SKILLMAN

Sector Skills Alliance
for Advanced Manufacturing
in the Transport Sector

COMPOSITE MATERIALS

Curriculum & Teachers methodological guide

This book has been co-ordinated, drafted and produced by Centro Studi "Cultura Sviluppo" (CSCS - IT) and Teknisk Erhvervsskole Center (TEC - DK)

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Innovative curricula: Skillman - Sector Skill Alliance for Advanced Manufacturing in the Transport Sector and the European VET system

Tiziana Chiappelli

Skillman project - Sector Skill Alliance for Advanced Manufacturing in the Transport Sector has provided an effective answer to the constantly and rapidly evolving scenario of new technologies affecting the advanced manufacturing in the transport sector by not only establishing innovative joint European curricula addressing current competencies and skills requirements, but also establishing a structured approach in detecting and sharing information on emerging new needs via the Observatory on Advanced Manufacturing for the Transport Sector.

The design of the innovative curricula has been carried on thanks to the collaboration and the synergies of key players in the field of Advanced Manufacturing in the Transport Sector: VET providers, enterprises, research centres and certification bodies.

THE METHODOLOGY

The Joint European Curricula developed by Skillman project are based on learning outcomes in adherence with ECVET principles and methodology. ECVET is adopted in the delivery of the educational activities and within the transnational mobility initiatives to facilitate the transfer, recognition and accumulation of assessed learning outcomes of individuals.

Skillman Curricula have been developed through the **quality assurance and improvement** cycle of **Planning, Implement, Assess/evaluate and Review/Revise** supported by common quality criteria, indicative descriptors and indicators as requested by the EQAVET INDICATORS' TOOLKIT [http://www.eqavet.eu/Libraries/Working_Groups/EQAVET_Indicators_Toolkit_final.sflb.ashx].

At European level, these common principles are defined in the "Recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the "European Qualifications Framework for lifelong learning" , which are listed in Annex III [http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:111:0001:0007:EN:PDF].

For instance:

[…]

- quality assurance should include regular evaluation of institutions, their programmes or their quality assurance systems by external monitoring bodies or agencies
- external monitoring bodies or agencies carrying out quality assurance should be subject to regular review,
- quality assurance should include context, input, process and output dimensions, while giving emphasis to outputs and learning outcomes

- quality assurance systems should include the following elements: > clear and measurable objectives and standards, > guidelines for implementation, > including stakeholder involvement, > appropriate resources, > consistent evaluation methods, > associating self-assessment and external review, > feedback mechanisms and procedures for improvement, > widely accessible evaluation results
- quality assurance should be a cooperative process across education and training levels and systems, involving all relevant stakeholders, within Member States and across the Community
- quality assurance orientations at Community level may provide reference points for evaluations and peer learning

All the **Skillman project Curricula** have been **developed to implement** the indicators included in the **"Recommendation on the establishment of a European Quality Assurance Reference Framework for Vocational Education and Training"** of EQAVET [http://www.eqavet.eu/gns/home.aspx], accomplished through common principles for quality assurance.

Quality assurance and improvement cycle

THE PHASES OF THE CURRICULA ELABORATION

In order to design the Curricula, Skillman project has:

a. Conducted a background survey, collecting the main results in a "State of the art on Advanced Manufacturing in the Transport Sector"

b. Produced three Yearly Outlooks of the Observatory on Advanced Manufacturing for the Transport Sector, each of them focused on specific fields: Robotics, Composite Materials, Industry and Production 4.0 and Energy Performance

c. Detected and defined competencies and skills requirements in the selected professional area by the means of accessing and aggregating existing data and research findings on labour market, particularly the research results of the National and European "Skills councils and from EU Skills Panorama"

d. Defined the needs of and requirements for VET programmes, particularly referring to tertiary qualifications for youngsters and the short-cycle qualifications for workers

e. Designed a first draft of the Joint European curricula in line with the sector requirements in the field of Advance Manufacturing conceived on the basis of learning outcomes and units of learning, in compliance with ECVET and EQF

f. Implemented the Joint European Curricula in piloting activities, workshops, trainings a National and International level

g. Assessed and revised the Curricula on the basis of the feedbacks collected during the implementation phase, and produced the final version.

Project teams experts have conducted all the phases in strict collaboration, combining the point of view of the research centers, the companies, the VET providers and the certifying bodies. The delivery of educational programmes has been based upon the reference framework promoted by EQAVET, its procedures and 10 indicators for monitoring the quality and impact of VET programmes.

THE BENEFICIARIES OF SKILLMAN CURRICULA

The main target groups who will benefit from the Curricula are:

- Youngsters: the Skillman Curricula foster tertiary qualifications and higher apprenticeship schemes in the field of Advanced Manufacturing. One of the challenges determining significant unmatched job vacancies within European Advance Manufacturing sector, is, from one side, that youngsters (and their parents) are not well informed about the educational and job opportunities and, from the other side, difficulties on the part of National education systems to offer innovative and attractive training courses based on the latest technologies.

- Workers: many businesses are opting to retain their staff rather than employing youngsters and engaging in apprenticeship schemes and thus, in the short term, they are faced with the need of re-skilling and up-skilling workers. The Skillman Curricula offer short-cycle qualifications, adopting modular and blended learning approach, embedding ICT and Open Educational Resources, ensuring validation of non-formal and informal learning and its recognition

- VET system: the Skillman Curricula support the improvement of the quality of the European VET system, by embedding EQAVET and European transparency tools and measures in the delivery of educational programmes; specific educational resources are offered to VET providers with the aim of updating their technical competencies and fostering their staff's professional profile.

- Businesses: the Skillman Curricula support both large sized as well as small and medium sized companies and those in the supply chains active in the field of Advance Manufacturing for the Transport Sector. The qualifications and educational programmes developed are meant to support businesses in their recruitment and HR activities.

- Decision and policy makers: the Skillman Curricula are also aimed at widening and mainstreaming the qualifications and educational programmes and in this respect they can be a point of reference for public authorities interested in the improvement of the educational systems and labour market policies.

THE CONTENTS

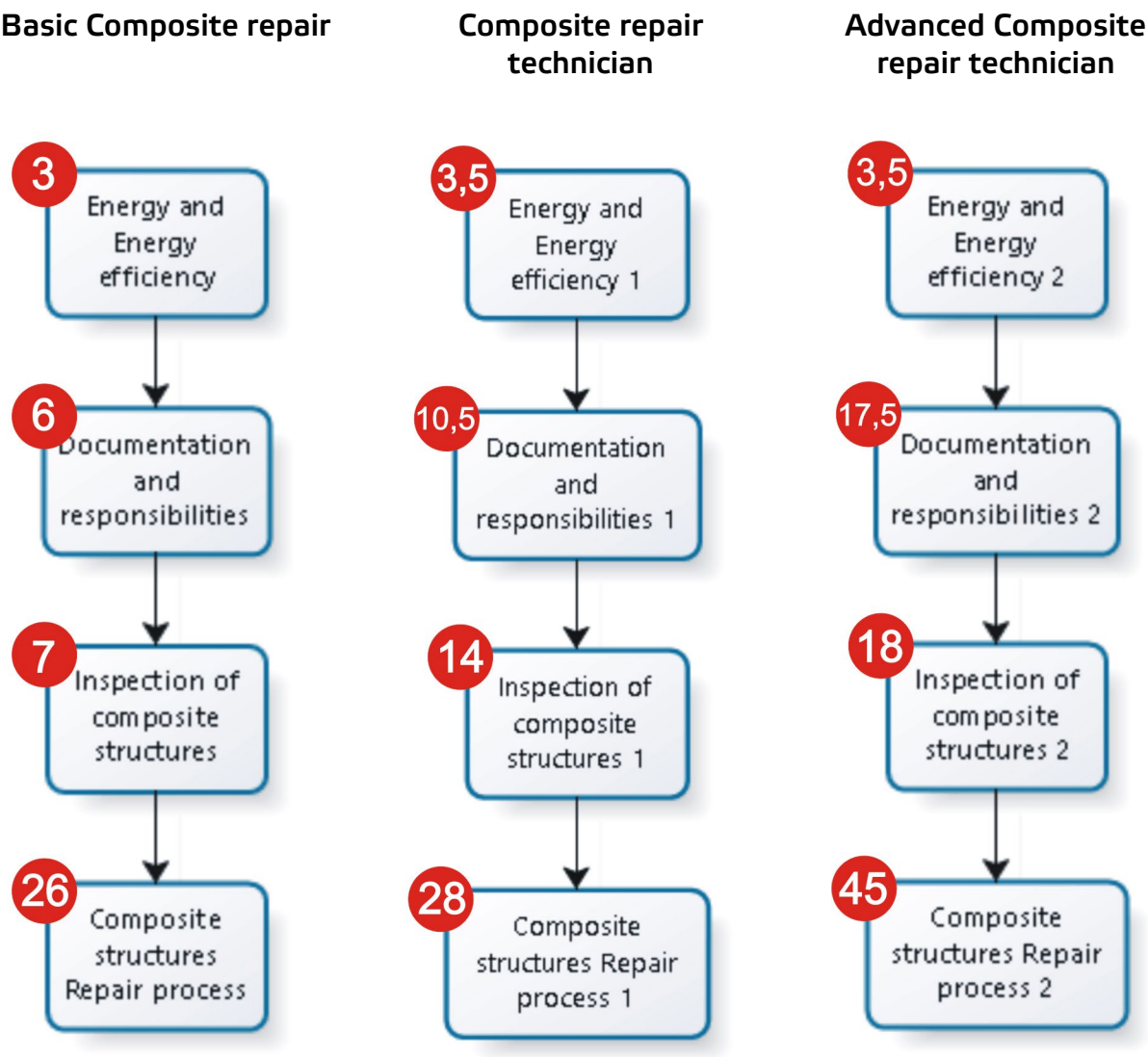
In the next sections you will find:

PART A: the **Methodological guide** for teachers with all the necessary definitions, information and explanations regarding the model applied and how to use Units of learning.

PART B: the **Units of Learning** focused on the competencies, knowledge and skills necessary to operate in the Advanced Manufacturing in the Transport Sector.

All the **Units of learning** are based upon the European Qualification Framework and they are referred to ESCO codes in order to ensure the maximum transparency and applicability in all European countries.

Here the map of the Units of learning of the three curricula on Composite materials repair with the duration in hours:



Part A
Teachers methodological guide

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21-12-2016

Part A
Teachers methodological guide

1. Introduction

Skillman, the challenges for VET in the EU and the need for cross-national recognition of competences between countries, educational systems and industries

A main purpose in the Skillman project is to take the first steps towards cross-industry training (i.e. advanced production for the transport sector) and national training suitable for recognition by other countries and educational systems in the EU.

The main problem areas that the Sector Skill Alliance aims to address are related to three challenges which are transferable and relevant for the automotive, aerospace and rail sectors of industry, namely the energy performance of production processes and end products, advanced production processes, robotics and advanced combined materials, and information technology wireless technologies and information and communications technology for safety and user purposes.

The working process for the Skillman project, which is lasting three years, ending in 2017, can be described in brief as a process where:

- Training needs, work tasks and future requirements are examined for the three industrial sectors.
- Where training curricula in aviation, car manufacturing and IT support is examined.
- Curricula are developed and common qualifications and competences outlined according to EU standards.

In the new curricula developed in the different industries, learning modules with cross-national and industrial relevance are selected, and syllabuses developed.

The new learning modules as a part of the new curricula are tested, evaluated and adjusted according to feedback from the participants, who may be unskilled workers, experienced workers, leaders or specialists according to the needs in the specific industry.

The new learning modules are supported by, and linked to, an Open Learning Resource.

The purpose of this teacher's methodological guide is to offer a framework for understanding, developing, conducting and evaluating competence-based training across industries and countries according to EU standards. The EU vocabulary, like 'lifelong learning, EQF, NQF, permeability, utilization, stakeholders' interests in education and accreditation', is briefly outlined.

2. The EU's educational vocabulary and context

In the following, the reader will find a brief introduction to the vocabulary the EU uses as the framework within the Skillman project. The purpose is to give trainers, teacher's leaders and other relevant stakeholders with limited knowledge of European educational policy an understanding of how industrial and educational problems are addressed in an EU context.

Lifelong learning

The EU has adopted the so-called Lisbon strategy, which states that in 2010 'Europe must be the most competitive and dynamic knowledge-based economy in the world – with more and better jobs and greater social cohesion'.

The main tool for achieving this goal is to ensure lifelong learning in all its aspects. This means that citizens and employees must constantly be able to continue learning. Seen from the point of view of VET (Vocational Education and Training), it is important that skilled workers can continue their education later on in their working lives and, for example, can attend the junior program or University (HE or higher education).

For unskilled workers, it is important that they can continue learning and become skilled workers later in life. This requires that their skills can be recognized, both informal skills acquired in their work and the retraining they have participated in, so that they have an opportunity to pass an examination and to become a skilled worker.

EQF/NQF (European Qualification Framework and National Qualification Framework)

The EQF for lifelong learning is a common European reference framework which enables European countries to compare and their different qualification systems and link them to one another. The history of the EQF has been one of rapid development. Thirteen years ago, only three countries had this system, namely Ireland, France and the UK – now over 140 countries are currently developing NQFs.

The main aim is to help learners and workers who wish to move between EU countries, change jobs or switch between educational institutions. It also helps to promote the lifelong learning philosophy by opening up pathways for the EU's citizens, and more generally to make the education and training system more transparent and to promote access, transfer and progression into, within and between programmes of learning and lifelong learning.

The EQF works to provide the best possible levels of opportunity by helping promote the mobility of learners and employees between countries. The EQF can only work if NQFs are in place nationally. Apart from purposes of mobility (for a limited number of people), the objectives of NQFs are much broader and wider, namely to foster and enhance access to and participation in lifelong learning and use of qualifications for everyone, including those who are disadvantaged or affected by unemployment.

As a reference structure for qualifications, the NQF is in the first place a tool for classifying qualifications (described in terms of learning outcomes) transparently. To achieve its

various objectives, it needs to be combined with a number of change processes.

An NQF introduces a common language for learning outcomes, levels, types of qualifications (awards), credit transfers etc. This language is used for developing qualification standards (occupation, education, assessment) and needs to be applied and elaborated on the general level down to the individual qualification. It also provides conceptual tools for planning and coordinating learning to make the system more coherent and unified. The common language for learning outcomes supports permeability between VET and HE. The use of levels clarifies where potential overlaps exist between qualifications. Mapping qualifications against the same set of descriptors makes it apparent where two (or more) qualifications lead to comparable learning outcomes and what learners might need to achieve in addition.

Permeability

The adoption and implementation of comprehensive NQFs across Europe influences the relationship between (higher) education and training subsystems.

For both VET and HE outcomes-based qualifications are developed, even though differences exist in the benchmarks on which outcomes are formulated, namely occupational standards in VET qualifications and programs and curricula for HE qualifications. VET and HE qualifications focus on employability and the required knowledge, skills and competence, but in the case of HE they are understood in broader terms than just preparation for a specific profession or group of professions. Improving the links and bridges between levels and types of qualification, eliminating dead-ends and promoting vertical and horizontal progression is considered a key task of most of the new frameworks.

Unitization

In many NQFs, qualifications are structured in units of assessment, with programs being structured accordingly in modules of learning, which can be combined and accumulated in different ways and used for credit transfer and progression. Unitization is claimed to provide opportunities for learners or end-users to exercise choice and increase their power in the learning market. Transfers between VET and HE can be made possible by unitization or modularization, making it easier to identify overlaps and to exempt learners from a module and its assessment. Modules or units also enable the delivery of pathways once the learner has obtained recognition and been exempted from certain units or modules.

Stakeholder engagement and coordination

The process of developing and implementing an NQF, and the institutional arrangements for maintaining and supporting it, are contexts in which different stakeholders in education and training may come together to identify mutual interests and coordinate their activities. Stakeholders include a range of actors, such as ministries, education and VET agencies, providers, employment services, employers, trades unions and civil society. This, it is claimed, enables standards to be updated and made more relevant and the learning system to become more coherent and demand-driven. The involvement of the private sector and social partners is of critical importance for the relevant qualifications. NQFs can provide a platform for social dialogue.

Regulation

An NQF may be an instrument for regulating qualifications and thereby mandate reforms in education and training. Qualifications within a framework may have to meet the requirements for standards development (procedure, content and structure); delivery (provision of programs and rules for access, transfer and progression); and assessment and certification (including the recognition of non-formal/informal learning), all of which are aspects of quality assurance. The formal basis of the NQF thus varies according to the national context and the 'policy-making culture', as well as existing governance arrangements: it can consist of one (integrative) new law, creating new institutions, of a number of laws or of by-laws or orders making reference to the NQF and assigning new tasks to existing institutions. However, the legal basis alone is insufficient – reaching an agreement between key stakeholders on how to implement the framework after adoption is crucial. The most important criterion for deciding whether an NQF has reached the operational stage is whether there is an agreement on sharing responsibilities and roles between the different stakeholders.

A crucial issue to be addressed in implementing an NQF is to decide the roles and responsibilities involved in the management of the framework. An NQF needs national co-ordination, or in EU terminology national coordination point'. In fact, there is a great variety of solutions for this in European countries. While the majority of these 'coordination points' are with institutions of the education system, some countries have chosen institutions which fall under the Ministry of Labour. Most of these institutions are well integrated into the national qualifications structures and, at the minimum, are able to support framework implementation at the technical and administrative levels.

Accreditation of prior learning and recognition of non-formal learning

One of the more important aspects of qualification frameworks is that they encourage and facilitate the validation of non-formal and informal learning. Informal learning is especially important because many unskilled and semi-skilled workers have a lot of qualifications that are not formal, but can be recognized and used as part of an adult VET.

In accordance with the principle of lifelong learning, it should be possible for older workers with no formal qualifications to enter the vocational training system and obtain qualifications, thereby improving their employment prospects and expanding the pool of skilled labour available for industry. Older workers often come with substantial practical experience (non-formal learning) from the sector in which they are now seeking a qualification, and in order to avoid repetitive learning and shorten the time spent in training, most EU countries have now implemented opportunities for the accreditation of prior learning (APL) as part of their VET systems. As well as practical experience, APL also takes into account theoretical learning achieved in other contexts, such as other courses or educational programmes (e.g. evening classes).

In Denmark, older workers may apply to have their skills assessed in order to determine to what extent they already possess the knowledge, skills and competences necessary to obtain a qualification. This process, known as realkompetencevurdering ("assessment of real competences"), takes place at a vocational school and may last up to two weeks. During this period, the worker undergoes a series of theoretical and practical tests, at the

end of which the school issues an assessment of what the worker already knows, understands and can do, and what elements are missing before a full qualification can be obtained. This assessment also indicates what theoretical learning and practical training he or she must undertake to complete the programme. Depending on the nature of the experience, the time required to obtain the qualification may be shortened substantially. As many older workers have families and other obligations, they may also be given financial compensation during their time in training on top of the going apprenticeship stipends to enable them to complete the programme without endangering the welfare of themselves and their dependents.

3. Open Educational Resources or OER

Definition

Open Educational Resources (OER) are teaching, learning and research materials in any medium that reside in the public domain and have been released under an open licence that permits access, use, repurposing, reuse and redistribution by others with no or limited restrictions (Atkins, Brown and Hammond, 2007). The use of open technical standards improves access and reuse potential. OER can include full courses and programmes, course materials, modules, student guides, teaching notes, textbooks, research articles, videos, assessment tools and instruments, interactive materials such as simulations and role plays, databases, software, apps (including mobile apps) and any other educationally useful materials. The term 'OER' is not synonymous with online learning, eLearning or mobile learning. Many OERs, while shareable in a digital format, are also printable.

Skillman's use of Moodle as OER software

Moodle is the OER software used in Skillman. Moodle is a commonly used open-source software in education. The website for Moodle is www.moodle.org. Moodle is compatible with Linux, UNIX, Windows, Mac OS X, FreeBSD and any other system that supports PHP. In 2011 it was downloaded about 500 times a day and contains more than 28,000 registered sites, over a million courses and a learning community of ten million.

The rationale for use of distance education methods

Whether consciously or unconsciously, attempts to make use of distance education methods have generally been driven by a desire to build on some or all of the following lessons emerging from the history of distance education practices:

1. *Providing access to students who, because of work commitments, geographical distance, or poor quality or inadequate prior learning experiences, would be denied access to traditional, full-time contact educational opportunities*. This motivation may have been the key motivating factor behind the use of distance education methods. The drive has been stimulated partly by growing awareness of the importance of lifelong learning and corresponding attempts to respond to market needs. It has also been motivated by dwindling student numbers in some of the more traditional areas of educational provision and a corresponding need to find new educational markets.
2. *Seeking to expand access to educational provision to significantly larger numbers of students*. This motivation is linked to the previous one, but is not the same. Its differ-

ence lies chiefly in the scale of the programmes. Many programmes motivated by a desire to provide access to students who would be denied access to traditional full-time contact education do not really have the goal of reaching significantly larger numbers of students. Indeed, it is notable that large-scale distance education programmes are, in general, confined to very few educational sectors, most notably nursing and teacher training. Most other programmes tend to be small-scale interventions, although there may be a change in this regard as alignment between industry/commerce and programme providers gathers momentum.

3. *Shifting patterns of expenditure to achieve economies of scale by amortizing identified costs (particularly investments in course design and development and in effective administrative systems) over time and large student numbers*. This motivation draws together the above two motivations and has been an underlying economic rationale for many distance education institutions around the world. Its success depends on limiting the number of courses but maximizing enrolments in them. Many distance education programmes simply have neither the intention nor the capacity to exploit these economic benefits. The reasons for this are varied, but most commonly it is because market demand is simply not big enough to create programmes enrolling thousands of students or because institutions or programmes have neither the financial nor the human capacity to make large-scale venture capital investments in course design and development or administrative systems to support the implementation of large-scale distance education. The latter problem is exacerbated by the reality that administrative systems at these institutions have been so narrowly designed to support full-time contact education that the investments necessary to adapt these systems would often exceed what would be necessary to set up new systems from scratch.

4. The components of a well-functioning distance education system

Course design and development

a. Well-designed courses

In good distance education, it is the course rather than the educator that provides an appropriate learning environment for students. Rather than simply referring to a set of materials, however, the course is the structure of learning that is designed into the materials. It has three basic elements:

- Conceptual pathways to command of its knowledge, conceptualizing skills and practical abilities.
- Educational strategies to help the student find his or her way through these pathways.
- Summative and formative assessment, which should be integral to the learning process. The materials and presentation of the course as a whole must excite, engage and reward the student. Courses should be designed so as to involve students actively in their own learning and should allow them quick access and clear pathways through them. Although there is no need for courses to use advanced technologies, most, but not necessarily all, will make use of a variety of media. In designing courses, provision

should also be made for the necessary practical work. In order to be as flexible and open as possible, courses should be organized in modules.

b. Programme and course development in a team

An essential component in the successful design of courses is collaboration. This can be achieved by using an approach where a group of people, each with particular skills and competencies, develop a course as a team. Although there is no golden mean, nor indeed an absolute minimum, a substantial ratio of staff course design time to student study time will be inevitable in developing courses. However, some of the better courses in more challenging subjects might have ratios of fifty to a hundred hours of design time to each hour of student study time. This has clear implications for courses designed for small numbers of students: they are simply not financially viable if collaborative design processes are to be used.

Counselling and support

a. Counselling

Distance education providers should make provision to advise and help individuals who would otherwise be isolated throughout the learning process, and in particular, to help them to make choices before enrolling in educational programmes. It should be made easily available through a variety of devices, including, most importantly, human intervention.

b. Learner support

If students are to adapt to the special requirements of guided self-study, they require various forms of support, for example, satisfactory access to tutors and facilitators, opportunities to interact with other students and access to the necessary facilities.

c. Provision of adequate administrative support to students

This would involve administrative support on a number of levels, including enrolment procedures, payment of fees, delivery of materials and keeping channels of communication open. The aim throughout should be to keep administrative procedures few and simple.

d. Quality Assurance

Quality assurance should be an element of all learning programmes. Several mechanisms need to be established to ensure the quality of learning programmes and their capacity for self-improvement. One of the most critical of these is a mechanism which enables meaningful and reliable feedback from students and tutors into the ongoing performance of the institution.

e. Research, evaluation, and development

As with all aspects of education, continuing research, evaluation and development are necessary for the improvement of distance education provision. Distance education providers also need to have effective research as the basis for improving the quality of their performance.

f. Effectively managed distance learning

Effectively managing distance learning involves establishing performance criteria and targets for the institution, together with mechanisms for publicly and regularly evaluating performance and incorporating lessons learned into improved practices.

5. Validation and OER

EU policy-makers are focusing on how to validate OER, especially in light of the 2013 communication on opening up education, which states that validation should address the challenges linked to the emergence of OER.

Up to now it has been virtually impossible to acquire formal recognition for learning achieved by OER, hence almost no credits are given for learning acquired through OER, in contrast to "formal education" or distance learning courses.

Nonetheless it is possible to establish links between OER and validation. The European Centre for the Development of Vocational Training published a Thematic Report on Validation concerning OER mentions four types of example. These are listed below:

Identification	List of open resources and materials that can give individuals awareness of their knowledge, skills and competences, prevalent standards, level of competence and gaps in their knowledge, skills and competences.
Documentation	OER may support documentation and non-formal learning by means of reference to course material.
Assessment	OER may be linked to various forms of assessment, from self to peer and institutional assessment.
Certification	OER may lead to certification entitling individuals to certain rights: for example, it may have a labour market value or value in the education system (e.g. a value for course entry, waiving the requirements to complete elements of courses or the award of full qualifications).

6. Teachers using OER: some pedagogical considerations

Didactic perspectives

The OER concept is not new, but is based on the principle that educators should select, from the full range of educational provision, those resources and methods that are most appropriate to the context in which they are providing education. The learning materials produced in the Skillman project, this means that teachers can benefit by considering some didactic perspectives.

A didactic framework for VET teachers and educational planners

The central questions a VET teacher or educational planner must consider, to meet the required learning goals and competences described in the curricula, are outlined here. These can be viewed as six perspectives, described by two Norwegian educational VET researchers, Hiim and Hippe (2003 and 2007).

Six didactic perspectives for teacher's didactic considerations

- **Learning prerequisites.** Concerns learner's and teacher's prior knowledge and experience.
- **Evaluation and assessment.** Concerns both formative and summative methods, and requirements that can be referred to learning goals, competences and skills and likewise described in the curricula and other official documents.
- **Planning for learning processes, methods and activities.** Concerns teaching methods, videos apps, task-based work etc., considering the relation and flow in the design of the learning process for the participants.
- **Content.** Selection of content in order of presentation.
- **Learning goals.** Concerns the teacher's considerations of progression and the development of learning goals that VET students must reach. Naturally these goals should also be linked to the overall curriculum and official documents that describe the competences, skills and attitudes that the student must acquire.
- **Frame factors.** Concerns the learning environment. These could be factors such as number of students, time to reach the learning goals etc.

The main point made by the two researchers is that all six perspectives are interrelated. This means that teachers and educational planners should be able to distinguish between the six elements, bearing in mind that change in one aspect affects the other five aspects.

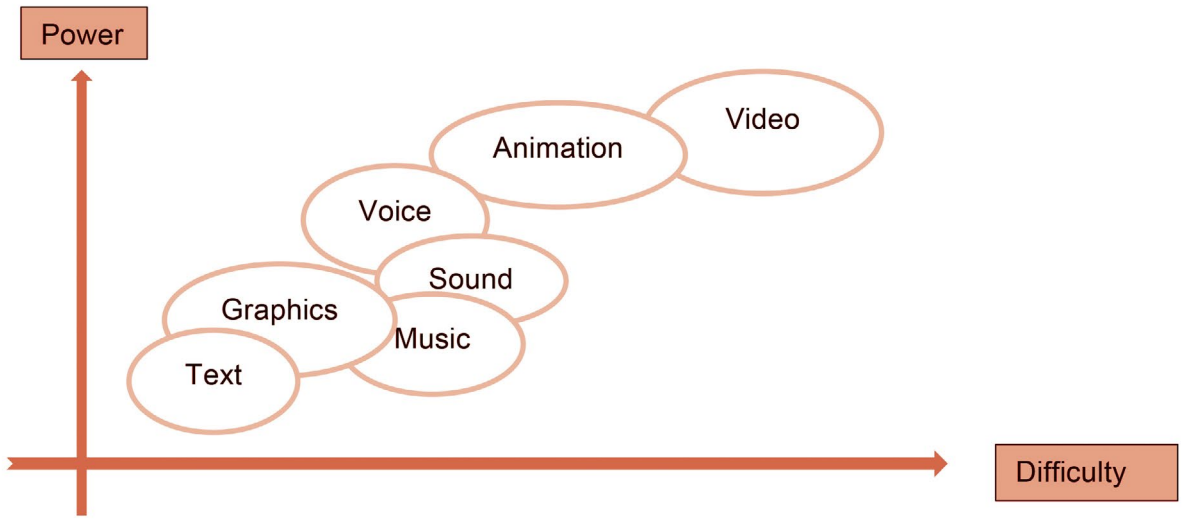
In the following, we will present some models that can help VET teachers and educational planners transform the curricula developed in Skillman into learning activities linking with and using elements from Skillman's OER Platform.

Teacher's choice of media, power and difficulty

When the teacher has considered and described the goals, content, learners and the requirements and activities necessary to achieve the learning goals in the Skillman curricula, it might be useful to specify the media needed to implement the activities and tests.

Each learning object may require a different mix of media. Each medium should be more or less easy to use, and the requirements concerning the teacher's ability to use it, storage space, tools, network speed and so on varies, as does the difficulty of the media. Likewise it will be found that the power of the media – that is, the ability to communicate facts, explain concepts and trigger emotions – can differ.

Though all media are possible, the following figure may be useful in considering which media are most appropriate for particular learning activities.



Technology applications that can be used in OER: a brief overview

This short overview provides a quick guide to some of the technology applications which are available to support education and development initiatives and that are helping to stimulate the creation and use of openly licensed, or at least openly available, educational resources.

- **Social network sites.** These are web-based services that allow people to construct a public or semi-public profile within a bounded system, define a list of other users with whom they share a connection, and view their list of connections and those made by others within the system. The best known of such sites are probably Facebook and MySpace, although many such sites exist. Some also focus on specific dimensions of social networking. For example, social bookmarking sites such as Del.icio.us allow people to save bookmarks to websites and tag them with keywords, generating community-driven, keyword-based classifications known as 'folksonomies'. Likewise, photo-sharing websites such as Flickr allow people to upload, tag, browse and annotate digital photographs, as well as participate in self-organizing topical groups. While social networking sites have massive potential for influencing the ways in which we organize and find information and how we interact with people, it is important to note that the for-profit sector is selling itself as the provider of choice for these Web 2.0 collaboration capabilities, predominantly in an effort to create new platforms to fund consumers and sell advertising.
- **Blogging.** Blogging is remarkable for the speed at which it has grown as an online communication vehicle. 'Blog' is an abbreviated version of 'weblog', a term used to describe websites that maintain an on-going chronicle of information. A blog is a frequently updated, personal website featuring diary-type commentary and links to articles or other websites (and, in the case of video-blogging, video). Given the personal perspectives presented on blogs, they often generate ongoing discourse and a strong sense of community. Blogs provide diverse, alternative sources of information for higher education, as well as supplying tools that can be used by academics and students for a wide range of educational purposes.
- **Wikis.** A wiki enables documents to be written collaboratively in a simple mark-up language using a web browser. A defining characteristic of wiki technology is the ease with

which pages can be created and updated. This ease of interaction and operation makes a wiki an effective tool for mass collaborative authoring. The most famous example is Wikipedia, an online phenomenon that has played a massive role in challenging notions of what constitute 'expertise' and reliability of information. Wikis are already extensively used in many higher education programmes for educational purposes and are one of the authoring tools being used to generate 'open' content (see below).

- **RSS.** Real Simple Syndication (RSS) is a protocol that allows users to subscribe to online content by creating lists of preferred sources of information in a 'reader' or 'aggregator' that automatically retrieves content updates, saving the user's time and effort. RSS feeds can be very helpful in managing information and undertaking ongoing research.
- **Podcasting.** This refers to any combination of hardware, software and connectivity that permits automatic download of (usually free) audio and video files to a computer, smart phone or MP3/MP4 player to be listened to or watched at the user's convenience. This is typically done by subscribing to an RSS feed linked to the specific podcast, so that when new editions of a podcast are made available, they are automatically downloaded by podcasting software. Podcasting has made available a very broad spectrum of educationally useful audio and video material, including radio programmes from around the world, lectures, conference speeches and custom-produced podcasts created by enthusiasts. Growing numbers of universities and academics are making lectures available as podcast series, which are usually freely available to anyone around the world with Internet access.
- **Virtual worlds.** These are immersive online environments whose 'residents' are avatars representing individuals who participate via the Internet. Some, such as the very popular World of Warcraft, are explicitly focused on gaming and entertainment. However, possibly the best known of these from an educational perspective is Second Life, a fully three-dimensional world where users with many varying interests interact, but within which many universities and businesses are now constructing virtual campuses for their students.
- **Voice-Over Internet Protocol (VOIP).** VOIP is a protocol optimized for the transmission of voice through the Internet or other packet-switched networks. VOIP is often used abstractly to refer to the actual transmission of voice, rather than the protocol implementing it. VOIP facilitates applications such as Skype, which allow users to make free telephone calls between computers.
- **Instant messaging (IM).** IM is a form of online communication that allows real-time interaction through computers or mobile devices. It is often bundled into applications such as Skype and social networking sites, so that it can be used seamlessly while within those applications. It has become such an integral part of students' lives that many universities are working to move IM beyond the social sphere into teaching and learning.
- **Online applications.** These are web-based programmes that run in web browsers and typically replicate the functionality currently available on desktop-based applications. A good example is Google Apps, which provides access to office productivity, communication and file storage tools. Another, more specialized example is Lulu, which offers online access to the tools one needs to design, publish and print original material, facilitating inexpensive production of publications. The online nature of such tools is also intended to facilitate collaboration, peer review and the collective generation of knowledge.

Wielding the applications

By drawing on the potential of the above technologies, several new possibilities are emerging that can be useful for teachers using OER.

Mashups are web applications that combine data from more than one source into a single integrated tool. The power of mashups for education lies in the way they help us reach new conclusions or discern new relationships by uniting large amounts of data in a manageable way. Web-based tools for manipulating data are easy to use, usually free, and widely available. Mashups include:

- Digital storytelling, which involves combining narrative with digital content to create a short movie or presentation.
- Data visualization, which is the graphical representation of information to find hidden trends and correlations that can lead to important discoveries.
- Open journaling, which manages the process of publishing peer-reviewed journals online, allowing authors to track submissions through the review process, and creating a sense of openness and transparency unusual in traditional, peer-reviewed publications.
- Google jockeying, which involves a participant in a class surfing the Internet during the class for terms, ideas, websites or resources mentioned by the presenter. These searches are then displayed simultaneously with the presentation.
- Virtual meetings, which are real-time meetings taking place over the Internet using integrated audio and video, chat tools and application sharing.
- Grid computing, which uses middleware to coordinate disparate IT resources across a network, allowing them to function as a virtual whole and providing remote access to IT assets and aggregating processing power.

7. Teacher's choice using OER: linking learning to life, work and future learning

When the teacher plans learning activities in VET programmes, it is useful to ensure that people can apply what they have learned. This is especially emphasised in VET education, European policy and research linked to transfer.

In an OER-supported educational program, it can therefore be useful to consider "connect" activities that can help the learner apply what he or she has learned. Connected activities can make existing knowledge more useful. Connected activities range from a simple stop-and-think questions to a full-scale work project. To design effective "connect" activities, one should start with a clear idea of what one wants to connect.

The figure below is designed to help the planning process.

To connect this	To this	Use this type of Connect activity
Individual principles, concepts, and other bits of learning	The learner's work or studies	Consider activities such as identifying examples
Critical bits of information	Gaps in the learner's current understanding	Questioning activities
Major themes in the OER supported learning environment	The learner's life	Stories told by the learner
Producers and policies	The learner's professional work	Job aids and original work activities
Limited information in the learner's course	The large body of knowledge in a field	The learner's active search for knowledge, problems and answers to a subject. 'Research' activities
Current information	New information that the learner will encounter	The learner's active search for knowledge, problems and answers to a subject. 'Research' activities

8. Teacher's choice using OER: feedback, test evaluation and goals, accessed learning

In this methodological guide, a test is an activity that indicates how well learners are meeting learning objectives. In this understanding, any activity that provides feedback on learners' performance in relation to an object, goal, skill knowledge etc. can serve as at test.

Teachers feedback: an effective tool with three types of feedback

In this guide, we focus on both formal and informal tests. In this understanding, feedback has at central role. According to Hattie, drawing on research on the teacher's impact on students learning, feedback is one of the most effective methods of enhancing students' learning.

Hattie develops the concepts of effective feedback by dividing feedback in to three perspectives and questions that must be answered. The purpose of feedback, in Hattie's view, is to reduce discrepancies between the learner's current understandings and performance on the one hand and the goals that have been set on the other. In the feedback

process, both teacher and the student can address the student's learning process by fulfilling the following tasks.

The teachers task is to provide appropriate challenging and specific goals, or to assist students to reach the goals through effective feedback.

The students task is to increase the effort and employment of more effective strategies, or to abandon, blur or lower the goals.

Effective feedback requires answers to three questions:

1. Question: Feed up: Where am I going? The goals.

2. Question: Feed back: How am I going?

3. Question: Feed forward: Where to next?

In Hattie's view, each question works on four levels that are important for teachers, leaders and educational planners to incorporate into the student's test.

On the task level, the student and teachers will encounter information of how well tasks are being understood and performed. *On the process level*, information concerning the processes needed to understand and perform tasks is revealed. *On the level of self-regulation*, the feedback guides the students and teacher towards the self-monitoring, direction and regulation of actions. And finally, on the *level of the self*, teachers and students receive feedback on their personal behaviour and their ability to perform the task effectively and reach visible goals.

Teacher's choice: a test guide

Before testing the learner's achievement of goals, skills and competences from the curricula developed under the Skillman project, the following should be considered: What is your aim in testing when you decide to test? How important are recorded scores? And what kinds of feedback is it important to give learners in light of the feedback questions and levels mentioned above? These decisions will be crucial and can later be incorporated or used as an training tool in addition to Skillman's OER.

The table below can serve as the first step in deciding and designing the quality of a test.

What do you want to accomplish with your test?

Purpose of testing	How to test	Record scores	Feedback
Measure the progress of learners.	At the end of each topic, lesson and course.	Yes.	Numeric, at end of test.
Help learners measure their own progress.	Frequent, short test.	No.	Descriptive and numeric.
Certify learner's knowledge.	Proctored, legally defensible test.	Yes.	Pass-fail or overall score. May also provide scores for sub-components so learners can study and try again.
Certify learner's skills.	Observed accomplishment of prescribe tasks.	Yes.	Pass-fail or overall score. May also provide scores for sub-components so learners can study and try again.
Motivate learners.	Informal pre-test.	No.	Recommended areas of study.

Purpose of testing	How to test	Record scores	Feedback
Exercise independent learning skills.	'Open-book' test where learners can find answers in available resources.	No.	Recommended search targets and strategies.
Teach new knowledge and skills.	Informal, frequent, before presentation of content.	No.	Presentation of just the content that testing indicates the learner needs.
Diagnosing learner's skills and knowledge.	Comprehensive test.	Yes.	Complete profile of what learners already know and need to learn.
Measure the effectiveness of learning modules.	Comparison of test scores between different modules and between modules before and after revision of pre-and post-test.	Yes.	

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Part B
Curriculum: Basic Composite repair
EQF level 3

Part B
Curriculum: Basic Composite repair EQF level 3

1. Introduction

This curriculum is designed to meet the needs of a wide range of technician in the field of composite repair.

This developed curriculum identifies the required knowledge and skills of a composite structure repair for **level EQF 3** according to EU standards.

These training program is a short individual training course.

In the proposal curriculum developed, learning units are selected and syllabuses are developed.

The new learning units as a part of the new curriculum are tested, evaluated and adjusted according to feedback from the participants during piloting process. Participants were trainees/students in the field of aircraft maintenance.

The curriculum is designed to meet the needs of a wide range of technician in the field of composite repair.

According to SKILLMAN project goals, the training program curriculum are divided into 4 main blocks (units), based on ECVET principles, articulated in Units of Learning aggregating a limited number of Learning Outcomes, which should be described in terms of Competencies, Skills and Knowledge compliant with ECVET requirements and consistent with the European Qualification Framework EQF, adopting ICT and Open Educational Resources OER.

During curriculum designing, we focused on aviation sector, because composites science is important in Transport manufacturing sector, and we can consider that this curriculum is general composite structure repair curriculum.

It means that we can use this curriculum for any industrial sector (Wind mill, automotive, boats…), because the scientific principles and learning objects of this training curriculums contents - Composite structures repair- are similar for different application sectors (air-transport, wind energy, automotive sector, sea transport…), the difference is the application field and operation conditions of certain structure.

The learning outcomes of this training curriculums are similar for different application, and may use it for any application with doing a minor change in part of content (The structure type and used documentation).

This training curriculum give access to continuing and further training to next level EQF-4 and work experience in other industrial sector, for example Wind mill maintenance, materials science application, boat structure maintenance, automotive structure application.

2. Overall description of the qualification: (Aircraft maintenance license B1)

Introduction

The proposal curriculum of composite structure repair training **EQF level 3** is a part of Total Training Course Program for obtaining license as an **Aircraft maintenance license B1** (*In Danish: Flymekaniker – Flight mechanic B1*).

In Aviation industry, according to **Part 66 - EASA** European Aviation Safety Agency regulation, the Complete training program course of Aircraft mechanic B1 consists of 17 modules (school tuition and practical training).

This proposal training program EQF-3 is a part of module 7 – Maintenance practices, and this training program (Composite structure repair) is very important section in the aircraft maintenance and flight safety.

Profile of skills and competences

The overall aim of the complete training program as an aircraft mechanic is that through school based period and practical training, the student gains knowledge and skills so that the conditions described in the Commission's Regulation (ER) No. 2042/2003 part-66 on the regulations for aircraft mechanics are fulfilled within the following general fields of competence. The qualified aircraft mechanic will be able to perform service, maintenance and commissioning of fixed-wing aircraft with turbine engines, single piston engines as well as helicopters with turbine engines and single piston engines.

An important part of the work is about checking the aircraft condition and reporting them as ready and without any damage before they are allowed to fly.

Duration and mode of education and training

The total duration of the education program varies from 4 ½ years up to 6 years, depending on types.

Vocational education and training program are alternating programs – dual training, which means that the education and training activities alternate between education and training at a school and on-the-job training in a company.

Level of certificate

According to Danish Educational System (www.ug.dk), The training program is a vocational education program, which is placed in:
The Danish qualification framework for life-long learning at level: 5
European Qualification Framework (EQF) at level: 5

This is general curriculum that has been developed to identify the minimum knowledge and skill requirements of a composite repair personal (EQF level 3).

This curriculum is designed to meet the needs of a wide range of personnel in the field of composite repair.

Following is the description of the curriculum, which is divided into four units.

Pre-requisites

Apprentice full VET programme

Regarding to Flight mechanic B1 course:
Students who are aiming at holding an aircraft maintenance "B1" license, should complete primary school with 9 or 10 class or equivalent.

It means, the basic knowledge in the following disciplines: mathematic level C, physics level C, and English level D and Danish level E is acquired, when entering the main course, which starts after 20-40 basic VET training at school.

Further training Course/For general Trainees:
Basic knowledge and experience in structure repair works (or sheetmetal work).

Prior composite materials experience or training equivalent should be considered. Evaluation of prior education can be accomplished by examination of school transcripts, and/or by review of the training received through approved training providers.

The whole training program curriculum is divided into 4 Units
Training duration:

- Training duration: about 42 hours during 6 days
- Total hours: about 42 hours
- Classroom hours: 18.25 hours
- Practical hours: 21.5 hours
- Assessment hours: 2.25 hours

Assessment
For aviation the assessment is according to EASA-regulation. (European Aviation Safety Agency)

- Total assessment duration: 2.25 hours.
  - Unit-1 assessment: 15 minutes
  - Unit-2 assessment: 30 minutes
  - Unit-3 assessment: 30 minutes
  - Unit-4 assessment: 60 minutes
- Final assessment: A final assessment is a sum of all units' assessment.
- The assessment may be online assessment (multiple choice) and open-book test consisting of questions that cover the knowledge of composite repair methods, materials, and procedures, and take in consideration the specific composite structures application.
- Grading: Trainee must have at least a 75 % overall average to pass the course.

A. Qualification template			
Title	**Basic Composite repair**		
Description	Inspects, repairs basic damaged composite structures according to guided instructions using hands and power tools, specialized equipment and materials.		
Thematic focus	Robotics	**Composite materials**	Wirelesss and Industry
Country	Denmark		
Occupations	Composite repair		
Credit levels			
EQF compliancy		**EQF level 3**	
ECVET compliancy	6 days (tbc)		
Conditions	The training curriculum is divided into 4 Units and the students have to pass all 4 in succession		
Language	English		
Web page			
Assessment	In general the assessment will always follow the industry-specific requirements and it is possible for adjusting according to national, regional and local standards and practices.		

3. Curriculum

3.1 Unit-1

B. Curriculum template		
Module		
Unit of learning	**1. Energy and Energy Efficiency**	
Duration *Hours*	3	Lessons hours: 2,75 Self-study hours: - Hands-on hours: - Other (please specify): - Assessment hours: 0.25
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Understanding Energy issues and role composite materials, and energy efficiency in composite manufacturing.	
Competences 1. Support acknowledge about the energy and energy efficiency issues in composites applications.		
Knowledge 1. To know basic concepts about energy and energy efficiency (second law of thermodynamics). 2. To know the Energy and energy efficiency issues and trends in manufacturing and production process. 3. Understand the impact of composite materials on energy efficiency.		**Skills** 1. To follow the energy performance requirements and instructions during work tasks. 2. To use the required documentation system – manuals concerning energy matters
Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):	
Assessment criteria *Description and timing*	0,25 hr.	
Qualifications framework *Reference to EQF and NVQ*	3	

Delivery methods	☐ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals - references numbers: 15, 16. Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.2 Unit-2

B. Curriculum template		
Module		
Unit of learning	**2. Documentation and responsibilities ''Repair references, human factor and environment''**	
Duration	6	Lessons hours: 4 Self-study hours: - Hands-on hours: 1,5 Other (please specify): - Assessment hours: 0,5
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Use the guided documentation, human safety requirement, and environmental risks during composite structures repair.	

Competences
1. To comply with the regulations and safety legislation during working at the workshop (work environment)
2. Acknowledge about the correct and latest amended reference system (according to the trade).

Knowledge	**Skills**
1. To know the specific safety requirements around composite materials. 2. To understand the environmental risks from work activities and protection methods. 3. To know the basic technical terminology. 4. To understand the main architecture of the documentation system.	1. To follow the safety requirements and instructions at the work place. 2. To use basic technical language and terminology 3. To use the required documentation system – manuals

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	0,5 hr.
Qualifications framework *Reference to EQF and NVQ*	3
Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals - references numbers: 1, 2, 3, 4, 9 Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.3 Unit-3

Unit of learning *Number and title*	**3. Inspection of composite structures**	
Duration *Hours*	7	Lessons hours: 3.5 Self-study hours: - Hands-on hours: 3 Other (please specify): - Assessment hours: 0,5
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Classification of main composite and lightweights materials and basic inspection methods of composite damages.	

Competences
1. To recognize the main different typologies and shapes of composite materials.
2. To carry out basic inspection processes – search and detect of basic structural failures.
3. To estimate and classify main damages for determination for further repairing process according to the working conditions.
4. To Understand the main inspection methods of composite (NDT)

Knowledge	**Skills**
1. To know basic lightweights and composite materials properties. 2. To know about the basic relevant chemistry for composite structures 3. To know the basic composite materials technologies (composition, types, properties…) 4. To know the damages types and resources of composite structures. 5. To know the main Non-Destructive Testing methods.	1. To determine the basic lightweights and composite materials properties. 2. To handle main different chemicals as cleaning and matrix materials for composite structures repair. 3. To follow guided instructions provided by approved technical documentation. 4. To follow guided instruction in Non-Destructive-Test techniques (NDT).

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	0,5 hr.
Qualifications framework *Reference to EQF and NVQ*	3

Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals-references number: 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 14. Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.4 Unit-4

Unit of learning *Number and title*	**4. Composite structures Repair process**	
Duration *Hours*	26	Lessons hours: 8 Self-study hours: - Hands-on hours: 17 Other (please specify): - Assessment hours: 1
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Basic composite structural repairs using required tools and machines according to guided standards.	

Competences
1. To distinguish between the different ways of handling the main composite material and doing it according to the safety requirements
2. To follow the right repairs method and perform basic repair of failures eliminating according to technical manuals.
3. To select and use the proper tools and workshop equipment

Knowledge	**Skills**
1. To know the basic composite materials repair (types, methods, processes…) 2. To know the basic machines and tools for composite repairing workshop. 3. To know the main technical terminology	1. To handle and store different types of main composite materials to standards. 2. To apply hands skills (sensory and physical demands). 3. To perform basic composite structures repairs 4. To use appropriate hand tools and main machines during repairing processes (drilling, cutting, curing equipment….)

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ■ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	For all 6 days. 1 hr.
Qualifications framework *Reference to EQF and NVQ*	3
Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals-references number: 1, 2, 3, 5, 6, 7, 8, 9, 10, 11.12, 13, 14 Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

4. Syllabus

The main theoretical content includes the topics of each unit (that are performed as lectures inside classroom). Therefore, the literatures and the references in unit table as referred numbers from the list mentioned below.

Many references are used for more than one unit.

C. Syllabus template	Unit-1	
Title	**Energy and Energy efficiency**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to energy and energy efficiency.	0.75	-
2. Energy & Energy efficiency issues and trends.	1	-
3. Composites materials & Energy Efficiency, and instruction concerning energy matters.	1	
Unit assessment	0.25	
Duration - hours	2.75	-
Total unit duration	3 hrs. = 0.5 day	
Main hands-on content	NA	

C. Syllabus template	Unit-2	
Title	**Documentation and environment factors of composite repair "Repair references, human factor and environment"**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Safety and environment	1	1,5
2. Documentation	2	-
3. Human Factors	1	
Unit assessment	0.5	
Duration - hours	4	1,5
Total unit duration	6 hrs. = 1 day	
Main hands-on content	Presentation of workshop Clean, Sanding and storage rooms environmental condition and awareness. Human factor and safety presentation in workshop and awareness together with documentation.	

C. Syllabus template	Unit-3	
Title	**Inspection of composite structures**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to lightweights and composite materials.	1	-
2. Composite Structures technology. 2.1. Composite structural design 2.2. Reinforcement fiber 2.3. Matrix system	1.5	2
3. Inspection techniques NDT	1	1
Unit assessment	0.5	
Duration - hours	3.5	3
Total unit duration	7 hrs. = 1 day	
Main hands-on content	Introduction of composite fiber types, monolithic and sandwich structure samples. Basic intro to non-destruction inspection method.	

C. Syllabus template	Unit-4	
Title	**Composite structures Repair process**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to composite structures repair	1	-
2. Composite repair process 2.1. Adhesives 2.2. Wet lay-up General 2.3. Post repair process	2	10.5
3. Handling and storing materials	1	1
4. Equipment and facilities	1	1.5
5. Vacuum bagging	1	1
6. Heating devices	1	1
7. Machining of composite materials	1	2
Unit assessment	1	
Duration - hours	8	17
Total unit duration	26 hrs. = 4 day	
Main hands-on content	Preform minor composite repairs, damage preparing. Build up monolithic structure, sandwich Panel, perform sandwich panel repair with core replacement and perform edge matrix closing. Be familiar with different types of bagging procedure. Environment condition, tools, hot bonder equipment, heating devices, machining and facilities.	

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6. ARP5256: Mixing Resins, Adhesives and Potting Compounds
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Part C
Curriculum: Composite repair technician
EQF level 4

Part C
Curriculum: Composite repair technician
EQF level 4

1. Introduction

This is a curriculum that has been developed to identify the required knowledge and skills of a composite structure repair for **level EQF 4**.

The training curriculum is designed to meet the needs of a wide range of technician in the field of composite repair.

This training programs is short individual training course.

The new learning units as a part of the new curriculum are tested, evaluated and adjusted according to feedback from the participants during piloting process. Participants were trainees/students in the field of aircraft maintenance.

The curriculum is designed to meet the needs of a wide range of technician in the field of composite repair.

According to SKILLMAN project goals, the training program curriculum are divided into 4 main blocks (units), based on ECVET principles, articulated in Units of Learning aggregating a limited number of Learning Outcomes, which should be described in terms of Competencies, Skills and Knowledge compliant with ECVET requirements and consistent with the European Qualification Framework EQF, adopting ICT and Open Educational Resources OER.

The unite titles of level 4 and 3 have similar titles, but the differences between levels are the depth of knowledge and skills.

During curriculum designing, we focused on aviation sector, because composites science is very important in air-transport manufacturing sector, and we can consider that this curriculum is general composite structure repair curriculum.

It means that we can use these curriculums for any industrial sector (Wind mill, automotive, boats…), because the scientific principles and learning objects of these training curriculums contents, Composite structures repair, are similar for different application sectors (air-transport, wind energy, automotive sector, sea transport…), the difference is the application field and operation conditions of certain structure.

The learning outcomes of this training curriculum are similar for different application, and may use it for any application with doing a minor change in part of content (The structure type and used documentation).

This training curriculum gives access to continuing and further training to next level 5 and work experience in other fields, for example Wind mill maintenance, materials science application, boat structure maintenance, automotive structure application.

2. Overall description of the qualification: (Aircraft maintenance license B1)

Introduction

This proposal training program EQF-4 is higher level than training EQF-3, it means the knowledge and skills are deeper.

According to European Aviation Regulation, the composite structure repair course (EQF level 3) is a section of the discipline Maintenance practices (one module of Total Training Course Program for qualification an **Aircraft maintenance license B1**)

In aviation industry, according to **Part 66 - EASA** European Aviation Safety Agency regulation, the complete training program course of Aircraft mechanic B1 consists of 17 modules (school periods and practical training in companies – dual training).

The training program EQF-3 is a part of module 7 – Maintenance practices, and this training program (Composite structure repair) is very important section in the aircraft maintenance and flight safety.

Profile of skills and competences

The overall aim of the complete training program as an aircraft mechanic is that through school periods and practical training, the student gains knowledge and skills so that the conditions described in the Commission's Regulation (ER) No. 2042/2003 part-66 on the regulations for aircraft mechanics are fulfilled within the following general fields of competence. The qualified aircraft mechanic will be able to perform service, maintenance and commissioning of fixed-wing aircraft with turbine engines, single piston engines as well as helicopters with turbine engines and single piston engines.

An important part of the work is about checking the aircraft condition and reporting them as ready and without any damage before they are allowed to fly.

Duration and mode of education and training

The total duration of the education program is from 4½ years up to 6 years, depending on type.

Vocational education and training program are alternating programs, which means that the education and training activities alternate between education and training at a school and on-the-job training in a company.

Level of certificate

According to Danish Educational System (www.ug.dk), The training program is a vocation-

al education program which is placed in:

The Danish qualification framework for life-long learning at level: 5

European Qualification Framework (EQF) at level: 5

This is general curriculum that has been developed to identify the required knowledge and skills of a composite repair technician (EQF level 4).

This curriculum is designed to meet the needs of a wide range of technician in the field of composite repair.

Following is the description of the curricula which is divided into four units.

Pre-requisites

For aviation sector/Apprentice VET Programme:
Students/Apprentices are still studying, aiming at aircraft maintenance "B1" license OR equivalent, AND have a limited experience in structure repairs.

For general trainees/Further training courses:
Completion training level 3 and have a minimum amount of experience in the area of composite structures, or Maintenance Technicians with previous structure experience, and basic knowledge of composite structures repair.

Prior composite materials experience or training equivalent should be considered. Evaluation of prior education can be accomplished by examination of school transcripts, and/or by review of the training received through approved training providers.

The whole module is divided into 4 Units
Training duration:

- Training duration: about 56 hours during 8 days
- Total hours: about 56 hours
- Classroom hours: 24.25 hours
- Practical hours: 29.5 hours
- Total Assessment hours: 2.25 hours

Assessment
For aviation the assessment is according to EASA-regulation. (European Aviation Safety Agency)

- Total assessment duration: 2.25 hours.
  - Unit-1 assessment: 15 minutes
  - Unit-2 assessment: 30 minutes
  - Unit-3 assessment: 30 minutes
  - Unit-4 assessment: 60 minutes
- Final assessment: A final assessment is a sum of all units' assessment.
- The assessment may be an open-book test consisting of questions that cover the knowledge of composite repair methods, materials, and procedures, and take in consideration the specific composite structures application.
- Grading: Trainee must have at least a 75 % overall average to pass the course.

A. Qualification template			
Title	**Composite structures repair technician**		
Description	Inspects basic repairs and replaces damaged composite structures according to approved engineering data and process requirements using hands and power tools, specialized equipment and materials.		
Thematic focus	Robotics	**Composite materials**	Wirelesss and Industry
Country	Denmark		
Occupations	Composite repair technician		
Credit levels			
EQF compliancy		**EQF level 4**	
ECVET compliancy	8 days (tbc)		
Conditions	The training program curriculum is divided into 4 Units and the students have to pass all 4 in Succession.		
Language	English		
Web page			
Assessment	In general the assessment will always follow the industry-specific requirements and it is possible for adjusting according to national, regional and local standards and practices.		

3. Curriculum

3.1 Unit-1

B. Curriculum template		
Module		
Unit of learning	**1. Energy and Energy Efficiency 1**	
Duration	3.5	Lessons hours: 3.25 Self-study hours: - Hands-on hours: - Other (please specify): - Assessment hours: 0.25

Number of ECVET Points *(if applicable)*	
Learning outcome *Number and title*	1. Understanding Energy issues and role composite materials, and energy efficiency in composite manufacturing.

Competences
1. Support acknowledge about the energy and energy efficiency issues in composites applications.

Knowledge	**Skills**
1. To know basic concepts about energy and energy efficiency (second law of thermodynamics). 2. To know the Energy and energy efficiency issues and trends in manufacturing and production process. 3. Understand the impact of composite materials on energy efficiency.	1. To follow the energy performance requirements and instructions during work tasks. 2. To use the required documentation system – manuals concerning energy matters.

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	0,25 hr.
Qualifications framework *Reference to EQF and NVQ*	4
Delivery methods	☐ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals - references numbers: 15, 16. Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.2 Unit-2

B. Curriculum template		
Module		
Unit of learning	**2. Documentation and responsibilities ''Repair references, human factor and environment'' 1**	
Duration	10.5	Lessons hours: 6 Self-study hours: - Hands-on hours: 4 Other (please specify): - Assessment hours: 0,5
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Use the required documentation, human and environmental safety procedures during teamwork with composite repair	
Competences 1. To work with the correct reference system 2. To comply with the regulations and safety legislation during working at the workshop (work environment) 3. To be able to communicate with composites team work		
Knowledge 1. To understand the architecture of the documentation system. 2. To know the specific safety requirements around composite materials. 3. To understand the environmental risks from work activities and protection methods. 4. To know the technical terminology. 5. To understand the importance of professional responsibilities of team work.		**Skills** 1. To select and use the correct manuals. 2. To follow the safety requirements and instructions at the work place. 3. To use technical language and terminology 4. To communicate in writing and orally on technical issues 5. To apply the communication skills.
Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):	
Assessment criteria *Description and timing*	0,5 hr.	
Qualifications framework *Reference to EQF and NVQ*	4	

Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals - references numbers: 1, 2, 3, 4, 9 Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.3 Unit-3

Unit of learning	**3. Inspection of composite structures 1**	
Duration	14	Lessons hours: 6.5 Self-study hours: - Hands-on hours: 7 Other (please specify): - Assessment hours: 0.5
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Classification of main composites and lightweights materials, and inspection methods of composite damages using required NDT	

Competences
1. To differentiate between the main different typologies and shapes of composite materials.
2. To search and detect main structural failures.
3. To estimate and classify damages for further repairing process.
4. To understand the using instructions of main NDT for damages inspection.

Knowledge	Skills
1. To know basic lightweights and composite materials properties. 2. To know the basic composite materials technologies (composition, types, and properties) 3. To know the basic damages types and resources of composite structures. 4. To know the main Non-Destructive Testing methods and application.	1. To determine the lightweights and composite materials properties, that required for the inspection process. 2. To follow instructions provided by approved technical documentation. 3. To follow the composite manual 4. To follow instruction in using the Non-Destructive-Test techniques (NDT).

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	0,5 hr.
Qualifications framework *Reference to EQF and NVQ*	4
Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals - referencesnumber: 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 14. Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.4 Unit-4

Unit of learning	**4. Composite structures Repair process 1**	
Duration	28	Lessons hours: 8.5 Self-study hours: - Hands-on hours: 18.5 Other (please specify): - Assessment hours: 1
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. General composite structural repairs using suitable method, required tools and machines according to required standards.	

Competences
1. To distinguish between the different ways of handling the composite material and doing it according to the safety requirements
2. To determine and execute the right repairs method for failures eliminating according to technical manuals.
3. To be able to receive skill assistance from instructors during repairing.

Knowledge	**Skills**
1. To know the composite materials repair (types, methods, processes…) 2. To know the workshop machines and tools. 3. To know about the basic chemical agents that used during composite repair. 4. To know the main measurement instruments. 5. To know the basic technical terminology	1. To handle and store basic types of composite materials to standards. 2. To apply hands skills. 3. To perform main composite structures repair works (patch repair, bonded and bolted repair, scarf and step sanded ...) 4. To use appropriate workshop tools and machines and basic curing machines.

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ■ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	For all 8 days 1 hr.
Qualifications framework *Reference to EQF and NVQ*	4
Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals - referencesnumber: 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 14. Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

4. Syllabus (Template C)

The main theoretical content includes the topics of each unit (that are performed as lectures inside classroom). Therefore the literatures and the references in unit table as referred numbers from the list mentioned below.

Many references are used for more than one unit.

C. Syllabus template	Unit-1	
Title	**Energy and Energy efficiency**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to basics energy & energy efficiency (second law thermodynamics)	1	-
2. Energy and Energy efficiency issues, challenges, and trends	1	-
3. Composites materials & Energy Efficiency, and instruction concerning energy matters.	1	-
Unit assessment	0.25	
Duration - hours	3.25	-
Total unit duration	3.50 hrs. = 0.5 day	
Main hands-on content	NA	

C. Syllabus template	Unit-2	
Title	**Documentation and responsibilities ''Repair references, human factor and environment''**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Human Factors	1	-
2. Safety and environment	1	1.5
3. Documentation	3	2.5
4. Responsibilities and roles of composites team work	1	-
Unit assessment	0.5	
Duration - hours	6	4
Total unit duration	10.5 hrs. = 1.5 day	
Main hands-on content	Using documentation, evaluation, and mapping procedures. Presentation of workshop clean, sanding and storage rooms' environmental condition and awareness. Human factor, work team, and safety presentation in workshop and awareness together with documentation.	

C. Syllabus template	Unit-3	
Title	**Inspection of composite structures**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to lightweights and composite materials.	2	-
2. Composite Structures technology. 2.1. Composite structural design 2.2. Reinforcement fiber 2.3. Matrix system	3	5,5
3. Inspection techniques NDT	1,5	1,5
Unit assessment	0.5	
Duration - hours	6,5	7
Total unit duration	14 hrs. = 2 days	
Main hands-on content	Demonstration of composite fiber types, monolithic and sandwich structure complexity build up. Introduction and using non-destruction inspection NDT method and selection.	

C. Syllabus template	Unit-4	
Title	**Composite structures Repair process**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to composite structures repair	1	-
2. Composite repair process 2.1. Adhesives 2.2. Wet lay-up General 2.3. Prepreg General	2.5	10.5
3. Handling and storing materials	1	1
4. Equipment and facilities	1	1.5
5. Vacuum bagging	1	1
6. Heating devices	1	1
7. Machining of composite materials	1	3.5
Unit assessment	1	
Duration - hours	8.5	18.5
Total unit duration	28 hrs. = 4 days	
Main hands-on content	Monolithic structural repair, Build up monolithic structure and wet lay-up, sandwich construction structural repair. Perform sandwich panel repair with core replacement and perform edge matrix closing. Vacuum bagging different shapes procedure. Environment condition, tools use, hot bonder, basic heating devices, and facilities.	

5. References

1. Structural composites: Advanced composites in aviation, 2013, book by Avotek Information Resources, LLC. USA, www.avotek.com
2. Essentials of advanced composite fabrication & repair, by ABARIS training staff, 291 pages, published 2009 by Aviation Supplies & Academics ASA, Inc. www.asa2fly.com
3. Aviation Maintenance Technician Handbook –Airframe, volume 1, chapter 07, FAA – 2012.
4. Society of Automotive Engineers (SAE) Aerospace, SAE AIR4844B, Composites and Metal Bonding Glossary.
5. ARP5143: Vacuum Bagging of Thermosetting Composite Repairs
6. ARP5256: Mixing Resins, Adhesives and Potting Compounds
7. ARP5319: Impregnation of Dry Fabric and Ply Lay-Up
8. ARP5701: Lay-Up of Pre-Preg Composite Materials
9. Structural Repair Manuals SRM.
10. The Boeing Company DVDs, Advanced composite repair.
11. ARP 5089 Composite Repair NDT/NDI Handbook
12. ARP 5144 Heat Application for Thermosetting Resin Curing
13. AMS 2980A Technical Specification: Carbon Fiber Fabric and Epoxy Resin Wet Lay-Up Repair Material
14. AMS 3970 Carbon Fiber Fabric Repair Prepreg.
15. Training Manuel Unit-1: Energy and energy coefficient.
16. The Second Law of Thermodynamics.

Part D
Curriculum: Advanced Composite repair technician
EQF level 5

Part D
Curriculum: Advanced Composite repair technician
EQF level 5

1. Introduction

This general curriculum has been developed to identify the required knowledge and skills of a composite structure repair for **level EQF 5**.

The Curriculum is developed and common qualifications and competences are outlined according to EU standards based on learning outcomes and quality assurance framework (EQAVET, ECVET and EQF), adopting ICT and Open Educational Resources OER.

In the new curriculum developed, learning units that has cross national and industrial relevance are selected. And syllabuses are developed.

The new learning units as a part of the new curriculum are tested, evaluated and adjusted according to feedback from the participants during piloting process. Participants were trainees, technicians, and trainers in the field of composite repair

The new learning units are supported by, and linked to an Open Learning Resource (SKILLMAN website).

The curriculum is designed to meet the needs of a wide range of technician in the field of composite repair.

The training program is a short training course type.

According to SKILLMAN project goals, the training program curriculum are divided into 4 main blocks (units), based on ECVET principles, articulated in Units of Learning aggregating a limited number of Learning Outcomes, which should be described in terms of Competencies, Skills and Knowledge compliant with ECVET requirements and consistent with the European Qualification Framework EQF, adopting ICT and Open Educational Resources OER.

The unites titles of this level EQF-5 and previous levels EQF 3, EQF-4 have similar unit titles, but the differences between levels are the depth and complexity of knowledge and skills.

During curriculum designing, we focused on aviation sector, because composites science is very important in transport manufacturing sector, and we can consider that this curriculum is general composite structure repair curriculum.

It means that we can use these curriculums for any industrial sector (Wind mill, automotive, boats…), because the scientific principles and learning objects of these training curriculums contents, Composite structures repair, are similar for different application sectors (air-transport, wind energy, automotive sector, sea transport…), the difference is the application field and operation conditions of certain structure.

The learning outcomes of this training curriculum are similar for different applications, and may be used for any application within doing a minor change in part of content (The structure type and used documentation).

These training curricula give access to continuing and further training and work experience in other fields, for example wind mill maintenance, materials science application, boat structure maintenance, automotive structure application.

The duration of our Composite structure repair Training **EQF-5 is 12.5 days**, and we considered the training level is **EQF-5**, because the trainees have already level EQF-5 as Flight mechanic (or as technician finished level 4 and has an experience period), it means he/she has prior competence and skills at level 5 and experience in aircraft maintenance (**In General**). The 12.5 days training are aimed at improving, upgrading and updating the knowledge and skills of the trainees in the field of composite repair (Specifically).

In some cases, Training program as short training course may consider as continuing education and training and that means: (Cedefop)

Education or training after initial education and training – or after entry into working life – aimed at helping individuals to:

- improve or update their knowledge and/or skills;
- acquire new skills for a career move or retraining;
- continue their personal or professional development.

Regarding to EQF 5 Training program, and in some cases, according to European Centre for the Development of Vocational Training www.cedefop.europa.eu, EQF level 5 qualifications can be obtained through validation of work experience, as is the case in the Czech Republic or in Estonia. Validation of non-formal and informal learning generally plays an important role at this level in many countries. It enables the students/ trainee to acquire a qualification or it shortens the duration of a programme that leads to the award of a qualification. In France, BTS and DUT qualifications can also be obtained through the validation of prior experiential learning (validation des acquis de l'expérience) (VAE). In 2010, 66% of higher education qualifications acquired through validation were at EQF level 5, most as BTS.

The core of the EQF is its eight reference levels described in terms of learning outcomes. This enables the EQF to serve as a bridge between national qualification systems and the different subsystems these build on (general, vocational or higher education) and learning contexts (formal, non-formal and informal learning).

Validation of learning outcomes: The confirmation by a competent body that learning outcomes (knowledge, skills and/or competences) acquired by an individual in a formal, non-formal or informal setting have been assessed against predefined criteria and are

compliant with the requirements of a validation standard. Validation typically leads to certification.

2. Overall description of the qualification: (Aircraft maintenance license B1)

Introduction

According to European Aviation Regulation, the composite structure repair course (EQF level 3) is a section of the discipline Maintenance practices (one module of Total Training Course Program for qualification an **Aircraft maintenance license B1**)

In the aviation industry, according to **Part 66 - EASA** European Aviation Safety Agency regulation, the complete training program course of Aircraft mechanic B1 consists of 17 modules (school periods and practical training).

The training program EQF-3 is a part of module 7 – Maintenance practices, and this training program (Composite structure repair) is important section in the aircraft maintenance and flight safety now and future.

In this proposal training program curriculum EQF-5 is higher level than training level 3, it means the knowledge and skills contents are deeper and more complexity and meet EQF requirements.

Profile of skills and competences

The overall aim of the complete training program as an aircraft mechanic is that through school periods and practical training, the student gains knowledge and skills so that the conditions described in the Commission's Regulation (ER) No. 2042/2003 part-66 on the regulations for aircraft mechanics are fulfilled within the following general fields of competence. The qualified aircraft mechanic will be able to perform service, maintenance and commissioning of fixed-wing aircraft with turbine engines, single piston engines as well as helicopters with turbine engines and single piston engines.

An important part of the work is about checking the aircraft condition and reporting them as ready and without any damage before they are allowed to fly.

Duration and mode of education and training

The total duration of the education program is about 4½ years and up to 6 years, depending on type.

Vocational education and training program are alternating programs – dual training, which means that the education and training activities alternate between education and training at a school and on-the-job training in a company.

Level of certificate

According to Danish Educational System (www.ug.dk), The training program is a vocational education program which is placed in:

The Danish qualification framework for life-long learning at level: 5

European Qualification Framework (EQF) at level: 5

Following is the description of the curricula which is divided into four units.

Pre-requisites

For aviation sector:
Personnel with aircraft maintenance that holds a "B1" license and an experience period in the area of structure repair.

For general trainees:
Skilled structural repair technician with completion training level 4 and has experience period in the area of composite repairs.

Prior composite materials experience or training equivalent should be considered. Evaluation of prior education can be accomplished by examination of school transcripts, and/or by review of the training received through approved training providers.

Training duration

- The training curriculum is divided into 4 units.
- Training duration: about 84 hours during 12.5 days
- Total hours: about 84 hours
  - Classroom hours: 33,25 hours
  - Practical hours: 48,5 hours
  - Assessment hours: 2.25 hours

Assessment
For aviation the assessment is according to EASA-regulation. (European Aviation Safety Agency)

- Total assessment duration: 2.25 hours.
  - Unit-1 assessment: 15 minutes
  - Unit-2 assessment: 30 minutes
  - Unit-3 assessment: 30 minutes
  - Unit-4 assessment: 60 minutes
- Final assessment: A final assessment is a sum all units´ assessment.
- The assessment may be online assessment (multiple choice type) and open-book test consisting of questions that cover the knowledge of composite repair methods, materials, and procedures, and take in consideration the specific composite structures application.
- Grading: Trainee must have at least a 75 % overall average to pass the course.

A. Qualification template			
Title	**Advanced composite structures repair technician**		
Description	Inspects, and work with developing of repair solution of damaged composite structures based on approved engineering process requirements using hand and power tools, specialized equipment and materials.		
Thematic focus	Robotics	**Composite materials**	Wirelesss and Industry
Country	Denmark		
Occupations	Composite Repair technician		
Credit levels			
EQF compliancy		**EQF level 5**	
ECVET compliancy	12.5 days (tbc)		
Conditions	The training program is divided into 4 Units and the students have to pass all 4 in Succession		
Language	English		
Web page			
Assessment	In general the assessment will always follow the industry-specific requirements and it is possible for adjusting according to national, regional and local standards and practices.		

3. Curriculum

The training curriculum is divided into 4 units:

3.1 Unit-1

B. Curriculum template		
Module		
Unit of learning	**1. Energy and Energy Efficiency 2**	
Duration	3.5	Lessons hours: 3.25 Self-study hours: - Hands-on hours: - Other (please specify): - Assessment hours: 0.25
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Understanding Energy issues and role composite materials, and energy efficiency in composite manufacturing.	
Competences 1. Support acknowledge about the energy and energy efficiency issues in composites applications.		
Knowledge 1. To know basic concepts about energy and energy efficiency (second law of thermodynamics). 2. To know the Energy and energy efficiency issues and trends in manufacturing and production process. 3. Understand the impact of composite materials on energy efficiency		**Skills** 1. To follow the energy performance requirements and instructions during work tasks. 2. To use the required documentation system – manuals concerning energy matters.
Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):	
Assessment criteria *Description and timing*	0,25 hr.	
Qualifications framework *Reference to EQF and NVQ*	5	

Delivery methods	☐ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals (references numbers): 15, 16. Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.2 Unit-2

B. Curriculum template		
Module		
Unit of learning	**2. Documentation and responsibilities ''Repair references, human factor and environment'' 2**	
Duration	17.5	Lessons hours: 12 Self-study hours: - Hands-on hours: 5 Other (please specify): - Assessment hours: 0,5
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Dealing with different documentation, human safety and environmental risk procedures during teamwork with complicated composite repair.	

Competences
1. To work with the correct and latest amended reference system (according to the trade), and develop creative repair solutions.
2. To comply with the regulations and safety legislation during working at the workshop (work environment).
3. To be able to communicate and cooperate remotely with team members and other professionals, describing the technical characteristics of the damage.

Knowledge	**Skills**
1. To understand the architecture of the documentation system. 2. To know the specific safety requirements around composite materials. 3. To understand the environmental risks from work activities and protection methods. 4. To know the technical terminology. 5. To understand the importance of professional and organisational relationship and responsibilities.	1. To navigate in the documentation system – manuals (ex. Being able within the approved Structural Repair manuals SRM reference system or other approved OEM repair document to find the correct repair procedure). 2. To follow the safety requirements and instructions at the work place. 3. To work and develop creative repair solutions and suggestions. 4. To use technical language and terminology 5. To communicate in writing and orally on technical issues 6. To apply the organizational, interpersonal and communication skills

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	0,5 hr.
Qualifications framework *Reference to EQF and NVQ*	5
Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals (references numbers): 1, 2, 3, 4, 9 Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.3 Unit-3

Unit of learning	**3. Inspection of composite structures 2**	
Duration	18	Lessons hours: 6 Self-study hours: - Hands-on hours: 11.5 Other (please specify): - Assessment hours: 0,5
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Classification of composites and lightweights materials, avanced inspection of composite structure damages, and selection of suitable inspection methods.	
Competences 1. To differentiate between the different typologies and shapes of composite materials. 2. To carry out all inspection processes – search, detect and diagnose of structural failures. 3. To assess, estimate and classify damages for determination for further repairing process according to the working conditions. 4. To be able to give clearance after a routine check or composite changes (ex. birds strike, cracks, hits, lightening, corrosion etc.)		
Knowledge 1. To know basic lightweights and composite materials properties. 2. To know the composite materials technologies (composition, types, properties, application…) 3. To know the damages types and resources of composite structures. 4. To know the basic Non-Destructive Testing methods and application.		**Skills** 1. To determine the lightweights and composite materials properties, that required for the inspection process. 2. To follow instructions provided by approved technical documentation. 3. To navigate in the composite manual 4. To follow instruction in using the Non-Destructive-Test techniques (NDT) and assessment of their strengths and weaknesses.
Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ☐ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):	
Assessment criteria *Description and timing*	0,5 hr.	
Qualifications framework *Reference to EQF and NVQ*	5	

Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals (references numbers): 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 14. Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

3.4 Unit-4

Unit of learning	**4. Composite structures Repair process 2**	
Duration	45	Lessons hours: 12 Self-study hours: - Hands-on hours: 32 Other (please specify): - Assessment hours: 1
Number of ECVET Points *(if applicable)*		
Learning outcome *Number and title*	1. Select and execute on advanced composite structural repairs using required tools and machines and propose the optimal repair solution.	

Competences
1. To distinguish between the different ways of handling the composite material and doing it according to the safety requirements
2. To select and execute the right repairs method for failures eliminating according to technical manuals, and design organisation technical instruction.
3. To evaluate personal competence and skill limits, and where to receive assistance during maintenance.

Knowledge	**Skills**
1. To know the advanced composite materials repair (types, methods, processes…) 2. To know the machines and tools for composite repairing workshop. 3. To know about the basic relevant chemistry for composite structures. 4. To know the basic electrical and measurement instruments for composite structures. 5. To know the technical terminology	1. To handle and store different types of composite materials to standards. 2. To apply hands skills (sensory and physical demands). 3. To perform all composite structures repair works (patch repair, bonded and bolted repair, scarf and step sanded ...) 4. To use appropriate hand tools, instruments, and machines during repairing processes (drilling, cutting, curing equipment….)

Assessment methods *(Click appropriate box/s)*	☐ Written exercises and test ☐ Oral examination and exercises ☐ Practical assignment under supervision ■ Practical assignment autonomously and responsibly ■ Multiple choice ☐ Other activities (please specify):
Assessment criteria *Description and timing*	For all 12.5 days: 1 hr.
Qualifications framework *Reference to EQF and NVQ*	5
Delivery methods	■ Hands-on ■ Lectures/lessons/presentations ☐ Job-shadowing ☐ Placement ☐ Project work ☐ Role-play ■ Video tutorials ☐ Other activities (please specify):
Resources	Readings: Related reading materials and manuals (references numbers): 1, 2, 3, 5, 6, 7, 8, 9, 10, 11.12, 13, 14 Websites: www.skillman.eu Videos and tutorials: Open educational resources OER- Skillman

4. Syllabus

The main theoretical content includes the topics of each unit (that are performed as lectures inside classroom). Therefore the literatures and the references in unit table as referred numbers from the list mentioned below.

Many references are used for more than one unit.

C. Syllabus template	Unit-1	
Title	**Energy and Energy efficiency**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to basics energy & energy efficiency (second law thermodynamics)	1	-
2. Energy and Energy efficiency issues, challenges, and trends	1	-
3. Composites materials & Energy Efficiency, and instruction concerning energy matters	1	-
Unit assessment	0.25	
Duration - hours	3.25	-
Total unit duration	3.50 hrs. = 0.5 day	
The main content of the Hands on Exercises	NA	

C. Syllabus template	Unit-2	
Title	**Documentation and responsibilities ''Repair references, human factor and environment''**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Human Factors	1	-
2. Safety and environment	1.5	2
3. Documentation	8	3
4. Responsibilities and roles of composites team work	1.5	-
Unit assessment	0.5	
Duration - hours	12	5
Total unit duration	17.5 hrs. = 2.5 day	
The main content of the Hands on Exercises	Using Documentation, Evaluation, reporting and mapping procedures. Presentation of workshop Clean, Sanding and storage rooms' environmental condition and awareness. And understanding workshop build up requirements. Human factor, work team, and safety presentation in workshop and awareness together with safety documentation.	

C. Syllabus template	Unit-3	
Title	**Inspection of composite structures**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to lightweights and composite materials.	1.5	-
2. Composite Structures technology. 2.1. Composite structural design 2.2. Reinforcement fiber 2.3. Matrix system	3.5	10.5
3. Inspection techniques NDT	1	1
Unit assessment	0.5	
Duration - hours	6	11.5
Total unit duration	18 hrs. = 3 days	
The main content of the Hands on Exercises	Demonstrate advanced composite fiber types, monolithic and sandwich structure. Detailed introduction and using of non-destruction inspection method and selection.	

C. Syllabus template	Unit-4	
Title	**Composite structures Repair process**	
Topics	**Classroom hours**	**Laboratory and practical hours**
1. Introduction to composite structures repair	1	-
2. Composite repair process 2.1. Adhesives 2.2. Wet lay-up General 2.3. Prepreg General 2.4. Bolted 2.5. Post repair process	3.5	12
3. Handling and storing materials	1.5	2
4. Equipment and facilities	1.5	1
5. Vacuum bagging	2	7
6. Heating devices	1.5	6
7. Machining of composite materials	1	4
Unit assessment	1	
Duration - hours	12	32
Total unit duration	45 hrs. = 6.5 days	
The main content of the Hands on Exercises	Damage assessment and removal of damage per repair plan. Build up monolithic structure Glass and Carbon fibers with prepreg and wet lay-up, sandwich Panel fabrication, perform sandwich puncture repair with step sanding procedure, edge damage repair, core replacement and perform edge matrix closing. Perform a bolted repair. Perform a bonded metal to metal repair. Insert installation and sealant application. Use different types of bagging procedure. Use tools, hot bonder programing, heating devices, environment condition and facilities. Use main types of bagging procedure. Post repair evaluations and inspection (Cat. A, B, C) and documentation.	

5. References

1. Structural composites: Advanced composites in aviation, 2013, book by Avotek Information Resources, LLC. USA, www.avotek.com
2. Essentials of advanced composite fabrication & repair, by ABARIS training staff, 291 pages, published 2009 by Aviation Supplies & Academics ASA, Inc. www.asa2fly.com
3. Aviation Maintenance Technician Handbook –Airframe, volume 1, chapter 07, FAA – 2012.
4. Society of Automotive Engineers (SAE) Aerospace, SAE AIR4844B, Composites and Metal Bonding Glossary.
5. ARP5143: Vacuum Bagging of Thermosetting Composite Repairs
6. ARP5256: Mixing Resins, Adhesives and Potting Compounds
7. ARP5319: Impregnation of Dry Fabric and Ply Lay-Up
8. ARP5701: Lay-Up of Pre-Preg Composite Materials
9. Structural Repair Manuals SRM.
10. The Boeing Company DVDs, Advanced composite repair.
11. ARP 5089 Composite Repair NDT/NDI Handbook
12. ARP 5144 Heat Application for Thermosetting Resin Curing
13. AMS 2980A Technical Specification: Carbon Fiber Fabric and Epoxy Resin Wet Lay-Up Repair Material
14. AMS 3970 Carbon Fiber Fabric Repair Prepreg.
15. Training Manuel Unit-1: Energy and energy coefficient.
16. The Second Law of Thermodynamics.

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