Skillman.eu: a Sectoral skills model that includes sustainability and ethical values

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Skillman.eu is a worldwide network based in the EU, addressed to introduce skills, competences and innovative curricula for the advanced manufacturing sector within the VET pathways. It has a **large geographical coverage** and connects industry and training providers with civil society giving support services that drive growth and effectiveness in the sector.

It was launched in 2015 with the European Commission support in the field of education and training and in its specific field of intervention is currently became the largest EU multilateral network **combining a solid knowledge of skills needs and training practices with a well organised systemic and sector-related information system**.

It was founded by well-known VET providers and industry leaders like Scandinavian Airline Systems, FIAT FCA, Jaguar Land Rover, the Italian National Research Centre, TKNIKA and other organisations and accreditations bodies from various EU countries. **Currently it is joined by more than 280 regional, national and international organizations** also based outside the EU, including new affiliated industries, notable universities and research centres as well NGOs, public bodies and other umbrella organisations like Cumulus, which jointed recently the skillman.eu initiatives and which represents other additional 250 members, universities, training providers etc, from 54 countries worldwide, and which is currently the only global association to serve design education and research, addressed to the transfer of knowledge and best practices in coherence with the skillman.eu mission.

Potentials

Skillman.eu demonstrated, in its first three years life, a very lively attitude to promote significant initiatives in the field of the European education and training polices like the realisation of relevant publishing and debates, highly participated international conferences, numerous online impacting dissemination activities, contributions and affiliations as, for example, the membership of the **European Sector Skills Council in Automotive Industry** or the participation to the EU public consultations to interact with the EU institutions and to represent the specific interests of its members in the field of the VET in the advanced manufacturing sector.

The skillman.eu's members expressed their commitment and political will to foster cooperation and to devise joint European curricula basing on their concrete experience and resources and, in line with the European education and training polices, they currently express their potential working in three main areas:

- **the development of a clear strategy** and instruments to reduce the mismatch between the skills people are taught and the skills needed for the Advanced Manufacturing by the service sector and the manufacturing industry
- **the identification and deployment of an unique framework** for strategic cooperation between key stakeholders in the field of the Advanced Manufacturing.
- **the design** of a relevant set of innovative curricula, tools and resources for the education in the advanced manufacturing

New challenges

The original Skillman.eu mission, the facilitation of the EU Skills Agenda designing new learning pathways in the advanced manufacturing sector, has been afterwards added with a particular debate, generated among the members about the **UNESCO 17 goals on sustainable development** and related, in particular, to the ethical values that connect the competences necessary for Advanced Manufacturing to the personal responsibility.

The AM technologies require different profiles provided with skills and ethical values that currently in both, the job market in general and in the industrial companies too, are still lacking in terms of numbers, knowledge and know-how. Different figures are required, from the design phase, up to the manufacturing technician to be committed in the plant, up to the technological skilled people which have a global vision (from design, up to all the post processing), without forgetting, for example, the material experts on the different additive manufacturing portfolio[1].

The Skillman.eu members think that the new advanced manufacturing technologies and the additive manufacturing in particular, will be more and more extended to all plants and on all manufacturing process level, since the initial prototyping phase up to the real mass production. The additive manufacturing technologies will be, also, adopted in the design and manufacturing of tools for the production process itself.

Thus, the current perspective and the objectives of the members of the Skillman.eu platform, regarding the new printing technologies in particular, includes two aspects that mainly fit also with supranational policies in the fields of education and training:

1. **the ethical issues**, that placed the Advanced Manufacturing sector skills to the attention of the skillman.eu members due to the existing easy possibility to use low cost 3d printing system to make weapons and
2. **the need to approach the Advanced Manufacturing for a large mass market production** to support a '*rapid European or international scale-up of innovative solutions*'[2].

Targets

The members of the skillman.eu Alliance has already designed a relevant set of innovative curricula, tools and resources for education and are still fully committed to continue their active involvement in the skills foresight exercises started in 2015. They recently added to their original mission a special attention to the ethic issues launching a large debate among industry, educational institutes and social parts, about the individual responsibility consequent to linking the technological competences to the ethical values.

They finally will to upscale the skillman.eu model, experience, approach and results to a largest coverage and to the systemic level and in particular they aim to:

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1 Regards education, one should not underestimate the added value of re-training existing workers. Key for the deployment of additive methods in Europe is not only teaching AM skills in the educational context, but also re-focusing skills of existing workers. AMEC 2017 - http://www.cecimo.eu/site/additive-manufacturing/cecimo-conferences/amec/amec-takeaways/

2 LAB – FAB – APP — Investing in the European future we want, ISBN 978-92-79-70571-7, Luxembourg: Publications Office of the European Union, 2017

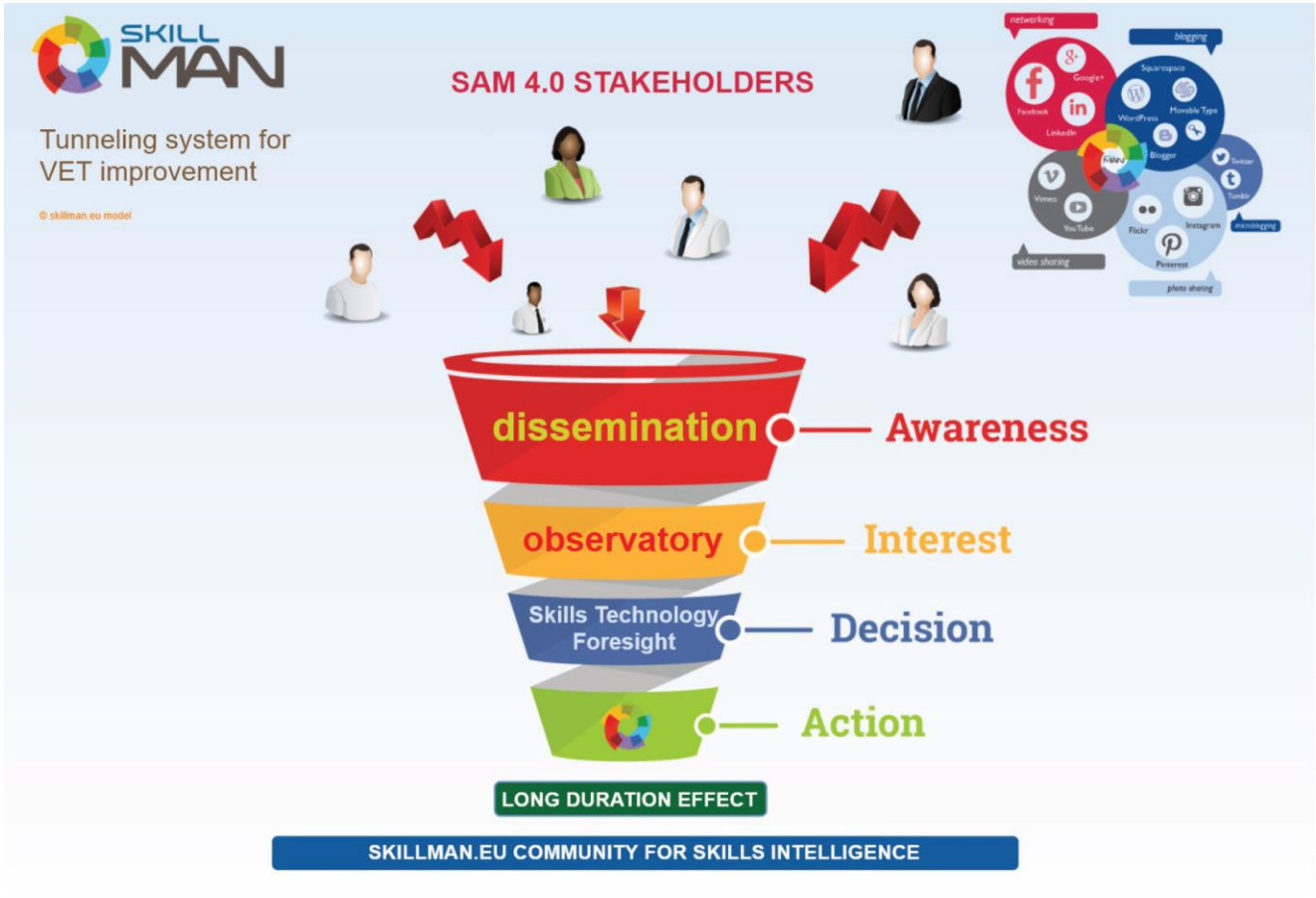
- create innovation in the VET system, finalising **the circular approach for the skills foresight** in a more mature system and giving tangible results suitable for the publication in the EU Skills Panorama or in other collection systems
- improves existing learning pathways and devises additionally new joint European curricula for professions forecasted for the Advanced Manufacturing sector
- release curricula solutions and open educational materials **for free and open use**
- makes changes in the VET provisions that are measurable
- envisage results and solutions for the VET system that are aligned with the EU standards, transferable and accessible to a broader audience

The anticipation lifecycle model

Skillman.eu Alliance deploys his plans implementing a tunnelling system aimed to involve the stakeholders and to make them to give and effective contribution to the skillman.eu targets and finally to valorise these contributions in the concrete development of new or revised curricula. The system is composed by four steps that occur in continuous:

1. Dissemination / awareness creation
2. Observatory activities / consolidation of interest
3. Skills technology foresight / decision and identification of skills needs
4. Skillman.eu constructional design implementation / sectoral action

The following chart illustrates the skillman.eu's tunnelling structure:



The Observatory on Advanced Manufacturing Sector

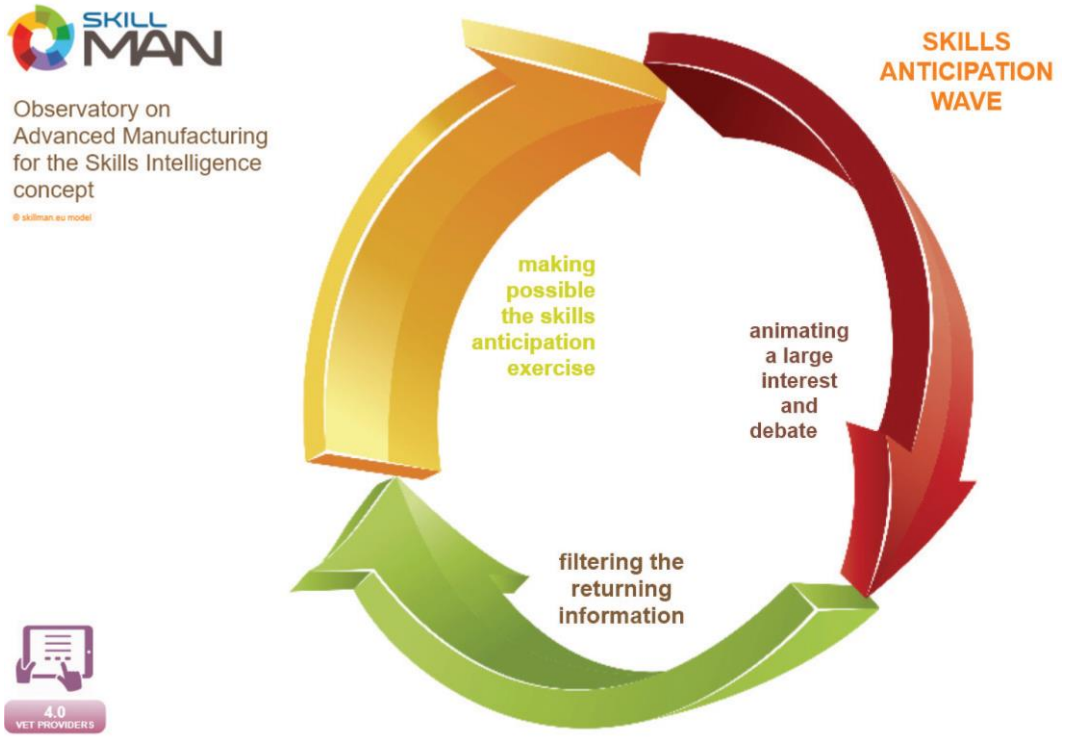
Skillman.eu has set its Observatory on Advanced Manufacturing Sector aiming to provide the forefront solution for the innovation and improvement of the Skills Intelligence in the sector. The Observatory implements a **long-term strategy** aimed to:

- build resistant, live, bi-directional interactions with a wide range of different stakeholders
- create a persistent system of cross-relationships for the long-duration of the skillman.eu model
- make a concrete influence in the industry sector and in the VET system addressing policy makers, universities and technical colleges with concrete results

To make possible the more general **skillman.eu anticipation lifecycle concept** the Observatory implements a circular action, the '***Skills anticipation wave***[3]**'** composed by the following three moments that repeat:

1. provoking a large interest and debate
2. filtering the returning information
3. making the skills anticipation exercise possible

The following chart represents the 'Skills anticipation wave':



The Observatory is designed in a way that:

- provokes and sources a large debate able to stimulate a relevant interest about the skills anticipation in the sector
- creates the necessary conditions to implement the Technology Foresight exercise and makes possible the sector skills anticipation

To provoke interest and consensus among the sector and skills needed topics, the Observatory makes publications, sign agreements of collaboration, circulates technical documents and position papers, develops the contents for the conferences, the webinars and the workshops and circulates many relevant information with the participation of the Observatory team members to a significant number of conferences and debates for an effective impact on the final targets.

3 © skillman.eu consortium

To make its effect real the Observatory implements various activities and activates differentiated channels addressing diverse areas with the installation of specialised **Thematic Commissions.**

The Thematic Commissions are responsible for implementing on an on-going basis the animation among the stakeholders and to source their debate involving the VET practitioners', the scientific community, the public authorities, the policy makers, the industry experts etc., focusing their attention and curiosity on the coming technologies and the needed skills and identifying and detecting all the potential sources for circulating information.

The **Thematic Commissions** are the operational arms of the Observatory and are planned, for the next period, to make concrete effects within the following three areas of specialization:

- 3D Printing, jetting technologies, photopolymerisation, powder bed fusion, material extru-sion, directed energy deposition.
- Established Manufacturing industries in transition towards industrial modernisation, e.g. in-jection moulding, machining, forming and joining
- Creative industries, e.g. industrial and graphic design, software development, 3D publish-ing.

On annual basis, the Observatory on Additive Manufacturing for the Skills Intelligence publishes:

- The skillman.eu 4.0 Annual Position Paper on education strategies for the AM sector
- The Skillman 4.0 European outlook on AM competences and skills needs

The publications are based on desk researches, existing analysis from research bodies, including National and European Sector Skills Councils, EU Skills Panorama etc.

The focus of the Observatory is on **specific challenges of the sector** especially in relation to:

- High-performing manufacturing
- Key Enabling Technologies (KETs)
- Digital transformation/industry 4.0, and advanced materials
- Service innovation concepts for space data services
- Creative industries
- Additive Metal Hybrid Technology and multimaterial printing
- New polymer-based additive manufacturing system for large parts
- New direct 3D free form approaches
- Industrial AM scenarios: medical, aerospace, automotive, industrial and other applications
- Standardization requirements

Each Thematic Commission focuses on a specific challenge and detects its existing potential interlocutors to address them with a series of activities for sharing and interaction.

The skillman.eu Observatory is also addressed to exploiting synergy, at national and regional level, rolling-out a concrete cooperation with national and regional authorities and key stakeholders and finding possible interactions and collaborations with sister or complementary initiatives.

In general, the **Observatory** actively interconnects and coordinates all the skillman.eu actions and results with the existing tools and initiatives for skills development at international national and regional level.

For this process, **the value of dialogue is very high** and is pursued through the involvement of many different parts that, at the end are pushed to develop new needs of networking, social interaction, mutual collaboration and support in the field of skills intelligence, foresight and curricula design.

In response to change, all relevant actors need the opportunities offered by the skillman.eu Observatory, to sit at the same table translating the strategic dialogue into enhanced government-to-government, government-to-business, and government-to-citizen cooperation and need to support their interactions within a participate mechanism of capacity building and constructions of new knowledge.

Labour Market and Skills Intelligence set

The skills anticipation lifecycle that skillman.eu adopts, incorporates as one of its key components for the identification of skills needs[4], the ***ILO skills anticipation system***[5] and it's also ispired by the five methodological guides[6] to anticipating and matching skills and jobs, published in 2016 by Cedefop in collaboration with the ILO and ETF.

In one side, the skillman.eu Alliance produces researches that are accomplished via its research centres, though existing international networks, as well as in cooperation with and support of the extensive network of the numerous complementary organizations who have joined the skillman.eu Alliance.

In the other side the Observatory aims to actively interconnect and coordinate all the actions and results with the existing EU tools and initiatives for skills development and aims to source a large debate among stakeholders.

This process wants make tangible results such as:

- total engagement of the audience and conversion of valuable stakeholders in assets for the future sustainability as they become skillman.eu open network members
- valorisation of the skillman.eu results that are fully distributed and implemented by the industries and VET providers belonging to the engaged stakeholders
- final beneficiaries involvement, because in this process, also the learners are fully engage with various dissemination campaigns, piloting, mobility and finally personal experiences that make them more aware and attracted by the sector working opportunities.

Within this approach, each stakeholder become engaged at the moment that acquires the consciousness that the updating of the existing curricula and the learning pathways is not a one time problem. The stakeholder become engaged when decide to join the skillman.eu community realising that the need to forecast the skills is a continuous necessity and:

- It's not just a *one time problem* for the company, that needs to follow rapid market changes and to continuously update his personnel
- It's just a *one time problem* for the VET providers that have to respond to the needs of work giving competences for the future and for life
- It's not just a *one time problem* for the learners, in a certain time of their life, because they need to plan their pathways in a lifelong learning perspective.

The researches and the stakeholders interactions are deployed within a Labour Market and Skills Intelligence European panorama that is represented by the following chart:

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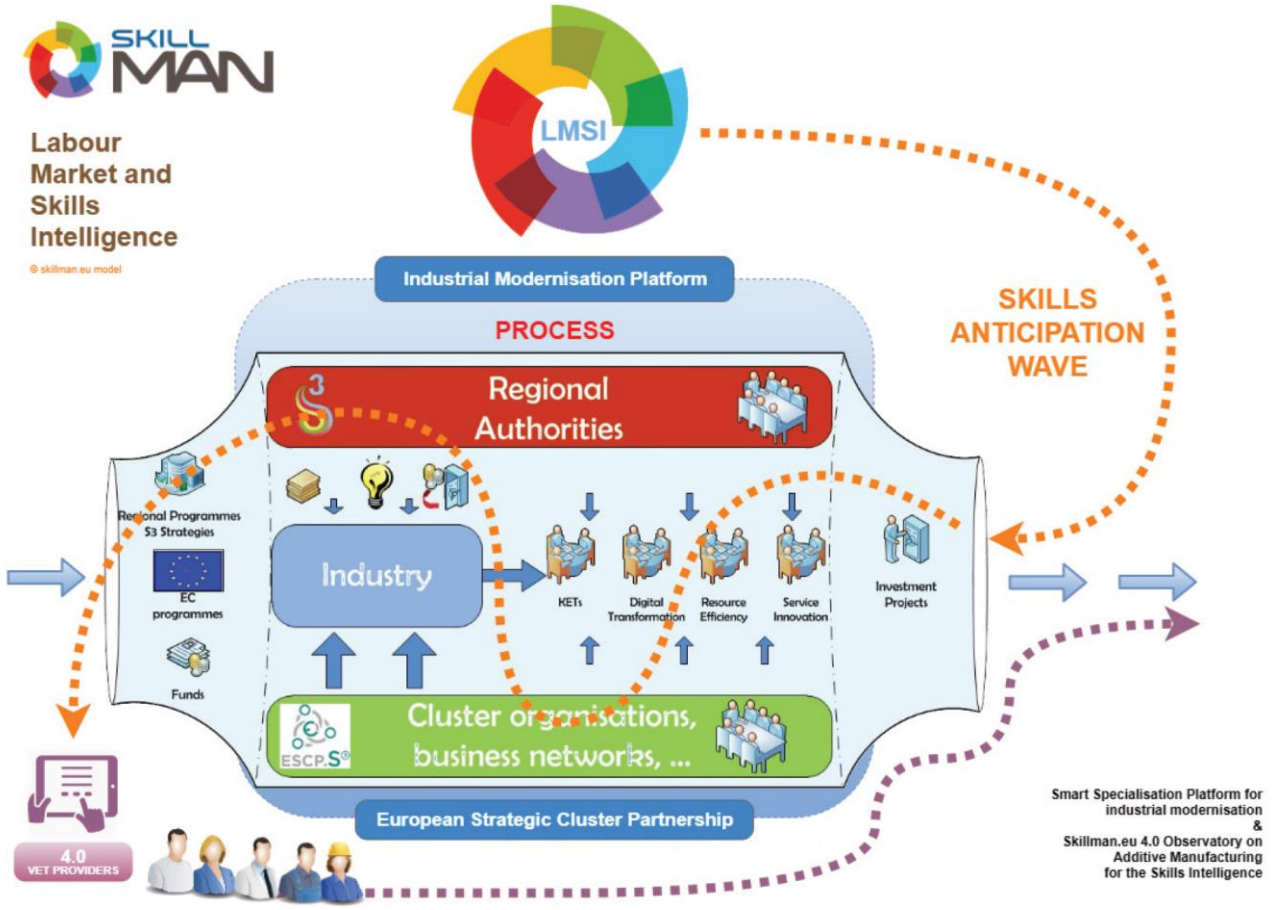
4 Skills Strategies for Future Labour Markets, ILO - http://www.ilo.org/skills/areas/skills-training-for-poverty-reduction/lang--en/index.htm

5 Sudakov, Dmitry; Luksha, Pavel; Strietska-Ilina, Olga; Gregg, Con; Hofmann, Christine; Khachatryan, Liana, Skills Technology Foresight Guide, ILO - SKOLKOVO Education Development Centre (SEDeC), June, 2016

6 Skills for trade and economic diversification: A practical guide. ILO, 2012 / Addresses anticipation of skills needs in promoting trade strategies and in exporting industries.
Anticipating skill needs for green jobs: A practical guide. ILO, 2015a / Addresses approaches to analysing and anticipating skills needs for the green economy and sustainable development.
Guidelines for inclusion of skills aspects into employment-related analyses and policy formulation ILO, 2015b. / Addresses the analysis of skills barriers to employability and skills needs for employment, and how to integrate the analysis in the process of national employment policy formulation.
Guide to anticipating and matching skills and jobs. Cedefop, ETF, ILO, 2015: / A compendium of tools for guidance and assistance in designing methods, instruments and institutional solutions to meet the challenge of matching current and future skills and jobs:
➢ Volume 1: Using labour market information Provides guidance on the principal types of data, data sources and indicators that can answer key policy questions related to overcoming or preventing skills mismatch.
➢ Volume 2: Developing skills foresights, scenarios and forecasts Addresses quantitative and qualitative methods of anticipation and forecasting of future skills needs at a macroeconomic level.
➢ Volume 3: Working at sector level Addresses methods, processes and institutional mechanisms of skills identification and anticipation at sectoral level.
➢ Volume 4: The role of employment service providers Addresses the role of public employment services and private employment agencies in skills anticipation and matching, including the collection and use of relevant labour market information.
➢ Volume 5: Developing and running an establishment skills survey Provides guidance on the implementation of surveys among employers (establishments) on skills shortages and gaps, recruitment difficulties and training measures.
➢ Volume 6: Carrying out tracer studies Assists training providers and analysts in designing and implementing surveys among their graduates on their employability, how their skills are used, and how those skills relate to gaps on the labour market.



The skillman.eu Observatory provides the desk researches and organises a collaborative work with key stakeholders involved in focus group sessions, running with them a capacity building activity to design and anticipate the demand for skills in three perspectives:

- the short-term
- the mid-term and
- the long-term.

The Observatory identify and involve various external participants to the foresight process and pursues a very relevant dialogue among them which, in response to change, have to sit at the same table and to translate the strategic dialogue into an enhanced cooperation. The result of this interaction that skillman.eu manages among the key stakeholders is also a capacity building effect that represents an additional invaluable asset in itself.

The stakeholders are actively involved to implement the **STF exercises** which are organised in the three canonical ILO – SKOLKOVO's blocks:

- designing the 'map of the future'
- transforming the map into a set of requirements
- identifying specific practical recommendations

The skillman.eu's skills pillars

Skillman.eu' skills anticipation lifecycle anticipates the skill needs in Advanced Manufacturing implementing a "*systematic, future intelligence-gathering and medium to long-term vision-building process aimed at identifying opportunities and areas of vulnerability to assist present-day decision-making*"[7]. Within these processes, the experts

[7] JRC-IPTS, For-Learn online foresight guide: an A to Z of foresight http://forlearn.jrc.ec.europa.eu/guide/A1_key-terms/foresight.htm

and the stakeholders participants' attention is pointed to a set of specific **skills pillars** that have to be taken into account for the analysis and thus balanced to be properly included, when possible, in the identified policy strategies and in the curricula newly designed or revised.

Skillman.eu has identified its set of '**skills pillars**' taking a priori inspiration from the EU 2020 strategies, from educational and labour trends[8],' from other sectoral initiatives[9], analysis and from the European policies in the fields of education and training and takes also into account the CEDEFOP and the ESCO[10] developments in relation to skills needs and professional standards.

The skillman.eu's skills pillars are grouped in "**critical skills**", skills related to "**challenges and future trends**", "**AM skills for KETs**[11]", "**skills for ICT**", "**Green skills**", "**Entrepreneurial skills**", and "**Ethical Skills**".

Critical skills

The 2020 target points to a work fully networked, flexible, integrated, open and innovative and the skillman.eu takes it in charge aiming to identify the new skills and competences and to design new learning pathways that allow the European industry to "*stay or become the world leader in innovation, digitisation and decarbonisation*"[12] promoting the following critical skills:

- Social Intelligence
- Novel and adaptive thinking
- Cross-cultural competency
- Computational thinking
- Transdisciplinary
- Virtual collaboration

Skills for challenges and future trends

The renewed EU Industrial Policy Strategy brings together all existing and new horizontal and sector-specific initiatives into a comprehensive industrial strategy. It also clarifies the tasks ahead for all actors involved and makes all the actors responsible to make the workforce equipped with the right skills for the future trends, like:

- Complex problem solving
- Critical thinking
- Creativity
- People management
- Co-ordinating with others
- Emotional intelligence
- Judgment and decision making
- Service orientation

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8 The talent challenge: Harnessing the power of human skills in the machine age, 20th CEO Survey, PWC, https://www.pwc.com/gx/en/ceo-survey/2017/deep-dives/ceo-survey-global-talent.pdf

9 The consortium takes into account various SSA and SSC documents and in particular valorises, among the most relevant for the AM sector, the results and publications of the SkillMan - Sector Skills Alliances for the Advanced Manufacturing (skillman.eu), the EASC - European Sector Skills Council in Automotive Industry (euautomotiveskillscouncil.eu), METALS - Machine Tool Alliance for Skills (metalsalliance.eu), SkillME - Skills in Metal and Electro Industry (gzs.si/skill-me), LET'S MAKE IT HAPPEN – A SHIFT INTO LEARNING OUTCOMES IN THE WELDING SECTOR (makeitproject.eu), 4CHANGE - Industry 4.0 CHAlleNGE: Empowering Metalworkers For Smart Factories Of The Future (metindustry.eu/projects/linpra) including, for the coming years the future results that will be published by the most recently approved new European Alliances like: MeMeVET – Mechatronics and Metallurgical VET for sectors' industries, CLLAIM – Creating knowLedge and skilLs in AddItive Manufacturing and DRIVES – Development and Research on Innovative Vocational Education Skills.
Furthermore, the project take in general consideration the literature and results produced among the Blueprint action for sectoral cooperation on skills and in addition to the valorisation of the specific SSC in the automotive sector, take into account the results generated by the European Sector Skills Councils set up and funded in the Marine Technologies sector and to the feasibility studies, also related to AM industry, done in the Construction, Steel, Automotive, Chemicals, Furniture, Shipbuilding and Electricity.

10 ESCO is the multilingual classification of European Skills, Competences, Qualifications and Occupations. ESCO is part of the Europe 2020 strategy.

11 Key Enabling Technologies (KETs) provide the basis for innovation in a range of products across all industrial sectors. They underpin the shift to a greener economy, are instrumental in modernising Europe's industrial base, and drive the development of entirely new industries. Their importance makes them a key element of European industrial policy.

12 On 13 September, in his annual State of the Union address, President Jean-Claude Juncker stated: "I want to make our industry stronger and more competitive. The new Industrial Policy Strategy we are presenting today will help our industries stay or become the world leader in innovation, digitisation and decarbonisation." http://ec.europa.eu/growth/content/state-union-2017-%E2%80%93-industrial-policy-strategy-investing-smart-innovative-and-sustainable_en

- Negotiation
- Adaptability

AM skills for KETs

KETs are a group of six technologies: micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies. These technologies are related to the AM and can be found in the following specific aspects of the competences that in some case can overlap with the ICT skills (see below):

- AM machine-specific knowledge
- AM design and optimization
- Manufacture additive parts for production according to **quality standards**
- Manage the effect of processes and materials on part quality and safety and applying **regulations and standards**.

Skills on ICT

Digital skills are nowadays a key competence for all. *The Digital Skills and Jobs Coalition Members Charter*[13], applied by the skillman.eu, promotes a modernisation of the education and training that includes the skills related to:

- digital skills for employability,
- competitiveness and
- participation in society.

skillman.eu introduces these concepts in its review and aims to include the digital skills as an integral part of his results. In particular, the specific skills of:

- coding and
- user skills belonging in particular to the Advanced Manufacturing technology and related, more in general, to the Internet of things, the Robotic, the Big Data, the Cloud Manufacturing, the Advanced Human Machine interface, the Advaced Automation and the Augmented reality.

Green skills

Skillman.eu takes inspiration from existing initiatives[14] and implements a general concept and approach to greening human capital and economy referred to the wider approach to sustainability introducing skills linked to the transition to a circular and greener economy. The skillman.eu approach to green skills requires that the workforce is equipped with technical skills, knowledge, values and attitudes **to develop and support a sustainable social, economic and environmental outcomes in business, industry and the community**.

Skillman.eu considers the green skills as a fundamental for the sustainability deployment and therefore embeds, in its methodological solutions and curricula, the needed skills for green economy and sustainability.

The skillman.eu curricula have to be provided with specific units of learning that make the students apply the knowledge of:

- engineering
- biology and

13 https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/digital_skills_and_jobs_coalition_members_charter_0.pdf

14 From the Dutch perspective for all public vocational training courses, the Netherlands have introduced the so-called optional specialisations (keuzedelen) entitled /Sustainabiltity in the profession/. These optionals can be selected by students at the four different TVET levels of the Dutch TVET system. They focus mainly on the in-company training period and aim at formulating personal improvement opportunities in the field of sustainability, conducting research on sustainability in the company, making a proposal for sustainability improvement in the profession and calculating the revenue. The combination of these activities depend on the level of qualification.
Specific sector related optionals also exist and most qualifications have introduced specific green and sustainability aspects related to the profession. Some sectors (mainly in the technological areas) have started initiatives to support TVET institutions in promoting sustainable craftsmanship, e.g. in the construction sector https://buildupskills.otib.nl/english.

- ecology

through hands-on activities and simulations, to make them able to research and design potential solutions to these true-to-life challenges. The skillman.eu green skills include the **skills to investigate and design solutions in response to real-world challenges related to clean and abundant drinking water, food supply issues, and renewable energy**.

Entrepreneurial skills

Skillman.eu takes inspiration from the European Entrepreneurship Competence Framework[15] to introduce entrepreneurial skills and to apply a logic of progression, as it is described in the EntreComp Progression Model. The EntreComp framework is made up of three main areas that include:

- ideas and opportunities
- resources
- into action

Each of these is in turn made up by a number of competences that, together, are the building blocks of a sense of initiative and entrepreneurship as a competence that skillman.eu introduces to the attention of its stakeholders and experts.

Ethical Skills

Since the Advanced Manufacturing technologies allow individuals to realise extremely powerful and dangerous productions, the Skillman.eu Alliance aims to consider the relevance of the ethical skills that are classified taking inspiration and applying the James Rest's (1983; Narvaez & Rest, 1995)[16] 'Four Component Model'. This model describes the psychological that comprise an ethical or moral action and groups the skills as following:

ETHICAL SENSITIVITY
- Identify the interested parties
- Weigh the possible outcomes

ETHICAL REASONING (Selecting the most ETHICAL action)
- List all possible options
- Make a decision

ETHICAL FOCUS/ MOTIVATION
- Value identification
- Prioritize the action

ETHICAL ACTION
- Judge the feasibility of the chosen option
- Take action
- Follow through
- Reflect

15 BACIGALUPO Margherita, KAMPYLIS Panagiotis, PUNIE Yves, VAN DEN BRANDE, EntreComp: The Entrepreneurship Competence Framework, European Union, 2016

16 Narvaez, D. with Endicott, L., Bock, T., & Mitchell, C. (2001). Nurturing character in the middle school classroom: Ethical Action. St. Paul: Minnesota Department of Children, Families and Learning.
Narvaez, D. & Bock, T., with Endicott, L., & Mitchell, C. (2001). Nurturing character in the middle school classroom: Ethical Judgment. St. Paul: Minnesota Department of Children, Families and Learning.
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