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Alliance for Batteries Technology, Training and Skills

2019-2023

* Preparatory development of the education and training framework and choice of tools *

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Deliverable 6.2

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Preparatory development of the education and training framework and choice of tools

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Executive Summary

ALBATTS deals with the batteries and electromobility value chain, which is far from static and demands our constant and close attention.

This deliverable in the ERASMUS+ Sector Skills Alliances ALBATTS project is a visible result of the preparations of Work Package 6, Education and Training, while waiting for the sectoral Work Packages 3-5 to proceed enough for meaningful development of education and training structures in the project. A milestone will be reached with publishing the Sectoral Skill Strategy and Roadmap (D 3.6), which is published simultaneously.

In this report, we outline the ***drivers of change*** that have been identified, such as economic factors, globalisation, social and demographic change and emerging drivers of change. Furthermore, we go through recent ***European policies and initiatives***, as the *New Skills agenda*, the *EU Digital Action Plan*, the *EU recovery plan*, the *Council regulations on VET* from November 2020 and the recent accessibility regulations.

As ALBATTS is an EU-funded project, we see it as one of our missions to apply and use existing ***frameworks, instruments and tools on the European level.*** Therefore, we review USCED, EQF/NQF, EHEA, EURASHE, ECVET, and Key Competencies. In addition, we continue with more application-based issues: I-VET and C-VET; re-skilling and up-skilling; formal, non-formal and not-formal learning, work-based learning, transnational learning.

For each of these existing factors above, we have formed **a relevance comment text box** at the end of each subsection – reflecting over what this can mean for ALBATTS education development.

When we proceed to the art and practice of curriculum design, where we discuss writing of learning outcomes and objectives, modules and units and micro-credentials, we will also try to learn from **ongoing Blueprint projects** that started in 2017.

We will then move on with more global issues about **learning content design and creation**. First, the Open Educational Resources (OER) area is reviewed, including its legal implications of use and ways to handle that, such as the Creative Commons license. Tools for OER creation are also an important area and what software licenses and competencies to create OERs we already have within the partnership. We go through and comment on available sources of OERs, and how existing OERs can be adapted for various cases. A similar discussion is had

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about ***existing MOOCs*** and how these can be used, adapted, and even integrated into other courses. The next section handles possible ***MOOC creation*** within ALBATTS.

After this inventory of available factors and resources, we issue recommendations for our own remaining work in "relevance comments" text boxes after each subsection. This becomes a value-based transition from "is" to "should", which we have handled at three levels: What "**to watch"** closely (on rapidly developing issues), what to **"be aware"** of in work (as frameworks, instruments, legal matters of IPR) and what **"to do".**

Finally, we collect it all into a concluding **"approach"** consisting of 6 (4+2) pillars.

The document has seven appendices. Some are not our own work, but public records which are attached as a service to the reader.[1]

[1] Likewise, when we review EC policy initiatives, we are following original documents rather closely to not confuse readers with paraphrases and alternative terminology. Sources are given in footnotes.

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Introduction

In 2018, the European Commission adopted a Strategic Action Plan on Batteries[2] as a part of the Clean Mobility Package.[3] Until 2030 there are targets to reduce greenhouse emissions by at least 40% from 1990s level, and to reach at least a 32% share for renewable energy of the total energy production and at least 32,5% improvement in energy efficiency. This is a step toward becoming climate-neutral by 2050 and an essential part of the European Green deal and a part of the global commitment under the Paris agreement.

From this follows that a fully working and competitive value chain for batteries and electromobility in Europe is necessary. Europe has about 6 million direct jobs in the vehicle and electromobility sector, producing about 18 million vehicles.[4] If side-effects on jobs are included, the automotive industry employs approximately 12,6 million Europeans or 6.6% of the working population. There will be many changes in this value chain. The core issue is the production of battery cells for an increasing number of cars; in 2030, about 30 million vehicles in Europe will run without traditional combustion fuels. In Asia, the production of Li-Ion batteries has been ongoing and maturing for decades, while Europe has imported batteries.

For the direct cell production with large production units, *gigafactories*, featuring mainly European experience and competence, must be built up during a very short time of considerable industrial transition. This production is complex, energy-demanding, and highly IT-dependent, of type “Industry 4.0”. Presently, about 38 cell gigafactories are being built or planned all over Europe.[5] Some of these are placed in sparsely populated areas close to green energy production, as in the Nordic countries, where there is a lack of workforce overall for these massive activities. Other factories are growing up closer to car manufacturing plants in

[2] European Commission (2019) Report from the Commission...on the Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/strategic-action-plan-batteries-report Accessed 16-11-2021

[3] European Commission (2019) Europe on the Move: Commission completes its agenda for safe, clean and connected mobility. Press release. https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_18_3708/IP_18_3708_EN.pdf Accessed 28-11-2021

[4] Electromobility: a green boost for European automotive jobs? Web resource. https://www.platformelectromobility.eu/2021/04/14/webinar-electromobility-a-green-boost-for-european-automotive-jobs/ Accessed 28-11-2021

[5] https://insideevs.com/news/517931/europe-plans-38-battery-factories/ Accessed 16-11-2021

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continental Europe and demand a massive up- and reskilling of people.[6] Public education on adult and higher education levels will be essential in both cases besides up- and reskilling.

The European Commission's Vice President Šefčovič estimated in a press conference in March 2021 that "by 2025, the growing skills shortage could amount to 800 000 jobs" across the entire value chain.[7] The need for expertise and engineers is obvious, but it is important to note that many of these jobs are blue-collar ones. In a typical gigafactory, as the in 2021 opening Northvolt Ett in Skellefteå, Sweden, these jobs will count about 75-80% of the workforce. The education and training needed are not in place yet, especially for the lower education levels. In the higher education sector, the present education volumes are not big enough to meet future demand of electrochemists and other critical expertise.

The commission has worked with several policies, programs recommendations, and provision of tools to make European education competitive, agile, and flexible to meet tomorrow's industry's rapid societal changes and needs. These are the New Skills agenda, the EU Digital Action plan, the EU recovery Plan and the Council Recommendation 2020 on Vocational Education and Training (VET) for Sustainable competitiveness, social fairness and resilience. As a result, some governments have made changes to meet the challenges for the future, while systems in other countries are still very rigid and regulated only with room for slow changes.

In the ERASMUS+ Sector Skills Alliances ALBATTS project 2019-2023, the focus has so far been first on sectoral intelligence and sectoral skills strategy, a work that continues. This answers the question, "What is going on?" The work of WP6 (Education and training work package) is to build on this work to address the challenges and skills gap detected in various ways, to the assistance of European national educational systems and other education and training providers.

This report aims to research, develop, and design a framework and a set of tools for the education and training framework developed within WP6. It will also propose the digital tools and OER´s to be recommended for educators and, in addition, the development of training

[6] https://www.acea.auto/message-dg/reskilling-billions-of-euros-to-be-mobilised-for-making-europes-automotive-workforce-future-proof/ Accessed 28-11-2021

[7] Speech by Vice-President Šefčovič at the press conference following the 5th high-level meeting of the European Battery Alliance https://ec.europa.eu/commission/presscorner/detail/en/speech_21_1142 Last accessed 16-11-2021

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courses, modules and materials within the project. This report D6.2. lays the foundation for the development within WP6 for Definition and EU-wide recognition of new and emerging job roles and skills (6.3), Curricula, curriculum analysis, learning objectives, validation options and course/module creation for all levels (6.4), Creation/adaption of curricula/training course content based on OER (6.5), Pilots, demos and deliveries of developed courses and training modules and evaluation (6.6), Train the trainer (6.7) and finally the Strategy for education and training in the Batteries sector (6.8)

This report is structured in the following way.

In chapter one, we describe the methodology of the report.

In chapter two, we discuss drivers of change affecting education, training and the world of work. Finally, we describe different EU policies and programs and their relevance for this project and the battery sector.

Chapter three evaluates the state-of-the-art of existing frameworks, instruments and tools, and other relevant factors to consider, such as different types of education, different ways of learning, and different types of learners. In this chapter, we also discuss Curricula design and best practices of other Blueprint Erasmus+ projects.

In chapter four, we map and explore the state-of-the-art of available OER skills and tools.

Chapter five analyses the relevance and pros and cons for ALBATTS and the battery sector of what has been discussed previously in this project.

The final choice of tools is presented in chapter 6, and will show a unified methodology, a selection of applications and tools, and a choice of structure and format for content modules to be used within this project.

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List of Abbreviations and definitions[8]

AI – Artificial Intelligence

EAfA - European Alliance for Apprenticeships

AR – Augmented Reality

AMT - Advanced Manufacturing Technologies

CC - Creative Commons

CEDEFOP - European Centre for the Development of Vocational Training

COOC - Corporate Open Online Course

COOP - Cooperative Education (in higher education)

CVET – Continuous Vocational Education and Training

DEQAR - Database of External Quality Assurance Results

DS - Diploma Supplement

DOCCs - are delivered by a consortium of universities that jointly design course content while organising lectures and adapting the course material according to each particular educational setting

EC - European Commission

ECTS – European Credit Transfer System

ECVET - European Credit System for Vocational Education and Training

EHEA - European Higher Education Area

ENIC - European Network of Information Centres in the European Region

ENQA - European Association for Quality Assurance in Higher Education

EUA - European University Association

EQAR - European Quality Assurance Register for Higher Education

EQAVET - European Quality Assurance Reference Framework for Vocational Education and Training

ESCO - European Skills, Competencies, Qualifications and Occupations

ESG - European Standards and Guidelines for Quality Assurance of Higher Education

EQF – European Qualifications Framework

[8] An important source of these definitions is the *Glossary of terms - Common terms | Erasmus+*. https://erasmus-plus.ec.europa.eu/programme-guide/part-d/glossary-common-terms , so these are nearly citations. They are however important to include, as this document is also a handbook for the partners work.

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HE – Higher Education

ICT - information and communication technology

IEEE - Institute of Electrical and Electronics Engineers

IMS – Innovation Management System

IoT - Internet of Things

ISCED - International Standard Classification of Education (by Unesco)

IVET – Initial Vocational Education and Training

LMS – Learning Management System

LO – Learning Outcome

LOM - Electromagnetic listening devices

LTSC - The Long-Term Servicing Channel (Windows)

MOOC - Massive Open Online Course

NARIC - National Academic Recognition Information Centres in the European Union

NOOCs - Nano Open Online Courses

NRPs -National Reference points

NQF – National Qualification Framework

OER - Open Educational Resources

PDCA - Plan-Do-Check-Act cycle

PHE - Professional Higher Education

QFs – Qualification Frameworks

SCL – Student Centred Learning

SCORM - Sharable Content Object Reference Model

SEQF - Swedish reference frame for Qualifications

SPOC - Small Private Online Course

STEM - science, technology, engineering and mathematics

UAS - Universities of Applied Science

VET – Vocational Education and Training

VR – Virtual Reality

WBL - Work-based learning

XR – Mixed Reality

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The following definitions[9][10][11] were gathered to build a common understanding of the education and training terms used by the ALBATTS project. Thus, it includes not only terms mentioned in this report but also other terms that may be important for the following Work package 6 tasks and activities:

Basic skills

Literacy, mathematics, science and technology; these skills are included in the key competencies.

EQF (European Qualifications Framework)

EQF is a common European reference tool that serves as a translation device between different education and training systems and their levels. It aims to improve the transparency, comparability and portability of qualifications across Europe, promoting workers' and learners' mobility and facilitating their lifelong learning, as defined in the 2008/C 111/01 Recommendation of the European Parliament and the Council.

ESCO (multilingual classification of European Skills, Competencies, Qualifications and Occupations)

ESCO identifies and categorises skills and competencies, qualifications and occupations relevant for the EU labour market and education and training in 25 European languages. The system provides occupational profiles showing the relationships between occupations, skills, competencies and qualifications. ESCO has been developed in an open IT format and can be used by anyone free of charge.

Europass

The Europass online platform, an action of the European Skills Agenda, provides individuals and organisations with web-based tools and information on learning opportunities,

[9] https://ec.europa.eu/programmes/erasmus-plus/programme-guide/part-d/glossary-terms-common-terms_en (visited in 01.10.2021)
[10] https://erasmus-plus.ec.europa.eu/programme-guide/part-d/glossary-vet (visited in 01.10.2021)
[11] European Commission/EACEA/Eurydice, 2020. The European Higher Education Area in 2020: Bologna Process Implementation Report. Luxembourg: Publications Office of the European Union.

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qualifications frameworks and qualifications, guidance, skills intelligence, self-assessment tools and documentation of skills and qualifications, and connectivity with learning and employment opportunities.

The Europass platform also offers tools and software to support digitally-signed credentials, as announced in the Digital Education Action Plan. The platform interconnects with national data sources for learning opportunities and national qualifications databases or registers.

Informal learning

Informal learning refers to the learning in daily life activities, in work, with peers, etc. It is mainly learning by doing, is not organized or structured in terms of objectives, time or learning support, and it may be unintentional from the learner's perspective. In the youth sector, informal learning can take place in youth initiatives, in peer-group discussions, through voluntary activities, and in various other situations.

Key competencies

The basic set of knowledge, skills and attitudes which all individuals need for personal fulfilment and development, as active citizenship, social inclusion and employment, are described in the Council Recommendation of 22 May 2018 on key competencies for lifelong learning.

Learning outcomes

Statements of what a learner knows, understands and can do on completion of a learning process, which is defined in terms of knowledge, skills, and competence.

Life-long learning

All general education, vocational education and training, non-formal learning and informal learning undertaken throughout life, resulting in an improvement in knowledge, skills and competencies or participation in society within a personal, civic, cultural, social or employment-related perspective, including the provision of counselling and guidance services.

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Micro-credential

A micro-credential is recognised proof of the learning outcomes that a learner has achieved following a short learning experience, according to transparent standards and requirements and upon assessment.

The proof is contained in a certified document that lists the name of the holder, the achieved learning outcomes, the assessment method, the awarding body and, where applicable, the qualifications framework level and the credits gained. Micro-credentials are owned by the learner, are shareable, portable and may be combined into larger credentials or qualifications.

MOOC

The abbreviation “MOOC” stands for "Massive Open Online Course", a type of course that is completely delivered online and is open to be accessed by anyone without cost, entry qualifications, or other restrictions; participant numbers are often high. These courses can have in-person components, e.g. encouraging local participant meetings and formal assessment, but use peer review, self-assessment and automated grading. There are many variations of MOOCs, focused on specific sectors, target groups (e.g. vocational focus, teachers, etc.) or teaching methods. MOOCs funded under Erasmus+ have to be open to all, and both the participation and a certificate or badge of completion are free of charge for participants. The open-access requirement for educational resources also applies to MOOCs and other complete courses.

Non-formal learning

Non-formal learning refers to the learning which takes place outside the formal educational curriculum. It has a participative and learner-centred approach; it is carried out by learners on a voluntary basis and therefore is closely linked to young people's needs, aspirations and interests. By providing an additional source and new forms of learning, such activities are also important means to improve the attainment in formal education and training as well as to address young NEETs (i.e. young people not in employment, education or training) or young people with fewer opportunities and combat social exclusion.

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Occupational profile

An occupational profile is a set of skills, competencies, knowledge, and qualifications usually relevant for a specific occupation.

Open Educational Resources (OER)

OERs are educational materials of any kind (e.g. textbooks, worksheets, lesson plans, instructional videos, entire online courses, educational games) which can be freely used, adapted and shared. OERs have either been released under an open licence or are in the public domain (i.e. copyright protection has expired). Cost-free materials that cannot be adapted and shared by the public are not OERs.

Open licence

An open license is a way for copyright holders (creators or other rightsholders) to grant the general public legal permission to use their work freely. Under the Erasmus+ Open Access Requirement, any such open license must permit at least use, adaptation and distribution. The open license should be indicated on the work itself or wherever the work is distributed. Educational materials with an open license are called Open Educational Resources (OERs).

Peer Learning

Peer learning is a reciprocal learning activity, which is mutually beneficial and involves the sharing of knowledge, ideas and experience between the participants. Peer learning practices enable them to interact with other participants, their peers, and participate in activities where they can learn from each other and meet educational, professional or personal development goals.

Qualification

A formal outcome of an assessment and validation process is obtained when a competent body determines that an individual has achieved learning outcomes to given standards.

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Traineeship (work placement)

Time spent in an enterprise or organisation in another country, acquiring specific competencies needed by the labour market, gaining work experience, and acquiring more understanding of the economic and social culture of that country.

Transversal (soft; life) skills

Include the ability to think critically, be curious and creative, to take the initiative, to solve problems and work collaboratively, to be able to communicate efficiently in a multicultural and interdisciplinary environment, to be able to adapt to the context and to cope with stress and uncertainty. These skills are part of the key competencies.

Validation of non-formal and informal learning

A process of confirmation by an authorised body that an individual has acquired learning outcomes measured against a relevant standard and consists of the following four distinct phases:

1. Identification through a dialogue of particular experiences of an individual;
2. Documentation to make visible the individual's experiences;
3. A formal assessment of these experiences; and
4. Certification of the results of the assessment, which may lead to a partial or full qualification

Apprenticeship (Apprentice)

Apprenticeship-type schemes are understood as those forms of Initial Vocational Education and Training (IVET) that formally combine and alternate company based training (periods of practical work experience at a workplace) with school-based education (periods of theoretical/practical education followed in a school or training centre), and whose successful completion leads to nationally recognised initial VET qualifications.

EQAVET (European Quality Assurance Reference Framework for Vocational Education and Training)

A reference tool for policy-makers based on a four-stage quality cycle that includes goal setting and planning, implementation, evaluation and review. It respects the autonomy of

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national governments and is a voluntary system to be used by public authorities and other bodies involved in quality assurance.

Vocational education and training (VET)

VET is education and training which aims to equip people with knowledge, know-how, skills or competencies required in particular occupations or, more broadly, on the labour market. For the purpose of Erasmus+, projects focusing on initial or continuing vocational education and training are eligible under VET actions.

Work-based learning

Work-based learning is the acquisition of knowledge and skills through carrying out – and reflecting on – tasks in a vocational context, either at the workplace (such as alternance training) or in a vocational education and training institution.

Credit (ECTS)

ECTS credits express the volume of learning based on the defined learning outcomes and their associated workload. 60 ECTS credits are allocated to the learning outcomes and associated workload of a full-time academic year or its equivalent, which normally comprises several educational components to which credits (based on the learning outcomes and workload) are allocated. ECTS credits are generally expressed in whole numbers (European Commission, 2015b, p. 68).[12]

Credit transfer/Transfer of credits

The process of having credits awarded in one context (programme, institution) recognised in another formal context to obtain a qualification. Credits awarded to students in one programme may be transferred from an institution to be accumulated in another programme offered by the same or another institution. Credit transfer is the key to successful study mobility. Institutions, faculties, departments may make agreements that guarantee automatic recognition and transfer of credits (European Commission, 2015, p. 68).

[12] ECTS users' guide - European Commission. https://ec.europa.eu/assets/eac/education/ects/users-guide/glossary_en.htm

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European Credit Transfer and Accumulation System (ECTS)

ECTS is a learner-centred system for credit accumulation and transfer, based on transparency of the learning, teaching and assessment processes. Its objective is to facilitate the planning, delivery and evaluation of study programmes and student mobility by recognising learning achievements and qualifications and periods of learning (European Commission, 2015b, p. 69).

Formal learning

Formal learning means learning in an organised and structured environment, specifically dedicated to learning, and typically leads to the award of a qualification, usually in the form of a certificate or a diploma. It includes systems of general education, initial vocational training and higher education.[13]

Higher education institution (HEI)

An HEI is an institution providing services in higher or tertiary education, as defined by national law.

[13] Valikom: FAQ. https://www.validierungsverfahren.de/en/inhalt/process/faq/

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1 Methodology

This section provides an overview of the methodological approach (Figure 1) used to describe the education and training framework and tools chosen for a unified methodology describing curricula, educational programs, modules and learning outcomes for defined skills needs/job role definitions provided by WP3, WP4 and WP5. It will also provide the methodological approach to work design on course plans and educational modules.

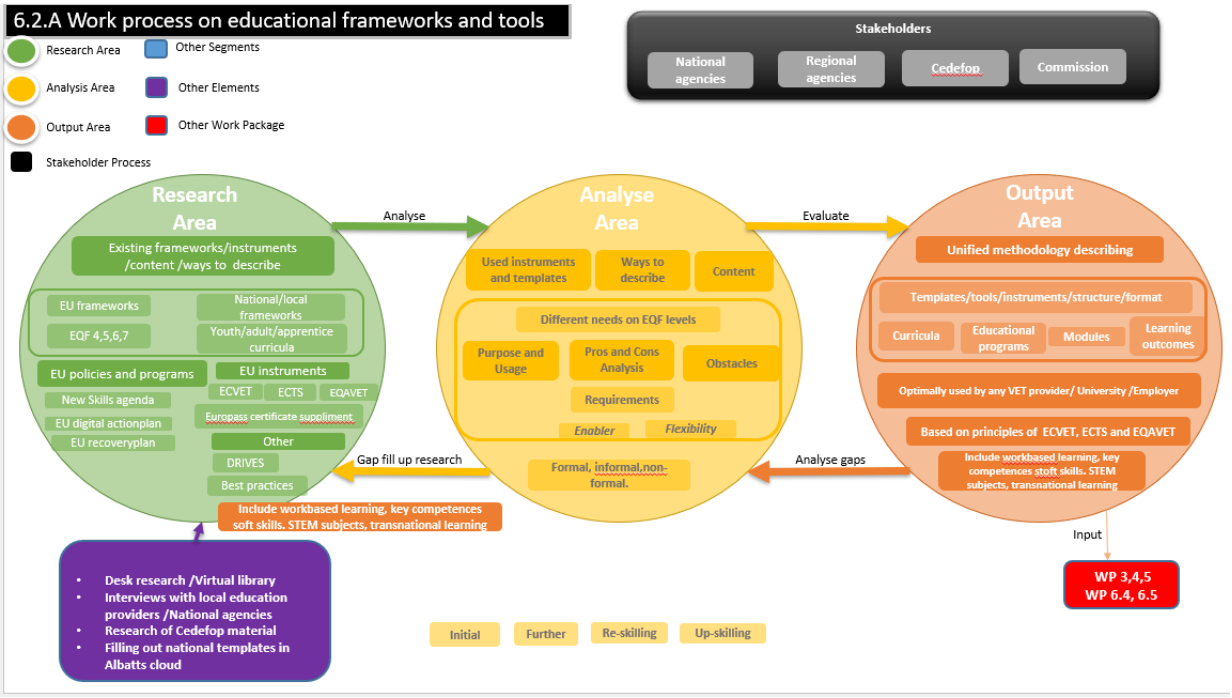

Figure 1 The Work process on educational frameworks and tools

Figure 2 shows the methodological approach to mapping and choice of Open Educational Resources (OERs) (such as metadata labels, modular granularity) and ICT-enabled adaptive learning tools to be used in 6.4 and 6.5.

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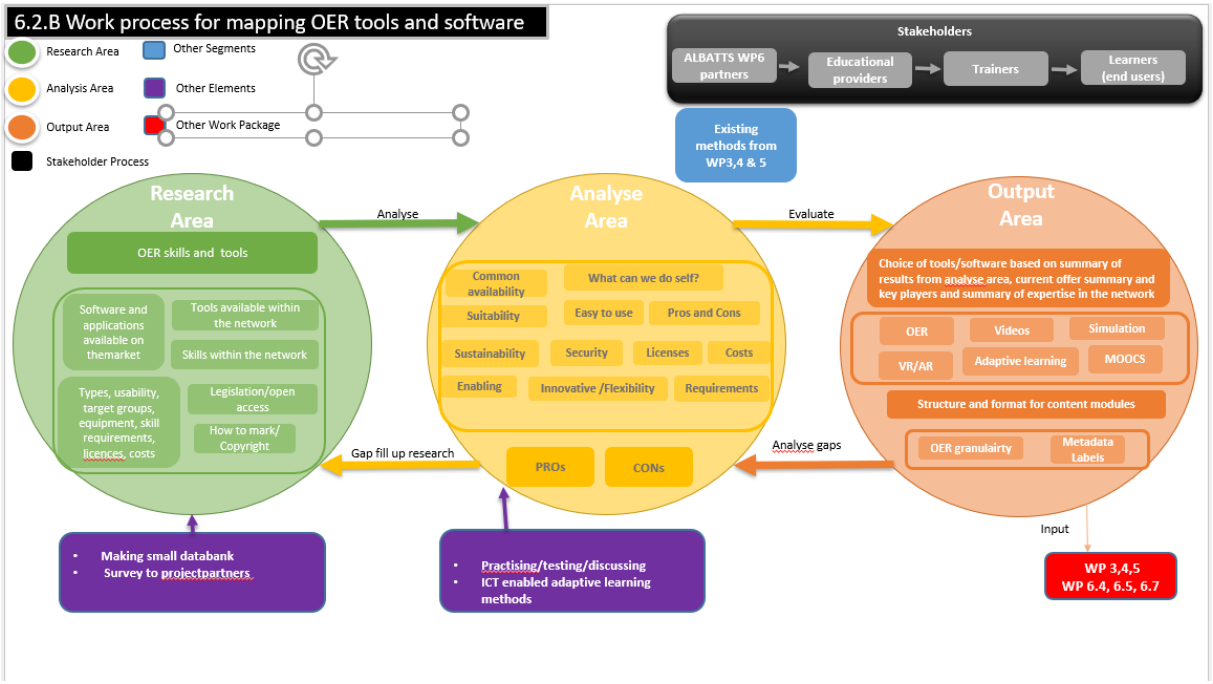

Figure 2 The Work process for mapping OER tools and software

Any European framework and instrument that may be relevant for the ALBATTS blueprint has been considered and analysed for how they can benefit the development of education within the battery sector in Europe. In addition, drivers of change that will affect the employment market and thereby the needs of education have been analysed.

1.1 PURPOSE OF THE DOCUMENT

The purpose of this document is to describe and discuss factors that need to be taken into consideration in the development of a unified methodology. We describe curricula, educational programs, modules and learning outcomes that VET providers, universities can optimally use, and employers in the EU within the battery sector. These are existing EU policies, initiatives and tools, reports from CEDEFOP, national frameworks, and factors such as drivers of change affecting the education sector. As ALBATTS is a European project, the education soft policy instruments will be used as far as possible, but not beyond the reasonable if our work leads us to other perspectives.

It will also describe and discuss the State of Art of available OERs and tools that can be used for making online courses for different types of learners and levels, taking factors such as pros and cons, flexibility, sustainability and legal issues into consideration.

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1.2 APPROACH TO RESEARCH - COHERENCE WITH OTHER WORK PACKAGES

As mentioned above, this document will describe a unified approach and methodology to describe modules and learning outcomes for defined skills needs, job roles and overall skills intelligence gathered in the WP3-5. If there is a need for entire new curricula and educational programs, we will describe them and give recommendations. Also, drivers and general needs in the education sector will be described to meet tomorrow's needs.

WP3 is the umbrella work package that encapsulates WP4 and WP5. All three work packages follow the same methodology when it comes to sectoral intelligence gathering. WP3 focuses on the overall EU battery sector, WP4 on the stationary and other industrial applications of batteries and WP5 focuses on the mobile applications of batteries.

WP3-5 will provide a picture of the following:

(1) Skills/competence and knowledge needs;

(2) Current and upcoming job roles;

(3) Main factors, trends and drivers of change in industry and society;

(4) Education findings with detailed skill/competence and knowledge concepts and job profiles;

(5) Approach to education, re-skilling and up-skilling - best practices;

(6) Challenges of the EU battery sector;

(7) Concrete statements and data;

(8) Needs of the major players in the sector.

All these inputs will be constantly fed into the WP6 for further work and updated every year during the project.

1.3 COHERENCE WITH OTHER WP6 TASKS

This 6.2 report has a close coherence with all the other work package 6 tasks as it lays the foundation for what is required to take into consideration in the other tasks together with input produced by work packages 3-5. This can be seen in Figure 3 that shows how all the tasks interact with each other. Task 6.2 outputs will be used for the upcoming work from ALBATTS work package 6 – Education and Training and is most important for setting the pillars for a successful education and training strategy in the Batteries for the electro-mobility sector.

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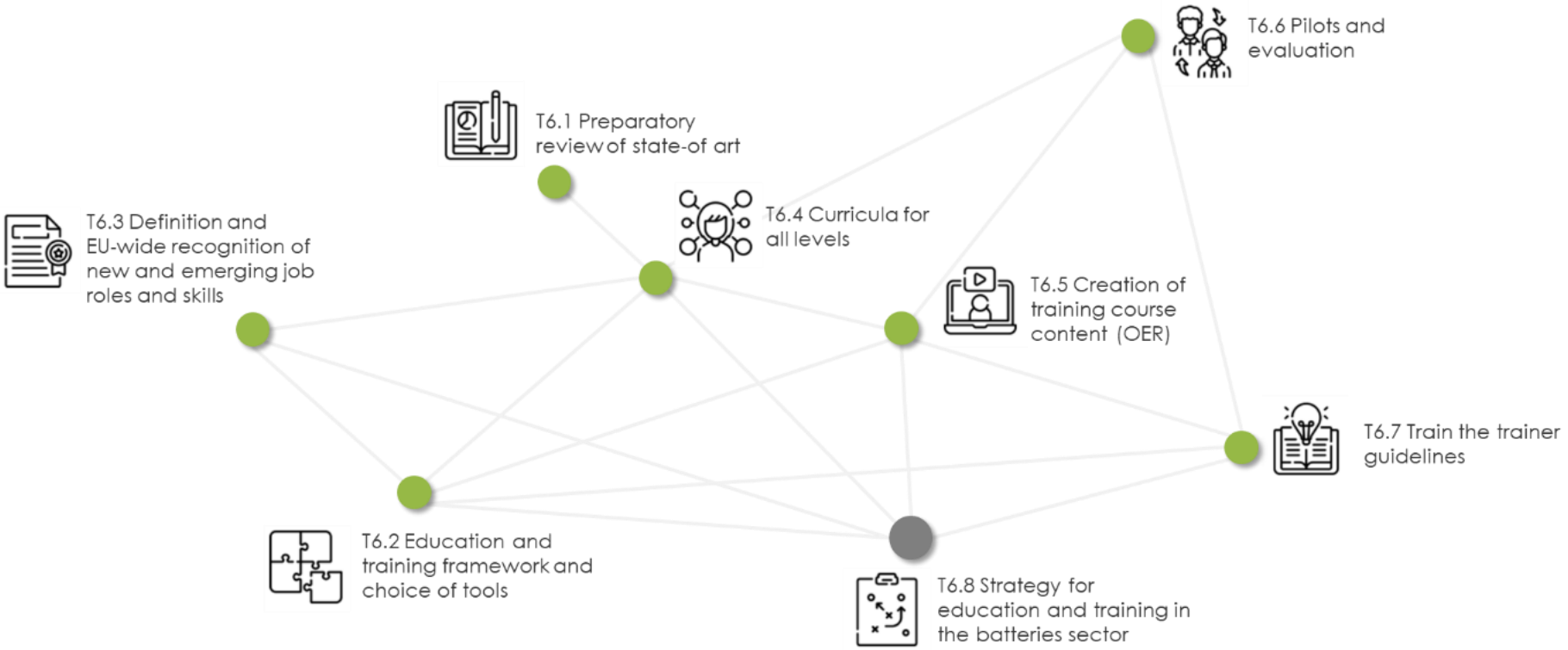

Figure 3 Work package 6 Training and Education structure

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This task is divided into two different parts:

a) methodology for the design of learning outcomes, modules and educational programs

Researching on existing EU and national frameworks and tools for the education and training sector allowed the definition of a unified methodology. This includes structure and formats for the design of learning outcomes, modules and educational programs within task 6.4, aligned with existing frameworks, thus facilitating wide recognition, which will be deeply worked in task 6.3.

At the same time, it was decided to develop a common Education and Training terminology to guarantee coherence inside the consortium and clarify ALBATTS terminology for all stakeholders using ALBATTS Education and Training outputs.

b) choice of tools/software

Based on partner's skills and tools available to work with OER and adaptive learning, as well as other ICT-enabled adaptive learning tools, together with the findings from WP3 on existing methods, partners chose the tools/software and defined the necessary structure and formats for the development of OER and adaptive learning solutions in task 6.5, as appropriate, and developed a guide on how to blend ICT into the teaching process. The latter will be integrated with the train the trainer guidelines, to be developed under task 6.7.

Both the methodological approach and the tools to be used in the definition of curricula and development of education and training programs for the battery sector will be central elements for the ALBATTS education and training framework and strategy (blueprint) in the Batteries for the electro-mobility sector to be delivered under task 6.8.

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2 Drivers of change affecting education and training

We define "Drivers of Change" as external and internal forces that compel companies, industries, or sectors to modify their actions. This includes a change to strategy, plans, designs, product, service, and operations. Drivers of change are also affecting education, the world of work and the labour market.

Technological, environmental, and demographic changes, alongside globalisation, are changing the nature of work, the content of jobs, and the demand for training. For the European Union (EU) to be competitive, it effectively has to adapt to these changes so that skills shortages do not inhibit growth. As a result, individuals are equipped with the skills needed to avoid the risk of job loss. In this sector, there are many jobs at stake; by competition with the US and Asia, by structural changes caused by electric vehicles being different from ICE vehicles in both manufacturing and service and need of fewer workers, and by new jobs emerging in the battery sector and in new applications made possible by electrification. EC vice president Vice-President Maroš Šefčovič recently estimated 800 000 new jobs in the battery value chain by 2025, and that the battery and electromobility transformation will in all include 3-4 million European jobs.[14]

Vocational Education and Training (VET) is one basic way individuals acquire skills, especially young people. At the same time, adults on an ongoing basis will have to participate in professional development and learning by upskilling and reskilling to adapt to the fast change.[15]

At the same time, some events may seem unlikely at present but could occur and are likely to bring about disruptive changes, such as the COVID19 outbreak.[16] Thus, they are obstacles to expected development in one sense but may also increase it in interesting ways.

The chosen drivers of change are the economy, globalization, social- and demographic and technological change. This categorisation is based on CEDEFOP's report "Vocational education

[14]Keynote speech by EC vice president Vice-President Maroš Šefčovič at the Battery Summit in Portugal March 22nd, 2021 https://ec.europa.eu/commission/commissioners/2019-2024/sefcovic/announcements/keynote-speech-vice-president-maros-sefcovic-battery-summit-portugal_en Accessed 22-03-2021

[15]Hogarth, T. (2019) Skills for the labour market: EU policies for VET and upskilling. European Parliament Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/638431/IPOL_BRI(2019)638431_EN.pdf Accessed 22-03-2021

[16]https://www.eea.europa.eu/publications/drivers-of-change visited Accessed 22-03-2021

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and training in Europe 1995-2035".[17] For this report, we decided to add EU policies and programs as one additional driver of change, affecting the whole sectoral education and training systems.

Relevance comment for the ALBATTS project:

To make a sustainable but at the same time flexible methodological approach to educational design in the battery sector, it is important to be aware of both internal and external factors affecting change both in the battery sector and within training and education. In addition, it is important to analyse and utilise existing EU frameworks and tools as this will facilitate the implementation of ALBATTS results on national levels, further development on an EU-level, and facilitate mobility and the recognition of skills across Europe.

2.1 ECONOMY

Improvements in workforce skills are essential for European countries to achieve higher economic growth rates and compete effectively against other advanced industrial nations.[18]

Skills mismatches are a growing concern in the EU, even though the characteristics and severity of the problem vary across member states, economic activities, and occupations. Skills mismatches are widely recognised as a factor that drags down on potential economic growth. The consensus among companies is that "finding suitable employees used to be easier, is currently hard and will become increasingly difficult in the future"[19] .Companies face difficulties when trying to find highly qualified workers. They usually need more than 90 days to fill positions for professionals and managers, technicians, or associate professionals.

[17]CEDEFOP (2020) Vocational education and training in Europe, 1995-2035. Cedefop reference series 114. Luxembourg: Publications Office of the European Union, 2020 https://www.cedefop.europa.eu/files/3083_en.pdf, visited 22-11-2021

[18]Mason, G., Holland, D., Liadze, I., O'Mahony, M., Riley, R., & Rincon-Aznar, A. (2014). Macroeconomic benefits of vocational education and training. Cedefop Research Paper, 40. https://www.cedefop.europa.eu/files/5540_en.pdf visited 22-11-2021

[19]Nikolov, A., Nikolova, D., Ganev, P., & Aleksiev, Y. (2018). Skills Mismatches. An Impediment to the Competitiveness of EU Businesses. Brussels: European Economic and Social Committee. https://www.eesc.europa.eu/sites/default/files/files/qe-02-18-922-en-n.pdf visited 22-11-2021 https://www.eesc.europa.eu/en/news-media/press-releases/skills-mismatches-eu-businesses-are-losing-millions-and-will-be-losing-even-more visited 22-11-2021

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Efficient education practices and the further emphasis on lifelong learning are key to the movement of labour between different industries. This enables flexibility on the labour supply side in the face of rapid technological advances and international competitive pressure. In addition, validation of skills acquired outside formal education systems will support labour mobility and help reduce skills mismatches.[20]

The growth of temporary and part-time employment and the "gig economy" has been a trend since 2000. Between 2002 and 2017, the share of temporary employees in the EU increased from 11% to 13%, and the share of people working part-time rose from 15% to 19%, most of these being women. The question is how to deliver VET efficiently and effectively into workplaces where temporary and part-time employment is growing in importance or are already the dominant mode of employment.

Relevance comment for the ALBATTS project:

To meet the industry needs and the mismatches in the employment market, a flexible training methodology for the learner and the training provider is needed. It should enable reskilling and up-skilling through lifelong learning and easy validation of prior learning. In addition, methods and tools independent of place and time also reach the increasing number of part-time workers and people working in shifts should be emphasised. These persons may not be able to or may not be entitled to participate in traditional training times, or may not be offered training by the employer at all. Digital learning independent of time and place can be a solution.

2.2 GLOBALISATION

The world is becoming increasingly interconnected through the flows of information, resources, goods and services, people and ideas. This implies that changes occurring in one part of the world are likely to have a ripple effect on others. As a result, Europe is highly intertwined with the rest of the world today, more than ever before.[21]

[20]Nikolov, A., Nikolova, D., Ganev, P., & Aleksiev, Y. (2018). Skills Mismatches. An Impediment to the Competitiveness of EU Businesses. Brussels: European Economic and Social Committee. https://www.eesc.europa.eu/sites/default/files/files/qe-02-18-922-en-n.pdf visited 22-11-2021

[21]Benini, L., & Viaud, V. (2020). Drivers of Change of Relevance for Europe's Environment and Sustainability. European Environment Agency, Luxembourg, European Union, https://www.eea.europa.eu/publications/drivers-of-change visited 22-11-2021

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The cross-border flow of capital, goods, services, people and ideas, together with rapid technological developments, transforms occupations and the skills needed in the labour market. New jobs are created while some skills are becoming obsolete. This creates pressure on vocational education to respond quickly to changing skill needs and to renew qualification requirements, training programs and curricula.[22]

Globalisation also has consequences for the internationalisation of the workforce, with multinational corporations setting the same skills and training standards for their employees irrespective of their location. Competing in this globalised economy has increased the need for Europe to become a single, united entity with regards to the supply of labour.[23]

Smooth labour migration within the EU and targeted migration from third countries are instrumental in addressing the skills mismatches issue and labour shortages in general. [24]

Immigration provides a means for some countries to meet their employment and skill demands, but there is a considerable variation between countries. The extent to which such people might provide a source of skills supply varies substantially by country.[25]

Migration causes the need to develop education programmes that help migrants upgrade their knowledge and skills and improve multicultural skills; it also increases the demand for the recognition of prior experience. Furthermore, the presence of multinational companies in local labour markets and the increased geographic mobility of workers increase the need for foreign language and intercultural skills such as working in a multicultural environment. It is not unusual that there are closer to 100 different nationalities working in gigafactories and that the general language of conduct is English. In addition, life and career skills (flexibility,

[22]Cedefop (2018). Globalisation opportunities for VET: how European and international initiatives help in renewing vocational education and training in European countries. Luxembourg: Publications Office. Cedefop research paper; No 71. http://data.europa.eu/doi/10.2801/425244 https://www.cedefop.europa.eu/files/5571_en.pdf Accessed 22-11-2021

[23]CEDEFOP (2020) Vocational education and training in Europe, 1995-2035. Cedefop reference series 114. Luxembourg: Publications Office of the European Union, 2020 https://www.cedefop.europa.eu/files/3083_en.pdf , visited 22-11-2021

[24]Nikolov, A., Nikolova, D., Ganev, P., & Aleksiev, Y. (2018). Skills Mismatches. An Impediment to the Competitiveness of EU Businesses. Brussels: European Economic and Social Committee. https://www.eesc.europa.eu/sites/default/files/files/qe-02-18-922-en-n.pdf visited 22-11-2021

[25]Cedefop (2018). The changing nature and role of vocational education and training in Europe. Volume 3: the responsiveness of European VET systems to external change (1995-2015). Luxembourg: Publications Office. Cedefop research paper; No 67. http://data.europa.eu/doi/10.2801/621137 https://www.cedefop.europa.eu/files/5567_en.pdf visited 22-11-2021

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teamwork, responsibility, problem-solving skills), learning and innovation skills and ICT skills are important to develop in VET. [26]

In 2017, the commission launched an initiative, "Employers together for integration"[27], to give visibility to what employers are doing to support the integration of refugees and other migrants into the labour market.[28]

The successful integration of third-country nationals in the EU labour market represents an opportunity for our societies. When effectively integrated, they can help improve the functioning and performance of the labour market and support fiscal sustainability. Accordingly, several initiatives have been initiated by employers, trade unions, chambers of commerce in many member states.[29]

Freedom of movement of workers is one of the fundamental 'four freedoms' of the European Union and has been in force for decades. Economists have long considered that labour mobility is too low in the EU. This is changing now as more and more EU citizens move to the other Member States to work. [30]

The latest developments confirm that intra-EU mobility continued to grow before the pandemic but at a slower pace than in the previous years. In 2018, there were 17.6 million EU-28 movers[19] in the EU, out of which 12.9 million were EU movers of working age (20-64 years), according to Eurostat population statistics. In addition, there were 1.5 million cross-border workers in the EU20. [31]

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[26]Cedefop (2018). *Globalisation opportunities for VET: how European and international initiatives help in renewing vocational education and training in European countries*. Luxembourg: Publications Office. Cedefop research paper; No 71.
http://data.europa.eu/doi/10.2801/425244 Accessed 22-11-2021

[27]https://ec.europa.eu/home-affairs/what-we-do/policies/legal-migration/european-dialogue-skills-and-migration/integration-pact_en Accessed 22-11-2021

[28]Employers together for Integration. A Commission's initiative to support labour market integration https://www.ceep.eu/employers-together-for-integration-a-commissions-initiative-to-support-labour-market-integration/ Accessed 22-11-2021

[29]Employers together for Integration. A Commission's initiative to support labour market integration https://www.ceep.eu/employers-together-for-integration-a-commissions-initiative-to-support-labour-market-integration/ Accessed 22-11-2021

[30]Alcidi, C., & Gros, D. (2019). Intra-EU labour mobility: From too little to too much?, EconPol Opinion, 17. https://www.econpol.eu/opinion_17 Accessed 22-11-2021
https://ec.europa.eu/social/main.jsp?catId=89&furtherNews=yes&langId=en&newsId=9877 Accessed 22-11-2021

[31]European Commission(2020.) 2019 Annual Report on Intra-EU Labour Mobility.
https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8242&furtherPubs=yes Accessed 22-11-2021

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Cross-border labour flows within Europe might even out the demographic pressures across Europe, but it will require implementing the systems developed for identifying existing skills.

Relevance comment for the ALBATTS project:

As already mentioned, the battery and electromobility transformation will need about 3-4 million workers in Europe. Most of the workers will be in positions with initial VET (IVET) or continuous VET (CVET) educational levels. For Europe to become a single, united entity regarding the supply of labour, mobility within Europe and successful integration of third-country nationals must be facilitated. Many gigafactories are multicultural environments with closer to 100 different nationalities. Therefore, language and intercultural skills have to be emphasised in training for the battery sector, and recognition and validation of prior learning need to be developed. Tools for validating prior learning and a unified way of the accreditation of skills will be explored and designed in 6.3. Therefore, a basic course for Intercultural skills and a basic language training course for the battery sector is suggested for task 6.4.

2.3 SOCIAL AND DEMOGRAPHIC CHANGE

Europe is projected to have a stable or declining population by 2050 as it is confronted with an ageing population, with people older than 65 years representing 30 % of the total population by 2070. However, given low fertility rates and migration's absence, this raises questions about a shortfall in working-age adults.[32]

The share of Europe's population in the world is shrinking, and by 2070 it will account for just under 4% of the world's population. [33]

It has become less feasible to rely on young people to acquire the necessary skills to sustain economic growth since their numbers are declining. At the same time, life expectancy is longer, and people need to stay longer in working life. Therefore, retraining and upskilling along with the validation of informally or non-formally acquired skills have become important. [34]

[32] Benini, L., & Viaud, V. (2020). Drivers of Change of Relevance for Europe's Environment and Sustainability. European Environment Agency, Luxembourg, European Union, https://www. eea. europa. eu. https://www.eea.europa.eu/publications/drivers-of-change Accessed 22-11-2021

[33] https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/impact-demographic-change-europe_en#Highlights Accessed 22-11-2021

[34] Cedefop (2018). The changing nature and role of vocational education and training in Europe. Volume 3: the responsiveness of European VET systems to external change (1995-2015). Luxembourg: Publications Office. Cedefop research paper; No 67. http://data.europa.eu/doi/10.2801/621137 Accessed 22-11-2021

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Europe's working-age population is shrinking, and we need to find ways to sustain economic growth by bringing more people into jobs and increasing productivity.[35] There is no one-size-fits-all approach, and demographic change will affect everybody. Bringing more people into the labour market, enabling them to work for longer and improving productivity, would help compensate for the shrinking working-age population.[36]

Accreditation of existing skills will be of considerable importance when including the skills of migrants.[37]

Migrant workers are becoming ever more accepted as companies find it difficult to fill job roles in lower and mid-level skill jobs. Organizations have started to increasingly depend on migrant and flexible workforces (temporary labour, gig economy, independent contractors, statement of work professionals, etc.)[38]

As European countries are facing major setbacks in growth for being unable to fill job roles in organizations, global companies implement regional strategies to overcome the problem of shortages and an ageing workforce with solutions such as:

- Hiring migrant workers from multiple low-income countries (including intra-EU migrants and third-country migrants)
- Training the existing workforce with advanced skills to fill vacancies of job requirements; hiring workers from countries where high-skilled labour is abundantly available; and increasing salaries of the existing workforce for doing additional work.[20]

It is essential to ensure that migrants learn the language, get their educational and professional skills validated/recognized, and receive adequate training. Among highly educated third-country nationals in employment, more than 40% work below their

[35] https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/impact-demographic-change-europe_en Accessed 22-11-2021

[36] https://ec.europa.eu/info/strategy/priorities-2019-2024/new-push-european-democracy/impact-demographic-change-europe_en#Highlights Accessed 22-11-2021

[37] Cedefop (2018). The changing nature and role of vocational education and training in Europe. Volume 3: the responsiveness of European VET systems to external change (1995-2015). Luxembourg: Publications Office. Cedefop research paper; No 67. http://data.europa.eu/doi/10.2801/621137 Accessed 22-11-2021

[38] Rustagi, M (2020).Solution to shortage of Skilled Workers|Labour Shortage in Europe. Podcast article. https://www.beroeinc.com/whitepaper/talent-migration-solution-labour-shortage-europe/ https://www.beroeinc.com/whitepaper/talent-migration-solution-labour-shortage-europe/ Accessed 22-11-2021

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qualification levels (i.e. in medium or even low skills occupations).[39] Therefore, member States and the European Union as a whole – and economic stakeholders - have both an interest and responsibility to put all skills to good use. [40]

More women are now engaged in paid employment in Europe, but many of them are working part-time. Therefore, VET providers have to develop ways to meet their needs, given that part-time employees are less likely to receive training in the workplace than full-time ones.[41]

With a shortage in the workforce, the attractiveness of VET, companies, industries and sectors will become important to attract and maintain employees/students. Increasing individualisation that is apparent in consumer behaviour and lifestyles is paralleled by the shift towards increasingly individualised pathways in VET and HE. More responsiveness has to be paid to the needs of the individuals by flexibility with the right to choose when and how one learns More attention has to be paid to the needs of the individual learner. This can be provided by flexible solutions enabling the learner to choose how and when to study and learn.

Relevance comment for the ALBATTS project

A system and suggestion for identifying and recognising prior skills for workers/students must be designed to identify what new skills they need to acquire for the battery sector. This includes workers from other sectors or from other countries within or outside Europe.

Training courses designed must be flexible and designed so that they can be offered in different settings by education providers and companies. But they must be flexible to facilitate individualised pathways and give the learner the right to choose when and how to learn. In this way, it may be easier to attract new potential workforce to the sector.

[39] https://ec.europa.eu/home-affairs/policies/migration-and-asylum/legal-migration-and-integration/integration/integration-labour-market_en Accessed 22-11-2021

[40] https://ec.europa.eu/home-affairs/what-we-do/policies/legal-migration/integration/integration-labour-market_en Accessed 22-11-2021

[41] Cedefop (2018). The changing nature and role of vocational education and training in Europe. *Volume 3: the responsiveness of European VET systems to external change (1995-2015)*. Luxembourg: Publications Office. Cedefop research paper; No 67. http://data.europa.eu/doi/10.2801/621137 Accessed 22/11/2021

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2.4 TECHNOLOGICAL CHANGE

Technological development is one important dimension determining labour and skill demand, in combination with economic development, globalization, and demographic trends. Technology has tended to redefine jobs in ways that demand higher skills rather than just replacing jobs.[42] We are in the age of the Fourth Industrial Revolution, and now we are already talking about Industry 5.0. Industry 4.0 refers to the intelligent networking of machines and processes for the industry with the help of information and communication technology. The main challenges are related to the exponential growth of digital tools that include robots, cobots, connected objects, communication systems, data centres, and associated energy consumption.[43] Industry 5.0 complements the existing "Industry 4.0" approach and can play an active role in providing solutions to challenges for society, including the preservation of resources, climate change and social stability[44].

Technology poses a significant challenge to VET systems, requiring them to respond more quickly than ever before to changes in the labour market. Technological change means skills become outdated more quickly than in the past and that new skills in new jobs emerge with unprecedented speed. Upskilling and reskilling of adults to meet these needs become critical.[45] In the report Skills for the industry - Curriculum guidelines 4.0 published by the Commission 2020, the main emphasis needs to be put on technical core competencies such as interacting with human-machine interfaces, data management skills, and specialised and interdisciplinary knowledge of technologies and processes. This is, however, not enough. Because of the rapidly advancing technology, a general mindset for continuous improvement and lifelong learning is needed. “It is no longer just about what one knows, but increasingly

[42]Hoftijzer, Margo; Gortazar, Lucas. (2018). *Skills and Europe’s Labor Market : How Technological Change and Other Drivers of Skill Demand and Supply are Shaping Europe’s Labor Market*. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/29965 Accessed 22-11-2021

[43]PwC EU Services. (2020). *Skills for industry Curriculum Guidelines 4.0: future-proof education and training for manufacturing in Europe.* Publications Office of the European Union, Luxembourg. https://op.europa.eu/en/publication-detail/-/publication/75478035-56b9-11ea-aece-01aa75ed71a1 Accessed 22-11-2021

[44]Breque, M., De Nul, L., & Petridis, A. (2021). Industry 5.0: towards a sustainable, human-centric and resilient European industry. Luxembourg, LU: European Commission, Directorate-General for Research and Innovation. https://op.europa.eu/en/publication-detail/-/publication/468a892a-5097-11eb-b59f-01aa75ed71a1/ Accessed 22/11/2021

[45]Cedefop (2018). The changing nature and role of vocational education and training in Europe. Volume 3: the responsiveness of European VET systems to external change (1995-2015). Luxembourg: Publications Office. Cedefop research paper; No 67.
http://data.europa.eu/doi/10.2801/621137 Accessed 22/11/2021

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about one's ability to adapt to continuously changing circumstances and to constantly advance one's knowledge and skills". Therefore, non-technical skills such as critical thinking, creativity, communication skills, and working in teams are also needed. This is also supported by job advertisements within the battery industry that the ALBATTS project has analysed.

All Europeans need digital skills to study, work, communicate, access online public services and find trustworthy information. However, four out of ten adults and every third person who works in Europe lack basic digital skills. There is also a low representation of women in tech-related professions and studies. The goal by the European Commission is that 70% of adults have basic digital skills by 2025.[46]

VET education also needs to ensure that VET teachers and in-company trainers have access to up-to-date technologies and associated technical knowledge so that the teaching they deliver is relevant to industry needs. This requires closer cooperation between industry and education in specifying competencies and curricula and the need for work-based learning where the students get to practice state of the art technology.[47]

By using remote technology-enabled teaching, education providers managed to offer some educational continuity when Covid19 hit in 2020. This was easier in academic settings, and vocational education has been hit particularly hard by the crisis. Work-based learning is crucial for VET. Social distancing requirements and the closure of enterprises have made it impossible to perform work-based learning in some sectors. New ways of meeting these challenges need to be found and this could be done by developing VR in education.

The European Commission has developed and imposed frameworks, initiatives, and tools to answer the above-discussed change drivers. These will form the requirements for how the education and training framework is developed and tools are chosen in this project.

[46] https://digital-strategy.ec.europa.eu/en/policies/digital-skills-and-jobs Accessed28-11-2021

[47] Cedefop (2018). The changing nature and role of vocational education and training in Europe. *Volume 3: the responsiveness of European VET systems to external change (1995-2015).* Luxembourg: Publications Office. Cedefop research paper; No 67. http://data.europa.eu/doi/10.2801/621137 Accessed 28-11-2021

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Relevance comment for the ALBATTS project

Due to the fast technological changes, workers will have to re-skill and upskill often. This requires a granularity of study units that can easily be upgraded or replaced whenever needed without changing entire modules or courses.

In designing the training courses, it is important to remember that students within VET normally do not have as strong academic skills as students from higher education. Therefore, different types of educational software have to be explored and utilised. Lessons learned from work-based learning during the pandemic and simulation, VR, AR and XR could be utilised.

Large amounts of the adult workforce need up-skilling and reskilling. Many of them have poor digital skills. This has to be considered in designing learning materials to be easy to use and easy to reach, and without any higher costs for the user.

As the technological change will be quick, close cooperation with working life is necessary as educational establishments will not be able to invest fast enough in the new technology. Therefore, new education technology should be used in the development as much as possible, and models for work-based learning, including international mobility, should be considered.

It is not only the adult workforce that needs up-skilling. Teachers within VET also need to improve their general digital skills and skills needed within Industry 4.0. In addition, they need to improve their English language skills, intercultural skills and new pedagogical methods to provide an excellent education for different target groups. The courses designed for students and workers could also be used for the teachers and more in-depth courses designed for HE. In 6.7, a train the trainer manual will be designed. In addition, work-placed learning for teachers should be developed, international online courses/forums for teachers, and Erasmus expert mobilities should be utilised to increase VET teachers' skills, including innovative pedagogics.

2.5 EMERGING DRIVERS OF CHANGE

In the future, there may also be unexpected drivers of change to react to rapidly, such as Covid19 in 2020. This cannot easily be predicted and thus prepared, but preparations can be made for several scenarios, both likely ones and less likely and disruptive. A common scenario-planning method can plot ongoing trends after a y-axis of the probability of a trend to occur and an x-axis about effect size if this trend increases. Thus, an unlikely trend of events with

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massive effects is what to look for. Any two trends can be chosen and discussed in a scenario-cross with the trends as crossing lines, forming four scenarios. Even so, the most unlikely development of events is hard to foresee and prepare for. Examples of such important but unlikely and not foreseen developments are the importance of the personal computer, the importance of the Internet, the fall of the Berlin Wall, the emergence of HIV/AIDS, etc.

Relevance comment for the ALBATTS project:

We have learned from the Covid Pandemic that anything may happen. Therefore, we need to develop an agile and flexible model and tools to react to changes and adapt them accordingly. In addition, we need to facilitate the development of transversal skills for lifelong learning.

2.6 EU-POLICIES AND PROGRAMS

Each EU country is responsible for its education and training systems. However, EU policies and programs are designed to support action at the national level and help address common challenges and such as ageing societies, skills deficits, technological developments, and competition at the global level.

2.6.1 New Skills Agenda

The *New Skills Agenda for Europe* is an initiative that builds upon the European Commission's *Skills Agenda* that was introduced in 2016. The New Skills Agenda introduced in 2020 is a five-year plan to up-skill and re-skill Europeans to respond to change by partnering with all member States and realizing the right to training and lifelong training according to the European Pillar *Social Rights*.

The Commission wants all Europeans to benefit whether they live in cities or remote rural areas. This initiative, as such, is a response to the transformation of the labour market due to the covid 19 pandemic with the green and digital transition in mind with the business environment alternation in the coming years. Therefore, Europe needs to make proper changes to respond to future needs - *12 action plan* was developed[48] organised around four building blocks:

[48] European Commission (EC). (2020). European Skills Agenda. https://ec.europa.eu/social/main.jsp?catId=1223&langId=en Accessed 28.11.2021

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A call to join forces in collective action:

Action 1: A Pact for Skills.

Actions to ensure that people have the right skills for jobs:

Action 2: Strengthening skills intelligence;

Action 3: EU support for strategic national upskilling action;

Action 4: Proposal for a Council Recommendation on vocational education and training (VET);

Action 5: Rolling out the *European Universities Initiative* and upskilling scientists;

Action 6: Skills to support the twin transitions;

Action 7: Increasing STEM graduates and fostering entrepreneurial and transversal skills;

Action 8: Skills for life;

Tools and initiatives to support people in their lifelong learning pathways:

Action 9: Initiative on individual learning accounts;

Action 10: A European approach to micro-credentials;

Action 11: New Europass platform;

A framework to unlock investments in skills:

Action 12: Improving the enabling framework to unlock Member States' and private investments in skills.

The *Pact for Skills* is the first and latest development in the new Skills Agenda for Europe initiative launched on 10 November 2020. The main objective of the Pact for Skills is an invitation to join forces for upskilling and reskilling the Europeans. Major target groups are public and private organisations and anyone who can play a key role in this workforce transformation.

Key principles of Pact for Skills are the following: (1) promotion of a culture of lifelong learning for all; (2) building of strong skills partnerships; (3) monitoring of skills needs and demands; (4) working against discrimination, for gender equality and equal opportunities.

Pact for Skills offers dedicated services such as a networking hub, a knowledge hub, and a guidance and resources hub in the form of findings, webinars and seminars to identify opportunities[49].

[49] European Commission (2020). Pact for Skills. https://ec.europa.eu/social/main.jsp?catId=1517&langId=en Accessed 29-11-2021

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Relevance comment for the ALBATTS project:

The New Skills Agenda is highly relevant for the ALBATTS projects as it will, during 2020 -2025, bring on and update actions, tools and initiatives and frameworks for both VET and HE. In addition, this will happen on both an EU-level, but also will most likely impose change at national levels. Therefore, ALBATTS will have to closely follow the development in Europe based on the New Skills Agenda.

2.6.2 EU Digital Action Plan

The Digital Education Action Plan (2021-2027) outlines the European Commission's vision for high-quality, inclusive and accessible digital education in Europe. It is a call to action for stronger cooperation at the European level to (1) learn from the COVID-19 crisis, during which technology is used at an unprecedented scale in education and training; (2) make education and training systems fit for the digital age[50].

The Digital Education Action Plan has two strategic priorities:

Fostering the development of a high-performing digital education ecosystem requires:

- infrastructure, connectivity and digital equipment;
- effective digital capacity planning and development, including up-to-date organisational capabilities;
- digitally competent and confident teachers and education and training staff;
- high-quality learning content, user-friendly tools and secure platforms which respect privacy and ethical standards.

Commission will:

- launch a *strategic dialogue with EU Member States* - preparation of proposals for a Council Recommendation on the enabling factors for successful digital education 2022;
- propose a *Council Recommendation on online and distance learning* - primary and secondary education, the effectiveness of distance, online and blended learning;

[50] European Commission (2021). Digital Education Action Plan (2021-2027) https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en Accessed 28-11-2021

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- develop a *European Digital Education Content Framework* and launch of *feasibility study on a possible European exchange platform* - sharing certified online resources and connection with existing education platforms;
- support the Gigabit connectivity of schools, as well as *connectivity in schools*, internet access, purchase of digital equipment, e-learning applications and platforms;
- support *digital transformation plans at all levels of education and training* through Erasmus cooperation projects;
- develop *ethical guidelines on artificial intelligence (AI) and data usage* in teaching and learning.

Enhancing digital skills and competence for the digital transformation requires:

basic digital skills and competence from an early age:

- digital literacy, including fighting disinformation;
- computing education;
- good knowledge and understanding of data-intensive technologies, such as artificial intelligence.
- advanced digital skills produce more digital specialists and ensure that girls and young women are equally represented in digital studies and careers.

Commission will:

- develop *common guidelines for teachers and educational staff to foster digital literacy* and *tackle disinformation* through education and training;
- update the *European Digital Competence Framework* to include AI and data-related skills and support the development of *AI learning resources* for schools, vocational education and training (VET) organisations, and other training providers;
- create a *European Digital Skills Certificate* (EDSC) that is recognised and accepted by governments, employers and others across Europe;
- propose a *Council recommendation on improving the provision of digital skills in education and training* - EU tools to invest in teacher professional development, sharing best practices on instructional methods in high-quality computing education working with industry to identify and update skills needs as they emerge;

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- encourage more participation in the *International Computer and Information Literacy Study* (ICILS), which gathers cross-national data on student digital skills and introduces *EU targets for student digital competence*.
- target advanced digital skills development through steps such as extending the *Digital Opportunity traineeships* to VET learners and apprentices and offering professional development opportunities for teachers, trainers and other educational staff;
- encourage *women's participation in STEM* (science, technology, engineering and mathematics) with the *European Institute of Innovation and Technology* (EIT).
- support the *EU STEM Coalition* to develop higher education curricula that attract women to engineering and ICT based on the 'STEAM' (science, technology, engineering, arts and mathematics) approach.

Relevance comment for the ALBATTS project:

Training for and working in the Battery industry needs good digital skills. Due to the rapid development in the battery sector, workers need to have good key competencies and transversal skills as lifelong learning will be continuous. The EU digital action plan will facilitate the development of higher digital skills in Europe and should be carefully monitored during the ALBATTS project time and beyond. It refers to the training of students, working life and teachers. The aim is to update the European Digital Competence Framework to include AI and data-related skills. Therefore, the development of AI learning resources for schools, vocational education and training (VET) organisations, and other training providers should be supported. In addition, a European Digital Skills Certificate (EDSC) will be created that is recognised and accepted by governments, employers and others across Europe.

2.6.3 EU recovery plan

The EU recovery plan is related to the present pandemic and the restart and acceleration of the European economy. The recovery plan has many parts and considerable budgets. Both the 7-year EU budget and the NextGenEU special budget with a combination of grants and loans are involved. Special parts that are involved relating to possibilities for the ALBATTS project directly are research and innovation, via Horizon Europe, and fair climate and digital transitions via the Just Transition Fund and the Digital Europe Programme.

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Relevance comment for the ALBATTS project:

The EU recovery plan can offer possibilities to further funding in the battery sector, both for the ALBATTS consortium and at a national level. For example, there will be a need for up-skilling digital skills, language skills and skills needed within Industry 4.0 for VET teachers, and other industry-specific skills in the battery industry. In addition, more projects and funding will be needed to produce virtual learning environments and materials for the battery industry.

2.6.4 Council Recommendation of 24 November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience

The Recommendation defines key principles for ensuring that vocational education and training is agile. It adapts swiftly to labour market needs and provides quality learning opportunities for young people and adults alike.

It places a strong focus on the increased flexibility of vocational education and training, reinforced opportunities for work-based learning and apprenticeships and improved quality assurance.[51]

The Recommendation aims at renewing the EU's VET policy by:

- modernising the European Union policy on VET, supporting transitions to a green and digital economy and supporting employability. It will also include the increased use of digital tools and continued digitalisation of VET systems to increase their resilience;
- confirming the central role of VET to lifelong learning and its strong links to all education and training sectors;
- streamlining the European cooperation process for VET by integrating and adapting two EU instruments for VET – the European Quality Assurance Reference Framework in Vocational Education and Training (EQAVET) and the European Credit System for Vocational Education and Training (ECVET), and
- simplifying VET governance at the EU level (related to integrated ECVET and EQAVET Recommendations) and defining the working methods, types of support activities at

[51] European Commission (2021) COUNCIL RECOMMENDATION of 24 November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. Official journal of the European Union C 417/1. https://www.cedefop.europa.eu/files/celex_32020h120201_en_txt.pdf

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the EU level and a monitoring framework to assess progress towards the implementation of this Recommendation.

New actions recommended at the national level are:

- Underlining the crucial role VET systems play for young people entering the labour market and for adults in need of continuous upskilling and reskilling;
- Granting VET providers a level of autonomy to allow them to react quickly to skills challenges, offer fast reskilling programmes and work in close partnerships with employers.

The recommendations have been categorised under the following headings:[52]

- Vocational education and training is agile in adapting to labour market changes
- Flexibility and progression opportunities are at the core of vocational education and training
- Vocational education and training is a driver for innovation and growth and prepares for the digital and green transitions and occupations in high demand
- Vocational education and training is an attractive choice based on a modern and digitalised provision of training/skills
- Vocational education and training promotes equality of opportunities
- A culture of quality assurance underpins vocational education and training

Implementation at the national level

It is recommended that the Member States implement this policy at the national level, together with social partners and other relevant stakeholders (see appendix 1 for 2020 recommendations).

[52]European Commission (2020). Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0275&rid=7 Accessed 28-11-2021

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Relevance comment for the ALBATTS project:

The 2020 council recommendations should be followed and continuously monitored during the execution of the ALBATTS project concerning what has been developed that will affect ALBATTS.

The Recommendations have been mentioned and considered under relevant headings in this report referring directly to different subjects.

2.6.5 Accessibility regulations

The European Union has, for a long time, had regulations about the internal market, and it addresses accessibility to products of services in the European Accessibility Act[53]. This applies to nations and corporations, as well as to individuals with disabilities. The Act is in parts a mirroring of the UN convention of persons with disabilities.[54] However, education is not explicitly mentioned as a service in this context.

IN 2021, a new EC Strategy for the Rights of Persons with Disabilities 2021-2030[55] specified that regardless of sex, racial or ethnic origin, belief or religion or sexual orientation, people should be able to enjoy, also in applied practice fully, the same human rights, equal opportunities, equal access to participation in societal and economic activities as anyone else. They should also be free to move in the EU "regardless of support needs" and no longer experience discrimination.

[53]Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services PE/81/2018/REV/1 https://ec.europa.eu/social/main.jsp?catId=1202 Accessed 28-11-2021

[54] Unitied Nations (2006) Convention on the Rights of Persons with Disabilities. https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html in relation to EU Disability Strategy 2010-2020: http://ec.europa.eu/social/main.jsp?catId=1138&langId=en Accessed 28-11-2021

[55] https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_813 Accessed 28-11-2021

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This 2021 Strategy has links to many other policy initiatives, as the digital action plan[56], the pillar of social rights[57], the LGBTIQ Equality Strategy[58], The EU Anti-Racism Action Plan[59], the Gender Equality Strategy[60] and the EU Roma Strategic Framework[61], following up on the Decade on Roma Inclusion[62].

The European Commission proposes to launch a resource centre, "AccessibleEU", in 2022 - to build a knowledge base and share best practices across sectors. There is coherence with corresponding UN policy documents in many cases.

In practice, not all people with physical disabilities, as an example, can do all jobs or go through all training. However, this can be understood as a "capability approach" (Sen 2009[63], Nussbaum 2013[64]) that all individuals should reach the maximum of their potential in the direction they want.

One observation that can be made here is that the place of living is presently not a disability in this sense. A person may have the right to move, but not the unconditional right to get an education of type x while being able to live in his home, even if this can easily be done with education ICTs also without threatening the rights of other students. An individual has the right to move but not to stay and be educated unconditionally. Place of living is not a discrimination criterion for access to education. This can be a thing to discuss in the future. The explanation for this phenomenon can be that it was not even possible to imagine not-place-bound education or campus prioritisation for ages.

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[56] European Commission (2021). Digital Education Action Plan (2021-2027) https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en Accessed 28-11-2021

[57] European Commission (2019) The European Pillars on Social Rights https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/jobs-growth-and-investment/european-pillar-social-rights_en Accessed 28-11-2021

[58]European Commission (2020). LGBTIQ Equality Strategy 2020-2025.https://ec.europa.eu/info/policies/justice-and-fundamental-rights/combatting-discrimination/lesbian-gay-bi-trans-and-intersex-equality/lgbtiq-equality-strategy-2020-2025_en Accessed 28-11-2021

[59] European Commission (2020) EU Anti-racism Action Plan 2020-2025 https://ec.europa.eu/info/policies/justice-and-fundamental-rights/combatting-discrimination/racism-and-xenophobia/eu-anti-racism-action-plan-2020-2025_fr Accessed 28-11-2021

[60] European Commission (2020). A Union of Equality: Gender Equality Strategy 2020-2025 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0152 Accessed 28-11-2021

[61] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1813 Accessed 28-11-2021

[62]Kirova, I. (2007). The Decade of Roma Inclusion: Addressing Racial Discrimination through Development. *UN Chronicle.* https://www.un.org/en/chronicle/article/decade-roma-inclusion-addressing-racial-discrimination-through-development Accessed 28-11-2021

[63] Sen, A. K. (2009). The idea of justice. Harvard University Press.

[64] Nussbaum, M. C. (2009). Creating capabilities: The human development approach and its implementation. Hypatia, 24(3), 211-215.

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Relevance comment for the ALBATTS project:

There should be recommendations in the ALBATTS blueprint on how people with disabilities and different backgrounds could be paid attention to when designing training and training material.

Finding employees in the future may be challenging, and all available workers will be needed. At the same time, companies are marketing themselves as inclusive and responsible employers. In addition, the European Accessibility Act applies to nations and corporations and individuals with disabilities. In 2021, a new EC Strategy for the Rights of Persons with Disabilities 2021-2030 specified that regardless of sex, racial or ethnic origin, belief or religion or sexual orientation, people should be able to enjoy, also in applied practice fully, the same human rights, equal opportunities, equal access to participation in societal and economic activities as anyone else. They should also be free to move in the EU "regardless of support needs" and no longer experience discrimination.

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3 State-of-the-Art of Existing frameworks, instruments and tools

3.1 REQUIREMENTS

According to the call of the proposal for Erasmus Sector Skill Alliance,[65] the following things need to be taken into consideration for designing and delivering trans-national sector-wide vocational curricula:

1. Identify and design VET curricula or qualifications standards (in line with EQF and informed by ESCO)
2. Translating skills needs into innovative, learning outcome-oriented modular VET programmes or qualifications
3. Applying ECVET for designing qualifications composed of units of learning outcomes to allow for transparency and comparability, also considering needs of validation of prior learning (e.g., non-formal or informal)
4. Applying quality management to the training content by applying the quality assurance of EQAVET or by using already existing quality assurance systems that should be in line with EQAVET.
5. Integrating periods of work-based learning into the new training content, including opportunities to apply knowledge in practical "real life" workplace situations, and embedding trans-national learning experience whenever possible
6. Designing VET provision focusing on both job-specific skills as well as key competencies, soft skills, and STEM disciplines – while providing effective opportunities to acquire or develop those competencies, particularly in work-related contexts
7. Promoting relevant VET sectoral qualifications (including trans-national joint programmes awarded by more than one VET provider) and support agreement for the recognition by implementing ECVET principles and referencing qualifications to NQFs and the EQF as well as other relevant European tools and instruments in the sector
8. Identifying the most appropriate delivery methodologies for the curricula, using innovative approaches to teaching and learning, as well as the strategic and integrated use of ICTs based on open educational resources according to the needs of specific target groups of learners
9. Workplace-based learning is hard to replace in vocational training, especially when the occupation is place-bound and equipment-dependent. During a crisis, alternatives must be tried. Examples of ICTs that can fill a part of the function are simulations /gamification of tasks and collaboration in a workplace and remote instrumentation of actual workplace equipment. Both demand development costs and time to set up. The

[65] European Commission/EACEA (2017) Call for proposals Erasmus+ Programme – KA 2 – Cooperation .... http://elke.eap.gr/?p=822 Accessed 28-11-2021

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use of discrete remote telepresence robots can give some spectator-type impressions of what is going on in the workplace but not real engagement in manual tasks. [66]

10. The chosen approach should be such that it is flexible and can be easily adapted to changes and requirements of the industry or of drivers of change. The granularity should be such that modules can be easily changed or updated according to the needs of the industry without having to change the whole program.
11. The chosen approach should be such that it can be optimally used and suits VET providers, universities, and employers whenever possible.

Relevance comment for the ALBATTS project:

All of the requirements mentioned above will be considered and discussed in this report and in report 6.3. As far as possible, we will utilise all the existing EU frameworks and tools in the development of the ALBATTS education and training framework, including new curricula and training. We will give recommendations to the ones that we cannot implement because of the scope of this project or where we cannot find solutions.

To make these choices, we need first to gain an understanding of how VET education and higher education in Europe is structured and what kind of mechanisms are forming the education systems in Europe, including similarities and differences. By comparing VET and Higher education, we can also get useful models from different praxis.

3.2 EUROPEAN FRAMEWORKS AND INSTRUMENTS

In this part, we will describe the core of different frameworks that will be referred to or considered in this report:

- International Standard Classification of Education (ISCED)
- European Qualifications Framework (EQF)
- European Higher Education Area and the Bologna Process (EHEA)
- European Association of Institutions in Higher Education (EURASHE)
- European Credit System for Vocational education and Training (ECVET)
- European Credit Transfer and Accumulation System (ECTS)
- The European Quality Assurance in Vocational Education and Training (EQAVET)
- The 2018 Key competencies framework

[66] Stoll, B., Reig, S., He, L., Kaplan, I., Jung, M. F., & Fussell, S. R. (2018, February). Wait, can you move the robot? Examining telepresence robot use in collaborative teams. *In Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 14-22).

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3.2.1 International Standard Classification of Education (ISCED)[67]

The International Standard Classification of Education (ISCED) belongs to the United Nations International Family of Economic and Social Classifications, which are applied in statistics worldwide to assemble, compile, and analyse cross-nationally comparable data. ISCED is the reference classification for organizing educational programmes and related qualifications by education levels and fields. ISCED is a product of international agreement and adopted formally by the General Conference of UNESCO Member States.

ISCED is designed to serve as a framework to classify educational activities as defined in programmes and the resulting qualifications into internationally agreed categories. Therefore, the basic concepts and definitions of ISCED are intended to be internationally valid and comprehensive of the full range of education systems.

ISCED classifies education programmes by their content using two main cross-classification variables: a) levels of education and b) fields of education[68]. [69]

Relevance comment for the ALBATTS project:

The ISCED classification is used in most national qualifications systems beside the EQF framework. In addition, ISCED classification could be useful in classifying learning modules as there may also be cooperation with entities outside Europe. The ISCED classification would make this cooperation easier.

3.2.2 EQF

EQF stands for *The European Qualifications Framework,* an EU-developed translation tool to make national qualifications easier to understand and more comparable. The main goal of the framework is to support *cross-border mobility* of learners and workers, promote *lifelong learning* and *professional development* across Europe.

[67] International Standard for the classification of Education. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_Standard_Classification_of_Education_(ISCED)
WHAT IS ISCED. http://emis.co.sz/AEC%202011.pdf

[68] OECD (2011), ISCED 2011 Operational Manual Guidelines for classifying national education programmes and related qualifications. https://www.oecd.org/education/isced-2011-operational-manual-9789264228368-en.htm Accessed 28-11-2021

[69] See appendix 2 - Levels and complementary dimensions of the International Standard Classification of Education (ISCED) 2011 Codification of education programmes and educational attainment.

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The EQF is an 8-level, learning outcomes-based framework for all types of qualifications that serves as a translation tool between different national qualifications frameworks. The framework is said to improve the following areas such as:

- transparency;
- comparability;
- portability of people's qualifications;
- comparison of qualifications from different countries and institutions.

As mentioned before, EQF is based on eight levels of qualifications and uses learning outcomes coherent with the knowledge that person knows, in simple words from EQF level 1 - meaning basic general knowledge - to EQF level 8 - knowledge at the most advanced frontier.[70]

By 2020, **39 countries** were cooperating on the European qualification's framework implementation. The EU Member States, EFTA countries (Iceland, Norway and Liechtenstein and Switzerland), EU candidate countries (Albania, North Macedonia, Montenegro, Serbia, and Turkey), potential candidate countries (Bosnia and Herzegovina, Kosovo), and the UK[71].

EQF level 3-4 normally covers I-VET. Initial vocational education and training (I-VET) are usually carried out at the upper secondary and post-secondary levels before students begin working. It occurs either in a school-based environment (mainly in the classroom) or in a work-based setting, such as training centres and companies. Although, this varies from country to country, depending on national education and training systems and economic structures.

EQF level 5 normally covers C-VET. Continuing VET (C-VET) takes place after initial education and training or after beginning working life. It aims to upgrade knowledge, help citizens acquire new skills, retrain and further their personal and professional development. C-VET is largely work-based, with the majority of learning taking place in the workplace.

EQF level 6 normally covers a Bachelor exam (undergraduate exam) at a University or applied science.

EQF level 7 normally covers a Master exam at University or University of Applied Science.

EQF level 8 normally covers post gradual studies at the PhD or doctoral level.

[70] See appendix 3 - Table describing every EQF level in more detail with the defined knowledge, skills, responsibilities and autonomy scope.

[71] National qualifications frameworks (NQFs) https://www.cedefop.europa.eu/en/projects/national-qualifications-framework-nqf Accessed 28-11-2021

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Relevance comment for the ALBATTS project:

ALBATTS proposal for the education and training framework for the battery sector is based on the European Qualification Framework (EQF), covering from level 3 to 8.

3.2.3 European Higher Education Area and the Bologna Process (EHEA)

Today, the European Higher Education Area is more or less identical to the work with the Bologna process, a collaboration between the signatory countries of the Bologna declaration 1999, now in all 49 countries, which is more than the EU member countries.[72] The goal is to increase staff and student mobility and facilitate student employability of students when leaving education. This is done through commitments as the common use of tools and structural reforms concerning lengths and structure of educational steps, with possibilities to transfer to another country for the next step. The idea is that it should be a normal thing with the first cycle of education in one country for about three years (with the possibility to take a job, not only to prepare for the next step of education), transfer to a specialised master education for normally two years (2nd cycle) in another country, and after that the possibility to continue with a PhD education (3rd cycle).

The tools keeping this together are:

- The ENIC and NARIC networks (the Gateway to recognition of academic and professional qualifications)[73]
- The ECTS - European Credit Transfer and Accumulation System (for transparency of student records and credits)[74]
- The DS - Diploma Supplement (A template document for making a national qualification understood in another country)[75]

[72] European Higher Education Area. Web resource https://ehea.info/ Accessed 28-11-2021
[73] About the ENIC-NARIC Network Werb resource https://www.enic-naric.net/ Accessed 28-11-2021
[74] European Credit Transfer and Accumulation System (ECTS). Web resource. https://ec.europa.eu/education/resources-and-tools/european-credit-transfer-and-accumulation-system-ects_en Accessed 28-11-2021
[75] What is the Diploma Supplement? Web resource. https://ec.europa.eu/education/diploma-supplement_en

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- The QFs -overarching and national qualifications frameworks (as EQF and national interpretations of this, as SEQF)[76].
- The ESG - European Standards and Guidelines for Quality Assurance of Higher Education (ESG) is related to ENQA, the European Association for Quality Assurance in Higher Education, and to EQAR, European Quality Assurance Register for Higher Education and to DEQAR - Database of External Quality Assurance Results[77], which is an ERASMUS+ project ongoing since 2018, to gather and make accessible these quality assessment reports[78].

Relevance comment for the ALBATTS project:

For ALBATTS, this has importance for the European dimension of education and training we are working in, the soft policy area which does not govern national education systems but instead eases collaboration and mobility of students, teachers, and workforce.

3.2.4 European Association of Institutions in Higher Education (EURASHE)

There are crossover issues or overlapping areas between academic education and professional education (also called Universities of Applied Sciences or Polytechnics) in some countries, especially when there is a dual higher education system with longer and tiered professional/applied education. Consequently, there is an association to represent these longer professional higher educations. This organisation is the EURASHE[79], representing PHE, Professional Higher Education. They cooperate with EUA, European University Association and the ESU, European Student Union (formerly ESIB), in many EHEA issues.

Relevance comment for the ALBATTS project:

Some cooperation may need to be carried out with EURASHE if questions arise regarding professional higher education development.

[76] EHEA Qualifications Frameworks http://ehea.info/page-qualification-frameworks Accessed 28-11-2021
[77] Public Preview: Database of External Quality Assurance Results (DEQAR). Web resource https://www.eqar.eu/the-database-of-quality-assurance-reports-deqar/
[78] Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG). (2015). Brussels, Belgium. https://www.enqa.eu/wp-content/uploads/2015/11/ESG_2015.pdf Accessed 28-11-2021
[79] https://www.eurashe.eu/

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3.2.5 European Credit System for Vocational education and Training ECVET

The European Credit System for Vocational Education and Training (ECVET) is a technical framework for the transfer, recognition, and accumulation of an individual's learning outcomes to achieve a qualification.[80] The ECVET recommendation was posed in 2009 but was repealed formally in the 2020 VET council recommendation. ECVET has been removed as an initiative, but the main objectives and principles of ECVET have been mainstreamed in the new VET Council recommendation 2020. ECVET principles will continue to be a priority in European VET policy. [81]

The objective of the 2009 ECVET recommendation was to improve recognition, accumulation and transfer of learning outcomes, supporting mobility and lifelong learning. In addition, as also the name suggests, the establishment of an EU credit system in VET. The credit points introduced by the 2009 Recommendation **will be discontinued** due to the very low take-up and no evidence of added value. [82] [83]

What have ECVET principles proved to facilitate?

- It facilitates better quality mobility of vocational learners and staff, including virtual mobility, long-duration mobility and mobilities in third party countries using ECVET tools such as a memorandum of understanding and learning agreements;
- the use and recognition of learning outcomes and European tools such as Europass;
- work towards a smoother cross-border validation in training and lifelong learning outcomes;
- ECVET has also influenced the development of flexible learning pathways in many countries.

In the context of economic restructuring, where certain sectors are declining whilst others have difficulties recruiting adequately qualified staff, there is a need for a flexible workforce.

[80] What is ECVET? Web resource. http://eu-mobility.eu/what-is-ecvet/ Accessed 28-11-2021
[81] Auzinger, M. & Luomi-Messerer, K. (2021) The European Credit System for Vocational Education and Training. Luxembourg: Publications Office of the European Union, 2021 https://3s.co.at/wp-content/uploads/2021/07/ECVET-Publication.pdf Accessed 28.-11-2021
[82] European Commission (2020). Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0275&rid= Accessed 28-11-2021
[83] Auzinger, M. & Luomi-Messerer, K. (2021) *The European Credit System for Vocational Education and Training.* Luxembourg: Publications Office of the European Union, 2021 https://3s.co.at/wp-content/uploads/2021/07/ECVET-Publication.pdf Accessed 28.-11-2021 Accessed 28-11-2021

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[84]Lifelong learning and the recognition of learning and skills aims at facilitating the transition between different jobs, companies or sectors, as well as the transition from unemployment or inactivity into employment. Figure 4 identifies the principles of ECVET, which are very useful in this context.

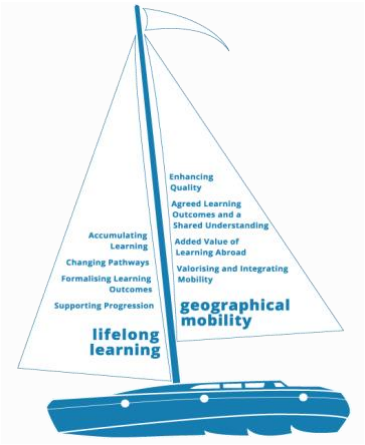

Figure 4 ECVET – benefits for geographic mobility and lifelong (from https://slideplayer.com/slide/2374268/)

The following paragraphs in the 2020 VET Recommendation are particularly showing the continuity of ECVET principles:[85]

"Point 5: *Vocational education and training programmes are learner-centred, offer access to face-to-face and digital or blended learning,* ***flexible and modular pathways based on the recognition of the outcomes of non-formal and informal learning****, and open up career and learning progression; continuing vocational training programmes are designed to be adaptable to the labour market, sectoral or individual up- or reskilling needs;*

Point 6: *Vocational education and training programmes are based on* ***modules or units of learning outcomes,*** *and validation mechanisms are in place allowing the* ***transfer, recognition and accumulation of individuals' learning outcomes*** *with a view to gaining a qualification, a partial qualification, as relevant in the national context; In initial VET the primary goal is to progress to a full qualification.*

Point 10: *Initial and continuing vocational education and training are part of lifelong learning.* ***Flexible and permeable pathways*** *are in place between both initial and continuing vocational education and training, general education and higher education."*

[84] ECVET presentation. https://www.slideshare.net/kalinat/ecvet-presentation

[85] European Commission (2021) COUNCIL RECOMMENDATION of 24 November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. Official journal of the European Union C 417/1. https://www.cedefop.europa.eu/files/celex_32020h120201_en_txt.pdf Accessed 28-11-2021

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The continuous use of learning outcomes will facilitate the development of **Micro-Credentials** and the development of **European Vocational Core Profiles.**

The new recommendation states that a concept of European Vocational Core Profiles will be explored with the aim to define a certain share of common training content at the European level. The profiles have the potential to significantly facilitate mobility of learners and workers, automatic recognition of vocational qualifications and the outcomes of learning periods abroad, and the development of joint VET qualifications and curricula;[86]

ECVET tools can assist lifelong learning by improving the transfer, recognition and accumulation of what has been learned in the past, irrespective of the learning environment. It can facilitate the development of individualised and flexible lifelong learning paths enabling individual learners to gain knowledge, skills and competence, and ultimately a qualification.[87]

Relevance comment for the ALBATTS project:

Most VET systems in Europe are using the ECVET system. Building up the qualifications and courses based on learning outcomes and units will enable the transfer between learning contexts and for the accumulation of learning outcomes also if achieved in a workplace or abroad. It will also facilitate identification and recognition of prior learning for people who need to be re-skilled or up-skilled or persons from another country. In addition, it will facilitate flexibility to change learning outcomes or entire units when there is a need for updating or replacement due to rapid changes in the industry without having to change a whole program.

It can also support the automatic mutual recognition of VET qualifications and cooperation at the sectoral level for the battery industry. The development of European vocational core profiles will be supported by this.

For EQF level education, 4-5 ECVET credit points will not be considered as the recommendation from the EC is discontinued.

[86] European Commission (2021) COUNCIL RECOMMENDATION of 24 November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. Official journal of the European Union C 417/1. https://www.cedefop.europa.eu/files/celex_32020h120201_en_txt.pdf https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0275&rid=7 Accessed 28-11-2021

[87] About ECVET. http://www.dovos.eu/about-ecvet/ Accessed 28-11-2021

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3.2.6 European Credit Transfer and Accumulation System (ECTS)

The European Credit Transfer and Accumulation System (ECTS) is a European Higher Education Area tool for more transparency of studies and courses. It helps students move between countries and to have their academic qualifications and study periods abroad recognised.

ECTS allows credits taken at one higher education institution to be counted towards a qualification studied for at another institution. ECTS credits represent learning based on defined learning outcomes and their associated workload.

ECTS enhances the flexibility of study programmes for students. It also supports the planning, delivery and evaluation of higher education programmes. It is a central tool in the Bologna Process, which aims to make national education systems more comparable internationally. [88]The ECTS Diploma Supplement also helps make exam documents clearer and easier to use in different countries.

ECTS has been adopted by most countries in the European Higher Education Area as the national credit system and is increasingly used elsewhere.

Why is ECTS needed?

Differences between national higher education systems can lead to problems concerning the recognition of qualifications and mobility periods abroad. This issue is addressed in part by enhancing the comprehension of the learning outcomes and workload of programmes of study.

ECTS also makes it possible to blend different learning styles, such as university and work-based learning, within the same programme of study or through lifelong learning.

How does it work? 60 ECTS credits are the equivalent of a full year of study or work. In a standard academic year, these credits are usually broken down into several smaller modules. A typical 'short cycle qualification' typically includes 90-120 ECTS credits. A ‘first cycle’ (or bachelor's) degree consists of either 180 or 240 ECTS credits.

Usually, a ‘second cycle’ (or master's) degree equates to 90 or 120 ECTS credits. The use of the ECTS at the ‘third cycle’, or PhD level, varies.

[88] European Credit Transfer and Accumulation System (ECTS) https://ec.europa.eu/education/resources-and-tools/european-credit-transfer-and-accumulation-system-ects_en Accessed 28-11-2021

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ECTS is applied to support student mobility between higher education institutions. The course catalogues, Learning Agreements and Transcripts of Records help recognise and transfer credits earned by students during a mobility period abroad.[89]

ECTS and the European Higher Education Area (EHEA)

In 1999 the Bologna Declaration included ECTS among the main objectives to be achieved by countries participating in the Bologna Process. Through the reforms implemented in the course of the process, ECTS has become a key tool of the European Higher Education Area (EHEA).

ECTS is adopted as the national credit system in most countries of the EHEA. In other regions of the world, it is increasingly used by institutions or interacts successfully with local credit systems [3] based on comparable criteria, thus playing a role in the growing global dimension of education.[90]

Within the EHEA, ECTS increases the transparency and readability of the educational process and thus plays an effective role in stimulating change and modernisation because its implementation encourages the paradigm shift from a teacher-centred to a learner-centred approach, which is, under the term of Student-Centred Learning (SCL), recognised as an underlying principle of the EHEA.

Relevance comment for the ALBATTS project:

The ECTS is important for the development of modules and programs for HE. It is as ECVET based on learning outcomes but does state the associated workload. This will help for up-skilling, transnational learning and the system of joint degrees in HE.

3.2.7 The European Quality Assurance in Vocational Education and Training EQAVET

According to the call of the proposal of this project, frameworks such as EQAVET should be considered when possible. The European Quality Assurance Reference Framework (EQAVET) is based on the 2009 Recommendation of the European Parliament and Council. It is an approach to quality assurance or a reference framework for VET, which the Member States agreed. It's part of a series of European initiatives which aim is to recognise qualifications and

[89] ECTS and the European Higher Education Area. Web resource. https://ec.europa.eu/assets/eac/education/ects/users-guide/ects-and-ehea_en.htm Accessed 28-11-2021

[90] ECTS and the European Higher Education Area. Web resource. https://ec.europa.eu/assets/eac/education/ects/users-guide/ects-and-ehea_en.htm Accessed 28-11-2021

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competencies received by learners across different countries or learning environments, thereby promoting modernisation, mutual trust and mobility in vocational education and training (VET).[91]

EQAVET framework offers a straightforward way for quality assurance and improvement, based on the PDCA cycle (Figure 5) of planning, implementation, evaluation and review, which is at the heart of many other quality assurances approaches, supported by common quality criteria and indicative descriptors (Annex I of the recommendation) and a coherent set of quality indicators (Annex II of the recommendation), which can be used both at VET provider and VET system levels[92] and can be seen in Appendixes nr 4 and 5. However, for ALBATTS and its objectives, the analysis of the EQAVET framework will be focused at the VET-system level.

Figure 5 The four phases of the Quality Assurance Model (from https://www.qse-vet.eu/en/6-how-to-assure-a-better-match/6-a-pdca-cycle.html)

According to the quality criteria in Annex I of the EQAVET recommendation, planning should reflect a 'strategic vision shared by the relevant stakeholders' which includes, among other (descriptors): (a) goals/objectives of VET for the medium and long terms, and linked to European goals; (b) mechanisms and procedures to identify training needs; and (c) standards and guidelines for the recognition, validation and certification of competencies of individuals.

[91] Attachment 1: RECOMMENDATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 June 2009 on the establishment of a European Quality Assurance Reference Framework for Vocational Education and Training

[92] The PDCA cycle. https://openqass.itstudy.hu/en/knowledge-repository/pdca-cycle Accessed 28-11-2021

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For the implementation stage of the PDCA cycle, the quality criteria explicit that plans are 'devised in consultation with stakeholders. Two particular quality descriptors should then be stressed: (a) consideration of the resources required, the capacity of the users and the tools and guidelines needed for support; (b) specific support towards the training of teachers and trainers.

The quality criteria in Annex I of the EQAVET recommendation stipulate that 'evaluation of outcomes and processes is regularly carried out and supported by measurement'. For the VET-system level, its descriptors suggest for the evaluation stage that: (a) methodology for evaluation has been devised, covering internal and external evaluation; (b) Stakeholder involvement in the monitoring and evaluation process is agreed and clearly described; (c) Systems are subject to self-evaluation, internal and external review, as appropriate; (d) Performance indicators are applied. Annex II of the EQAVET recommendation can be found in the Appendix of this report and proposes a comprehensive set of quality indicators, which can be used to support evaluation and quality improvement.

For the last stage of the PDCA cycle, the indicative descriptors in Annex I of the EQAVET recommendation suggest that: (a) Procedures, mechanisms and instruments for undertaking reviews are defined at all levels; (b) Processes are regularly reviewed and action plans for change devised. Systems are adjusted accordingly; (c) Information on the outcomes of evaluation is made publicly available

The Framework aimed to provide a European-wide system to help the Member States and stakeholders document, develop, monitor, evaluate, and improve the effectiveness of their VET provision and quality management practices and can be applied at both system and VET provider levels.[93] Moreover, it is adaptable to the different national systems and can be used under national legislation and practice.

However, according to the **Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience 97/2020,** the Recommendation did not significantly improve the transparency of quality assurance arrangements between countries and did generally not foster mutual trust.

[93] European qualification framework for the WBL professional. http://wbl-professional.eu/wp-content/uploads/2019/01/O2_WBL_PRO_EQF_EN.pdf

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Furthermore, there was a perception by some stakeholders that the tool is mostly applied in school-based initial VET.[94]

"Considering the results of different evaluation studies, the new proposal will, therefore:

- Repeal the 2009 EQAVET Recommendation and integrate the work on quality assurance in VET in the EU into the present proposal;
- Integrate the EQAVET+ initiative adding elements about learning outcomes, certification and assessment, stakeholders' consultation, the role of teachers and trainers;
- Add an additional indicative descriptor on the flexibility of VET learning pathways given the increased need to develop flexible VET provision and, on the need, to contribute to environmental sustainability;
- Include the aspect of the digital readiness of VET systems and institutions;
- Define new working method through peer reviews of quality assurance at the VET system level in order to improve mutual learning, enhance the transparency of quality assurance arrangements of VET provision and reinforce mutual trust between the Member States;
- Maintain the mission and functions of EQAVET national reference points (NRPs)."[95]

Relevance comment for the ALBATTS project:

ALBATTS project and recommendations must consider the PDCA (plan-do-check-act) cycle as the core pillar for the continuous improvement of the education and training framework for the battery sector, which should be based on the EQAVET quality criteria and the considerations for its new proposal.

Strong connection with relevant stakeholders is recommended and should be a key issue in all steps of the PDCA cycle, to identify the needed competencies in the sector and set the strategic vision, to implement flexible strategies with the local education providers, to guarantee national and European recognition, as well as to evaluate and continuously improve the framework. On the evaluation side, strong attention should be addressed on learning with peers by taking this approach as central to the overall (self-)evaluation processes of VET providers, by adapting already existing peer review models for quality assurance within VET

[94] European Commission (2020). Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0275&rid=7 Accessed 28-11-2021

[95] Ibid. Id.

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For the following developments of the project, a similar approach will be used, with a strong connection with stakeholders, which started with the work from previous work packages (Sectoral Intelligence) and will continue with work package 6 Education and Training with the involvement on the preparation of new training curricula for the battery sector and by testing the developed approaches by piloting courses. Furthermore, as the new EQAVET recommendations emphasise the flexibility of systems, we aim to build flexible suggestions and solutions that may support flexibility and sustainability and can be utilised in different settings and national systems for all different types of learners.

3.2.8 Key competencies

The most recent EU recommendation on eight key competencies for lifelong learning dates back to 2018 and revises the 2006 recommendation, also considering the preconditions of today's world. The European Commission works with the EU Member States to support and reinforce the development of key competencies and basic skills for all from an early age throughout life. As a reference tool for education and training providers, the recommendation identifies eight key competencies vital for personal achievement, lifestyle supporting health and sustainability, employability, active citizenship, and social inclusion. Furthermore, it presents various ways to successfully promote their development methods.

The key competencies are composed of knowledge, skills and attitudes and are developed all through life in formal, non-formal and informal settings. Knowledge comprises already settled concepts, facts, figures, ideas and theories that support understanding of a specific area or subject. Skills equal the capacity to accomplish processes and to put the existing knowledge into action. Attitudes depict the tendency and mentality to act or react to ideas.

The equally important key competencies are Literacy competence, Multilingual competence, Mathematical competence and competence in science, technology and engineering, Digital competence, Personal, social and learning to learn competence, Citizenship competence, Entrepreneurship competence and Cultural awareness and expression competence. [96]

3.2.8.1 Key competencies in VET

Key Competencies in VET are needed for continuous learning, taking on future and new situations, and changing working conditions. They form an important part of professionalism

[96] European Commission (2019) Key competencies for lifelong learning.Publications Office of the EU (europa.eu) https://op.europa.eu/en/publication-detail/-/publication/297a33c8-a1f3-11e9-9d01-01aa75ed71a1/language-en Accessed 28-11-2021

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and reflect an individual's intellectual flexibility and coping with various situations. The key competencies increase the necessary professional culture and civic competencies in all fields and the ability to keep up with changes in society and working life. They have great importance for an individual's quality of life and personal development. In the future, the key competencies will play an even greater role as lifelong learning and career opportunities diversify. Due to changes in working life and society, the need for continuous competence development is growing to ensure rapid upskilling and reskilling. [97]

3.2.8.2 The Relations between key competencies, soft skills, and transversal competencies

There is a special connection between the Personal, Social and Learning to Learn Competence which outlines the future-oriented competencies making it possible to cope with complexity, uncertainty and change in global contexts. These competencies have been increasingly debated in research, resulting in varied definitions such as soft skills or transversal competencies.

Soft skills are broadly applicable qualities, habits, and attitudes. Examples of soft skills cover many elements of the aforementioned key competence, mostly in the personal and social development areas, including self-esteem and self-management, motivation, sense of responsibility, flexibility (personal development); making decisions, empathy, leadership, sociability (social development), and time management (learning to learn). [98]

Transversal competencies, on the other hand, focus on holistic development and adapting to change. They foreground intrapersonal skills and add a reference to healthy lifestyles. Beyond technical skills, the labour market increasingly needs transversal skills like working together, critical thinking, and creative problem-solving.[99]

The new skills agenda 2020 states that to foster transversal skills, the Commission will:

- provide a strategic framework for the recognition of transversal skills to support validation practitioners in Europe.

[97] SECONDARY RESEARCH ON THE KEY COMPETENCES FOR LIFELONG LEARNING. Project Report https://www.tovet.eu/wp-content/uploads/2021/03/WP1_D2_report_v02.pdf Accessed 28-11-2021

[98] Ibid. Id.

[99] Caena, F., Developing a European Framework for the Personal, Social & Learning to Learn Key Competence (LifEComp). Literature Review & Analysis of Frameworks, Punie, Y. (ed), EUR 29855 EN, Publications Office of the European Union, Luxembourg, 2019, https://op.europa.eu/en/publication-detail/-/publication/99e3b8f2-e8ea-11e9-9c4e-01aa75ed71a1/language-en/format-PDF/source-177996684 Accessed 28-11-2021

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- develop resources to support the validation of transversal skills by employers and employment services.

This will include exploring EU-wide online courses and related micro-credentials for validation practitioners and establishing a network of validation pioneer organisations that can share best practices.[100]

This call of proposal emphasises designing VET provision focusing on both job-specific skills as well as key competencies, soft skills, and STEM disciplines – while providing effective opportunities to acquire or develop those competencies, particularly in work-related contexts

3.3.8.3 STEM

'STEM' is often used as an abbreviation and an acronym for study disciplines, labour markets and occupations with very different characteristics and definitions in the field of science, technology, engineering and mathematics. But now we are also talking about STEAM that also includes arts to make people more innovative.[101]

The battery industry is highly automatized, and within Industry 4.0, basic knowledge of computer sciences will be essential for mechanical, electrical, and electronic engineering in future. At the same time, computer sciences also need mechanical, electrical, and electronic engineering in connection with Industry 4.0. This demands a stronger interdisciplinary approach towards the content of study programs and improved collaboration between the individual departments and faculties.[102]

STEM skills are increasingly required by employers across a broad range of sectors and will have an important role in the digital and green transition. Improving the attainment of STEM skills should be a key priority for up and re-skilling initiatives. These skills help foster innovation and systemic and critical thinking in several areas and are not confined to four subjects alone.

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[100] European Skills Agenda. Web resource. https://ec.europa.eu/social/main.jsp?catId=1223&langId=en Accessed 28-11-2021

[101] PWc (2020). Skills for Industry - Curriculum Guidelines 4.0. Future-proof education and training for manufacturing in Europe. EC Executive Agency for Small and Medium-sized Enterprises. (EASME) https://op.europa.eu/en/publication-detail/-/publication/845051d4-4ed8-11ea-aece-01aa75ed71a1 Accessed 28-11-2021

[102] Ibid.

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Although data on STEM skills supply and demand suggest no overall quantitative shortages of STEM skills at the aggregate EU level yet, there are skills mismatches and shortages in specific sectors in specific countries and regions of Europe, primarily related to specific engineering disciplines and ICT studies.[103] Additionally, while in most countries, women represent a majority of all graduates from tertiary education, fewer women than men complete STEM university degrees.[104]

Therefore, the European Skills Agenda defined *Increasing STEM graduates, fostering entrepreneurial and transversal skills* as its key action number 7, to encourage young people, especially women, into Science, Technology, Engineering and Maths, as well as to strengthen support for entrepreneurs and the acquisition of transversal skills like cooperation and critical thinking.[105]

To create a wider understanding of batteries for consumers and as a potential field of future work, mandatory education could include orientation and experimentation with battery-related aspects within STEM projects or similar contexts. In addition, it is important to up-skill VET teachers on battery-related topics.[106]

Relevance comment for the ALBATTS project:

Key competencies for lifelong learning, soft skills and transversal skills are vital for the reskilling and upskilling of the workforce. ALBATTS education and training framework will consider key competencies in its structure, together with sector-specific skills.

This can be seen in the desk research on skills mapping done by WP3, WP4 and WP5. According to the skills agenda, online courses and microcredentials are made for transversal skills at a European level. As far as possible, ALBATTS will aim to explore, pilot or give recommendations on them.

[103] Ulicna, D., & Royale, R. (2015). Does the EU need more STEM graduates?. Report (120/01), Danish Technological Institute. Publications of the European Union, Luxembourg. https://op.europa.eu/en/publication-detail/-/publication/60500ed6-cbd5-11e5-a4b5-01aa75ed71a1 Accessed 28-11-2021

[104] Why don't more girls choose STEM careers? ? OECD Web resource. https://www.oecd.org/gender/data/why-dont-more-girls-choose-stem-careers.htm Accessed 28-11-2021

[105] https://ec.europa.eu/social/main.jsp?langId=en&catId=89&furtherNews=yes&newsId=9723, Accessed 28-11-2021

[106] ERASMUS+ ALBATTS project (2029) Deliverable 3.3. https://www.project-albatts.eu/Media/Publications/9/Publications_9_20201211_85443.pdf Accessed 28-11-2021

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ALBATTS will make some modules/courses specific to the battery industry, such as English language and cultural communication.

ALBATTS education and training framework will also integrate the necessary approaches to contribute to Skills Agenda Action 7 by promoting a learning continuum between secondary and higher education systems, developing education and business partnerships, and further developing education and training methods to promote STEM disciplines, including activities for teachers.

3.3 NATIONAL QUALIFICATIONS FRAMEWORKS (NQF)

Thirty-nine countries in the EU have committed to the EQF. Thirty-eight of these have formally implemented their National Qualifications Framework[107]:

National qualifications frameworks (NQFs) classify qualifications by level based on learning outcomes. Thus, the qualifications reflect what the certificate or diploma holder is expected to know, understand, and do. The learning outcomes approach also ensures that education and training sub-system are open to one another and allows people to move more easily between education institutions and sectors. These frameworks help to make qualifications easier to understand and compare. They can also encourage countries to rethink and reform national policy and practice on education, training and lifelong learning.[108] [109] However, although EU countries share goals and challenges, their VET systems are diverse and often shaped by socioeconomic contexts and traditions.[110]

To make a blueprint for Europe and design curricula and courses on a European level, we see it is important to understand how VET and HE may differ in different European countries as this affects things to consider in designing programs and courses. This is especially important for rolling out the results of this project at the national level.

In the tables below, it can be seen how VET systems differs between countries. The purpose is to get an overview of the variations between countries and how they have adopted some

[107] National qualifications frameworks (NQFs). https://www.cedefop.europa.eu/en/projects/national-qualifications-framework-nqf Accessed 28-11-2021

[108] Ibid.

[109] ERASMUS+ Bracket Project (2019). Definition of the learning outcomes. Project deliverable D2.1 https://bracket.erasmus.site/wp-content/uploads/2019/10/Definition-of-learning-outcomes_EN.pdf Accessed 28-11-2021

[110] Cedefop (2019). Spotlight on VET – 2018 compilation: vocational education and training systems in Europe.Luxembourg: Publications Office of the European Union. http://data.europa.eu/doi/10.2801/540310 Accessed 28-11-2021

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of the recommendations and instruments by the EC. The comparison is based on the partners' overview of their own countries, on data found in Cedefop publications and national documents. For the ALBATTS project, we wanted to make a comparison based on the following descriptors:

- **FLEXIBILITY** -the system gives the flexibility to offer courses locally based on the need of employers and the choice of the student (personal/individual study paths) On the scale: high, medium (e.g. only elective courses from 2nd year on), low
- **AUTONOMY** - the education provider can make decisions by themselves on designing and carrying out the educational programmes. On the scale: high, medium (minor changes themselves; larger changes through authorities), low
- **TIME-BASED** - the students have to attend a course for a certain number of hours to receive a pass. On the scale: yes, partially (e.g. only lab classes), no
- **NATIONAL EXAMS** - all students must carry out national/regional exams governed by a government or professional exams body. On the scale: yes, no
- **MODULES** - the curricula are built of modules. On the scale: yes, partially (e.g. only for 2nd or 3rd year?), no
- **LEARNING OUTCOMES** - the curricula are built on learning outcomes. On the scale: yes, no
- **WBL** - VET programmes include work-based learning in companies. On the scale yes, partially (some study programmes do), no
- **GENERAL SUBJECTS** - the curricula include general exams facilitating Key competencies

Table 1 Comparison of VET systems in different European countries

Country	Flexible	Autonomy by VET provider	Time-based	National exams	Modules	Learning outcomes	WBL	General subjects
Sweden	medium	high	yes	no	yes	yes	yes	yes
Norway	medium	medium	yes	no	no	yes	yes	partially
Finland	high	high	no	no	yes	yes	yes	yes
Germany	low	low	no	yes	yes	yes	yes	yes
Austria	low	low	yes	yes	yes	yes	yes	yes
Czech Republic	medium	medium	yes	yes	no	yes	yes	yes
Slovakia	low	medium	yes	yes	no	yes	yes	yes
Slovenia	yes	medium	yes	yes	no	yes	yes	yes

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Country	Flexible	Autonomy by VET provider	Time-based	National exams	Modules	Learning outcomes	WBL	General subjects
Italy	low	medium	yes	yes	yes	yes	yes	yes
Spain	low	medium	yes	no	yes	yes	yes	no
Portugal	low	medium	yes	partially	yes	partially	yes	yes
Ireland	high	low	yes	yes	yes	yes	yes	yes

In the table below, it can be seen how the HE system differs in different countries

- **UAS** - the country has a higher education system that also includes Universities of applied science. On the scale: yes, no
- **FLEXIBILITY** -the system gives the flexibility to offer courses locally based on employers' needs and the student's choice (personal/individual study paths). On the scale: high, medium (e.g. only elective courses from 2nd year on), low
- **AUTONOMY** - the education provider can make decisions by themselves on designing and carrying out the educational programmes. On the scale: high, medium (minor changes themselves; larger changes through accreditation authority), low
- **TIME-BASED** - the students have to attend a course for a certain number of hours to receive a pass. On the scale: yes, partially (e.g. only lab classes, …), no
- **NATIONAL EXAMS** - all students must carry out national/regional exams governed by a government or professional exams body. On the scale: yes, no
- **MODULES** - the curricula are built of modules. On the scale: yes, partially (e.g. only for 2nd or 3rd year?), no
- **LEARNING OUTCOMES** - the curricula are built on learning outcomes. On the scale: yes, no
- **WBL** - VET programmes include work-based learning in companies. On the scale: yes, partially (some study programmes do), no
- **ECTS** - the universities are using ECTS points. On the scale: yes, no

Table 2 Comparison of HE systems in some European countries

Country	UAS	Flexible	Autonomy [111]	Time-based	National exams	Modules	Learning outcomes	WBL	ECTS
Sweden	NO	medium	high	No	No	partially	yes	yes	Yes/no

[111] University Autonomy in Europe. EUA Web resource. https://www.university-autonomy.eu/ Accessed 28-11-2021

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Country	UAS	Flexible	Autonomy [111]	Time-based	National exams	Modules	Learning outcomes	WBL	ECTS
Norway	Yes,	high	high	no	no	yes	yes	yes	yes
Finland	yes	medium	medium	no	no	yes	yes	yes	yes
Germany	yes	medium	medium	Partially	no	yes	yes	yes	yes
Austria	Yes	medium	medium	partially	yes	partially	yes	yes	yes
Czech Republic	as study programmes at universities	medium	medium	partially	no	partially	yes	yes	yes
Slovakia	yes, polytechnic	low?	medium	Partially	no	no	yes	yes	yes

Relevance comment for the ALBATTS project:

Thirty-eight countries in Europe have a National Qualification Framework. These frameworks are continuously updated. With regards to the different recommendations and programs such as the new Skills Agenda and the New VET recommendation 2020, it can be expected with new updates by nations in Europe, especially as the recommendation states that Providers of vocational education and training have in line with their national context and a degree of autonomy, flexibility, support and funding to adapt their training offer to changing skills needs, green and digital transitions and economic cycles while ensuring quality. At the moment, autonomy and flexibility vary widely between countries in Europe. In addition, it should be emphasised that VET providers in Europe are much more regulated than HE providers. The EUAE providers in most European countries (26) can 100% freely design the content of degree programmes and courses (apart from some professional programs such as medicine).

3.4 OTHER RELEVANT FACTORS TO CONSIDER

3.4.1 Different types of VET education

There are different types of VET education and different types of learners. In this part, we consider what different types of learners and different types of education exist on EQF levels 4-7 and how this should be considered in the ALBATTS project.

3.4.1.1 Youth in VET

In most European education systems, full-time compulsory education/training lasts 9-10 years, ending at 15-16. After this, the individual can choose what they are doing. However, in several European countries such as Belgium, the Netherlands, Germany, Portugal and from 2021 also Finland, there is compulsory education and training for 12-13 years ending at the

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age 18-19. During the last years, students will choose whether to join upper secondary general education, often leading to academic studies or choosing VET.[112]

Initial vocational education and training (I-VET) are usually carried out at the upper secondary and post-secondary levels before students begin working. It occurs either in a school-based environment (mainly in the classroom) or in a work-based setting, such as training centres and companies. Although, this varies from country to country, depending on national education and training systems and economic structures. On average, 50% of young Europeans aged 15-19 participate in I-VET at the upper secondary level. However, the European Union (EU) average masks significant geographical differences in participation ranging from 15% to more than 70%.[113]

3.4.1.2 Youth in Higher education

Higher education designs vary between countries. Some countries have a dual system, distinguishing between a professional higher education system and an academic system. Other countries, like Sweden, claims to have a one and only academic university system including some professional education but also run systems of more applied education besides this, which results in a complex system with few possibilities to transfer between systems. Apprenticeship in academic settings is rarer than in the professional setting. Forms for apprentice-like education in academic programmes can be practice periods at a company included in a course or bigger sections as a COOP period at a workplace and as study object in an exam work, often hosted by a company. Education programmes as a teacher, nursing, therapists, social workers, and some shorter engineering programmes (which all can be based both in academic systems and in professional education systems) often have a practice period at the workplace included.

The Bologna declaration also clarified that the first cycle of post-secondary education, 3-4 years (bachelor level, EQF6), should make it possible for a student to get a job. This level is not

[112]European Commission/EACEA/Eurydice (2018). Compulsory Education in Europe – 2018/19. Eurydice Facts and Figures. Luxembourg: Publications Office of the European Union. https://eacea.ec.europa.eu/national-policies/eurydice/sites/eurydice/files/compulsory_education_2018_19.pdf Accessed 28-11-2021

[113] EU policy in the field of vocational education and training. Web resource. https://ec.europa.eu/education/policies/eu-policy-in-the-field-of-vocational-education-and-training-vet_en Accessed 28-11-2021

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only for preparation for entering higher levels (as the master level and post-graduate level). National systems do this in different ways and with different results.

The longer and more academic an education are, the more practical adaptation to an actual job can be needed at the workplace, but hopefully with better development possibilities in the long career perspective. From more applied education programmes, the way to a job and productivity is shorter, but more education and training can be needed in the long career perspective.

3.4.1.3 Adult education and training in VET

Adults can take part in either Initial VET or Continuing VET. As many adults have some previous education and training or work experience, many join C-VET. Continuing VET (C-VET), often EQF5, occurs after initial education and training or after beginning working life. It aims to upgrade knowledge, help citizens acquire new skills, retrain and further their personal and professional development. C-VET is largely work-based, with the majority of learning taking place in the workplace. Whether a program is part of C-VET or higher education (EQF6) differs from country to country. In some countries, a program can be classified as C-VET while it may be classified as Bachelor studies in a University of applied sciences in another. Some countries do not have the system of the University of Applied sciences, e.g. Sweden.

3.4.1.4 Adult education in Higher education

Generally, a university does not usually sort applicants in higher academic education (exception may occur) depending on age or previous experience. However, the ordinary and often preferred campus environment is more designed for younger students full time than for second-chance students or life-long learners. The flexible education offers can often accommodate older learners' needs but are often course-based, not programme-based, and may not have the same continuity in offerings as the campus education offerings. The offerings can vary not only with individuals' needs but also with the university's needs and actual situation, such as limited possibilities to recruit campus students in a subject, special government initiatives and funding, etc.

3.4.1.5 Apprenticeship learning

In an apprenticeship, the student shares the time between learning in school and training in a company. Normally the student has a contract with the company and gets paid for the work.

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When finishing the apprenticeship, the student receives a fully recognised diploma and qualification. The student gets valuable work experience to put on their CV and good contacts in the industry or sector that can help start the career. Two in 3 get hired immediately after they finish their apprenticeship.[114]

The EU promotes apprenticeships through the **European Alliance for Apprenticeships** (EAfA)[115] to strengthen the quality, supply, and overall image of apprenticeships across Europe while also promoting the mobility of apprentices.

The Apprenticeship Support Services aim to improve the quality of apprenticeships across the EU. EAfA members can benefit from Apprenticeship Support Services, which provide online resources and networking opportunities that enable like-minded individuals to connect, learn and act.[116]

The European parliament also recommends that apprenticeships serve a wide range of occupations and ensure that VET is available at all levels, from upper secondary to tertiary levels[117].

In some countries such as Germany, Switzerland and Austria, apprenticeship has long and strong traditions.

Relevance comment for the ALBATTS project:

Youth in IVET is an important group for employment within the battery industry.
On average, 50% of young Europeans aged 15-19 participate in I-VET at the upper secondary level. Although this differs from country to country'. Therefore, this group should be considered as a potential workforce in the battery industry.

Programs and training material for adults should be considered at both IVET level and CVET level. There will be a great demand for re-skilling and up-skilling of adults. Adults learners in VET often need another type of training material than youth, and the CVET level is often work-based. Recommendations for how such programs could be arranged should be offered.

[114] Apprenticeship. EU web resource. https://ec.europa.eu/social/main.jsp?catId=1198&langId=en
[115] European Alliance for Apprenticeships https://ec.europa.eu/social/main.jsp?catId=1147&intPageId=5234&langId=en Accessed28-11-2021
[116] European Alliance for Apprenticeships https://ec.europa.eu/social/eafa Accessed 28-11-2021
[117]Skills for the labour market. EU Policies for Upskilling and Reskilling. European Parliament Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/638431/IPOL_BRI(2019)638431_EN.pdf Accessed 28-11-2021

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Whether a program is part of C-VET or higher education (EQF6) differs from country to country. In some countries, a program can be classified as C-VET while it may be classified as Bachelor studies in a University of applied sciences in another. This should be taken into account in the recommendations in the blueprint.

Courses in higher education are aimed at both youth and adults. The courses for adults (second-chance students or life-long learners) are often course-based rather than program-based, and the offer is not as large. The courses/modules in ALBATTS should serve both groups. Due to the emerging battery industry, there may also be an increased need for life-long learners. One group of learners will most likely be teachers from EQF levels 4-5.

Apprenticeship will be highly relevant for ALBATTS. In some countries, it is the main way of VET, while in other countries, there is a large amount of WBL included in the training. How can apprentice training be done in practice when the plants and the training places do not exist yet? In addition, trained mentors do not exist in the workplace. Solutions and recommendations on how this could be carried should be considered.

If Apprenticeship training is difficult to arrange in practice, it will pressure the learning material developed and digital applications used to serve the same purpose. This will be explored in 6.2,6.5 and piloted in 6.6.

According to recommendations, apprenticeship should also be increased in Higher education. This is, however, more common in Universities of applied science. The system of UAS does not exist in all countries, e.g., in Sweden. What methods can be used to give these future professionals closer cooperation with the battery industry?

3.4.2 Re-skilling, up-skilling

Europe is facing a widening skills gap that impacts the ability of EU businesses and governments to benefit from the opportunities of advanced technologies and digitalisation. At the same time, the advent of new technologies and digital tools is making many manual jobs obsolete while creating demand for new types of skills. This has created an urgent need to upskill and re-employ the workforce that is becoming redundant.[118] Automotive is one of these sectors. The European automotive sector has about 6 million direct jobs in the vehicle and electromobility sector. If side-effects on jobs are included, the automotive industry

[118] Hogarth, T. (2019) Skills for the labour market. EU Policies fpor Upskilling and Reskilling. European Parliament Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/638431/IPOL_BRI(2019)638431_EN.pdf Accessed 28-11-2021

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employs approximately 12,6 million Europeans or 6.6% of the working population. As a result, there will be many changes in this value chain.[119]

Job openings require both a higher level and a broader range of skills. In the future, there will be fewer jobs of an elementary nature. Even jobs that traditionally required low-level qualifications or no qualifications at all are becoming more demanding. A large majority of jobs will require some level of digital competence, and an increasing number of elementary jobs require some core or generic skills (such as communication, problem-solving, teamwork and emotional intelligence). [120]

Upskilling and reskilling of adults is an urgent priority for European policymakers and stakeholders. Rapidly changing labour markets and multiple challenges, such as digitalisation and its consequences for the future of work, technological changes, the environment, ageing societies and social inclusion, require strong skill foundations and constant updating and acquiring new skills, knowledge and competencies.[121] Investing in upskilling and reskilling of low-skilled adults has become even more urgent because of the Covid-19 pandemic outbreak. The labour market has been strongly affected, both in terms of job losses and a new organisation of work through new technologies and digital means to ensure that every adult has lifelong opportunities to constantly update and acquire new skills in working life and society.[122]

Across the EU, there is evidence of widespread skill mismatches where people report that they are under- or over-qualified for their current job. It is also apparent that many people possess relatively low levels of proficiency in literacy and numeracy. These are some of the basic skills required to enter and sustain a position in the labour market. People with poorly developed skills are likely to be at relatively high risk of job loss in the future. And it is through

[119] Electromobility: a green boost for European automotive jobs? Platform for Electromobility. https://www.platformelectromobility.eu/2021/04/14/webinar-electromobility-a-green-boost-for-european-automotive-jobs/ Accessed 28-11-2021

[120] European Commission (2016). COUNCIL RECOMMENDATION of 19 December 2016 on Upskilling Pathways: New Opportunities for Adults. Official Journal of the European Union (2016/C 484) https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016H1224(01)&from=EN Accessed 28-11-2021

[121] https://www.cedefop.europa.eu/en/projects/adult-learning-empowering-adults-through-upskilling-and-reskilling

[122] Adult learning: empowering adults through upskilling and reskilling. Cedefop Web resource. https://www.cedefop.europa.eu/files/3082_en.pdf Accessed 28-11-2021

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participation in continuous professional development and learning that adults will access, on an ongoing basis, the upskilling and reskilling necessary to adapt to change. [123]

CEDEFOP estimates that in the EU-28+, there are 128 million adults (46.1% of the adult population of this area)[124] with potential for upskilling and reskilling since they present either low education, low digital skills, low cognitive skills or are medium- to high-educated at risk of skill loss and obsolescence because they work in elementary occupations.

In the future, people will be increasingly dependent upon upskilling throughout their adult lives so that they can adapt to whatever changes the 4th Industrial Revolution might bring about.

For VET to attract students and to answer the needs of the employment market, the following recommendations have been proposed:[125]

- ensuring that the content of VET programmes is broadly based so that it provides individuals with the capability to move between jobs and acquire new skills as the demand for skills changes. If there is too narrow an occupational focus in the delivery of the VET, then this can inhibit the learner's occupational mobility and decreases its attractiveness;
- engaging social partners to ensure that the skill needs in the labour market will be met;
- giving adults access to training that has been traditionally considered the preserve of IVET delivered to young people. If people spend longer in the labour market, then their skills will periodically need updating. There is no reason why an older student should not participate in an apprenticeship if it is the most effective means for them to acquire the skills needed in a new occupation;
- reinforcing the work-based element in VET. This is particularly effective to bring on skills needed by employers;

[123]Adult learning: empowering adults through upskilling and reskilling. Cedefop web resource.. https://www.cedefop.europa.eu/en/events-and-projects/projects/adult-learning-empowering-adults-through-upskilling-and-reskilling Accessed 28-11-2021

[124]Cournover, M. (2021). Upskilling and Reskilling in Europe – A potential of 128 million adults (46.1% of the adult population). Report. https://jobmarketmonitor.com/2021/01/22/upskilling-and-reskilling-in-europe-a-potential-of-128-million-adults-46-1-of-the-adult-population/ Accessed 28-11-2021

[125]Hogarth, T. (2019) Skills for the labour market: EU policies for VET and upskilling. European Parliament Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/638431/IPOL_BRI(2019)638431_EN.pdf Accessed 28-11-2021

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- ensuring that apprenticeships serve a wide range of occupations and that VET is available at all levels from upper secondary to tertiary levels.

A distinction needs to be made between those who are in employment and those out of work. [126]

The ones in work can be engaged in reskilling or upskilling before becoming unemployed. In contrast, unemployed people may need to require labour market-relevant skills such as basic functional skills related to literacy, numeracy and digital literacy. Therefore, different types of programmes may be needed for those with low skills in employment and those unemployed.

Relevance comment for the ALBATTS project:

Programmes and courses for the increasing demand for up-skilling and re-skilling are needed. They should preferably include work-based learning elements. People taking part in these courses may have low digital skills.

Ensure that the content of VET programmes is broadly based so that it provides individuals with the capability to move between jobs and acquire new skills as the demand for skills changes.

Different types of programmes may be needed for those with low skills in employment and those unemployed. For example, the ones in work can be engaged in reskilling or upskilling before becoming unemployed. In contrast, the people already unemployed may need to acquire labour market-relevant skills such as basic functional skills related to literacy, numeracy and digital literacy.

Recommendations on apprenticeships for both adults and tertiary education may be needed in the blueprint.

3.4.3 Formal, informal, non-formal learning

To get the workforce that needs re-skilling and upskilling out in the job market as soon as possible, all prior skills and learning need to be identified regardless of it being formal, informal or non-formal learning.

[126] Hogarth, T. (2019) Skills for the labour market: EU policies for VET and upskilling. European Parliament Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/638431/IPOL_BRI(2019)638431_EN.pdf Accessed 28-11-2021

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This section describes the categorisation of formal, non-formal and informal learning. These concepts are used both by the OECD[127] and the EU[128] for lifelong learning strategies. The recognition of skills learned formally, informally, and non- formally are important when we want to get people out on the job market.

Formal learning is a training and educational model where trained teachers deliver formal learning in a systematic way. Formal learning of established curricula leads to an internationally acknowledged qualification or diploma.[129] Formal learning is organised, structured and consists of learning objectives. It is always intentional from the learner's standpoint, whose main objective is to gain skills/competence or knowledge throughout the learning phase.[130]

Non-formal learning is the second form of learning defined by OECD. The main difference between non-formal and formal learning is that the non-formal occurs in a planned but highly adaptable manner. Non-formal learning takes place in institutions, organizations, and situations beyond formal and informal education.[131] Learning may occur as an initiative of the individual but also happens as a by-product of more organised activities such as in-house training. In some countries, the entire adult learning sector falls under non-formal learning, whereas in others, most adult learning is formal. As non-formal learning gives certain flexibility between formal and informal learning, it must be mutually exclusive and avoid overlaps.[132]

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[127]Recognition of Non-formal and Informal Learning OECD Web resource. https://www.oecd.org/education/skills-beyond-school/recognitionofnon-formalandinformallearning-home.htm Accessed 28-11-2021

[128]Cedefop (2015). European guidelines for validating non-formal and informal learning. Luxembourg: Publications Office of the European Union.. Cedefop reference series; No 104.http://dx.doi.org/10.2801/008370 https://www.cedefop.europa.eu/en/publications-and-resources/publications/3073?src=email&freq=weekly&mc_cid=e01159c85e&mc_eid=4408d25199 Accessed 28-11-2021

[129] ERASMUS+ Project Drives (2020). *Reference and Recognition Framework – Analysis.D 4.1.1 Open Automotive Skills and Quality Framework (OASQF)*. https://www.project-drives.eu/Media/Publications/25/Publications_25_20200604_132039.pdf

[130]Recognition of Non-formal and Informal Learning. OECD Web resource. https://www.oecd.org/education/skills-beyond-school/recognitionofnon-formalandinformallearning-home.htm Accessed 28-11-2021

[131] ERASMUS+ Project Drives (2020). *Reference and Recognition Framework – Analysis.D 4.1.1 Open Automotive Skills and Quality Framework (OASQF)*. https://www.project-drives.eu/Media/Publications/25/Publications_25_20200604_132039.pdf Accessed 28-11-2021

[132]Recognition of Non-formal and Informal Learning. OECD Web resource. https://www.oecd.org/education/skills-beyond-school/recognitionofnon-formalandinformallearning-home.htm Accessed 28-11-2021

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Informal learning takes place naturally as a part of other activities. Informal learning can be seen as a collection of learnings received from daily experiences, such as hobbies. It covers multiple activities, from personal research on a subject to passive absorption of information from television, radio, or other means of audio-visual mediums. The problem with informal learning is that it tends to be unpredictable, learning media may have wrong information, or the learning is not always evaluated.[133]

Relevance comment for the ALBATTS project:

Developing units with clear learning outcomes will make it easier to identify skills regardless of how, where, and when they are acquired. With clear learning outcomes also non-formal and informal learning can be identified and recognised. The use of digital badges (micro credentials) based on clear learning outcomes facilitates recognising previously required skills outside a formal education setting. This would diminish overlapping, and students/workers could progress faster when up-skilling or re-skilling.

3.4.4 Work-based learning

According to the proposal Integrating periods of work-based learning into the new training content, including opportunities to apply knowledge in practical "real life" workplace situations, and embedding trans-national learning experience whenever possible should be carried out. The Council recommendation is that 60% of recent VET graduates benefit from work-based learning during their vocational education and training[134]. This objective refers to all forms of work-based learning and will contribute to increased apprenticeship opportunities that can be supported with the Youth Guarantee.

Work-based learning refers to all forms of learning that take place in a real work environment. It provides students with skills needed in working life, improved employability, a faster transition to work and better access to jobs. At the same time, it gives employers the ability to affect technical and job skills among future workers and facilitates efficient recruitment. The most common forms of work-based learning are apprenticeships, internships/traineeships and on-the-job training. Often work-based learning is combined with

[133] ERASMUS+ Project Drives (2020). Reference and Recognition Framework – Analysis.D 4.1.1 Open Automotive Skills and Quality Framework (OASQF). https://www.project-drives.eu/Media/Publications/25/Publications_25_20200604_132039.pdf Accessed 28-11-2021

[134] European Commission (2020). Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0275&rid=7 Accessed 28-11-2021

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elements of class-room based or online learning. [135] Efforts to strengthen WBL, particularly in vocational education and training (VET), are increasingly common throughout European countries. WBL is also used in tertiary education but is not as common as in VET. WBL can be carried out nationally or internationally.[136] There are countries where WBL does not yet feature fully as a part of education and training provision.[137] In some countries, on-the-job and school-based learning alternate within a week; in others, two years of school are followed by two years in a firm.[138]

At the European level, targets and priorities for WBL have been confirmed (directly and indirectly) within several core strategies and initiatives:

- **Europe 2020 Growth Strategy**: with the aims to enhance the quality and relevance of education and training systems, to improve competitiveness and to achieve smart, sustainable and inclusive growth;
- **ET 2020 Strategic Framework**: to support policy development in the EU Member States, notably including targets for the implementation of national VET reforms to strengthen work-based learning and apprenticeship-type schemes;
- **Agenda for New Skills and Jobs**: to support the EU employment target of 75% of the working-age population (20-64 years) by 2020, also by involving employers in the co-investment, development and delivery of education;
- **European Alliance for Apprenticeships (EAfA):** established in 2013 and targeting the promotion of youth employment, the alliance works on a wide variety of initiatives and targets improvement in the quality, supply and perception of European apprenticeships.[139]

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[135] Investing in Work Based Learning. ILO/EC/ETF/Cedefop/OECD/UNESCO Leaflet. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_565923.pdf Accessed 28-11-2021

[136] Cedefop (2021). The role of work-based learning in VET and tertiary education: evidence from the 2016 EU labour force survey. Luxembourg: Publications Office of the European Union. *Cedefop research paper; No 80.* https://www.cedefop.europa.eu/en/publications-and-resources/publications/5580 Accessed 28-11-2021

[137] *Work based learning in Europe*. Web resource.https://www.wbl-toolkit.eu/index.php?id=16 Accessed 28-11-2021

[138] Cedefop/OECD (2021). The next steps for apprenticeship. Luxembourg: Publications Office of the European Union. Cedefop reference series; No 118 http://data.europa.eu/doi/10.2801/085907 https://www.cedefop.europa.eu/files/3087_en.pdf Accessed 28-11-2021

[139]Work based learning in Europe. Web resource.https://www.wbl-toolkit.eu/index.php?id=16 Accessed 28-11-2021 https://www.wbl-toolkit.eu/index.php?id=16
Accessed 28-11-2021

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The Bologna declaration demands that the degree awarded after the first cycle of tertiary education (bachelor level, EQF6) shall also be relevant to the European labour market as an appropriate level of qualification. However, the ways to solve that differ considerably, both between countries and types of education. For postgraduate levels (EQF 7 and 8), there are research-training possibilities in the Marie Curie Sklodowska Actions, both for students staying periods at other universities and working with R&D at corporations.[140]

Moreover, one of the four common EU objectives in the ET 2020 Strategic Framework for higher education context includes consultation and cooperation activities with stakeholders and business partner organizations. From an analysis of the relation between Advanced Manufacturing Technologies (ATM) and Higher Education in Europe,[141]it was possible to conclude that the workforce related to ATM does not necessarily have to be associated with a higher education trajectory explicitly in ATM. Based on educational programs related to Manufacturing Engineering, including specific areas as robotics and automation, production systems, engineering design and advanced materials, two pillars of knowledge necessary to feed the workforce at ATM were identified: general skills in STEM domains (Physics, Computer Science, Engineering, Mathematics) and general non-technical competencies (Project management, Law, Economics). Once these transversal skills are guaranteed, the strategy for ATM, such as battery manufacturing technology[142], is to encourage industry involvement by providing academic staff with concrete insight based on apprenticeship learning structures [143] [144] [145] [146] [147] In a sense, it is suggested that a platform for skilled personnel and high educational programs should be created in EU, with cross-regional education.

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[140]Marie Skłodowska-Curie Actions. Web resource. https://ec.europa.eu/research/mariecurieactions/node_en Accessed 28-11-2021

[141]PwC(2019). Curriculum Guidelines for Key Enabling Technologies (KETs) and Advanced Manufacturing Technologies (AMT) INTERIM REPORT https://op.europa.eu/en/publication-detail/-/publication/4dcaeee3-29c2-11e9-8d04-01aa75ed71a1/language-en/format-PDF/source-87225354 Accessed 28-11-2021

[142]Batteries Europe (2020) Strategic Research Agenda for batteries. Deliverable 3.6. https://ec.europa.eu/energy/sites/ener/files/documents/batteries_europe_strategic_research_agenda_december_2020__1.pdf Accessed 28-11-2021

[143]Davy, N. & Frankenberg, A. (2018) *Typology of Apprenticeships in Higher Vocational Education.* ApprenticeshipQ project report. https://multinclude.eu/wp-content/uploads/sites/3/2019/07/AppQ-Typology-of-App-in-HVET_final-version_v3.pdf Accessed 28-11-2021

[144]Decker, D. (2019). Student perceptions of higher education and apprenticeship alignment. Education Sciences, 9(2), 86. https://www.mdpi.com/2227-7102/9/2/86/htm Accessed 28-11-2021

[145]https://batterytechnologies.co.uk/power-to-learn/apprenticeship-program/ Accessed 28-11-2021

[146]https://www.jaguarlandrovercareers.com/content/Higher-Apprenticeship/ Accessed 28-11-2021

[147]https://www.getmyfirstjob.co.uk/discover/job/112349/1/automotive/coventry/advanced-apprentice--manufacturing--battery-assembly-centre Accessed 28-11-2021

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Relevance comment for the ALBATTS project:

Work-based learning (WBL) is part of most European VET systems. WBL will be difficult to implement in a new sector as there will not be WBL places available in many locations. We believe that there will be more available WBL places for HE students at the planning stage of the plants in the beginning. We also believe that in the beginning, when plants are built and developed, the training of staff will be more based on in-house training and apprenticeship as VET institutions will not have the required technology and skills for offering these courses. Work-based learning should also be required for teachers/trainers as this is the only way to learn what skills the industry requires. The so-called hybrid teachers – a type of personnel who is part-time working in a company and part-time as a teacher in a vocational school - can contribute to stronger cooperation arrangements between VET schools and companies in a more structured and frequent manner.[148] WBL, through transnational mobility, may be playing an important part role in the emerging sector. However, educational programs and course contents will be planned so that they can be utilised both in school education, WBL and in apprenticeship studies.

3.4.5 Transnational learning

Transnational learning is offered by both VET and HE mainly through mobilities. Students or experts either study, job shadowing, teach at college/university or do internships in companies in another European country or a third country.

Since the late 1990s, there has been a substantial increase in the number of higher education programmes offered jointly by consortia of HEIs in different European countries. For the last 5-10 years, there has been a political aim, on a European level, to facilitate the establishment of such programmes through, e.g. the Erasmus Mundus programme. Joint programmes are thought to enhance mobility of students and staff, facilitate mutual learning opportunities and create programmes of excellence, which can demonstrate the high quality of European higher education. The new Erasmus+ programme 2021-2027, with an almost doubled budget compared to the previous period, offers excellent and flexible opportunities for transnational learning and cooperation within education. The new council recommendation is that 8% of learners in VET benefit from learning mobility abroad [149]

[148] European Commission (2020). Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0275&rid=7 Accessed 28-11-2021

[149] Ibid.

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Joint Qualifications are common in HE but have also been developed and piloted within VET. The specific objective of the last call of Joint qualifications in VET was to support the preparation and set up joint VET qualifications or improve such existing qualifications. The transnational qualifications should comprise strong work-based learning and a mobility component, address learning outcomes, quality assurance and proper recognition while using relevant European tools and instruments.

During the Covid pandemic, digital skills, new teaching/learning methods, and virtual mobilities have been developed in VET and HE. These methods can be utilised for future international cooperation.

Relevance comment for the ALBATTS project:

Transnational learning and mobility will be a great opportunity for the ALBATTS project and the emerging sector in developing skills across Europe. Although this project does not finance mobilities, they can be financed by the project partners own mobility projects.

Transnational learning can be part of the piloting process where students can take part through mobilities, or it can be done virtually.

Students can do their studies or placements abroad and thereby bring back skills that they cannot acquire in their own country. Studies abroad can also be carried out virtually but may be more suitable for HE students.

Apprentice students can be sent to their employer's plants abroad that may be further ahead in the establishment and thereby bring back knowledge to their own region.

Teachers play a central part in education, and they can gain knowledge and skills in an authentic environment through job shadowing mobilities in companies and colleges/universities abroad. In addition, they may have the possibility to gain authentic teaching material from real life.

Joint qualifications could be considered to mobilise knowledge, skills, learning material, and learning environments. In cooperation, it could be easier for European education providers to design and offer courses. The joint qualifications could be offered virtually or face-to-face.

We will try to incorporate as many of these features as possible in this project and give recommendations on how transnational learning and Erasmus can facilitate learning between regions in Europe. The only concern is that the competition between companies and a continuation of the pandemic may restrict this.

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3.5 CURRICULUM DESIGN

3.5.1 Learning outcomes

Learning outcomes are statements of what a learner is expected to know, do, and understand at the end of a learning sequence[150]. Learning outcomes are used both in HE and VET across Europe and play an important role in improving the quality and relevance of education and training in Europe. Learning outcomes are not dependent on the learning process or the learning context in which they have been achieved, and therefore it is possible to use them to identify whether what the learner has achieved in one learning setting or context is comparable to what s/he is expected to have achieved in another setting or context.[151]

The learning outcomes approach shifts the emphasis from the duration (hours) of learning and the institutions where it takes place to the actual learning and the knowledge, skills and competencies that have been or should be acquired through the learning process.

Learning outcomes statements help to clarify programme and qualifications intentions and make it easier for those involved – learners, teachers, assessors and workers in WBL – to work towards these expectations. The increased transparency offered by learning outcomes also makes it easier to compare programmes and qualifications between different countries and facilitates, therefore, recognition of prior learning.[152] In addition, learning outcomes allow for different approaches to reach the same result.

3.5.2 Learning Outcomes in the Education context

Learning is defined in terms of its outcomes in different contexts and for different purposes. In the Educational context, learning outcomes are expressed in curricula, modules, course descriptions, educational standards, qualifications and assessment standards[153]:

- Curricula - to define each learning activity's expectations, guide teachers in the teaching process, choice of methods, etc., to inform learners about what they are expected to be able to do/know after a given learning activity.

[150] Cedefop (2017). Defining, writing and applying learning outcomes: a European handbook. Luxembourg: Publications Office. http://dx.doi.org/10.2801/566770 https://www.cedefop.europa.eu/files/4156_en.pdf Accessed 28-11-2021

[151] https://www.ecvet-secretariat.eu/en/faq-page#t1n968

[152] Defining, writing and applying learning outcomes | Cedefop (europa.eu)

[153] 2011, European Union, USING LEARNING OUTCOMES - European Qualifications Framework Series: Note 4 European Qualifications Framework Series: Note 4. https://www.aqu.cat/doc/doc_26184757_1.pdf

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- Qualifications - to define the overall expectations of a person holding the qualification, to inform employers when recruiting a person with a given qualification, to inform learners at the orientation stage (choosing a pathway) and consequently also to be used by guidance staff, to manage the qualifications system (for example, identify areas where qualifications are missing).

Assessment criteria/specifications - to define what is to be assessed and ensure that the learning outcomes (for a qualification or learning activity/module) are met to enable homogeneity in judging learners' performance.

The assessment of the learning outcomes in VET varies widely between countries. In some countries, as in Finland, it happens entirely in a workplace, and the evaluators are a workplace representative and a teacher. In some countries, it is carried partly in school and partly in the workplace. In some countries, it is based on theoretical exams and practical tests in the school environment. Some countries have national exams for the students. Whichever assessment system a country has, learning outcomes can be used for the skills to be acquired.

3.5.3 Definition and writing of Learning Outcomes

Learning outcomes are statements of what a learner knows, understands and is able to do on completion of a learning process, defined in terms of knowledge, skills and competencies.[154]

Learning outcomes can be written in many different ways, and it is not a given that they will add value as expected. Formulating learning outcomes requires expertise and experience; they should express reality and always be measurable.

Simplicity is important when writing learning outcomes. Too much detail and overly complex statements prevent learners, teachers and assessors from relating to the statements [155].

When writing learning outcomes CEDEFOP (2017) recommends the following:

- "defining and writing learning outcomes should be treated as iterative, starting from overall objectives and moving stepwise towards specific statements for units and assessment. Having arrived at specific statements, overall objectives could be reviewed and changed;

[154] ESCO - ESCOpedia - European Commission (europa.eu)

[155] Cedefop (2017). Defining, writing and applying learning outcomes: a European handbook. https://www.cedefop.europa.eu/files/4156_en.pdf

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- when writing learning outcomes to orient a qualification/programme or a qualification unit/course, carefully consider the number of statements used. When defining a course or unit, it is generally recommended to limit the number of statements (perhaps four to six statements);
- when defining and writing learning outcomes for a full qualification or a programme, it is generally recommended to keep the number of statements as low as possible. The purpose should be to identify the overall scope and profile, not to list all technical details;
- limiting the number of statements makes it easier for the learner to relate to the intentions and engage in the learning;
- limiting the number of statements makes it easier to plan teaching, facilitate learning and eventually carry out assessments;
- when writing a learning outcomes statement, focus on the learner and start with an action verb, followed by the object of the verb as well as a statement specifying the depth/breadth of learning to be demonstrated, and complete with an indication of the context (which can be related to learning, work or other relevant social contexts);
- in general, there should not be more than one action verb for each learning outcome."[156]

The following table defines the basic structure of learning statements, according to CEDEFOP.

Table 3 The basic structure of learning outcomes statements (CEDEFOP, 2017)

The basic structure of learning outcomes statements			
… should address the learner.	… should use an action verb to signal the level of learning expected.	… should indicate the object and scope (the depth and breadth) of the expected learning.	… should clarify the occupational or social context in which the qualification is relevant.
Examples			
The student…	…is expected to present …	…in writing the results of the risk analysis	…allowing others to follow the process replicate the results.
The learner…	…is expected to distinguish between…	…the environmental effects…	…of cooling gases used in refrigeration systems.

[156] A EUROPEAN HANDBOOK - Cedefop. https://www.cedefop.europa.eu/files/4156_en.pdf

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Learning outcomes statements – combining action verb/object/context – need to be articulated vertically and horizontally.

Introducing the vertical dimension of learning outcomes statements is about indicating the level and complexity of learning. This will normally require referring to a hierarchy (implicit or explicit) of intended learning outcomes and achievements, such as defined by EQF.

The vertical dimension of learning outcomes can be described using different action verbs for different domains, as illustrated in Table 4.

Table 4 Common verbs per domains of learning (CEDEFOP, 2017)

Domain of learning	Common verb associations
Knowledge	define, identify, describe, differentiate, explain, apply, analyse, resolve, justify, recommend, judge, create, design
Skills	adapt, arrange, build, calibrate, construct, design, deliver, demonstrate, display, dissect, fix, mimic, operate, sketch, use, perform
Competencies (or attitudes)	ask, challenge, demonstrate, discuss, dispute, follow, justify, integrate, practise, judge, question, resolve, synthesise

The revised Bloom's Taxonomy Action Verbs (Appendix 6) is a very useful tool in writing learning outcomes that address what the student will be able to do at the end of the learning process. Using the appropriate verb clarifies the order of thinking the student is expected to obtain and helps the teacher/trainer to associate the appropriate teaching strategy and assessment types, as suggested by different authors.

In different countries learning outcomes are used in different ways. In Finland, for example, learning outcomes are not categorised under the headings of knowledge, skills and competencies in the curricula. They are, however, measuring that the student possesses proficiency on the levels of knowledge (what the student knows), skills (what the student can do) and competencies (the students' ability based on knowledge, skills and attitude combined). On the other hand, in Portugal, learning outcomes are described under the headings of knowledge, skills and attitude. Table 5 shows examples of learning outcomes described in Finland and Portugal *curricula*.

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Table 5 Examples of learning outcomes in Finnish and Portuguese curricula

Examples from Finnish national VET curricula	Examples from the Portuguese catalogue for VET
Students work safely on an electrical engineering and automation sector site -Move and operate safely in the installation environment, identifying different hazards and taking them into account; -Assess the occupational safety risks related to their work and report any shortcomings they have observed; -know how to help in emergencies and the event of an accident or illness; -carry out hot work and prevent hot work accidents **Students draw on their basic knowledge of electrical engineering in their tasks** -are familiar with basic electronic magnitudes and their interdependencies; -make connections, perform calculations and take measurements related to basic electrical magnitudes; -based on measurements, interpret the effect of different components and connections on the operation of direct and alternating current circuits **Students use the materials, components and methods needed in the electrical and automation engineering sector** -ensure they have the tools, protective equipment and materials needed in electrical and automation engineering installations and check their condition; -select and use appropriate raw materials for their work, process them and comply with the instruction for handling them	**Knowledge** Fundamental of technical standards and safety of the service table; Fundamental of raw materials, equipment and utensils; Fundamental of food manipulation procedures; Fundamental of hygiene and food safety norms **Skills** Organize the space, equipment and utensils according to the delicacies to be prepared in the dining room, at the customer's sight Identify the various types of food, their nutritional and dietetic characteristics Apply the rules of hygiene and food safety. **Attitudes** Demonstrate organisation skills Work as a team Demonstrate care and attention in the correspondence between requests and respective service; Demonstrate capacity for autonomy (restricted) and initiative; Demonstrate ability to adapt to new equipment, technologies and utensils; Comply with hygiene and food safety standards

Relevance comment for the ALBATTS project:

Learning outcomes are the basic element used for describing and comparing curricula/modules, thus guaranteeing a common understanding between actors and contributing to the recognition of competencies between countries, frameworks, systems and education and training models. Learning outcomes can be used despite what assessment methods are used on a national level.

According to the ALBATTS work plan, curricula will be defined during the project's timeline to close the gap between sectoral needs and the education and training offer available in the market. The learning outcomes approach will be used as the basic element for describing curricula and training modules, according to the guidelines set by CEDEFOP and the most relevant authors.

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3.5.4 Modules or Units

By Modularisation, we mean breaking vocational qualifications into smaller parts or units of learning outcomes. In this way, content can flexibly be updated and customised to the needs of individuals, and individual pathways can be built. In addition, validation of learning outcomes acquired in non-formal and informal learning will facilitate up- and reskilling, leading to full qualifications and micro-credentials or partial qualifications. It also helps to bridge between different fields, which is necessary for developing a green and sustainable economy [157].

Modules and Units of learning outcomes are used both in the ECVET and ECTS systems.

Relevance comment for the ALBATTS project:

Using modules or units of learning outcomes when making curricula and courses will make the use more flexible and versatile. Outdated units can quickly be updated, and the same unit can be used for different programs and professions to broaden them and make them cross-disciplinary. In this way, regional needs can also easier be fulfilled. Units with learning outcomes will also facilitate Action 9 in the new skills agenda with the Initiative on individual learning accounts. However, as the technological change will be fast and frequent updating or replacement will be needed, units should not be too large.

3.5.5 Micro-credentials

A micro-credential is a qualification evidencing learning outcome acquired through a short, transparently assessed course or module. Micro-credentials may be completed on-site, online or in a blended format.

The qualifications are flexible and allow learning opportunities to be opened up to citizens, including those in full-time employment. They are highly flexible and allow the targeted acquisition of skills and competencies. In addition, micro-credentials can be offered by higher and vocational education and training (VET) institutions and private organisations.

They can be particularly useful for people who want to:

- build on their knowledge without completing a full higher education programme;
- upskill or reskill to meet labour market needs or to develop professionally after starting work.

[157] Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience - Publications Office of the EU (europa.eu)

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The Commission seeks to develop a common definition and European standards for micro-credentials and explore the inclusion of micro-credentials in qualifications frameworks in dialogue with national qualification authorities. [158]

Relevance comment for the ALBATTS project:

Micro-credentials would bring a good opportunity for recognition and validation of skills in Europe and the battery sector. This will be discussed further in deliverable D6.3.

3.6 BEST PRACTICES AND EVALUATION OF OTHER BLUEPRINT ERASMUS+ PROJECTS

This section provides an overview of the approach and practices from other blueprint projects.

3.6.1 DRIVES Project

Project **DRIVES** is an ERASMUS funded project coordinated by VSB-TUO. The project aims to implement the Blueprint objectives for the automotive sector, namely the delivery of human capital solutions to the value chain (vehicle production, automotive suppliers and automotive sales and aftermarket services) through the establishment of an Automotive Skills Alliance.

(1) Training Offer - Project DRIVES is tackling the skills and education framework in various ways. When it comes to developing training material and its piloting through courses, the MOOC (Massive Online Open Course) approach was adopted. Since the project is ending in 2021, the courses are already running and available on the learning platform, developed as one of the project deliverables. The platform offers the selection of MOOC courses related to the identified job roles within the DRIVES project.

Each MOOC covers the job role to some extent, and learning resources are provided to the learners. Each MOOC is closed by a test questionnaire held on the platform, and further certification options are available through cooperation with ECQA. More information can be found here: Project DRIVES (project-drives.eu)

Project DRIVES is also piloting the trainer interaction courses, which are more specific and detailed.

(2) Skills and Competency Framework – project DRIVES tackled the questions of a sustainable approach to the skills/competence and knowledge definition, levels of maturity and overall

[158] European Skills Agenda - Employment, Social Affairs & Inclusion - European Commission (europa.eu)

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composition of job roles in connection to the European used frameworks. Project DRIVES developed a DRIVES Framework that facilitates the EU-wide database of skills/competencies, job roles, courses, and their linkage with maturity levels. It is also possible to see the coverage of job roles by different courses. DRIVES Framework also offers different types of digital badges based on the type of course completion. The types of competence achieved on different levels of maturity – recognition of badges is also achieved by quality criteria, such as the reflection of ECTS, ECVET credits or facilitation of ISO 17024. All of this will result in a different type of badge. Concepts contained within the DRIVES Framework and their definition as such is coherent with the ESCO. More information can be found here: Project DRIVES (project-drives.eu)

3.6.2 Next Tourism Generation Alliance

The **Next Tourism Generation Alliance, NTG,**[159] has formed a dichotomy of sectoral skills: digital skills, green skills and social skills. An online skills matrix and a toolkit follow with this[160], as a resource hub for linking useful project-external course content and categorised project-developed teaching content in the form of lesson plans, with detailed instructions to the teacher, and one or two customised ppt presentations for the teacher's use. The lessons should cover between one and three hours. However, the work seems not to focus on longer basic educations, but primarily on up- and reskilling of staff in the sector.

3.6.3 EO4GEO Project

The **EO4GEO project**[161]is working with the space- and geospatial sectors and their wide application areas, primarily focusing on EQF 4-6. They develop a "Body of Knowledge" (BoK) as a large set of concepts and relations between them, which will be covered in the education and training curricula. There are several tools with the BoK in the centre: Curriculum design tools, BoK visualisation tools, Occupational Profile tool, Job offer tool, BoK matching tool, and a BoK annotation tool. EO4GEO also has developed training materials based on the BoK concepts, which seem to be minicourses or lessons, often based on slides and video. Externally

[159] https://nexttourismgeneration.eu/
[160] https://nexttourismgeneration.eu/ntg-toolkit/
[161] http://www.eo4geo.eu/

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produced, already existing materials are mixed with project-produced material. This gives a very neat and orderly systematic impression. The blueprint project and most of its 26 partners are also highly integrated with the Copernicus Academy Network relating to the Copernicus Earth Observation Programme in the European Union.[162]

3.6.4 MATES Project

The **MATES project** on maritime issues, including the shipbuilding and offshore sectors, has a large online multifunctional directory, the "Ocean Best Practice" database. This includes events, conferences, projects, publications, educational games and tools and other accessible, useful materials relevant for upskilling and reskilling. The materials were collected during a year in 2018-2019. The target groups are VET teachers, educators, the public and the media, the research community and the maritime industry. It is difficult to know what has been produced in the project, but some resources are surely coming from partners work. The focus seems to be on assisting and inspiring new education and training by various providers, not running an educational system in the project nor forming courses or learning modules from the project.

3.6.5 Skills4Smart TCLF Project

The **Skills4Smart TCLF** blueprint project[163] (Textile, Clothing, Leather and Footwear) works with the European textile industry and primarily focuses on the VET level of education. It seems very well networked with relevant VET education in Europe. It aims to create "new education profiles" for its four sectors and four transversal profiles "common to the four sectors". For this seems also learning material to be planned, but not visible on the website yet. Plans of producing MOOCs for the sector are also included. Skills4Smart TCLF seems to be working for energising the networked VET education providers and, by standardising education solutions and qualifications, get all-European recognition in the sector.

For comparison, ALBATTS works primarily with new public education for new sectors and businesses in the battery value chain. In some sectors, have well over half of the newly hired

[162] https://www.copernicus.eu/en/copernicus-academy
[163] https://s4tclfblueprint.eu/

coming directly from education. Upskilling and reskilling is also an important part of the work. Furthermore, we have a clear connection with the DRIVES project, collaborating on electromobility issues and in Pact for Skills and ASA. Therefore, a collaboration with building further on the DRIVES learning platform with battery- and electromobility learning modules, small MOOCs and so on is one thing we aim at doing.

To inspire the public education system, we aim to collaborate with InnoEnergy and the EBA250 Academy to bring out best practice solutions, curricula, and learning materials to national education providers.

Relating to Skills4Smart TCLF, ALBATTS have the same task of energising VET providers and assisting national public education in various subjects on levels 4-6 mainly. A difference is that for battery and electromobility education, there is nothing there to start with. It is new and forming before our eyes.

Relating to Next Tourism Generation Alliance, NTG, versus ALBATTS, it seems that they are working primarily with upskilling and reskilling in the sector, with various providers, and in standardised ways with proposed lessons on courses. Our experience is that in public education programmes in the battery and electromobility sector on levels 4-6, this level of detailed instructions to the teacher would not work for us. On EQF levels 7 and 8, it is unthinkable.

Relating to the MATES project, ALBATTS seem to have some similarities in approach, but our sector of batteries and electromobility is all new and forming more every day. So the upskilling is not from an old-kind battery engineer to a new digitalised one, but instead directly from education or another sector.

Relating to the EO4GEO project, it seems quite embedded in the Copernicus context. Therefore, it can contribute to well-systematised resources in an interesting knowledge packaging -learning design way of working. This presupposes, however, a less volatile knowledge mass than what we currently have in the batteries and electromobility sector.

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Relevance comment for the ALBATTS project:

ALBATTS can learn from other blueprint projects that work with learning materials and platforms. However, ALBATTS works with a **new emerging large sector**, activating and supporting public education and upskilling and reskilling solutions. We have a clear connection with DRIVES and will, in part, continue their MOOC-type work. Concerning learning material, ALBATTS will both collect information on available learning material and create our own for missing parts. ALBATTS is working in a sector of constant and somewhat dramatic change, which also has its implications; we have a moving knowledge and skills mass, forming step by step, and can thus not make too rigid and detailed solutions that grow old too fast. We can also advise on how to update and create new materials in easy and fast ways.

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4 State-of-the-Art of Available OER skills and Tools

4.1 REQUIREMENTS AND DEFINITIONS

OER, Open Educational Resources, are freely available content resources for teaching and learning. Most are Internet-based and build on the digital precise duplication possibility without quality loss and direct cost for duplication. Another older term is “digital learning objects”. Digital re-usability is a central feature, but also the possibility to contextualise and adapt to various situations.

It is necessary to reference the creator of the material, depending on the type of licensing, and balance what can be done with or without special permission. There are also commercial, educational resources which we can sometimes reference, but the following is focused on the openly accessible materials.

4.1.1 Open Education Resources (OER)

Someone has to create OERs and keep them available, maintain and support them. In an earlier stage, a common understanding was that a course could be built by finding and combining such content objects as building blocks, a LEGO construction resulting in an Internet-based course. It showed soon not to be that easy, as education is not a content-provision-only process. Content is a part of teaching and learning, but not all that is needed for education. Internet just decreases the friction of information for making content available.

4.1.2 Legal issues

Not all digital learning resources are free or easy to use, although easy to copy and distribute. Learning resources for a student, besides tuition, were once just items as books and personal lab equipment, calculators, and so on. The cost for textbooks has been rising, and it is now, at least in the US, so high that the cost of textbooks can exceed the tuition fee, even for state-aided community colleges. In an increasingly digital age, there are many commercially produced digital resources and digital resources that are bonus resources and come with owning a physical coursebook as an example. These resources usually are offered under conventional copyright, meaning that they can’t be used outside conditions specified. Such conditions of *fair use* vary after some variables: the purpose, context and volume of use of a copyrighted resource, how many persons can access the resource, for how long, and the

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market effect on the original work. Internet-based content distribution has made it riskier to use copyrighted material illegally compared to use in a classroom (which was also not legal in many cases).

However, facts from a copyrighted work are not copyrighted, but the way of expressing them can be. A common practice for using copyrighted videos (as a commercial movie) is that 15 seconds can be used as a referenced citation, but only if the video snippet is contextualised, commented or analysed, not just presented as-is.

In some countries, for example, Sweden, there is a special academic right for teachers and researchers to own, decide over, and benefit from a product of their own intellectual origin, whether innovations or a recorded lecture. In practice, it is not so easy to monetize this right anyway. The Internet culture prioritises sharing and collaboration, and some teachers share material because they want feedback and contribute to good teaching in their subject. Teachers are accustomed to not getting paid for their research publications and not for the peer-reviewing of manuscripts either - but that is considered OK because it is a part of the university career credit system. Some OER sites offering up-and download of OER, as merlot.org, are trying to tap into this merit system concerning learning material contributions as well. If many persons download, use and recommend a resource - that could be measured and become a benefit for the creator in their academic career.

When this sharing of educational material began to happen and be observed, about 2000-2005, there were many makeshift models for allowing or limiting the use of learning material. This developed into a couple of new licensing models for OER, as for other digital works. The most used of these are Creative Commons license[164] that has a national legal definition in most nations, and easy-to-use standard sets of conditions to mark how an educational material can be used. For example, it is possible to search on google.com (Google advanced search) by applying a Creative Commons filter. When searching on keywords, the user will only find material possible to use on a specific license level. There are four symbols or license elements in CC to combine into sets for describing attribution demands, derivative works possibilities, commercial limitations, and the share-alike demand.[165]

[164] https://creativecommons.org/
[165] https://creativecommons.org/licenses/

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Figure 6 Example of Creative Commons symbol components[166]

CC BY

This license allows others to distribute, remix, adapt, and build upon existing work, even commercially, as long as they credit you for the original creation. This is the most accommodating of licenses offered and recommended for maximum dissemination and use of licensed materials.

CC BY-SA (SA ... ShareAlike)

This license lets others remix, adapt, and build upon existing work even for commercial purposes, as long as they credit the author and license their new creations under identical terms. This license can be compared to "copyleft" free and open-source software licenses. All new works based on this work will carry the same license, so any derivatives will also allow commercial use. Wikipedia uses this licence, and it is recommended for materials that would benefit from incorporating content from Wikipedia and similarly licensed projects.

CC BY-ND (ND ... No-Derivs)

This license lets others reuse work for any purpose, including commercial ones. However, it cannot be shared with others in adapted form, and credit must be provided to the originator.

CC BY-NC (NC ... Non-Commercial)

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CC BY-NC-SA (NC-SA ... NonCommercial-ShareAlike)

[166] Image source: https://jorg.pareigis.se/2/2019/02/10/anatomy-of-a-creative-commons-license/

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This license lets others remix, adapt, and build upon existing work non-commercially, as long as they credit the author and license their new creations under identical terms.

CC BY-NC-ND (NC-ND ... NonCommercial-NoDerivs)

This license is the most restrictive of the six main licenses, only allowing others to download the work and share them with others as long as they credit you, and they are not changed in any way (NoDerivs) or used commercially.

Another framework for the modern sharing of digital objects and code is the GNU (also called the GPL) license, created for open-source software code. It is run by the Free Software Foundation and is now in its version 3.[167] [168]

Relevance comment for the ALBATTS project:

ALBATTS must conform to all relevant IPR and copyright regulations and not cut any corners. The CC license offers a lot of possibilities to adapt and reuse existing learning material and is recommended for the use of all learning materials produced in the project. The basic CC BY-SA license fits most needs.

4.1.3 Usefulness issues

There are more issues when a teacher searches for an OER to use than finding an OER corresponding to a keyword search. There are issues like

- **Accessibility of the OER** The European Accessibility Act[169], of which the EU Web accessibility directive[170] is a part, requires that all new web and app-based information be accessible to everyone by alternative information about images presented, machine-readable text for audio listening and subtitles to videos, and so on.
- **Quality issues** (Is it academically sound? Does it fit the level of teaching?)
- **Pedagogical/didactic** fit into a course
- **Language** - even if English is often OK for academic levels, it is not the same for adult education. Some material is designed for ease of translation.

[167] https://www.gnu.org/licenses/gpl-3.0.html
[168] A comparison of licences is to be found here https://www.diffen.com/difference/Creative_Commons_License_vs_GPL
[169] https://www.funka.com/en/design-for-all/accessibility/the-european-accessibility-act-is-published/
[170] https://ec.europa.eu/social/main.jsp?catId=1202

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- **Technical format issues** - if a file format fits into the LMS used and can run on student computers and common home or mobile bandwidths.
- **Learning time of the OER** – if a module fits into the course concerning reasonable learning time. There is an obvious risk for a cognitive overload of student capacity if the teacher presents too much digital material or does not differentiate between central teaching and reference material.
- **Granularity of the OER** – A large OER, for example, a whole course, is a good find if it exactly corresponds to what a teacher needs. This is seldom the case. The optimal granularity of an OER should often be smaller - one concept, problem or at a time. If the size is too small, it is, of course, very flexible to use, but also not so difficult to just produce and solve locally – and therefore not always worth the time to search for.
- **Adaptability of the OER** - The possibility of using only a part of a learning resource or adapting it in other ways for a better fit.
- **Learning analytics possibilities** - Is there any assessment component attached, so the teacher can know if the material has been used or even mastered on a decent level. This also depends on the functionality of the LMS.
- **"Blending" issues for the OER** - How can this OER be integrated into a synchronous-asynchronous shift pattern in course design? Can it be prevented that the OER becomes just an extra asynchronous learning material, something ad-hoc?

Relevance comment for the ALBATTS project:

ALBATTS should aim at formats for learning material that are open, accessible, adaptable and have a useful granularity and learning time (as one concept at a time) for various uses. The produced material should fit on most LMSs and also in adaptive learning solutions. This does not rule out smaller courses and MOOCs. The multi-language question is also critical.

4.1.4 Practical Experiences using CC

The CC license means effectively making materials public and shared under the specific condition listed above. This, however, means that you cannot use company or IPR related content. So, for example, even if you are a teacher and use parts of teaching books, you cannot use the content unless it is CC-licensed material. Once you design CC-licensed training material, the following hints are from practice:

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- Only public material can be used which has no copyrights or free usage, but also then the materials used should be attributed/referenced to the creator
  E.g., Wikipedia
- Own drawings can be used (no copied pictures from books)
- If the publisher allows it, you can extract parts of your articles and put them on the slides.
  E.g., the CTA agreement of SPRINGER CCIS allows that only parts to be extracted, and a majority must be other material
- If a company allows free usage after request
  E.g., Texas instruments e-motor compendium, you must ask first and then mention courtesy of Texas instruments
- New material, for which you own by IPR, can be used. CC licensed journals can be used
- ERASMUS project results that already have CC licenses can be used, like many other recent EC-financed development of material, but all cases must be checked.

Students often search and use YouTube films for learning. For personal reference use, there are no problems. It may also be possible to use for on-the-side, extra recommended and reference material in a course, but not as a central mandatory material. This can be remediated by asking the creator for permission to use the YouTube film in an educational context, which is often granted as the creator wants to raise the video's ranking by views and subscriptions. A problem is the ads that often come along with the video for monetising the video. There are also embedding tools, such as the Ted-Ed Lesson maker[171], for using a part of a YouTube video in a context. More on this below.

4.2 LIST OF AVAILABLE RELEVANT OER SOURCES

4.2.1 OER repositories and referatories

A searchable OER referatory describes and links to resources, while a repository also hosts these resources. When searching a referatory, some links grow old and can end up nowhere, while a repository is usually better maintained as it hosts the resources. There have been several attempts to build a federated search, like a Google for OER. The search function closest

[171] https://ed.ted.com/videos

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to this now may be the Mason OER Metafinder[172], but for example, OERCommons.org[173] also search on some other OER sites and has a rich search functionality for advanced users.[174]

There are many types of OER, many OER projects and policies, many ways of thinking of what an OER is, and many websites (both referatories and repositories) specialise in a discipline or a kind of OER. Some are project-dependent and short-lived. In all, there are hundreds of sites offering OERs.

The kind of materials characterised as OERs on different sites stretches from learning modules such as tutorials, lectures, simulations, OER policy documents and papers (why?) to research articles, individual images for learning purposes, and complete textbooks and course designs with content. This wide variety makes it difficult for a teacher to find a learning module for designing a course or helping a student with problems. Sorry to say, there are few functional European OER repositories or referatories with more than examples of OERs.

Some of the biggest and most multifunctional sites are Merlot.org, OERCommons.org and Skillscommons.org.

All three aim to build educators' communities and foster cultures of creating, sharing, and recommending OER within disciplines. They have a lot of functions and offer some OER creation tools for teachers to make tutorials and learn websites.

For optimising the searchability of OERs, several systems of metadata labelling in XML format have been competing. A metadata label on a file can tell what is by specifying the subject, discipline, search terms, levels, creator, relation to other OERs, etc. Some standards have been very ambitious in this, often resulting in a non-use of metadata labels. Few teachers want to fill in dozens of boxes with technical specifications if they have made a nice animation they want to share. Metadata labels have also been controversial in other ways.[175] Much used learning resource metadata standards are the LTSC IEEE LOM[176], the IMS[177], and the SCORM specification[178]. Still, they all seem to recede in favour of the Dublin Core[179] standard, a librarian standard for classifying digital resources in general, including OERs. In practice,

[172] https://publishing.gmu.edu/whos-using-the-mason-oer-metafinder/
[173] https://www.oercommons.org/advanced-search
[174] https://www.cccoer.org/using-oer/find-oer/general-oer/
[175] https://opensource.com/education/13/7/oer-selling-metadata
[176] https://standards.ieee.org/standard/1484_12_1-2002.html
[177] http://www.imsglobal.org/specifications.html
[178] https://scorm.com/?utm_source=google&utm_medium=natural_search
[179] https://dublincore.org/

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teachers and students google for learning materials, and there are also some advanced functions in the google algorithm family for this in the Google advanced search.

An ultimate and frequently discussed dream is that an algorithm could know the needs for a specific teacher and his courses, and directly in an LMS (in the teacher's view) propose new OERs or updates on OERs used. This would be a push model of information instead of a pull model.

However, learning material on batteries and electromobility is hard to find, and when found, it is often recorded lectures at higher EQF levels from universities. An explanation can be that education and training in these fields also are rather new.

A list of OER sources

- MERLOT
- OER Commons
- SkillsCommons
- Open Yale
- MIT OCW Initiative
- MIT OCW Channel
- MIT Open Learning Library
- Khan Academy (multilingual)
- PhET (multilingual)
- Wiki Educator
- Wikiversity
- Open Course Library
- Open Education Consortium
- Open University Learning Space
- Edukatico
- Freevideolectures

EU resources and policies on OER

- EU science framework
- Open edu framework 2016

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- Open Edu guidelines
- Open edu publications
- EPALE
- OER Policy

Relevance comment for the ALBATTS project:

Learning material specially made for the battery value chain is not commonly found, but this may also be a question of time. ALBATTS can point at OER resource sites for the educators' own search, and it is likely that we will use some OER in our courses as well. The materials produced in ALBATTS will be hosted on the ALBATTS and DRIVES websites and made available via chosen and sustainable OER search sites after the project's finalisation.

4.2.2 Content sources for education adaption

A teacher or course designer can be happy over finding new material but not want to use it as it is, but instead adapt it somehow. This is possible for some types of OERs with CC licences; for others, derivative works are not allowed. Sometimes this need can be solved anyway by contacting the creator or by producing something new, inspired by the OER found. This balancing is trickier not to violate copyright or IPR generally. A reference to the original object with "created after example of x" is needed.

An interesting possibility is to embed YouTube or Vimeo videos in a larger instructional package. The most known of these tools is the TED-Ed lesson Maker[180] , which from the beginning was designed for embedding a TED lecture into a bigger but still modular OER. The Ted-Ed format is highly useful and easy to learn. The videos stay where they are, on YouTube, but are embedded in a larger object with an introduction, recommendations on issues to look for, and finally assignments, reflections and quizzes. TED lectures are declared free to use in this way, but it works technically with all YouTube videos. If videos are cropped (only a part is used), it is especially important to ask the creator for permission, but it should be done anyway. YouTube videos can be equipped with subtitles, but since September 2020, community-produced subtitles are no longer possible. A translation caption is not difficult but demands contact and agreement with the creator of the video.[181]

[180] https://ed.ted.com/educator
[181] https://www.wikihow.com/Contribute-Subtitles-to-Someone-Else%27s-YouTube-Video

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Below are some channels that can provide interesting material. ALBATTS have already been in contact with some of these, and the willingness to have their videos used in education is often good, as they want more viewers. But, on the other hand, they want to know what is happening with their material.

Engineering channels

- Crash course channel
- Lesic Learn engineering through physics
- The Engineering Mindset
- „10 best engineering education channels“

Battery/energy storage channels

- Billy Wu's Battery basics
- Panasonic battery education
- Matt Ferrell on battery technology
- The Limiting factor
- Undecided
- Now You Know Channel
- Just have a think

EV technology channels

- Electric Viking
- E for electric
- Fully Charged News
- Munro live
- LESIC tesla motor
- LESIC on battery car propulsion
- EV car maintenance

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Relevance comment for the ALBATTS project:

ALBATTS works in a highly volatile knowledge area. YouTube channels are often the first to pick up something new and discuss it in an often quite attractive multimedia package. Some of the creators also are rather knowledgeable, but a critical eye is important. This kind of resource is useful as a side resource for learning and creating new and last-minute content, as an example with TED-Ed Lesson Maker.

4.2.3 Relevant MOOC courses

MOOC courses („Massive Open Online Courses“) come in many versions and flavours, and the interpretation of the MOOC concept is very wide. Every word component in the MOOC abbreviation is heavily discussed and contested. There are also deviant interpretations of the term and related abbreviations, as SPOCs, COOCs, NOOCs, DOCCs etc. – often limiting the accessibility of the original MOOC idea and specialising the use of a course. Generally, an original c-MOOC and its relatives is a digital, globally available online asynchronous course that aims at creating a global market for a course subject that a university thinks it has special global relevance in, often supported by outstanding research. This works as marketing and general public relations.

Conventional MOOCs are often provided by platforms that serve several universities. The most known are Coursera, Edx, MiriadaX and Futurelearn. In addition, there are a couple of search sites that cover most of the platform’s offerings. The one we recommend is http://classcentral.com, which also provides analysis, rankings, and so on. According to Classcentral’s analysis for 2020, 16 300 courses were available from 950 providers, and over 18M students have studied a MOOC.

The original and most common use-case of a MOOC is an individual in front of his computer, most often a male with previous education, following a course of their interest, with some relevance for their job. A certificate is given with a fee, but most MOOCs can be studied for free as well, „audited“.

MOOCs can also be utilised in flexible use cases as the following:

- within a development or career plan for an employee - a very cost-effective, customizable and flexible solution.
- as a customised element in upskilling and reskilling for taking a new job or begin new work tasks

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- by a study group at a workplace or community learning centre to study a MOOC together and support one another. Each individual studies the course, but there are regular meetings for discussion and support between learners.
- as a „wrapped“ course in another regular course. A university or other education provider can sometimes validate a MOOC certificate and count it into an exam or „wrap“ a MOOC within another course – to use it as learning material but arrange labs, seminars and examination locally.
- As teacher training – a „train-the teacher“ solution. A teacher going into new fields of teaching can have considerable help by attending MOOC courses to get both new knowledge and ideas for teaching.

We have looked over MOOC offerings and provide below some examples of courses that can be interesting to use in one way or another for upskilling, reskilling and wrapping by individual learners or groups. Courses directly on batteries and electromobility, as well as courses on modern manufacturing technology. All course titles are linked.

Examples of MOOC courses on batteries and electromobility

- Li-Ion batteries: how are cathode materials made
- Electrochemical Energy Storage
- Equivalent Circuit Cell Model Simulation
- Batteries, fuel cells and their role in modern society
- Battery manufacturing: Trends in Battery Engineering
- Introduction to Battery Management Systems
- Battery State of Health Estimation
- Battery Storage - Understanding the Battery revolution
- Algorithms for Battery Management Systems
- Battery Pack Balancing and Power Estimation
- Battery State-of-Charge (SOC) Estimation
- Battery Storage Technology: Opportunities and Uses
- Electric cars, Technology
- Hybrid Vehicles

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- Electric Vehicles and Mobility

Examples of MOOC courses on modern manufacturing, general

- Lean production
- Six Sigma
- Applied Scrum for Agile Project Management
- Transport systems - global issues and future innovations
- Introduction to engineering mechanics
- Introduction to indoor air quality

MOOCs on transversal Skills

- Practical Thinking Skills
- Model Thinking
- Marketing Innovative products and services
- Product Management Essentials
- Technical report writing for Engineers
- The future of work – preparing for disruption

ICT, AI, Big Data, IoT – MOOC examples

- Elements of AI
- Machine learning
- Exploratory Data Analysis with Matlab
- Introduction to programming with Matlab
- Probability - the Science of Uncertainty and Data
- Information Systems Auditing, Controls and Assurance
- Fundamentals of reinforcement learning
- Cyber Security
- Divide and Conquer, Sorting and Searching and randomized Algorithms
- Algorithms, part 1
- Mining massive datasets
- Introduction to Computational Thinking And Data Science

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- Introduction to Mathematical Thinking
- Data Science with SQL and Tableau Certificate

Relevance comment for the ALBATTS project:

ALBATTS will mainly refer to and recommend useful MOOC courses for various needs and produce content of this kind. MOOCs have many flexible uses for individual and group studies, home and at the workplace. Most MOOCs demand in practice some educational background but are not closed for others. They can be hard to use on a vocational level, as the language is often English, background knowledge and study skills can vary, and there is a lack of social support. There is also a hesitation to use MOOC courses at the university level, as they break the traditional borders between universities in teaching and learning. However, MOOCs can probably be matched to most skills and knowledge needs we find, especially for EQF 5 and 6 levels of education and for teacher training on the VET level.

4.3 OER CREATION TOOLS

There are many digital tools available for creating content for courses and modules. We have first examined what is already used within the organisations of ALBATTS WP6. If an organisation owns licenses and have competence in using their tools, that is very valuable. Then we examine what is out there, especially of free tools that have a low learning threshold. To produce learning content to fit into different LMSs or other teaching setups, we should use tools that are easy to use, preferably free or already owned by a partner in the consortium. As we focus on vocational and professional levels of education primarily, we may also need a content matter expert involved in some of the content development. Some help has been promised from different parts of our EduBatt network.

A strategy is first to check if learning materials are freely available that satisfy our needs or can be adapted to do that.

One part of what we need is quite stable, for example, STEM subject and technology basics. Both are most needed mostly as a bridge to other more specialised course materials. These kinds of materials are often available for free in national languages and adapted to national curricula. We can instead focus on materials such as

- Battery and Electromobility orientation basics, as introduction units to reskilling and upskilling
- Basic course materials about safety and security in battery and electromobility

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- Customised material on the VET level, adapted to actual skills needs
- Customised materials on higher levels of education, pointing on useful, and providing guidance on how to use them in various settings.

Office/Presentation tools

Most partners have licenses on MS Office software and use Word, PowerPoint and Teams frequently. A PPT slide set can help a teacher but is more of a side reference material for students. To a PPT slide set, lecture audio, video and interactivity can be added quite easily inside the tool to make more purposed learning material. Interactivity can be added to slides by use of audience response systems as Menti and Slido. Another Office presentation programme in the same family is Sway, which one partner uses. It is a cloud software, and Sway content can be edited from any browser. Content can be drawn from various resources, and the object is hosted and can be linked.

A simple Word or pdf document can also be a functional learning object but needs a context, as an LMS or blended teaching environment.

Screencasting tools

With screencasting, a teacher can lead a learning expedition through different relevant parts of the Internet and record it all in a video, with audio comments. This can be useful as an orientation in a new area, for pointing out resources for student-driven desktop research, etc., and teaching content. A list of links should be embedded or follow the screencast video. The legal practice about doing this is unclear, but if it mostly consists of showing around and commenting on resources or ways of working, it is probably OK. If, however, it is essentially a recording of running animation or video with copyright, it is not recommended. Instead, the freedom to „cite“ resources could be used here. Then what is shown or „cited“ should be of a limited length and commented and placed in context. Free tools for video screencasting are Screencast-o-matic and TechSmith capture. There are commercial versions as well.[182]

[182] https://blog.elearningbrothers.com/top-5-screen-recorder-tools-for-elearning

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HTML5 e-learning authoring tools

For a conventional "e-learning module", a combination of text, images, videos and some interactivity or formative assessment as quizzes, etc., to be used in an LMS platform, tools like the following are commonly used: ISpring, Adobe Captivate, Articulate 360, Lectora online, Easygenerator and Elucidat.

This software is often pricey, but some come with trial test periods, others with a free version with limited functionality. ISpring is available in a free version without limitations for time or distribution, and ISpring authoring can also be based on slides.

There is also H5P, a collection of HTML5 content authoring tools available for free under an MIT open source license[183]. H5P works as a plugin to common browsers and LMS systems, WordPress and Drupal. It comes with tools and templates for many kinds of content modules and templates for many types of assignments and assessments.

Lecture-recording tools

Recorded lectures are often a part of flipped classroom solutions and a common kind of educational resource. One very easy way to make a lecture video is to use Teams or Zoom and record the lecture and save and link the recording. Interviews with interesting persons and similar can also be used as OERs, with permission of the interviewed person, of course. However, as no partner in WP6 uses lecture capture systems installed in classrooms[184], there is no reason to go into that area.

AR, VR, XR, games and gamification

To produce educational games and create augmented virtual and extended reality applications can be complicated. Still, there are also easier ways to develop functional educational resources and insert gamification elements in a course. Here we mention two free tools: Tale Blazer and Metaverse. Also, other tools can be used to develop this kind of functionality, such as Thinglink, Laerdal's SimCapture, Unreal, Unity, Wonda VR and Oculus Quest, all of which we have reported use of by project partners.

[183] https://opensource.org/licenses/MIT
[184] https://www.360quadrants.com/software/lecture-capture-systems-solution

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Relevance comment for the ALBATTS project:

Besides the tools partners already own and have skills on, there are many tools for creating OERs to choose from. In ALBATTS, free creation tools with low learning threshold are preferred to complement the partners' assets. H5p tools, screencasting tools, slide-related tools and video recording tools are very suitable for developing ALBATTS learning resources.

4.3.1 Results of the WP6 survey

In an online survey, the partners of WP6 were asked some questions about their use of OERs, LMSs and digital tools for content creation at their institution. Five answers were received.

Three of five answered that all teachers at their institution use an LMS. Examples of LMSes used are Moodle, Pinja and Canvas, beside synchronous communication software as Teams or Zoom.

Digital learning materials are produced by local teacher enthusiasts and by teacher teams or research groups. One VET institution has a team of specialists helping teachers with this production.

Tools for creating whole courses mentioned are Moodle tools, Office and Teams, Thinglink and Workseed.

For recording lectures, Teams or Zoom is used, not studio video or lecture capture systems. Video editing is done in PowerPoint with audio, Sway and Camtasia. Two partner organisations of five report no or little use of video editing.

Only one makes instructional animations, then with Doodly and Powtoon.

Two organisations use VR and AR applications. One uses Thinglink, the other Laerdal's SimCapture, Unreal, Unity, Wonda VR and Oculus Quest, and special camera equipment for 360-degree environments. So we can at this moment see that we have one experienced organisation when it comes to AR and VR creation.

No partner organisation uses adaptive learning yet (but one is a producer, and the coordinator is a researcher with interest in this).

Two partners use special software for learner interaction. One uses Kahoot, Quizlet, Socrative, Padlet, Google Jamboard, and Mentimeter, the other Menti, Socrative, Slido and Kahoot.

Only one organisation uses tools for making educational games or gamefic; they use Seppo.

Four of five organisations report some or a lot of willingness to use learning objects or recorded lectures produced elsewhere. However, three organisations report that sharing

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locally produced learning material with other education providers is not common. Two reports some factor-dependent use. Three of five organisations say, however, that teachers share material.

Concerning the attitude towards externally produced MOOCs, one organisation reports that people are very hesitant, two report a very positive attitude and one that is OK for use as extra material.

When we ask for content matter experts willing to help us, one partner has resource persons in AI, software development, and battery management systems. Another has possibly resources in manufacturing, and a third in the development of digital learning environments.

Relevance comment for the ALBATTS project:

Licensed tools for OER creation and competence to use these tools are available in WP6 partner organisations. This is an asset for the project. Some partners, in addition, have the skills to use some free tools, which is beneficial as well.

4.3.2 Adaptive learning

Adaptive learning is a personalised system of learning that takes as its foundation the principle that all learners can achieve a high level of knowledge and aims to help each learner to achieve to the maximum of their ability in the time they need to do so. A truly adaptive learning system is designed with the variability of learner capabilities in mind - it measures learner progress, allows learners to skip ahead where they demonstrate that they already understand concepts, and provides remediation where learners demonstrate deficits in their knowledge.

An ideal unit of learning for an adaptive learning course is highly modular and places knowledge testing at its core. Each lesson should teach only a single concept and include testing on the concept taught in that lesson. By ensuring that each lesson includes only one concept and questions about that concept, an institution using an adaptive learning system allows learner knowledge to be accurately assessed and necessary remediation to be delivered to the student to improve their understanding.

The order in which lessons are delivered is also important for adaptive learning. Concepts that are prerequisites for understanding others should be taught first, and students should only progress to new concepts after demonstrating understanding of their prerequisites. Similarly,

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if subsequent questioning reveals that student understanding of prerequisite concepts is no longer sufficient, remediation should be delivered by the adaptive learning system. The proper designation of prerequisite concepts allows students to skip ahead when they have demonstrated that they already understand some piece of knowledge. I.e., if a student understands a concept, they can also be assumed to understand prerequisites for that concept.

Adaptive learning can involve any variety of learning modalities, from text to audio to video, and any multimedia approach can also be used. In addition, the Realizeit adaptive learning platform can be configured to track the best form of content for any given student and deliver the preferred form of content to each student.

Realizeit is an online adaptive learning platform founded on the vision of helping every learner to reach mastery to their maximum potential. Realizeit individualises the student experience, supplying guidance and interventions to help students achieve their goals as they need them. Prerequisite relationships between lessons are displayed to the student using the learning map, a visual representation of what students need to learn, indicating where they should work next.

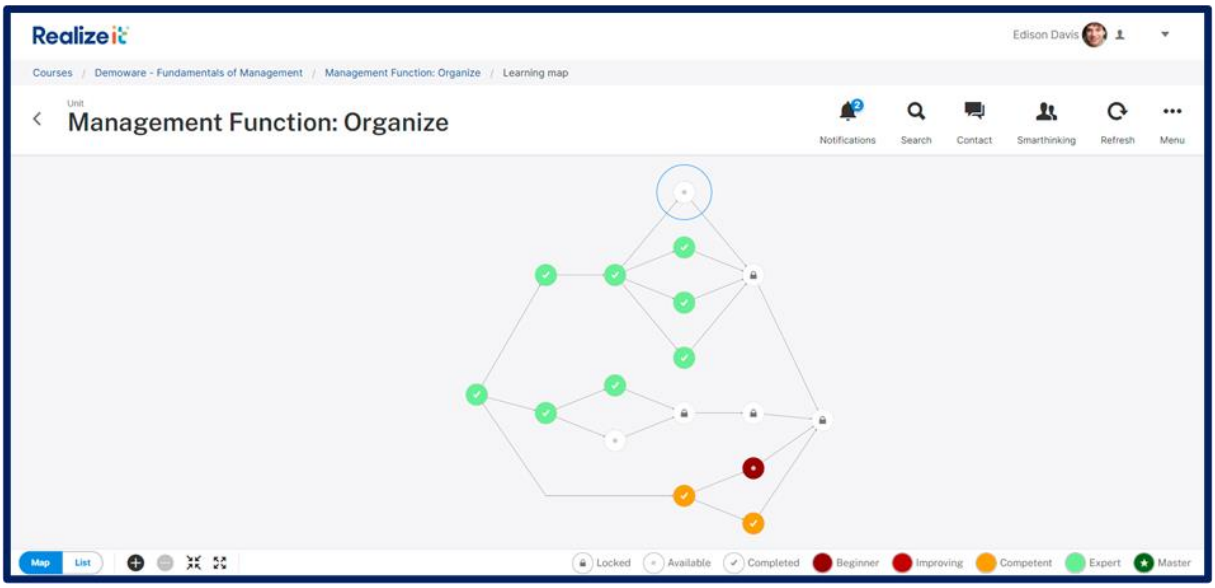

Figure 7 The Realizeit Learning Map

Realizeit uses intelligent technology and the power of data to create an informed teacher, an empowered learner, and a manageable, data-driven educational experience that can continuously measure and regulate the effectiveness of teaching and the mastery achieved.

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Realizeit utilises these features in both educational and corporate training settings and has produced successful large-scale implementations in both cases.

Realizeit has streamlined the migration and transformation of legacy content for large scale institutions by developing an interactive intelligent ingestion engine that can granularize, organize, and distribute existing content onto Realizeit's learning maps (Figure 7), simplifying the task of building personalized, adaptive learning experiences. In addition to facilitating the creation of learning experiences, this process also cuts down the set-up time from months to just days. Furthermore, it allows instructors to publish content in a variety of ways. Additionally, Realizeit can either be seamlessly connected with an institution's existing LMS (Learning Management System) or used in a standalone fashion, further easing any transition to using the platform.

Realizeit always respects the uniqueness of every client and adapts the learning platform to meet those unique needs. Realizeit's technology is robust yet versatile to accomplish most academic and corporate training requirements out of the box and via configuration. However, the flexibility of the technology allows for seamless customization and further product enhancements based on the unique training context, operations philosophies, and requirements arising from necessary integrations.

Relevance comment for the ALBATTS project:

Adaptive learning is a natural next technical step in education development. As we have competence within the consortium, we can try out adaptive learning functionality to create demo modules or a small demo course. Adaptive learning is especially useful for upskilling and reskilling as it permits different learning speeds.

4.3.3 MOOC course creation

There are many meanings to the word MOOC and many ways to use and create MOOCs. As MOOC stands for "Massive Open Online Courses", all of these words have been discussed, questioned, and altered. The main difference is between the X-MOOC (Extended in accessibility from a big university, often very scalable to many thousands of students) and the C-MOOC (a precursor beginning around 2008 - Connectivist MOOC[185], use of connectivism theory).

[185] https://cck11.mooc.ca/

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When MOOCs entered into the public awareness around 2012, "The year of the MOOC"[186] with the successful Stanford course on AI and self-driving cars with over 200 000 students, a lot of derivative concepts followed, as SPOC (Small Private Online Course), COOC (Corporate Open Online Course), etc.[187] The new MOOC phenomenon led to a discussion about the categorisation of online and distance teaching offers. In this, MOOC versions came to stand for asynchronous stand-alone units of teaching and learning. Today, the MOOC concept can stand for any online course from any provider and quite short asynchronous courses for introduction to a subject or covering a common knowledge gap before starting another course.

The big X-MOOC courses from platforms as EdX, Coursera and FutureLearn are created by instructional technologists in cooperation with subject matter experts. OpenEdX and the LMS Canvas also provide tools for making classic MOOCs for many users and on large platforms[188] [189]. For smaller MOOCs with a limited number of participants, many other tools can be used as well, and the MOOCs can be hosted on conventional servers. For planning a MOOC course, standard templates can be useful. One tool for this is the MOOC Maker Canvas.[190] One ALBATTS partner organisation, ISCN, has a lot of experience making smaller MOOCs for the automotive industry.

Relevance comment for the ALBATTS project:

To produce a MOOC is feasible, also in a project like ALBATTS. However, as it is basically a content-driven asynchronous course, its creation should aim at a high quality for a longer time of usage.

4.3.4 MOOC course wrapping

Already early in MOOC development, it happened that a good and up-to-date MOOC course from a well-known highly ranked university was embedded in a bigger course at a local

[186] https://www.classcentral.com/report/mooc-hype-year-1/
[187] https://epale.ec.europa.eu/en/resource-centre/content/mooc-cooc-and-spoc-different-online-courses-different-needs
[188] https://www.canvas.net/browse/itsligo/courses/moocs-on-a-budget
[189] https://youtu.be/0__QJ5OwaS4
[190] Kerr, J., Lorenz, A., Schön, S., Ebner, M., & Wittke, A. OPEN TOOLS AND METHODS TO SUPPORT THE DEVELOPMENT OF MOOCS. (preprint)
& https://www.researchgate.net/publication/345162321_MOOC_Maker_Canvas_English_Version

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university. Lab sessions, examinations, discussions etc., were added locally.[191] The MOOC was used basically as a modern textbook.[192] Students who found new possibilities with MOOCs online for their learning also brought these practices to their class. In some developing countries with low-paid faculty teachers with not so updated content, this became a problem. One solution was the wrapping solution. This was, however, not without technical problems.[193] A MOOC course could even be used as the away-from-campus part of a "flipped classroom" concept.[194] In this practice, it is important to watch the risk of too much cognitive load and the "ad-hoc" or the "a course and a half" phenomenon; the question of course integration is important. Nevertheless, for very specialised areas of teaching and learning, this is a rational solution to share courses and have one provider stand for the updates.

This solution can be practical in higher education institutions that need a course for a complete programme but does not have top-notch research and teaching in the area. However, there are problems in the longer perspective with this as well. EdX, Coursera, FutureLearn may not want to provide free teaching to other universities to save their courses by wrapping in the longer perspective.

Another kind of wrapping cannot be questioned in the same way. This is the forming of local groups that meet face-to-face during a MOOC course for learner discussions. This demands a coordinator who analyses interests and local needs, is active in marketing the course, coordinates the process, and provides meeting venues[195]. The model can be utilised in community learning centres, in company in-house training and as teacher training, etc. Some MOOC platforms have provided algorithms for students to localise other students and meet in the local environment.

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[191] Bruff, D. O., Fisher, D. H., McEwen, K. E., & Smith, B. E. (2013). Wrapping a MOOC: Student perceptions of an experiment in blended learning. Journal of Online Learning and Teaching, 9(2), 187.

[192] Ibid

[193] Vasiu, R. (2014). Wrapping MOOCs–Analysis from a technological perspective. In *Conference proceedings of» eLearning and Software for Education «(eLSE)* (No. 01, pp. 261-264). " Carol I" National Defence University Publishing House.

[194] Wang, K., & Zhu, C. (2019). MOOC-based flipped learning in higher education: students' participation, experience and learning performance. *International Journal of Educational Technology in Higher Education*, *16*(1), 1-18.

[195] Norberg, A., Händel, Å., & Ödling, P. (2015). Using MOOCs at learning centers in Northern Sweden. *International Review of Research in Open and Distributed Learning*, *16*(6), 137-151. http://www.irrodl.org/index.php/irrodl/article/view/2035 Accessed 28-11-2021

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Relevance comment for the ALBATTS project:

To wrap a MOOC in another course is a good possibility to broaden the teaching content but must be evaluated by the education provider. ALBATTS can inform about the possibility. Forming synchronous study groups that meet together while studying the same course demands some coordination but is an effective and risk-free practice for local and organisational training needs.

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5 Analysis of Available Existing frameworks, instruments, content and ways to describe curricula & OER and tools

In this chapter, we analyse the relevance of drivers of change on the training provision in the battery industry. Furthermore, state of the art of existing frameworks, instruments, recommendations and methods for curricula work is being analysed to find applicable and useful possibilities and solutions for education and training in the battery sector.

To find the best solutions for delivering courses, the pros & cons, sustainability and flexibility of available OER´s and digital tools are analysed.

5.1 CHOSEN CONSIDERATIONS CONCERNING DRIVERS OF CHANGE, STATE OF ART OF EXISTING FRAMEWORKS, INSTRUMENTS AND ADDITIONAL FACTORS

5.1.1 Chosen considerations/drivers of change

In ALBATTS' education and training development, we need a sustainable but at the same time flexible methodological approach to educational design in the battery sector. It is important to be aware of both internal and external factors affecting change in the battery sector and within training and education. In addition, it is important to analyse and utilise existing EU frameworks and tools as this will facilitate the implementation of ALBATTS results on national levels, further development on an EU-level, and facilitate mobility and the recognition of skills across Europe. In sections 3-4 above, we have been familiarising ourselves with all possible factors that reasonably should or can affect our development work. In the boxes with "Relevance Comments," we have tried to select extra relevant for us. Below, we go a step further and provide work advice for ourselves for each section and subsection. We have called these "chosen considerations". For each subsection, as "3.2.3", check the more detailed description above in chapters 3 and 4 above.

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Table 6 Chosen considerations/drivers of change

Chosen considerations /Drivers of change		
2.1	**Economy**	**To be aware of** Economic drivers of change for European life and competitiveness demand an educated workforce for the new jobs available. The individual must be able to access inclusive, flexible education and training both for Initial VET education and Continuous VET up- and reskilling (IVET and CVET) to take these job opportunities.
2.2	**Globalisation**	**To be aware of** The growing battery and electromobility sector, which Europe now is becoming a competitive part, is global. Most workers in the sector will be blue-collar workers (with IVET or CVET). A high degree of mobility is crucial both within countries, within the EU and globally. Validation of competencies from earlier education and work experience and special attention to language and culture questions are vital.
2.3	**Social & Demographic change**	**To be aware of** Education and training for new jobs must be designed as inclusive as possible, as we believe that all are needed to contribute to society by their work. **To do** ALBATTS will design and develop modules and courses that are flexible, agile, and adaptable for optimal implementations in national education systems and the business- and private sector. What ALBATTS develops should enable education and training designs with choices and options for the individual
2.4	**Technological change**	**To be aware of** VET learners may have limited digital skills and not the same academic study skills as higher education students VET learners need to apply their learning and train skills in labs, work-based learning, internships or possibly by AR and VR training VET teachers do also need training, work-based learning, peer-to-peer communication and learning by enabling mobility

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Chosen considerations /Drivers of change		
		To do: ALBATTS will prioritise a case- and situation-adapted granularity of learning materials for ease of re-use in various situations
2.5	**EU policies and programs:**	**To be aware of** EU is a supporter of the development of nationally governed education systems, not legislative power. ALBATTS is a part of EU action to meet challenges both on the European level and support the same on the national levels **To watch** EU policies and instruments are in continuous development and must be closely monitored **To do** ALBATTS will when applicable, use the European-level approach to education, with considerations taken to the differing implementation into national education systems
2.5.1	**New Skills Agenda**	**To be aware of** ALBATTS is an integral part of the New Skills Agenda and its development through revisions and updates, as in 2020. **To do** ALBATTS will also ensure its results' sustainability after the project by engaging in Pact for Skills, ASA and the EBA Academy context. (This list of alliances is not exhaustive.)
2.5.2	**EU Digital Action Plan**	**To watch:** The EU Digital Action Plan 2021-2027 has wide ambitions for developing digital skills in education and training. The European Competence framework will be updated to include AI and to create a Digital Skills Certificate. **To do** ALBATTS will apply and harmonize the work with the EU Digital Action plan whenever applicable
2.5.3	**EU Recovery Plan**	**To be aware of** The EU Recovery Plan can offer interesting funding possibilities to enable training for the battery and electromobility sector for

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Chosen considerations /Drivers of change		
		education and training providers, especially concerning upskilling of digital competencies. **To do** ALBATTS will, whenever motivated, recommend existing funding possibilities, like the ones within the EU Recovery Plan, to education providers in the sector
2.5.4	**Council recommendation 2020**	**To watch** The 2020 council recommendations and the development of its applications **To do** ALBATTS will follow the Council recommendations on VET of 2020 whenever applicable
2.5.5	**Accessibility regulations**	**To watch:** The European Accessibility Act 2019 and its application to our kind of development work The EC Strategy for the Rights of Persons with Disabilities 2021-2030 **To be aware of:** All produced learning materials should be adaptable for persons with disabilities and functional variations Produced ALBATTS learning materials must not in any way discriminate learners because of gender, functional variations, racial or ethnic origin, belief, religion or sexual orientation.

5.1.2 Considerations concerning the State of Art of Existing Frameworks and instruments

In this part, the state of the art of existing EU relevant frameworks and instruments is analysed for relevance to the ALBATTS project. The analysis can be seen in

Table 7 below. In addition, the call of the proposal for Erasmus Sector Skill Alliance blueprint projects has been used as a base for considering the important aspects for designing and delivering trans-national sector-wide vocational curricula. The R-coding in the left column refers to the numbered requirements in 3.1.

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Table 7 Chosen considerations concerning the State of Art of Existing Frameworks and Instruments

Chosen considerations /Existing Frameworks and Instruments			
	3.1	**Requirements**	**To do** ALBATTS will use existing EU framework and tools in education and training development, but can in some cases, discuss the application of these in the sector
R1	3.2.1	**International Standard Classification of Education (ISCED)**	**To be aware of** The ISCED classification for categorisation of learning modules enables global cooperation. **To do** ALBATTS will whenever applicable or motivated, use the ISCED classification
R1	3.2.2	**European Qualification Framework (EQF)**	**To be aware of** ALBATTS education and training framework covers EQF 3-8 but has a primary focus on EQF 3-5. **To do** ALBATTS will use the EQF framework as it is defined nationally in all member countries
R1	3.2.3	**European Higher Education Area and Bologna Process (EHEA)**	**To watch** The work with the EHEA and the Bologna process is in constant development and change both on the European level and in member and signatory countries **To do** The ambitions associated with the European Higher Education Area (EHEA) as the Bologna process will be used whenever applicable
R1	3.2.4	**European Association of Institutions of Higher Education (EURASHE)**	**To watch** HE VET area has its European process, represented by EURASHE, in line with the EHEA. **To do** ALBATTS will whenever applicable or motivated, use the EURASHE perspective of the Bologna process and EHEA.
R3	3.2.5	**European credit system for Vocational**	**To be aware of**

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Chosen considerations /Existing Frameworks and Instruments			
		Education and Training (ECVET)	ECVET principles are used in many member countries, but not in all. ECVET is based on learning outcomes and units and enables mobility and recognition/validation of prior learning. In addition, it facilitates different ways of assessing skills. **To do** ALBATTS will, whenever motivated, use ECVET principles, qualifications based on learning outcomes and units, as it can enable transferability and mobility ALBATTS will not use ECVET credit points for EQF 4.5, as this is no longer a recommendation
R3	3.2.6	**European Credit Transfer and accumulation system (ECTS)**	**To be aware of** The ECTS system is based on outcomes and associated workload and enables mobility and transferability of learning outcomes and qualifications ECTS is not used or applied in the same way in all EU member states **To do** ALBATTS will whenever motivated, use the ECTS system, based on outcomes and associated workload, as it enables transferability and mobility
R4	3.2.7	**The European Quality Assurance in Vocational Education &Training EQAVET**	**To be aware of** EQAVET is an important framework for quality assurance both in teaching and learning and to ensure the connection to employers/stakeholders and national VET education systems **To do** ALBATTS will use EQAVET and the PDCA cycle (Plan-Do-Check-Act) to meet and exceed quality demands ALBATTS will utilise the inherent flexibility in the new EQAVET recommendations to optimise connection to stakeholders' needs and adapt to national education systems.
R6	3.2.8	**Key competencies**	**To be aware of** Key competencies (soft skills and transversal skills) are vital for lifelong learning and sector-specific skills.

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Chosen considerations /Existing Frameworks and Instruments			
			STEM subject competencies are highly relevant for jobs in the sector, as being both directly applicable and a good basis for continuous learning, as in Industry 4.0 settings. **To do** ALBATTS will emphasise the development of key competencies, including soft skills and transversal skills, alongside the more sector-specific skills. ALBATTS will adapt, produce and recommend learning material for the English language as a standard working language in the sector. ALBATTS will wherever applicable, prioritise the need for STEM subject knowledge for long-term sustainability.
R7	3.3	**National Qualifications Framework NQF**	**To be aware of** NQFs are constantly developing, and national VET education is often more regulated than higher education **To do** ALBATTS will utilise the helpful connection between EQF and national NQFs and their development

5.1.3 Analysis of additional factors of relevance

In Table 8 below, the Analysis of additional factors of relevance, different types of learners, different ways of learning, Curricula writing including learning outcomes and modules and finally, best practices of other Blueprint projects are analysed.

Table 8 Chosen considerations / Additional factors of relevance

Chosen considerations/ Additional factors of relevance			
R11	3.4.1.1.	**Youth in VET**	**To be aware of** Young people coming directly from education to their first job in the sector is a crucial part of the workforce recruitment in the sector. **To do** ALBATTS will focus on initial VET education for the sector, besides the appropriate up-and reskilling

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Chosen considerations/ Additional factors of relevance			
R11	3.4.1.2	**Youth in higher education**	**To do** ALBATTS courses or modules produced for higher education should be possible to use both for initial education and lifelong learning
R11	3.4.1.3	**Adult education and training in VET**	**To be aware of** Depending on national systems, what is possible within higher education in one country could be useful in VET education in another and the other way around. **To do** ALBATTS courses or modules produced for VET should, in applicable cases, be possible to use both for initial education and training and lifelong learning
R11	3.4.1.4	**Adult education in higher education**	**To be aware of** Courses in higher education can be used both for the initial education of young people and for the up-and reskilling of older learners, including VET teachers.
R11	3.4.1.5	**Apprenticeship training**	**To be aware of** Apprenticeship training is very relevant for the sector, whenever possible, due to national frameworks and workplace conditions When an apprenticeship is not possible, there must be other solutions in place for the same purpose of application and training of skills **To do** ALBATTS will develop this further in task 6.5 and pilot it in task 6.6.
R11	3.4.2	**Re-skilling and Up-skilling**	**To be aware of** The expected changes in the work market will necessitate large up- and reskilling measures in the sector. **To do** In ALBATTS: as WP 3, 4 and 5 are mapping up skills bridges between one kind of vanishing work and another emerging sector, ALBATTS training and education will assist with solution designs.
R3	3.4.3	**Formal, informal and**	**To be aware of**

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Chosen considerations/ Additional factors of relevance			
		non-formal learning	Clear learning outcomes are useful for assessment and also makes validation of prior learning easier **To do** ALBATTS will develop clear learning outcomes for courses and course units ALBATTS will explore and use open badges based on learning outcomes whenever applicable
R5	3.4.4.	**Work-based learning**	**To be aware of** Work-based learning is crucial for both VET and HE learners. In many countries, it is compulsory in VET. In this sector, due to its fast expansion, the possibilities for WBL may be limited Work-based learning is very important also for teachers The distribution between training taking place in VET or HE institutions and work-based learning will be developing **To do** ALBATTS will develop thinking for when WBL can be used, and when this is difficult, propose other solutions
R7	3.4.5	**Transnational learning**	**To be aware of** ALBATTS is not a mobility project, nor is it awarding joint degrees or similar **To do** ALBATTS will present and connect to possibilities for transnational learning for both students and teachers
R3	3.5.1	**Learning Outcomes**	**To be aware of** Carefully written learning outcomes is a cornerstone in the construction of curricula **To do** ALBATTS will develop curricula with clear learning outcomes for new and central areas of education and training in the sector ALBATTS will take help from the CEDEFOP guidelines and relevant research in writing learning outcomes ALBATTS will especially care for curricular gaps in the current provision of education and training

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Chosen considerations/ Additional factors of relevance			
R3	3.5.4	**Modules and Units**	**To be aware of** The use of modules and units of learning outcomes increases flexibility and versatility in the application The modular approach will also facilitate the development of individual learning accounts (Action 9 in the updated New Skills Agenda) **To do** ALBATTS will, whenever applicable, work with modules as adaptable components in courses and other learning solutions
R3	3.5.5	**Micro-credentials**	**To watch** Micro-credentials is a promising area of development both for learning assessment and for recognition and validation of skills
	3.6	**Best practices and Evaluation of other Blueprints**	**To do** ALBATTS will follow the development in other blueprint projects to learn from them whenever applicable ALBATTS special overlapping relation to the DRIVES blueprint will be utilised as much and well as possible, as an example in work for the Pact for Skills and ASA. ALBATTS will consider adding additional learning solutions into the DRIVES learning platform, such as smaller MOOCs

5.2 THE PROS & CONS, SUSTAINABILITY AND FLEXIBILITY OF OER´S AND DIGITAL TOOLS

5.2.1 Chosen considerations concerning available OERs, skills and tools

Table 9 Chosen considerations/Available OERs, skills and tools

Chosen considerations/Available OERs, skills and tools			
R11	4.1	**Legal issues**	**To do** ALBATTS will adapt to all legal limitations of use and re-use of learning materials ALBATTS will make use of the CC license whenever possible to provide optimised freedom of use for education providers

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Chosen considerations/Available OERs, skills and tools			
R11	4.1.3	**Usefulness issues**	**To do** ALBATTS will prioritise openness, accessibility and adaptability in its development of learning resources ALBATTS will apply a conscious evaluation of the best granularity size of learning materials in the specific case
R11	4.2	**List of available relevant OER sources**	**To do** ALBATTS will recommend and link to useful learning materials produced by others in parallel to the presentation of own materials ALBATTS will advise on how to find external learning materials and how to use them together with other material and in blended learning solutions
	4.2.2	**Content sources for education adaption**	**To be aware of** New material on new issues are often presented well in Youtube videos, which can be used under some conditions and developed as part of more designed learning materials **To do** ALBATTS will examine how to optimise the use of well-made youtube videos or parts thereof, considering needed permissions, etc.
	4.2.3	**Relevant MOOC courses**	**To be aware of** MOOCs is a rich and often up-to-date resource that can probably be matched to most skills and knowledge needs we find, especially for EQF 5 and 6 levels of education and teacher training on the VET level. **To do** ALBATTS will recommend suitable MOOC courses and advise educators on how they can be used ALBATTS will develop asynchronous learning materials, which is sometimes also named MOOCs or mini-MOOCs
	4.3	**OER creation tools**	**To watch** Tools for learning content creation and design develops and innovates constantly XR /VR/AR applications are developing fast and may provide valuable training opportunities before beginning employment if apprenticeship periods are difficult to arrange

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Chosen considerations/Available OERs, skills and tools			
			To do ALBATTS will, for its work, prioritise the use of free tools and the use of tools that a partner have own licences on
	4.3.1	**Results of the WP6 survey**	**To do** ALBATTS will use existing licensed tools and associated skills in the partner organisations
	4.3.2	**Adaptive learning**	**To be aware of** Adaptive learning is a new developing technology and practice that adapts the progression of learning and the course to the individual's prior knowledge and progression in the course **To do** ALBATTS has a partner specialised in adaptive learning and will use this for developing examples of best practise on one or a few chosen subject areas
	4.3.3	**MOOC course creation**	**To do** ALBATTS will develop asynchronous learning material and perhaps also present these in MOOC versions, especially for covering gaps in offerings
	4.3.4	**MOOC course wrapping**	**To do** ALBATTS will provide advice and research references to education providers on how to wrap MOOC courses into campus-based or blended courses

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6 Chosen Approach

ALBATTS education approach considers the main drivers of change that affect skills needs, education and training, the relevant European frameworks, instruments and tools and pros and cons of existing OER and ICT tools, as discussed in previous chapters.

In Figure 8, four central pillars constitute the guiding principles of the ALBATTS education and training framework for the battery sector:

- Pillar 1 – Curricula for all levels
- Pillar 2 – Innovative and flexible learning
- Pillar 3 – Competent trainers and tutors
- Pillar 4 – EU wide recognition

Each of these pillars is in close connection with Sectoral Intelligence (Pillar 0) to guarantee stakeholders participation and up to date information into the system and are underpinned with quality assurance mechanisms (Pillar Q). EQAVET quality criteria are used to continuously guarantee the improvement of the education and training provision, based on the PDCA cycle, supported in strong feedback loops, which includes evaluation by Peers, as established by the new recommendations for EQAVET.

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Pillar 0
Sectoral Intelligence

- Job roles and skills needs for the entire battery value chain
- Desk research, questionnaires, workshops, trend analysis

Pillar 1
Curricula for all levels

- EQF levels 3 to 8
- Assessable competence units based on ECTS and ECVET principles
- Learning outcomes approach
- Modular approach (training units) based on micro-learning
- Reference of transversal skills (key competences, soft skills, STEM disciplines, digital skills adapted to different public), cross-sectoral, sector specific and occupation specific skills
- European Vocational Core Profiles

- Reference to ESCO taxonomy and registration on ESCO database
- Digital badge per training unit
- Model to validate informal and non-formal learning at the job
- Europass certificate supplement per training course
- Adapted to national and regional frameworks
- Validation of Key Competences and transversal skills

Pillar 4
EU wide recognition

Pillar 2
Innovative and flexible learning

- Individualized training pathways
- Inclusive training methods
- Training methods adapted to initial and up/re-skilling programs
- Work-based learning
- ICT based on open educational resources
- Virtual learning environments
- Adaptive learning solutions
- Joint educational programs, including transnational learning

- Continuous train the trainer programs for sectoral skills update
- Digital skills development programs (based on DigCompEdu)
- Language skills (VET)
- Companies' tutors development programs (Dual system)
- Mobility programs for teachers/trainers in companies
- Expert and discussion international forums

Pillar 3
Competent trainers and tutors

Pillar Q
Quality Assurance

- EQAVET quality criteria (system level)
- Peer Learning

Figure 8 ALBATTS education and training framework overview

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6.1 PILLAR 1 – CURRICULA FOR ALL LEVELS

As its first key principle, pillar 1 of the ALBATTS education and training framework establishes Curricula for all levels. Under this one, which will be further developed in ALBATTS 'Task 6.4 - Curricula analysis, learning objectives, validation options and course/module creation for all levels, the following requirements will be addressed:

- EQF levels 3 to 8
- Assessable competence units based on ECVET and ECTS principles
- Learning outcomes approach
- Modular approach (training units) based on micro-learning
- Reference of transversal skills (key competencies, soft skills, STEM disciplines, digital skills adapted to different public), cross-sectoral, sector-specific and occupation-specific skills
- European Vocational Core Profiles (recommendations)

Although the framework states curricula from levels 3 to 8, as the main findings from the Sectoral Intelligence suggest, at an operational level ALBATTS project will mainly focus on vocational levels. For these levels, recommendations will be made regarding referencing transversal skills and definition of European Vocational Core Profiles for the battery sector.

The chosen approach to come from Job Roles and skills identified by the labour market to Units of Competence and Learning Outcomes for the definition of education and training modules is based on the functional analysis, as represented in Figure 9.

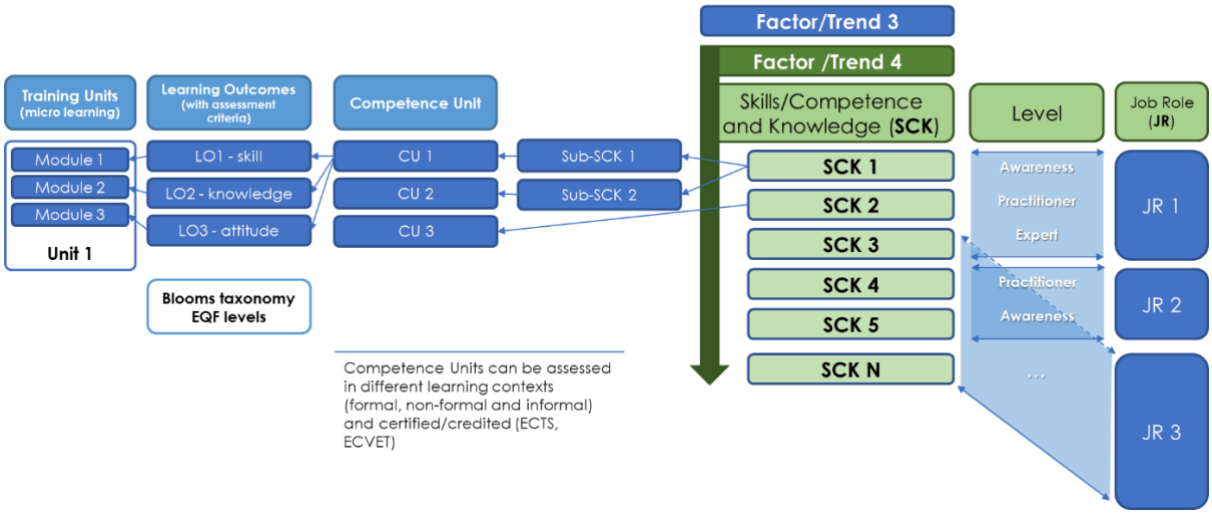

Figure 9 Cascading process for the definition of Competence Units, Learning Outcomes and Training Units/Modules

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A functional analysis applies from the general to the particular through successive disaggregation, determining at each level which functions need to be fulfilled for the immediately preceding level to be realised and so on until the particular and individual realisation is reached.

The ALBATTS approach to this cascading process starts with analysing the job roles and skills mapped under the Sectoral Intelligence process. Then, employing a cause-effect relationship, basic functions will be mapped, each of which serves a unique purpose, i.e. each function appears only once on the map (so functions should not be repeated). This disaggregation process ends when the description of a function translates a performance (function to be performed by an individual and capable of being assessed). It comprises several steps that are consolidated into a disaggregation process (as many as necessary, considering the scope and complexity of the sectors) that culminates in the identification of the Competence Unit.

A Competence Unit is a coherent combination of learning outcomes, able of autonomous assessment and validation. The learning outcomes are broken down into knowledge, skills and competencies (attitudes) mobilised into achievements. Then, according to certain performance criteria and context conditions, the individual pieces of evidence demonstrate the mastery of the required competence. The concept of learning outcomes can be used for any type of assessment and environment of assessment.

Each Competence Unit will be linked to a different Training Unit composed of independent modules, based mainly on the microlearning approach. The modules can flexibly be combined with different educational programs in the national or regional system, or they can serve a particular industry that needs a combination of skills from different sectors.

6.2 PILLAR 2 – INNOVATIVE AND FLEXIBLE LEARNING

Innovative and flexible learning is the principle defined in Pillar 2 of the established framework, identifying the following requirements to be addressed:

- Individualized training pathways
- Inclusive training methods
- Training methods adapted to initial and up/re-skilling programs
- Work-based learning
- ICT based on open educational resources

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- Virtual learning environments
- Adaptive learning solutions
- Joint educational programs, including transnational learning

ALBATTS 'Task 5 Creation/adaption of curricula/training course content (OER)' will be the baseline for developing and suggesting the most adequate and flexible education and training methods solutions be adapted to different VET programs and publics, taking advantage of ICT tools and OER already available in the market.

For this purpose, MOOC, blended and adaptive learning solutions will be developed and tested in different learning environments under 'Task 6 Pilots, demos and deliveries of developed courses and training modules and evaluation'. In addition, the proposed solutions will include experiments of work-based learning and joint educational programs, which can run at national or international levels, according to the financing opportunities that may be available.

6.3 PILLAR 3 – COMPETENT TRAINERS AND TUTORS

A reliable education and training framework needs to guarantee competent actors for the learning process, either in an education and training provider or at the company. ALBATTS education and training framework will be built taking into consideration the following requirements:

- Continuous train the trainer programs for sectoral skills update
- Digital skills development programs (based on DigCompEdu)
- Language skills programs for VET teachers and trainers
- Companies' tutors' development programs (Dual system)
- Mobility programs for teachers/trainers in companies
- Expert and discussion international forums

For this purpose, ALBATTS will develop under its task '6.7 - Train the trainer guidelines coherent set of recommendations and solutions to build and maintain a competent network of teachers and trainers for the battery sector, considering technical and pedagogical competencies. Work will be built upon other existing frameworks, take advantage of financing opportunities from national and European programs, and rely on the cooperation between all interested stakeholders.

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6.4 PILLAR 4 – EU WIDE RECOGNITION

A key to the success of an education and training framework is to guarantee a wide European recognition. This is what Pillar 4 stands for and will be developed on 'Task 6.3 Definition and EU-wide recognition of new and emerging job roles and skills, taking into consideration the following requirements:

- Reference to ESCO taxonomy and registration on ESCO database
- Digital badge per training unit
- Model to validate informal and non-formal learning at the job
- Europass certificate supplement per training course
- Adapted to national and regional frameworks
- Validation of Key Competencies and transversal skills

All new job roles and profiles identified by Sectoral Intelligence work will need to be referenced according to ESCO taxonomy to optimize its European recognition. Additionally, several other instruments will be used to certificate competencies acquired in different learning environments, including formal, informal and non-formal, and the ones acquired at an international level, including key competencies and transversal skills.

6.5 PILLAR Q – QUALITY ASSURANCE

EQAVET principles are used in the previously described central pillars to continuously guarantee the education and training provision improvement by adopting the PDCA cycle in all of its phases.

Under the purpose of the ALBATTS education and training framework, special attention is addressed to the EQAVET quality criteria and in how they will be addressed:

Planning reflects a strategic vision shared by the relevant stakeholders and includes explicit goals/objectives, actions and indicators

Sectorial Intelligence (Pillar 0) plays a major role in this quality criteria by engaging stakeholders to participate in the process of defining a strategy for education and training for the battery sector, including the identification of actual and future skills and training needs.

Implementation plans are devised in consultation with stakeholders and include explicit principles

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The implementation phase from the PDCA cycle is supported by Pillars 1, 2, 3 and 4 from the framework. First, by defining curricula for all levels of qualification, according to the needs identified by stakeholders in the Sectoral Intelligence. Secondly, by guaranteeing the most adequate resources, by making available innovative and flexible learning solutions that fit the preferences of the different audiences that will be targeted by the battery sector, by developing the capacity of trainers and teachers regarding technical and pedagogical competencies, and also by guaranteeing the recognition of competencies acquired in different learning environments.

Evaluation of outcomes and processes is regularly carried out and supported by measurement

At the VET-system level, the evaluation phase will strongly be supported by feedback loops which include an evaluation by Peers, as established by the new recommendations for EQAVET. More information on how this will be developed within EQAVET will be released shortly, and according to those guidelines. ALBATTS will also make recommendations for this phase of the PDCA cycle, eventually in the final report of 'Task 6.8 - Strategy for education and training in the Batteries sector, part II'.

Review

According to the methodologies and results from the evaluation phase, guidelines suggestions for the review phase will also be defined, eventually in the final report of 'Task 6.8 - Strategy for education and training in the Batteries sector, part II'.

6.6 PROPOSED STRUCTURE AND FORMAT FOR CONTENT MODULES

6.6.1 Competence Units definition

For the definition of competence units, a draft template was prepared (Appendix 7), which includes the following attributes:

- Competence Unit designation
- Publication date
- EQF and ISCO levels
- Battery value chain step
- Department
- Associated job roles and skills (from ESCO)

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- Code
- Achievements/functions/topics
- Learning Outcomes (Knowledge, Skills, Competencies)
- Competence requirements/assessment criteria

6.6.2 Approach to OER development of learning content material including choice of tools

For the use of Open Educational Resources and development of learning material, the table below illustrates how we plan to go about when we have determined that we need a learning content material for a specific learning objective or competence unit. This checklist will be developed further when we apply it to specific cases. It is a kind of worksheet to ensure that we do not miss anything important in the process.

Table 10 development of learning material checklist

Checklist	**Yes/No, comments**
Determining the character of a needed teaching/learning material Is it a material for freestanding asynchronous use we are envisioning? Is it intended for use with the support of a teacher in blended learning with shifts between synchronous and asynchronous modalities? Is the needed content of linear curriculum kind (the student must know A for learning B, and both to learn C, etc.), or is the content of hub-and-spoke kind (a final learning objective can be approached from various examples or directions to reach a final understanding)?	
Localisation of existing resources Where do we have subject matter expertise enough for development or feedback on content for the wanted unit/module? Are there already MOOC courses available covering the unit? Are there existing Open Educational Resources (OER) in a referatory or repository? Are there existing lectures or similar direct teaching material covering the whole or part of the competence unit, and is it clear by licensing that they can be used? Are there documentary-type Youtube films covering the whole or part of the unit? Are there images, animations or similar media materials available with a permitting license?	

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Checklist	Yes/No, comments
Planning of granularity and versatility of use How can the module we are about to develop become as versatile for use in various contexts (I-VET, CVET, regular HE courses, etc.)? Can the module be used both as a component in adaptive learning and in, for example, LMS use besides a classroom course? How can we, for our project use fit this module into a small course or learning solution to pilot-test? How can the module become as accessible for disabled people as possible, and if there are limitations – how can we do it instead? How can the language question be solved, especially for the VET level use? Do we see any special obstacles to the use of this planned module in national education systems?	
Adaption of existing learning material to fit the defined learning objective Can permission to use the material be obtained, or is it already clear? Can the material be wrapped as a whole into a larger unit (as a MOOC into a campus course with local labs, seminars and examination)? Will the localised existing material be used as a central part of the module, or can it be presented just as a reference link (when permission for us is less necessary)? Can the localised existing material be transformed into a learning unit using contextual tools, as the TED-Ed lesson maker?	
Adaptive learning perspective Can this planned content module be part of an adaptive learning bigger module/course?	
Project development of learning material Is the learning objective such a gap in provision that we should develop it ourselves? Do we have the subject matter expertise available, or how do we satisfy the need for this? Do we have a natural narrative for presentation? Which tool – as easy -to use and cost-free as possible - do we want to use for this purpose?	

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Checklist	Yes/No, comments
Do we have the competence ourselves to use this tool, or can we acquire help? Can it be enough with a good text or a PowerPoint presentation with audio? Can the content be solved in whole or parts with a recorded lecture, discussion or expert interview? Do we need to develop our animations and graphics?	
Licensing and metadata labelling Can this module be labelled with a CC license, or do we need another way to tell that it is free to use? Can we allow adaption and repurposing without any special obstacles?	
OER Development Do we have instructional design competence at hand for this module, or can we manage that in some other way? Do we have subject matter expertise for this module, or can we manage this through contacts? Can we use the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation) or an agile framework model?	
OER piloting Where can we pilot this course? • At an educational institution? • As teacher training? • In a company? • In an internal study circle?	
Interactivity design How can this planned module support interactive features for the individual as formative assessment functions? How can this module support social learning functionality, stimulating peer-to-peer discussion and mutual help? Will the interactivity be built-in, or will it be associated materials?	

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Checklist	**Yes/No, comments**
Which kind of interactivity applications can we recommend to educators concerning this module?	
Distribution / Access / How do we publish this module? In an OER repository? In the DRIVES learning platform? On our website? A combination of the above?	

This checklist and planning help will be developed further when we can add experience to the process.

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7 Conclusions

This deliverable 6.2 constitutes ALBATTS' preparation work for the future development of examples of guidelines, good practice, and practical action plans to be implemented in the education systems of Europe. When the project now has sectoral intelligence to build education and training development on, the actual development of learning objectives, course plans and training concepts, course modules and new ways to use OER will scale up.

We have as training and education partners in the project learnt a lot together. We have analysed what factors as the drivers of change, EU education policies, the national education systems, general trends and technical development of the education sector can be used and adapted for education and training in the battery- and electromobility sector. We have also worked through the questions on how to best benefit from the new practices of sharing teaching and learning content, Open Educational Resources, and how to produce and combine such resources ourselves in the project, and together with other initiatives.

The content of this report is living material, to which experience will be added during our work to come. During the coming two years, 2022-2023, ALBATTS will develop and propose learning objectives and concepts, course materials and modules, train-the-trainer solutions, etc. In addition, we will pilot courses, learning materials and concepts, and bring it all together, synced with our sectoral intelligence work in ALBATTS, into what will become the mature education Blueprint for the battery and electromobility sector.

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Reference list (listing of most important source materials used)

Alcidi, C., & Gros, D. (2019). Intra-EU labour mobility: From too little to too much? *EconPol Opinion, 17.*

Auzinger, M. & Luomi-Messerer, K. (2021) *The European Credit System for Vocational Education and Training.* Luxembourg: Publications Office of the European Union, 2021 https://3s.co.at/wp-content/uploads/2021/07/ECVET-Publication.pdf

Batteries Europe (2020) *Strategic Research Agenda for batteries*. Deliverable 3.6. https://ec.europa.eu/energy/sites/ener/files/documents/batteries_europe_strategic_research_agenda_december_2020__1.pdf

Benini, L., & Viaud, V. (2020). *Drivers of Change of Relevance for Europe's Environment and Sustainability*. European Environment Agency, Luxembourg, European Union, https://www.eea.europa.eu

Bruff, D. O., Fisher, D. H., McEwen, K. E., & Smith, B. E. (2013). Wrapping a MOOC: Student perceptions of an experiment in blended learning. *Journal of Online Learning and Teaching*, 9(2), 187.

Caena, F., Developing a European Framework for the Personal, Social & Learning to Learn Key Competence (LifEComp). *Literature Review & Analysis of Frameworks*, Punie, Y. (ed), EUR 29855 EN, Publications Office of the European Union, Luxembourg, 2019, https://op.europa.eu/en/publication-detail/-/publication/99e3b8f2-e8ea-11e9-9c4e-01aa75ed71a1/language-en/format-PDF/source-177996684

Cedefop/OECD (2021). *The next steps for apprenticeship.* Luxembourg: Publications Office of the European Union. Cedefop reference series; No 118 http://data.europa.eu/doi/10.2801/085907 https://www.cedefop.europa.eu/files/3087_en.pdf

Cedefop (2011). *USING LEARNING OUTCOMES.* European Qualifications Framework Series: Note 4. https://www.aqu.cat/doc/doc_26184757_1.pdf

Cedefop (2017). *Defining, writing and applying learning outcomes: a European handbook.* Luxembourg: Publications Office. http://dx.doi.org/10.2801/566770 https://www.cedefop.europa.eu/files/4156_en.pdf

Cedefop (2018). *Globalisation opportunities for VET: how European and international initiatives help in renewing vocational education and training in European countries*. Luxembourg: Publications Office. Cedefop research paper; No 71. http://data.europa.eu/doi/10.2801/425244

Cedefop (2018). The changing nature and role of vocational education and training in Europe. *Volume 3: the responsiveness of European VET systems to external change (1995-2015).* Luxembourg: Publications Office. Cedefop research paper; No 67. http://data.europa.eu/doi/10.2801/621137

Cedefop (2019). *Spotlight on VET – 2018 compilation: vocational education and training systems in Europe.* Luxembourg: Publications Office of the European Union. http://data.europa.eu/doi/10.2801/540310

Cedefop (2020) *Vocational education and training in Europe, 1995-2035*. Cedefop reference series 114. Luxembourg: Publications Office of the European Union, 2020. https://www.cedefop.europa.eu/en/publications/3083

Co-funded by the Erasmus+ Programme of the European Union

Cedefop (2021). *The role of work-based learning in VET and tertiary education: evidence from the 2016 EU labour force survey.* Luxembourg: Publications Office of the European Union. Cedefop research paper; No 80. https://www.cedefop.europa.eu/en/publications-and-resources/publications/5580

Database of External Quality Assurance Results (DEQAR). Web resource https://www.eqar.eu/the-database-of-quality-assurance-reports-deqar/

Davy, N. & Frankenberg, A. (2018) *Typology of Apprenticeships in Higher Vocational Education.* ApprenticeshipQ project report. https://multinclude.eu/wp-content/uploads/sites/3/2019/07/AppQ-Typology-of-App-in-HVET_final-version_v3.pdf

Dervojeda, K. (2020). *Skills for industry curriculum guidelines 4.0*. https://op.europa.eu/en/publication-detail/-/publication/75478035-56b9-11ea-aece-01aa75ed71a1

European Union (2019) *Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services* PE/81/2018/REV/1 https://ec.europa.eu/social/main.jsp?catId=1202

ERAMUS+ (2021) *Glossary of common terms*. https://erasmus-plus.ec.europa.eu/programme-guide/part-d/glossary-common-terms

European Commission (2016). COUNCIL RECOMMENDATION of 19 December 2016 on Upskilling Pathways: New Opportunities for Adults. *Official Journal of the European Union (2016/C 484)*

European Commission (2017). *Employers together for Integration. A Commission's initiative to support labour market integration*. https://ec.europa.eu/home-affairs/policies/migration-and-asylum/legal-migration-and-integration/cooperation-economic-and-social-partners/employers-together-integration_en

European Commission (2019) *Key competencies for lifelong learning.* Publications Office of the EU (europa.eu) https://op.europa.eu/en/publication-detail/-/publication/297a33c8-a1f3-11e9-9d01-01aa75ed71a1/language-en

European Commission (2019) *Report from the Commission...on the Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe* https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/strategic-action-plan-batteries-report

European Commission (2019) *The European Pillars on Social Rights* https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/jobs-growth-and-investment/european-pillar-social-rights_en

European Commission (2020) *EU Anti-racism Action Plan 2020-2025* https://ec.europa.eu/info/policies/justice-and-fundamental-rights/combatting-discrimination/racism-and-xenophobia/eu-anti-racism-action-plan-2020-2025_fr

European Commission (2020). *A Union of Equality: Gender Equality Strategy 2020-2025* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0152

European Commission (2020). *LGBTIQ Equality Strategy 2020-2025.* https://ec.europa.eu/info/policies/justice-and-fundamental-rights/combatting-discrimination/lesbian-gay-bi-trans-and-intersex-equality/lgbtiq-equality-strategy-2020-2025_en

Co-funded by the Erasmus+ Programme of the European Union

European Commission (2020). *Pact for Skills*. https://ec.europa.eu/social/main.jsp?catId=1517&langId=en

European Commission (2020). *Proposal for a COUNCIL RECOMMENDATION on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience*. https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0275&rid=7

European Commission (2021) COUNCIL RECOMMENDATION of 24 November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience. *Official journal of the European Union C 417/1.* https://www.cedefop.europa.eu/files/celex_32020h120201_en_txt.pdf

European Commission (2021) *ECTS User's Guide* / Glosssary. https://ec.europa.eu/assets/eac/education/ects/users-guide/glossary_en.htm

European Commission (2021). *Digital Education Action Plan* (2021-2027) https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en

European Commission(2020.) *2019 Annual Report on Intra-EU Labour Mobility*. https://ec.europa.eu/social/main.jsp?catId=738&langId=en&pubId=8242&furtherPubs=yes

European Commission/EACEA (2017) *Call for proposals Erasmus+ Programme – KA 2 – Cooperation* .... http://elke.eap.gr/?p=822

European Commission/EACEA/ERASMUS+ (2020) https://erasmus-plus.ec.europa.eu/programme-guide/part-d/glossary-vet

European Commission/EACEA/Eurydice (2018). *Compulsory Education in Europe – 2018/19*. Eurydice Facts and Figures. Luxembourg: Publications Office of the European Union. https://eacea.ec.europa.eu/national-policies/eurydice/sites/eurydice/files/compulsory_education_2018_19.pdf

European Commission/EACEA/Eurydice (2020.) *The European Higher Education Area in 2020: Bologna Process Implementation Rep*ort. Luxembourg: Publications Office of the European Union.

European Credit Transfer and Accumulation System (ECTS) Web resource. https://ec.europa.eu/education/resources-and-tools/european-credit-transfer-and-accumulation-system-ects_en

European Higher Education Area. Web resource. https://ehea.info/

European Union (2020) *European Skills Agenda.* https://ec.europa.eu/social/main.jsp?catId=1223&langId=en

Hoftijzer, Margo; Gortazar, Lucas. (2018) *Skills and Europe's Labor Market : How Technological Change and Other Drivers of Skill Demand and Supply are Shaping Europe's Labor Market.* World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/29965 License: CC BY 3.0 IGO. http://hdl.handle.net/10986/29965

Hogarth, T (2019) *Skills for the labour market. EU Policies for Upskilling and Reskilling*. European Parliament Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/638431/IPOL_BRI(2019)638431_EN.pdf

Co-funded by the Erasmus+ Programme of the European Union

International Standard for the classification of Education. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_Standard_Classification_of_Education_(ISCED)

Kerr, J., Lorenz, A., Schön, S., Ebner, M., & Wittke, A. (202x) *OPEN TOOLS AND METHODS TO SUPPORT THE DEVELOPMENT OF MOOCS. (preprint)* https://www.researchgate.net/publication/345162321_MOOC_Maker_Canvas_English_Version

Kirova, I. (2007). *The Decade of Roma Inclusion: Addressing Racial Discrimination through Development.* UN Chronicle. https://www.un.org/en/chronicle/article/decade-roma-inclusion-addressing-racial-discrimination-through-development

Mason, G., Holland, D., Liadze, I., O'Mahony, M., Riley, R., & Rincon-Aznar, A. (2014). Macroeconomic benefits of vocational education and training. *Cedefop Research Paper, 40.*

Nikolov, A., Nikolova, D., Ganev, P., & Aleksiev, Y. (2018). *Skills Mismatches. An Impediment to the Competitiveness of EU Businesses*. Brussels: European Economic and Social Committee.

Norberg, A., Händel, Å., & Ödling, P. (2015). Using MOOCs at learning centers in Northern Sweden. *International Review of Research in Open and Distributed Learning*, 16(6), 137-151. http://www.irrodl.org/index.php/irrodl/article/view/2035

Nussbaum, M. C. (2009). *Creating capabilities: The human development approach and its implementation*. Hypatia, 24(3), 211-215.

OECD (2011), *ISCED 2011 Operational Manual Guidelines for classifying national education programmes and related qualifications*. https://www.oecd.org/education/isced-2011-operational-manual-9789264228368-en.htm

PwC EU Services (2020). *Skills for Industry - Curriculum Guidelines 4.0. Future-proof education and training for manufacturing in Europe.* EC Executive Agency for Small and Medium-sized Enterprises. (EASME) https://op.europa.eu/en/publication-detail/-/publication/845051d4-4ed8-11ea-aece-01aa75ed71a1

PwC EU Services (2019). *Curriculum Guidelines for Key Enabling Technologies (KETs) and Advanced Manufacturing Technologies* (AMT) INTERIM REPORT https://op.europa.eu/en/publication-detail/-/publication/4dcaeee3-29c2-11e9-8d04-01aa75ed71a1/language-en/format-PDF/source-87225354

Rustagi, M (2020). *Solution to shortage of Skilled Workers|Labour Shortage in Europe.* Podcast article. https://www.beroeinc.com/whitepaper/talent-migration-solution-labour-shortage-europe/

Šefčovič, Maroš (2021) *Keynote speech at the Battery Summit in Portugal March 22nd.* https://ec.europa.eu/commission/commissioners/2019-2024/sefcovic/announcements/keynote-speech-vice-president-maros-sefcovic-battery-summit-portugal_en

Sen, A. K. (2009). *The idea of justice*. Harvard University Press.

Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG). (2015). Brussels, Belgium.

Stoll, B., Reig, S., He, L., Kaplan, I., Jung, M. F., & Fussell, S. R. (2018, February). Wait, can you move the robot? Examining telepresence robot use in collaborative teams. In *Proceedings of the 2018 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 14-22).

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Unitied Nations (2006) *Convention on the Rights of Persons with Disabilities*. https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities.html

Vasiu, R. (2014). Wrapping MOOCs–Analysis from a technological perspective. In *Conference proceedings of eLearning and Software for Education* No. 01, (pp. 261-264). Carol I National Defence University Publishing House.

Wang, K., & Zhu, C. (2019). MOOC-based flipped learning in higher education: students' participation, experience and learning performance. *International Journal of Educational Technology in Higher Education,* 16(1), 1-18.

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APPENDIX 1

The Council Recommendation of the 24th of November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience can be downloaded at https://op.europa.eu/en/publication-detail/-/publication/08b9af27-3465-11eb-b27b-01aa75ed71a1/language-en . Only the first page of this document, available in multi-lingual versions, is visible below.

2.12.2020 EN Official Journal of the European Union C 417/1

I

(Resolutions, recommendations and opinions)

RECOMMENDATIONS

COUNCIL

COUNCIL RECOMMENDATION

of 24 November 2020

on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience

(2020/C 417/01)

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Articles 166 and 165 thereof,

Having regard to the proposal from the European Commission,

Whereas:

(1) The Charter of Fundamental Rights of the European Union [1] recognises education and access to vocational and continuing training as a fundamental right, the United Nations' Sustainable Development Goals envisage by 2030 equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university, and a substantial increase in the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

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APPENDIX 2

Table - Levels and complementary dimensions of the International Standard Classification of Education (ISCED) 2011 Codification of education programmes and educational attainment[196]

Level	Criteria for classifying national programmes by levels	
1st digit	Main criteria	Subsidiary criteria
1 Primary education	Education with systematic teaching and learning in reading, writing and mathematics (§125). Admission/age and duration: official age of entry between ages 5 and 7 years; typical duration of 6 years (range is 4 to 7 years) (§122). Teacher: typically, one main teacher is in charge of a group (§126).	Often coincides with the beginning of compulsory education (§127).
2 Lower secondary education	Transition to subject-oriented instruction (§144). Entry requirements: completion of primary education (or the capacity to study at ISCED level 2) (§145). Cumulative duration: ends after 8 to 11 years of education (often 9) from the start of primary education (§146).	Typical entry age is between 10 and 13 years, the most common being 12 (§141). Subject teachers, with qualifications in specific subjects as well as pedagogy (§147). The end of the level often coincides with the end of compulsory education (§148).
3 Upper secondary education	Second/final stage of secondary education, in form of general or vocational programmes (§167). Entry requirements: completion of lower secondary education (or the capacity to study at ISCED level 3) (§168).	More differentiated programmes: increased range of options and streams (§169). Teachers often more qualified with respect to the subject matter they teach than lower secondary teachers (§170).

[196] 2015, UNESCO, ISCED 2011 Operational Manual Guidelines for classifying national education programmes and related qualifications

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	Cumulative duration: programmes end 12 or 13 years since the beginning of ISCED 1 (§164).	
4 post-secondary non-tertiary education	Post-secondary education, generally vocational and terminal programmes preparing for the labour market; typically, not considered as tertiary education at the national level (§190). Programmes which serve to broaden rather than deepen the knowledge, skills and competencies of participants. Often not significantly more advanced than programmes at ISCED level 3 (§191). Entry requirements: completion of upper secondary education (§186).	
5 Short-cycle tertiary education	Programmes often designed to provide participants with professional knowledge, skills and competencies; may provide pathway to academic programmes (§207). More complex than levels 3 and 4 but less than 6 (§212). Entry requirements: successful completion of upper secondary or post-secondary nontertiary education giving access to ISCED levels 5, 6 or 7 (§208) Minimum duration: 2 years (§213).	Institutional transition points: often provided by different institutions from ISCED levels 6, 7 and 8 (§214). Typical duration: 2 to 3 years (§213).
6 Bachelor's or equivalent	Programmes often designed to provide participants with intermediate academic or professional knowledge, skills and competencies, leading to a first degree, such as a	The requirement of a doctorate (ISCED level 8) qualification for some of the teaching staff may help distinguish ISCED levels 5 and 6 (§231).

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	Bachelor's, or to an equivalent qualification (§224). Entry requirements: successful completion of upper secondary or post-secondary nontertiary education giving access to ISCED levels 5, 6 or 7; may require the passing of an entrance examination (§226). Minimum cumulative duration of first degrees: 3 to 4 years full-time (§229). Position in the national degree structure: typically, a first degree in tertiary education; sometimes a second degree of 1 to 2 years (§230)	Further studies: does not give direct access (usually) to doctoral programmes (ISCED level 8) (§226).
7 Master's or equivalent	Programmes often designed to provide participants with advanced academic or professional knowledge, skills and competencies, leading to a second degree, such as a Master, or to an equivalent qualification (§241). Position in the national degree structure: typically, a second or further degree in tertiary education following a first degree at ISCED level 6 or 7 (§246) or a long first degree of at least 5 years if equivalent to a Master's in terms of the complexity of content (e.g. medicine) (§247). Entry requirements: in the case of a 2nd degree, the successful completion of a Bachelor's or equivalent (ISCED level 6) or a Master's or equivalent (ISCED level 7) is required; in the case of a 1st degree, the successful completion of upper secondary or of ISCED 4 granting access to tertiary education is required	Minimum duration of long 1st degree: 5 years; complexity of content comparable to a Master's (§247). Further studies: often gives direct access to doctoral programmes (ISCED level 8) (§249).

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	and, eventually, an entry examination (§243).	
8 Doctoral or equivalent	Its successful completion requires the submission of a thesis or an equivalent written work, of publishable quality, which is the output of original research representing a considerable contribution to knowledge in the field (§264). Entry requirements: the successful completion of an ISCED 7 programme (§261). Minimum duration: at least 3 years of full-time studies and a total cumulative duration of at least 7 years of tertiary education (§265)	Degree gives access to faculty positions and research posts (§266).

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APPENDIX 3

Table - describing every EQF level in more detail with the defined knowledge, skills, responsibilities and autonomy scope.

EQF	Knowledge	Skills	Responsibility and Autonomy
1	Basic general knowledge	Basic skills required to carry out simple tasks	Work or study under direct supervision in a structured context
2	Basic factual knowledge of a field of work or study	basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve routine problems using simple rules and tools	work or study under supervision with some autonomy
3	Knowledge of facts, principles, processes and general concepts in a field of work or study	a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	take responsibility for completion of tasks in work or study; adapt own behaviour to circumstances in solving problems
4	Factual and theoretical knowledge in broad contexts within a field of work or study	a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	exercise self-management within the guidelines of work or study contexts that are usually predictable but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
5	Comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	a comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop the performance of self and others
6	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	advanced skills, demonstrating mastery and innovation, required to solve complex and	manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility

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		unpredictable problems in a specialised field of work or study	for managing professional development of individuals and groups
7	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking or research Critical awareness of knowledge issues in a field and at the interface between different fields	specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields	manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams
8	Knowledge at the most advanced frontier of a field of work or study and at the interface between fields	the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice	demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts, including research

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APPENDIX 4

ANNEX I

THE EUROPEAN QUALITY ASSURANCE REFERENCE FRAMEWORK: QUALITY CRITERIA AND INDICATIVE DESCRIPTORS (1)

This annex proposes common quality criteria and indicative descriptors to support Member States, as they deem appropriate, when implementing the Framework (2).

Quality Criteria	Indicative descriptors at VET-system level	Indicative descriptors at VET-provider level
Planning reflects a strategic vision shared by the relevant stakeholders and includes explicit goals/objectives, actions and indicators	Goals/objectives of VET are described for the medium and long terms, and linked to European goals The relevant stakeholders participate in setting VET goals and objectives at the different levels Targets are established and monitored through specific indicators (success criteria) Mechanisms and procedures have been established to identify training needs An information policy has been devised to ensure optimum disclosure of quality results/outcomes subject to national/regional data protection requirements Standards and guidelines for recognition, validation and certification of competences of individuals have been defined	European, national and regional VET policy goals/objectives are reflected in the local targets set by the VET providers Explicit goals/objectives and targets are set and monitored Ongoing consultation with relevant stakeholders takes place to identify specific local/individual needs Responsibilities in quality management and development have been explicitly allocated There is an early involvement of staff in planning, including with regard to quality development Providers plan cooperative initiatives with other VET providers The relevant stakeholders participate in the process of analysing local needs VET providers have an explicit and transparent quality assurance system in place
Implementation plans are devised in consultation with stakeholders and include explicit principles	Implementation plans are established in cooperation with social partners, VET providers and other relevant stakeholders at the different levels Implementation plans include consideration of the resources required, the capacity of the users and the tools and guidelines needed for support Guidelines and standards have been devised for implementation at different levels Implementation plans include specific support towards the training of teachers and trainers VET providers' responsibilities in the implementation process are explicitly described and made transparent A national and/or regional quality assurance framework has been devised and includes guidelines and quality standards at VET-provider level to promote continuous improvement and self-regulation	Resources are appropriately internally aligned/assigned with a view to achieving the targets set in the implementation plans Relevant and inclusive partnerships are explicitly supported to implement the actions planned The strategic plan for staff competence development specifies the need for training for teachers and trainers Staff undertake regular training and develop cooperation with relevant external stakeholders to support capacity building and quality improvement, and to enhance performance

(1) For the purposes of this recommendation, definitions which apply are based on Cedefop's Glossary on Quality in Training (working paper, November 2003).
(2) A further set of selected quality indicators is detailed in Annex II.

Quality Criteria	Indicative descriptors at VET-system level	Indicative descriptors at VET-provider level
Evaluation of outcomes and processes is regularly carried out and supported by measurement	A methodology for evaluation has been devised, covering internal and external evaluation Stakeholder involvement in the monitoring and evaluation process is agreed and clearly described The national/regional standards and processes for improving and assuring quality are relevant and proportionate to the needs of the sector Systems are subject to self-evaluation, internal and external review, as appropriate Early warning systems are implemented Performance indicators are applied Relevant, regular and coherent data collection takes place, in order to measure success and identify areas for improvement. Appropriate data collection methodologies have been devised, e.g. questionnaires and indicators/metrics	Self-assessment/self-evaluation is periodically carried out under national and regional regulations/frameworks or at the initiative of VET providers Evaluation and review covers processes and results/outcomes of education including the assessment of learner satisfaction as well as staff performance and satisfaction Evaluation and review includes adequate and effective mechanisms to involve internal and external stakeholders Early warning systems are implemented
Review	Procedures, mechanisms and instruments for undertaking reviews are defined at all levels Processes are regularly reviewed and action plans for change devised. Systems are adjusted accordingly Information on the outcomes of evaluation is made publicly available	Learners' feedback is gathered on their individual learning experience and on the learning and teaching environment. Together with teachers' feedback this is used to inform further actions Information on the outcomes of the review is widely and publicly available Procedures on feedback and review are part of a strategic learning process in the organization Results/outcomes of the evaluation process are discussed with relevant stakeholders and appropriate action plans are put in place

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APPENDIX 5

ANNEX II

A REFERENCE SET OF SELECTED QUALITY INDICATORS FOR ASSESSING QUALITY IN VET

This Annex proposes a comprehensive set of selected quality indicators which can be used to support the evaluation and quality improvement of VET systems and/or VET providers. The set of indicators will be further developed through European cooperation on a bilateral and/or multilateral basis, building on European data and national registers.

In terms of their nature and purpose, they should be distinguished from the indicators and benchmarks referred to in the Council conclusions of 25 May 2007 on a coherent framework of indicators and benchmarks for monitoring progress towards the Lisbon objectives in education and training.

Furthermore, the table of indicators does not include aggregated indicators at national level in cases where these do not exist or are difficult to obtain. The aggregation of such indicators at national level can be carried out at a later stage on the basis of a joint agreement between the Member States, the Commission and the European Quality Assurance Reference Framework network.

Indicator	Type of Indicator	Purpose of the Policy
Overarching Indicators for Quality Assurance		
No 1 Relevance of quality assurance systems for VET providers: (a) share of VET providers applying internal quality assurance systems defined by law/at own initiative (b) share of accredited VET providers	Context/Input indicator	Promote a quality improvement culture at VET-provider level Increase the transparency of quality of training Improve mutual trust on training provision
No 2 Investment in training of teachers and trainers: (a) share of teachers and trainers participating in further training (b) amount of funds invested	Input/Process indicator	Promote ownership of teachers and trainers in the process of quality development in VET Improve the responsiveness of VET to changing demands of labour market Increase individual learning capacity building Improve learners' achievement
Indicators supporting quality objectives for VET policies		
No 3 Participation rate in VET programmes: Number of participants in VET programmes (1), according to the type of programme and the individual criteria (2)	Input/Process/Output indicator	Obtain basic information at VET-system and VET-provider levels on the attractiveness of VET Target support to increase access to VET, including for disadvantaged groups

Indicator	Type of Indicator	Purpose of the Policy
No 4 Completion rate in VET programmes: Number of persons having successfully completed/abandoned VET programmes, according to the type of programme and the individual criteria	Process/Output/Outcome indicator	Obtain basic information on educational achievements and the quality of training processes Calculate drop-out rates compared to participation rate Support successful completion as one of the main objectives for quality in VET Support adapted training provision, including for disadvantaged groups
No 5 Placement rate in VET programmes: (a) destination of VET learners at a designated point in time after completion of training, according to the type of programme and the individual criteria (*) (b) share of employed learners at a designated point in time after completion of training, according to the type of programme and the individual criteria	Outcome indicator	Support employability Improve responsiveness of VET to the changing demands in the labour market Support adapted training provision, including for disadvantaged groups
No 6 Utilisation of acquired skills at the workplace: (a) information on occupation obtained by individuals after completion of training, according to type of training and individual criteria (b) satisfaction rate of individuals and employers with acquired skills/competences	Outcome indicator (mix of qualitative and quantitative data)	Increase employability Improve responsiveness of VET to changing demands in the labour market Support adapted training provision, including for disadvantaged groups
Context information		
No 7 Unemployment rate (*) according to individual criteria	Context indicator	Background information for policy decision-making at VET-system level
No 8 Prevalence of vulnerable groups: (a) percentage of participants in VET classified as disadvantaged groups (in a defined region or catchment area) according to age and gender (b) success rate of disadvantaged groups according to age and gender	Context indicator	Background information for policy decision-making at VET-system level Support access to VET for disadvantaged groups Support adapted training provision for disadvantaged groups

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Indicator	Type of Indicator	Purpose of the Policy
No 9 Mechanisms to identify training needs in the labour market: (a) information on mechanisms set up to identify changing demands at different levels (b) evidence of their effectiveness	Context/Input indicator (qualitative information)	Improve responsiveness of VET to changing demands in the labour market Support employability
No 10 Schemes used to promote better access to VET: (a) information on existing schemes at different levels (b) evidence of their effectiveness	Process indicator (qualitative information)	Promote access to VET, including for disadvantaged groups Support adapted training provision

(1) For IVT: a period of 6 weeks of training is needed before a learner is counted as a participant.
For lifelong learning: percentage of population admitted to formal VET programmes.
(2) Besides basic information on gender and age, other social criteria might be applied, e.g. early school leavers, highest educational achievement, migrants, persons with disabilities, length of unemployment.
(3) For IVT: including information on the destination of learners who have dropped out.
(4) Definition according to ILO and OECD: individuals aged 15-74 without work, actively seeking employment and ready to start work.

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APPENDIX 6

REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

Anderson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.

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APPENDIX 7

Draft template for the definition of competence units

Competence Unit name:

EQF level:	ISCO level:	raw materials	components	modules & pack	integration	operation, r, m	second life	recycling

Department:	Production Maintenance	Logistics	quality	purchasing	HR	Finance	Sales	RnD	Construction	Intellectual, Legal	Recycling	Environment	IT, Digital

Job roles/skills associated:

Code	Achievements/ Functions / Topic	Learning Outcomes (Knowledge, Skills, Competences)	Competence requirements/assessment criteria	Badge (Y/N)
XXX01	Asdfdsfsadfsd sdfsdfasdfsd	**Knowledge:** 1.1 xdfre	1.1.1 sdfsdfd 1.1.2 sadfasf	
		Knowledge: 1.2 adsdafsf	1.2.1 fgsdfg	
		Skills: 1.3 adsdfdsf	1.3.1 asdfs 1.3.2 sdfgdgd 1.3.3 dfgdfsgsd	
		Competence: 1.4 dsfsdfsd	1.4.1 gdfgfd	
XXX02				
XXX03				

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