ambivalent. While the transparent description of units in terms of learning outcomes and the possibility to have learning achievements from mobility phases recognised for the national VET qualification are seen as major assets of the ECVET specifications, the allocation of credit points according to the relative weight of a unit is a challenge not to be underestimated. This is especially true in the context of systems dominated by small and medium-sized enterprises. The partners' view is that from a systemic perspective credit points entail the risk that in dual systems especially SMEs or highly specialised enterprises do not have the training capacity to respond to the paradigm shift from minima to rigid benchmarks. Consequently a ***decline in these companies' willingness to train*** has to be expected.

Concerning the type of assessment the AEROVET partners also believe that a revision of the ECVET Recommendation is necessary. For instance, the German social partners make the following comment with regard to “mobility”:

The descriptions of competence areas and the related competences in the curricula aim to contribute to the transparency of training contents, thereby paving the way for undergoing parts of the training programme in other European countries and earning credits for the related training contents.

Source: Memorandum of understanding of the German social partners, see annex 10/11

At the same time the (holistic) assessment approaches in Germany, however, are explicitly affirmed, i.e. the separate assessment of units is rejected:

The assessment takes place in the form of an extended final examination. The examination consists of two parts. It remains to be clarified whether and to what extent it is possible to organise already Part 1 with a view to the assessment of professional action competence.

Source: Memorandum of understanding of the German social partners, see annex 10/11

Besides these concrete reservations, which are limited in their national as well as sectoral scope, the AEROVET partners also face more far-reaching issues. Doesn't a policy approach based on the accumulation of certified units misconceive the power

relations between learners and training providers, be they public or private, and thus entail the inherent risk of a fragmentation of existing occupational profiles? Doesn't this approach promote the emergence of an (expensive) assessment and certification landscape with detrimental effects on vocational education and training (due to, for example, teaching to the test)? At this point all the AEROVET partners can do is express their hope that these questions and findings may be taken into account in the possible revision of the ECVET Recommendation in 2014.

4. Partnerships

The network of manufacturing enterprises, VET schools and research institutions which was established in the preceding AERONET project was extended in the current project by important actors. Especially partners with institutional legitimacy (e.g. BIBB (DE) and QCDA (UK)), schools of further education (e.g. CESDA (ES)), training providers in the maintenance sector (e.g. Lufthansa, Atlas Air Service, Lycée Professionnel Saint-Exupéry at Blagnac (FR)), Eurocopter and the sectoral employer association (BDLI (DE)) contributed to the AEROVET project through suggestions and validation.

Contacts beyond the sector were established especially by means of the meetings of all ECVET pilot projects, which were organised by GHK. One can especially highlight the close coordination in terms of content and organisation with the CREDCHEM and SME Master+ projects. This cooperation led to concrete outcomes such as the joint organisation of a conference (see annexes 36 and 51) and the joint preparation of a scientific discussion paper (see annex 40/41).

5. Plans for the Future

The cooperation of the partners that was established or, respectively, intensified by the project in this high technology sector will continue after the end of the project period. It will be activated by further initiatives concerning the modernisation of occupational profiles (especially with regard to permeability).

The project results will be included in curriculum development activities of the institutionally legitimating partners and, as far as possible, transferred to other related sectors. The 'impact' of AEROVET is of crucial importance because it is transferable in an extensive way (to other sectors and subsystems). One impact is constituted by the analysis and definition of professional work tasks, the other by the demonstration of professional competence development. The concept of professional work tasks allows for a relatively precise targeting. Potential users are the actors who are concerned with the reorganisation of vocational curricula. This is a relatively small target group, which however has a considerable multiplier effect. A decisive factor for the further development of the professional work tasks approach is the outcome of the current reorganisation procedures for the aeronautics occupations and the occupation of process mechanic. Given that the BIBB (and at a superior level the Ministry of Education and Research as well as the Ministry of Economics) is involved here as a crucial actor, our hope is that there will be a positive effect on forthcoming curriculum development procedures. The social partners are supported and advised to the fullest possible extent by the AEROVET partners. For instance, the proposal by the BDLI for a position paper in the context of the reorganisation of aeronautics occupations in Germany not only advocates that the recommendations of the commission with regard to the NQF and ECVET be taken into consideration, but also recommends an explicit orientation towards the European core occupation (in terms of professional work tasks).

Concerning the impact in terms of competence demonstration: the methodological focus is on integrating the application of things learned, making visible the mastery of requirements that cannot be taught in principle and therefore can only be learned informally. In the case of ECVET this method helps to make informal experience visible as a factor that supports competence development. In addition we think that there is also a potential in this method with a view to application to ECTS. The combination of learning something and applying it by participating in work is a new one as far as academic forms of learning are concerned. As regards permeability we still take the question to be open as to whether the academic track in vocational education is capable of solving the problem of aligning the learning outcomes with the demands of professional work. The competence demonstration à la AEROVET would make the requirement dimension in professional tasks testable when professionally experienced learners with their informally acquired competences are to be compared with graduates who have undergone a primarily academic learning pathway at a single learning venue.

The further utilisation of the project results in the mobility measures will take place within Airbus. "It would be desirable for the future to use these sheets for all step 3 missions in order to improve the coordination of training measures at home and abroad and to track these measures. The participants find the application of these sheets very useful for making visible the competences acquired abroad." (Statement,

training coordinator at Airbus). These measures will be further supported and scientifically monitored by the AEROVET partners.

Support was given by advising the Portuguese colleagues from INOVA+ (<http://www.inovamais.pt/>) in the preparation of a project application on “sector skills alliances” (http://ec.europa.eu/education/calls/s0112/agenda_en.pdf).

The partners will continue to be involved in the development and testing of ECVET in the future. For instance, P(1) ITB and P(2) BIBB are experts within the German ECVET network, P(2) BIBB is also participating in the Federal ECVET Board, P(3) Céreq is represented in the board of advisors of one of the 2nd wave projects (MEN-ECVET) and P(5) University of Warwick is a member of the UK ReferNet group, which reports trends and developments in vocational education and training, including ECVET, to Cedefop.

6. Contribution to EU policies

Support for mobility in training by applying ECVET

One of the key priorities of the European Union is to enable and to promote mobility of EU citizens for training or work. There are several EU programmes to support mobility, but the organisation of mobility phases abroad – especially in countries whose VET systems feature a strong involvement of enterprises in the organisation of training – is associated with a number of obstacles and challenges. Training providers **and** learners need to be convinced that there is an added value to these mobility schemes. The acquisition of intercultural competences may be valuable from a pedagogical and political perspective, but practitioners are also interested in the development of the learner's professional competence. The approach developed in the AEROVET project allows for a simple documentation and recognition of learning outcomes without a lot of bureaucracy, and accordingly it can be integrated optimally into the organisation of the learners' competence development in the various national VET systems.

Description of professional core competence areas at the European level

Despite the well-known principle of subsidiarity in the area of education the European economy is integrating, work processes and requirements are increasingly standardised, which is initiated by, for example, transnational enterprises (like Airbus in the case of technical occupations in aeronautics), as they strive for a more effective use of resources or to comply with Europe-wide certification requirements (like those required for the sector by the European Aviation Safety Agency (EASA)).

The description of learning units (competence areas) in the sector at the European level was a contribution made to this development. This contribution is also immediately relevant for practice as the reorganisation, in terms of content and structure, of the occupational profiles in Germany builds on these competence areas.

Mutual trust

One of the key terms of EU policy is 'mutual trust', and for good reason. Unfortunately this trust is still not put into practice very often. Even when it comes to the recognition of formal qualifications from other countries there is still a lot of reservation in the Member States. On the other hand, it is not possible to implement trust; it needs to grow. The qualitative performance-oriented description of the learning outcomes in the AEROVET project allows for an honest and sound feedback, which lays the foundations for the development of real trust.

Development of ECVET

Some of the core elements of the ECVET Recommendation were met with strong approval in the AEROVET project: a (moderate) learning outcomes approach, taking into account especially the coherence of knowledge, skills and competences, the formulation of learning outcomes independent of the learning venue, the support for

mobility and the documentation of the learning outcomes from the mobility phases were considered a true added value of the project.

One of the dimensions that describe the structure of national VET systems is the degree of standardisation. One extreme is a nationwide standardised curriculum of learning units with fixed volumes that each training provider has to comply with, similar to the general school system. The other extreme is a modular system in which every training provider is offering only the learning units that are relevant for “their” region or enterprises. According to the AEROVET partners’ view neither of these extremes is the optimum. Instead, the best approach consists, to quote the German social partners in this sector, in the “internal flexibility of the training occupations instead of fragmented modularisation”. This approach combines the principle of vocationalism (each training provider is required to teach all learning units) with the opportunity to define regional or company-specific priorities. For instance, the relative weight of a learning unit may vary between 5% and 10% of the entire qualification. This approach is incompatible with the allocation of a fixed number of points to the units, which is why the AEROVET partners think that a revision of the ECVET Recommendation with a view to a flexible weighting of learning units should be considered.

A point of concern that was often expressed by the expert practitioners is that the implementation of ECVET might require considerable effort and resources. Accordingly a “lean” implementation should be envisaged.

A controversial issue was also the degree of recognition: apart from the legal conditions, which make a formal recognition of fundamental learning outcomes from the mobility phases impossible in countries with a holistic tradition of assessment, the AEROVET partners are also aware of the question as to whether such a recognition is desirable at all from a pedagogical point of view, given especially the experience of the Bologna process. Is it comprehensive professional competence that is to be assessed, or a bundle of modules?