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Skills for Industry: **Curriculum Guidelines 4.0**

Curriculum Guidelines for Key Enabling Technologies (KETs) and Advanced Manufacturing Technologies (AMT)

CONFERENCE REPORT

European conference
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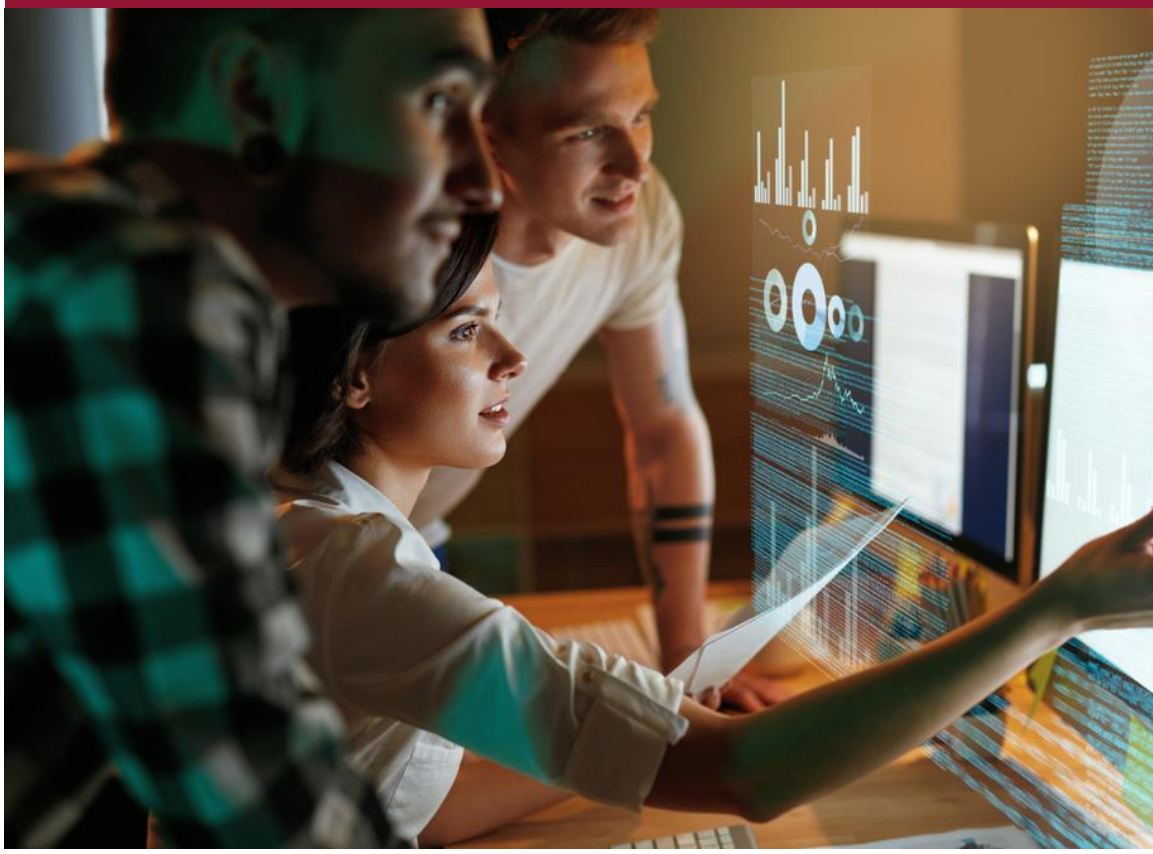

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For further information on this report, please contact:

Dr. Kristina Dervojeda
Project Manager and Senior Expert
Tel.: +31 88 792-3228
Email: kristina.dervojeda@pwc.com

Engagement Partner:
Anton Koonstra
Public Sector Leader PwC NL
Tel.: +31 88 792-3303
Email: anton.koonstra@pwc.com

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Executive summary

This document summarises the key outcomes of the "Skills for Industry: Curriculum Guidelines 4.0" conference. The conference was organised in the context of the "Curriculum Guidelines for Key Enabling Technologies (KETs) and Advanced Manufacturing Technologies (AMT)" initiative of EASME and DG GROW of the European Commission, that is coordinated by PwC. The conference took place in Brussels on 26 November 2019. It brought together policy makers, industry professionals, education & training providers, supporting structures and students.

We live in the New Industrial Age. The manufacturing domain undergoes a profound transformation, driven not only by technological (e.g. Artificial Intelligence, robotics, 3D/4D printing, IoT), but also societal, market and regulatory developments. These developments have fundamental implications for competency requirements, and companies struggle to find the right talent. The current initiative produced the Curriculum Guidelines 4.0 that aim to equip all key stakeholder groups with the knowledge base needed to advance the overall learning experiences of individuals and groups in line with the requirements of the New Industrial Age. The conference brought together the representatives of all key stakeholder groups, to discuss the key principles of the guidelines and agree on the next steps for their massive implementation across Europe. Big picture education, problem-based and student-centric approaches, experiential learning, human-robot interactions, evolving forms of collaboration with industry, peers and community - these and other relevant issues were actively addressed.

The key outcomes of the discussion are as follows:

- The curriculum of today is the society of tomorrow.
- Students need to be prepared for the realities of lifelong learning, which implies providing them with specific tools, techniques and skills needed to continuously advance competencies.
- In order to create lifelong learners, they need to be given responsibility for their own learning process as early as possible.
- Europe needs effective learning eco-systems bringing all key stakeholder groups together for tackling key challenges and developing large-scale solutions.
- Automation can help us take the robot out of the human and enhance our truly human capabilities. Robots can enhance our learning experiences.
- There is a need to shift from a mind-set of human-machine interaction towards human-machine collaboration, and start developing collaboration skills with robots.
- New technologies do not destroy or create jobs, they influence specific tasks that humans perform.
- Future-proof curricula imply developing techno-literacy or understanding of technology and the ability to use it.
- Education needs to be built around learning, not around teaching.
- The role of teachers is to support and facilitate the learning process, and learners need to be given a central role in the education and training processes.
- Curiosity is the main driver of learning, so we need to offer curiosity-driven curricula.
- Creative problem solving starts with creative problem spotting.
- Ergonomics goes far beyond the adjustable chairs, and learners need to be made aware about the effects of technology on their physical and mental health.
- Good leadership implies creating good conditions for people to perform.
- Health and well-being represent a collective responsibility.
- We should stop seeing learners just as users of education & training offers, and instead view them as humans with their own priorities, needs, behaviours and motivations.
- We need to be open to innovation in education methods, but we should not be obsessed with it.
- The importance of informal learning should not be underestimated. Informal learning is often not recognised, while recognition is key for learner's motivation.

1. Introduction

This document represents a conference report for the "Skills for Industry: Curriculum Guidelines 4.0" conference. The conference was organised in the context of the "Curriculum Guidelines for Key Enabling Technologies (KETs) and Advanced Manufacturing Technologies (AMT)" initiative (contract nr. EASME/COSME/2017/004), that is coordinated by PwC EU Services (PwC), under the auspices of the Executive Agency for Small and Medium-sized Enterprises (EASME) and the Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) of the European Commission (the Commission). The conference took place at Thon Hotel EU in Brussels (Belgium) on 26 November 2019. It brought together policy makers, industry professionals, education & training providers, supporting structures and students.

FIGURE 1: Key highlights of the conference

The conference was opened by *Dr. Kristina Dervojeda* and *Prof. Jan Willem Velthuijsen*, PwC (Netherlands).

1.1. *Opening words*: by Prof. Jan Willem Velthuijsen, PwC (Netherlands)

Prof. Jan Willem Velthuijsen addressed the theme of the conference from the economist's perspective.

Getting and keeping as many people at high productivity levels is an excellent way of maximising **welfare**. Welfare here is meant in the economic sense, and refers to the sum of producer and consumer surplus. Staying as close as possible to the moving productivity frontier with the working population is the best hope of achieving the Lisbon objectives of competitiveness, innovation and long-term growth.

The best way, in turn, to optimise productivity is **adequate education**. What is adequate in the era of rapid technological change is subject of intense discussions, as not just the range of jobs will change over time, but the spectrum of competencies itself needed for the majority of jobs will change. Adequate education has to transform from the orthodox classroom-until-20 system to a system of lifelong learning and upskilling.

There is in theory a huge **demand** for lifelong learning and upskilling. However, the demand is latent, and there is no up-to-scale provision system in place. Given the economic imperative of adequate education, there is a clear need for a market for lifelong learning and upskilling. In fact, developing such a system is arguably one of the most important challenges of the EU.

Economic theory suggests that there are at least four types of **stakeholders** that will benefit from the system, and that each have a role to play:

(1) Being adequately educated is, first of all, relevant for the individual herself. It raises the ability to participate in the economic process, contributes to the sense of inclusion, and enhances the potential to earn the means of living. Being and staying adequately trained is therefore a private responsibility, at least to a certain extent. The decision to invest in education is a trade-off between the material and immaterial costs associated with the training programmes and the expected material and immaterial returns.

(2) Having a well-educated workforce is crucial for companies and institutions in order to stay ahead of the curve in the market place. Again, this motivates the responsibility of the employer to invest, and again, the decision to invest is a cost-benefit analysis.

(3) It is good for society if we are all adequately educated. My adequate education adds to higher growth, of which society as a whole benefits. This so-called externality of learning is the first of two important economic arguments for the State to take a certain responsibility.

(4) The fourth stakeholder obviously is the teaching industry, both private and public, as there are business cases to be made out of the developing demand.

A well-functioning lifelong learning and upskilling market does not come into existence automatically, due to a number of so-called **market failures**. Among them are:

- **Myopism** - individuals tend to undervalue long-term benefits of education in their trade-off against short-term investment in time, effort and money;
- **Sub-scale** - provision is scattered and fragmented, and therefore far more costly than necessary. A learning and up-scaling curve needs to be paid somehow by someone;
- **Intransparency** - companies and institutions, especially the smaller ones, face huge search costs in finding the right programmes for their specific needs;
- **Incentive structures** - currently, the funding structures of the orthodox public teaching industry are not designed to incentivise the development of the system with the specific requirements for the future.

These market failures constitute the second reason for intervention by the State, and especially at the EU level.

1.2. *Towards a Skills for Industry Strategy in Europe*: by André Richier, DG GROW of the European Commission (Belgium)

Mr. André Richier thanked PwC for organising the conference and gave a keynote speech to set the scene.

The fourth industrial revolution and the transition to a low-carbon economy are creating considerable stress for traditional sectors and labour market. Europe's workforce of over 270 million people does not fully match the skills needs of the labour market. The World Economic Forum calls for a reskilling revolution. We need to make lifelong learning a reality for all, launch an ambitious industrial policy for Europe and foster new policies in support of SMEs.

The **Skills Agenda** for Europe was adopted in 2016. It included a **Blueprint for Sectoral Cooperation on Skills** - a new approach to mobilise stakeholders from industry, education and employment to implement demand driven sectoral skills strategies in Europe. It is implemented through multi-stakeholder partnerships in key sectors for Europe. It aims to stimulate an efficient use of the European Social, Regional and Investment Funds as well as national resources to support the rollout at national/regional level.

Its pilot implementation (4 Million EUR in total for duration of four years) in started in January 2018, and included Automotive; Space; Tourism; Textile; and Maritime technologies. Additional sectors joined in January 2019, namely Construction; Steel; Additive Manufacturing and Maritime Shipping. The third wave, which will start in January 2020, will include Batteries; Defence; Microelectronics; Energy and Bio-economy. The fourth wave would include Rail supply; Social Economy; Cybersecurity; Software; Blockchain and Cultural Heritage.

The Commission also launched the **Digital Skills and Jobs Coalition**. It has more than 400 members providing more than 11 million digital skills trainings to Europeans, as well as certifications and skills assessment to half a million people. National Coalitions exist in 23 countries, where they create partnerships to work together at national, regional or local level. The Digital Opportunity traineeship provides cross-border traineeships for 6,000 students and recent graduates between 2018 and 2020.

For the period 2021 – 2027, the Commission proposed to create a **Digital Europe** programme and invest 9.2 billion EUR. 700 million EUR are proposed to address advanced digital skills through training courses and on-the-job traineeships. Yet, despite significant efforts being made at all governance levels since 2016, growing skills gaps can be observed emphasising the need for a comprehensive strategy on skills for industry.

Behind the current and future skills gaps lies a changing demand for various skills. The demand for high-tech skills remains on a solid growth track compared to the supply, which remains notoriously insufficient. Employers, especially SMEs, have difficulties to find employees with relevant high-tech skills. It is estimated that the shortage of IT professionals would reach 750,000 in 2020 (Source: Capgemini, empirica and IDC, 2018).

Making projections until 2030 will be a challenge, as a report from the Institute for the Future indicates that many jobs that will exist at that time have not been invented yet. CEDEFOP, the OECD and the World Economic Forum forecast that elementary work, manual, low-skilled jobs, and jobs consisting of routine tasks will decline, while non-manual, and highly skilled jobs will increase.

However, the skills requested by industry are not merely technical. The concept of **T-shaped skills** has emerged, referring to a professional worker having a combination of both general skills across multiple domains and specialist skills within (at least) one domain. Facing the challenges of automation and artificial intelligence, future professionals are likely to be increasingly creative, innovative and entrepreneurial, able of building relationships, advancing research and strengthening their organisations.

Both state-of-play analyses provide multiple examples of initiatives and programmes that support the development of T-shaped skills. Examples of good practices have been initiated at different levels:

- National authorities (e.g. Skillnet Ireland, Luxembourg Digital Skills Bridge);
- Regional and city authorities (e.g. Baden-Wurttemberg, Lombardy, Rotterdam, Helsinki, London);
- Clusters (e.g. Brainport, Silicon Europe), non-profit organisations (e.g. Technofutur, ReDI School of Digital Integration);

- Corporates (e.g. Airbus Engineer of the future, Bosch Centre of Artificial Intelligence, IT vendors Academies);
- Academic institutions (e.g. IMEC Academy, PROMPT) have initiated programmes that proved to be successful.

With regard to the size of the upskilling and reskilling challenge, at first glance, the expenses appear daunting. The World Economic Forum estimates a cost of 24,800 USD (22,500 EUR) per person to retrain displaced workers in the US. Those numbers or even higher costs are realistic for high-tech industries. For large efforts, the expense might drop to 5,000 USD (4,500 EUR) or 10,000 USD (9,100 EUR) per person.

Upskilling and reskilling strategies are crucial for the current workforce. The cost of training is just one element, and not necessarily the most expensive one. To bring someone to a new level of competence — for example, from an accountant to a data analyst — might take nine weeks. During that time, individuals need financial support, and their current job must be covered with a full- or part-time substitute. Skills mismatches have a direct impact on GDP, taxation revenues, and social safety net bill. Financing mechanisms could include individual learning accounts, skills insurance plans and tax incentives for enterprises and employees.

DG GROW is very keen to support small and medium-sized enterprises (SMEs). President-elect Ursula von der Leyen called for a new dedicated SME strategy in her political guidelines. This new strategy will be an integral part of the work towards the greater goal of an economy that works for all. We have already started to prepare this new SME strategy. It will target SMEs of all sizes, i.e. start-ups, scale-ups and traditional SMEs.

Three **key priorities** are:

- An SME-centric approach to policy and regulation, ensuring better and more predictable framework conditions;
- Supporting the SME transition to a greener and digitalised world with incentives and flanking measures;
- Helping SMEs to innovate, grow and expand in a sustainable manner.

The strategy will also help SMEs to transition to more environmentally and socially sustainable business models. SMEs' access to a skilled labour force, ready to face these challenges, will be a core element. There is a clear divide between large companies and SMEs on the adoption of new technologies. For example, only 9 percent of SMEs have adopted Artificial Intelligence so far compared to 29 percent of large companies. For them, cybercrime can have a huge impact: 60 percent of SMEs that were victims of cyberattacks did not recover and had to shut down within six months.

The upskilling and reskilling effort will need to be a **joint responsibility** for industry, social partners, public authorities, and education and training organisations, working together based on a shared vision and in an impactful manner.

The topic will also to be integrated in the preparation of the future EU industrial policy. We launched this year a series of dialogues with the EU Industry Days, the Industry 2030 Roundtable and Strategic Forum for Important Projects of Common European Interest as well as conferences on the Future of Work, Online Training for the Workforce, Skills for Smart Industrial Specialisation and Digital Transformation etc.. Their reports have been released recently. Strategic value chains and ideas for joint or coordinated investments have been identified. These domains include clean vehicles and batteries; low-carbon industry; smart health etc.

Our future European industrial model should also connect economic progress with our values. Essential will be the link with the European Pillar of Social Rights and the UN Sustainable Development Goals. Three **game changers** of a broader European skills strategy for industry would be:

- Supporting industry-led partnerships (involving SMEs) in strategic domains of common European interest to implement large-scale upskilling and reskilling initiatives;

- Introducing some kind of individual learning accounts to address the financial barrier preventing people to get training;
- Simplifying access to relevant investment and funding schemes to maximise the use of public resources.

The skills issue is at the heart of policy challenges facing the European Union. We need to come forward with solutions and keep it at the top of the political agenda.

1.3. *Curriculum Guidelines 4.0: Future-proof Strategy, Collaboration Patterns, Learning Environment and Content*, by Dr. Kristina Dervojeda and Naveen Srivatsav, PwC (Netherlands)

Dr. Kristina Dervojeda first addressed the context and objectives of the Curriculum Guidelines initiative.

Context and objectives

We live in the New Industrial Age. The manufacturing domain undergoes a profound transformation, driven not only by technological (e.g. Artificial Intelligence, robotics, 3D/4D printing, IoT etc.), but also societal, market and regulatory developments. These developments have fundamental implications for competency requirements.

The manufacturing domain relies on **a balance of both technical and non-technical competencies**. Technical competencies can be considered the 'heaviest' category in terms of required knowledge and skills due to a highly knowledge-intensive nature of AMT. However, the competencies needed to successfully operate within AMT go far beyond the technical field and also cover a wide range of non-technical/transversal areas. These non-technical competency areas include competencies related to quality, risk & safety; management & entrepreneurship; communication; innovation-related competencies and emotional intelligence. Most of them are insufficiently addressed or completely missing in the current curricula.

Designing and implementing education & training in the "VUCA" world is quite a challenge. While the term emerged in late 1980s, it becomes increasingly popular among experts, specifically due to its ability to capture the sophisticated dynamics of the current world. VUCA stands for:

- **V**olatility: high speed of change in industry, market and the world in general; fluctuations in demand, turbulence, short time to markets;
- **U**ncertainty: different scenarios are possible, it is difficult to make predictions;
- **C**omplexity: the immense number of factors that need to be taken into account, with a high variety and complex relationships between them;
- **A**mbiguity: a need to deal with incomplete, contradicting or too inaccurate information to draw conclusions.

In order to survive and prosper in the VUCA world, there is a need for a strategic approach towards vocational education, based on the following elements:

- **V**ision: anticipating change; not just predicting but creating the future;
- **U**nderstanding: making informed decisions based on best available data;
- **C**ommitment: investing effort to transform vision into reality;
- **A**gility: adapting efficiently and fast to constantly changing circumstances.

The current initiative aimed to produce the **Curriculum Guidelines 4.0** that would equip all key stakeholder groups with the knowledge base needed to transform the chaotic VUCA (first definition) into the manageable VUCA (second definition).

The initiative was launched in January 2018, by EASME and DG GROW of the European Commission, with a title **"Curriculum Guidelines for Key Enabling Technologies (KETs) and Advanced Manufacturing Technologies (AMT)"**. This initiative aimed to contribute to increasing the quality and relevance of existing curricula and to promote better cooperation between industry and education and training organisations in order to align AMT education and training with the needs of the New Industrial Age. It involved data collection and research, design of guidelines, testing and validation, taking into account industry and market needs and best practices, based on contributions from key stakeholder groups. The guidelines aim to be applicable for both designing fundamentally new educational offers and/or advancing the existing curricula, depending on the level of required change. The initiative focusses on **VET, higher education and on-the-job training for AMT**. The objective is to offer educational and training institutions a source of inspiration, conceptual guidance and good practice examples.

Key outcomes

The **Final Report** presents the key outcomes of the initiative, and covers the activities carried out in the period from January 2018 until December 2019. The report first provides an overview of the latest technological trends and market developments for AMT, and addresses the key needs in terms of skills, education and on-the-job training. Furthermore, it contains a state-of-play analysis with regard to supply and demand of AMT professionals in Europe, the key players in AMT education and training in Europe, as well as the relevant policy initiatives and key publications. The report also provides sample descriptions of good practice curricula, and the key barriers for the successful transformation of the AMT-related education and training system. The report specifically sets priorities for the Curriculum Guidelines 4.0, targeting Europe's education and training providers, and highlighting the key points of attention and good practice examples in the context of education and training for manufacturing in the new age. Finally, the report also offers an overview of the proposed future promotion and implementation activities. The report will be published online in January 2020.

Curriculum Guidelines 4.0

When talking about the curriculum guidelines, there is first a need to have a common definition of the curriculum. In our approach, we suggest to shift from a narrow perspective, viewing the curriculum as a list of subjects to be taught, towards a broader perspective, characterising **the curriculum as the overall learning experience of individuals (and groups) not only in schools, but throughout their professional lives**.

The **target groups** of this initiative are all stakeholder groups that have direct influence on the education and training system at different levels, namely teachers/trainers and learners at a *micro-level* (classroom); managers of educational and training institutions at a *meso-level* (organisation); and policy makers and supporting structures such as, for example, industry associations, cluster organisations and trade unions at a *macro-level* (inter-organisational, national and EU levels). The term "target group" here refers to the stakeholders that this initiative aims to reach as *change agents* for the current education and training system. The initiative follows a holistic approach and aims to address all key stakeholder groups, while specifying roles and activities for each of these groups. This approach acknowledges that in order to effectively tackle the identified challenges, there is a need for all key stakeholder groups to join forces.

In the Curriculum Guidelines 4.0, we aimed to follow a holistic approach covering a broad spectrum of dimensions relevant to curriculum design and implementation. Specifically, the following eight dimensions were considered by the analytical framework:

(1) **Strategy:** defining core values, commitments, opportunities, resources and capabilities of an educational/training institution;
(2) **Collaboration:** promoting practices that move beyond the typical institutional collaboration patterns and engaging individuals and communities;

(3) **Content:** defining the nature of educational content, including specific principles related to the actual content of the curricula;
(4) **Learning environment:** types of environment that is created during the program, e.g. stimulating multidisciplinary orientation, design thinking, team spirit, collective problem-solving, risk-taking behaviour, experimental approaches etc.;
(5) **Delivery mechanisms:** means by which learners experience and access education/training; special attention to technology-enabled learning;
(6) **Assessment:** identifying most appropriate forms of assessment, including advantages and disadvantages;
(7) **Recognition:** exploring appropriate formal and informal ways of recognition;
(8) **Quality:** identifying the determinants of education & training quality: what makes students' and employers' perception different?

Based on the results of the pan-European survey, the four key elements that require the most substantial change include Strategy, Collaboration, Learning Environment and Content.

Strategy

The conceptual principles that were derived for the Strategy element of the framework include:

1.1 **Preparing students for life-long learning**, i.e. making sure the educational offer develops the ability and readiness of students to engage in continuous learning throughout their professional lives;
1.2 **Offering 'big picture education'**, keeping in mind the bigger picture of how the educational offer fits into the overall learning trajectory and labour market;
1.3 Viewing **students as change agents** and actively engaging them in curriculum development and implementation;
1.4 **Shifting from knowledge towards competencies** that students should acquire for their personal development and for employment and inclusion in a knowledge society; adding a dimension of **Mindsets**, e.g. Growth, Innovation, Ethics and Safety;
1.5 Considering not only **market/company needs** (employability), but also **societal needs** (sustainability, ethics) and **learner's needs/individual characteristics** (i.e. respecting diversity of learners' contexts and capacities);
1.6 Ensuring freedom of curriculum goals and learning outcomes from conventional qualification frameworks to offer **relevant personalised & personal learning**.

As examples, multiple programmes and initiatives of Aalto University were presented by *Naveen Srivatsav*, including:

- **Aalto Junior Program** that promotes STEM subjects and supports youth hobbies;
- **Aalto Design Factory** that provides an experiential learning location for students and professionals to interact;
- **Aalto Ventures** that provides entrepreneurship classes and exposure to students.

Another example referred to the **Management Engineering programme at the Politecnico Di Milano**.

Collaboration

The conceptual principles that were derived for the Collaboration element of the framework include:

2.1 Further **increasing university-industry collaboration** in terms of both volume and diversity of collaboration forms (e.g. internships/apprenticeships, mentoring, project banks, think tank competitions, summer schools etc.);

2.2 Acknowledging the role of industry partners as educational, research and employment partners, and ensuring their **engagement in the full student's learning experience**, including strategy development;
2.3 Creating effective **learning ecosystems** that engage all key stakeholder groups, including education & training providers, industry, policy makers, supporting structures and broader community;
2.4 Creating more opportunities for **exchanging experiences with other educational institutions** (e.g. via joint platforms, thematic networks etc.);
2.5 **Facilitating peer-to-peer learning**, to enable students to learn with and from each other as fellow learners;
2.6 Shifting from human-machine interaction **towards human-machine collaboration** as an evolving collaboration form.

As examples, **4CHANGE** (an Erasmus+ funded program) and **Centres of Vocational Excellence (CoVEs)** of the European Commission were presented by *Naveen Srivatsav*.

Learning Environment

The conceptual principles that were derived for the Learning Environment element of the framework include:

3.1 Applying **problem-based learning**, i.e. stimulating students to work on challenging real-life problems for which there are no established answers; encouraging students to contextualise their theoretical learning in relation to how it would be useful in the world around them;
3.2 Instead of focus on standardised thinking, correct answers and objectivity of judgment, creating a learning environment that would **stimulate creativity, forming of own opinion and divergent interpretations**;
3.3 Creating a **culture that accepts potential failures** and developing the ability in students to turn those failures into valuable learning experiences;
3.4 **Stimulating technology-enabled learning**, encouraging the use of technology and software applications for learning, including Massive Open Online Courses (MOOCs), mlearning, gamification, Augmented and Virtual Reality, Artificial Intelligence etc.;
3.5 Creating learning environments that can offer **experiences relevant to real-world working conditions** (i.e. in a physical and/or virtual form, maximally resembling a factory setting, featuring modern and state-of-the-art equipment);
3.6 Encouraging **collaborative learning** by offering suitable physical spaces and virtual platforms for diverse forms of collaboration, including collaboration with peers, industrial partners, community etc.

As examples, the concept of **Teaching Factory** and **the Learning Garage of KU Leuven** were presented by *Naveen Srivatsav*.

Content

The conceptual principles that were derived for the Content element of the framework include:

4.1 **Upgrading the technical side of the curriculum** to accommodate the learning of next-generation robotics, additive manufacturing, smart materials, Artificial Intelligence and machine learning, Internet of Things, predictive analytics, augmented and virtual reality technologies etc.;
4.2 Paying special attention to the questions of **ethics, social inclusion, diversity and sustainability** (e.g. incorporating the Sustainable Development Goals (SDGs) into the curricula);
4.3 Offering a **holistic view of a product and system life cycles**, in which students learn to alternate between the abstract and the precisely detailed, to deconstruct big problems and accept failure and model real-life situations by simplifying assumptions;

4.4 Incorporating **non-technical disciplines** into the curriculum (e.g. communication, project management, arts, marketing etc.), in order to develop cross-cutting competencies and a mind-set beyond technical expertise;
4.5 Teaching students **how to acquire knowledge from the ever increasing 'ocean' of data**, and how to find out what to make of it when it has been found;
4.6 Teaching students to be mindful of their **safety and ergonomics at work**, and specifically about the necessity of maintaining good physical and mental health, and the possible consequences of risk exposure (including what can be done about it).

As examples, the partnership of **Karlsruhe Institute of Technology** with industry technology labs, and **people-centered inter/trans-disciplinary collaboration of the University of Ljubljana** were presented by *Naveen Srivatsav*.

Next steps

In order to achieve impact from the developed Curriculum Guidelines, there is a need to ensure their massive dissemination and the facilitation of their adoption by education and training providers. For that, we proposed a roadmap for the promotion and implementation of the Curriculum Guidelines 4.0.

The key elements of the roadmap include the following:

- After the presentation of key highlights at the conference of 26 November 2019 and the official release of the Guidelines in January 2020 on the EU Publications website, the **first-stage dissemination** will take place in late January 2020 - early February 2020 among the key stakeholder groups and among the coordinators of the key networks/communities.

- The coordinators of the abovementioned networks/communities will be provided with the necessary communication materials and will be invited to disseminate this information among the specific members of their networks by means of newsletters, websites, direct email campaigns and social media. This approach represents the **second-stage dissemination** and allows for ensuring a broad coverage of the targeted audience via familiar communication channels. The second-stage dissemination will take place in February 2020.

- Following the two-stage dissemination campaign, the stakeholders will be encouraged to initiate discussions and exchange opinions via a **dedicated LinkedIn Group**. Furthermore, in order to ensure continuity, we suggest creating a **roundtable/thematic network**, with an objective to facilitate further exchanges of experiences, monitor the implementation and keep updating the Guidelines.

- Specifically, the original version of the Guidelines could be made open for stakeholders in a form of an 'open source' approach, allowing for continuous comments, updates and additions.

2. Models and approaches for the New Industrial Age (Morning session)

The morning session of the conference was continued by the session on models and approaches for the New Industrial Age. The session consisted of five presentations.

2.1. *Scalable approaches to collaborate and learn manufacturing-related skills*, by Bernd Rieth, Festo Didactic (Germany)

Mr. Bernd Rieth addressed the topic of scalable approaches to collaborate and learn manufacturing-related skills.

We live in volatile and increasingly complex world. We have to manage uncertainty at a much higher level than in the past. Digitalisation, AI, new business models, new technologies. Change happens. What has been true for the past, may not be so any more in future. While this transformation takes up speed, we continue to educate young people as we did 100 years ago. As industries, education needs to rethink and maybe disrupt itself to some extend to provide an avenue to the skills for the future.

Clear evidences are visible that this transformation impacts the number and types of jobs available. Those jobs in demand are high-skilled, with much IT embedded. We need to address this change with new and updated VET and Tertiary programs with collaborative learning environments, in cooperation with industries and to be used across our "old-school" systems.

The presentation showed some scalable practical examples on how education & training providers and manufacturing professionals can join forces to foster employment and well-being of industries. Close cooperation between industry and education providers leads to success, including opening schools for the qualification of employees. Further, networking among schools rather than singular school initiatives, applying interdisciplinary approaches including IT and Commercial trades, teamwork and game-based learning approaches in combination with close-to-reality learning factories and digital approaches with digital twins, AR and VR, all contribute to the challenge to educate and employ the 21st Century manufacturing professionals.

2.2. *Education and training models for the "Automation First" era*, by Margareta Chesaru, UiPath (Romania)

Ms. Margareta Chesaru presented education and training models for the "Automation First" era.

There is an acknowledged pressing need to develop digital competences, bridge the skills gap and adopt digital technologies in education. At the same time, the landscape of the educational stakeholders is growing, as companies can contribute to the learning ecosystem through courseware and communities that were not available in the past.

Bringing automation skills to students and the workforce through dedicated programs is part of UiPath's overarching goal to democratise Robotic Process Automation (RPA) and equip people with the skills needed to thrive in an automated world. There is a massive shortage of professionals having the skills and expertise to fully deploy RPA and take advantage of this latest and innovative technology. Furthermore, the skills gap and

skills mismatches may lead to decreased job satisfaction which may trigger lower wages and labor productivity, thus generating a negative effect on economies and the whole society.

Since 2017, more than 400,000 students from 170 countries have joined an online Academy to learn RPA. UiPath Academy[1] offers courses to prepare people for new and exciting, high-paying roles like RPA Developers, Business Analysts, Implementation Managers, and Solution Architects.

The next step is on developing new education and training opportunities at multiple levels, aiming to help the future and current workforce develop new skills and match industries' demand for new roles:

- **Academic Alliance Program**[2]: working with leading higher education institutions, universities, and colleges, we are crafting the global RPA knowledge ecosystem, and shaping the future of work through an inclusive community of academic educators and students;
- **Automation Ready Programs**: partnering with government, non-profits, and professional bodies, we want to ensure every person is Automation Ready through tailored (and free) automation curricula, in-person and remote learning opportunities, while building a community of automation educators.

Furthermore, through the Robot for Every Student initiative, UiPath brings innovation in education by inviting all students to develop their own digital assistants, enabling them to work faster and smarter and conduct research more easily.

2.3. *Rethinking (Higher) Education – why we need a radically different learning concept to educate the digital pioneers of tomorrow*, by Manuel Dolderer, CODE University of Applied Sciences (Germany)

Mr. Manuel Dolderer invited the audience to rethink the approaches of (higher) education and to consider a radically different learning concept suitable for educating the digital pioneers of tomorrow.

Software is eating the world, and digital technologies are changing products, companies, markets, our society. Big data, adaptive algorithms, and the internet of things will only accelerate this change. Whoever wants to **co-create that future**, needs to have a few fundamental competencies: creative problem-solving, collaboration and communication, critical judgment, digital literacy, and an entrepreneurial mind-set.

Yet – we are still relying on outdated educational models when it comes to preparing students for this future. Instead, educational institutions should offer an **inspiring and challenging learning environment**. A learning concept that enables students to develop the competencies mentioned above needs to focus on self-directed and project-based learning in international and interdisciplinary teams embedded in an entrepreneurial environment.

Above all, students need to be able to **re-discover their inner curiosity** as the main driver towards meaningful and successful life-long learning. CODE is a new kind of university that offers such a learning concept – educating the digital pioneers of tomorrow.

2.4. *Teaching students about human well-being and system performance at work*, by Dr. Cecilia Berlin, Chalmers University of Technology (Sweden)

Dr. Cecilia Berlin addressed the topic of human well-being and system performance at work.

1 https://www.uipath.com/rpa/academy
2 https://www.uipath.com/rpa/academic-alliance

It is crucial that Europe's future workforce becomes highly knowledgeable in the capabilities and limitations of the human body and mind, and what each of these requires to perform and thrive sustainably in a multitude of systems.

The current internationally ratified definition of Ergonomics and Human Factors - which according to the *International Ergonomics Association* (IEA) is a ***Systems science and profession,*** whose purpose is to ***"design to optimise human well-being and overall system performance"*** - must be well-understood among the future creators of industrial work and workplaces, to realise the inherent social sustainability of ergonomics, and to lift its potential from mere chair- and equipment- design to an overall, systemic attitude of how all elements in a workplace should interact and function. Only in this way will it benefit not just individuals, but in the long run, all system levels all the way up to society.

While the world of technology is rapidly changing, human capabilities remain a precious resource that must be spent wisely, nurtured and restored. Alongside learning about highly advanced technology, we must ensure each individual's future mastery of the health and performance of their body and mind, to become truly sustainable working humans. To this end, **a thorough understanding of Ergonomics and Human Factors** will be a safeguard for health and performance at all system levels – individual, group, company and society.

2.5. *Data Analyst Full Digital Learning Program*, by Jean-Hugues Rodriguez, Airbus (France)

Mr. Jean-Hugues Rodriquez presented the Data Analyst Full Digital Learning Program of Airbus.

Airbus has released a new **Global Workforce Forecast** (GWF; 2019/2029). The GWF is public since June 2019 to open exchange with anyone willing to contribute. The ambition of the Global Workforce Forecast is to provide all employees with relevant data, information and analysis to better understand, anticipate and prepare the evolution of our company competencies.

The GWF highlights the main challenges Airbus is facing in a volatile, uncertain, complex and ambiguous world worldwide and internal demographic evolutions to better prepare the future workforce; how Airbus competence strategy, in a five year timeframe, is supporting the business strategy by analysing how jobs and competencies are impacted by future evolutions and setting up all necessary actions; and how Airbus manages and enhances HR levers to contribute to company business objectives for today and tomorrow.

The Learning Framework of the **Data Analyst Full Digital Learning Program** consists of the following **elements**:

- Online Community Platform (Data Wiki, Business Problem posts, Communication, Code sharing);
- Practice & Play (Sandbox Environment, Test PoCs, Training Data);
- Theory and practical learning (Data analyst Nanodegree via Udacity online course, including programming (R & Python), Data Structuring, Analytics, Visualisation);
- Coaching and drop-in sessions (skills sharing within the community of data scientists, classroom drop-in sessions to progress on MOOCs, test PoCs etc.);
- Webcasts & top talks (broaden view of data skills and activities within Airbus Group);
- Hackfests (Participate in internal and external hackathons).

The focus was provided on the "**Data analyst Nanodegree**", an Analytics Upskilling programme co-created by our Digital Academy with UDACITY and our learning experts. Entry Test is accessible for everyone in order not to miss suitable profiles. Managers are engaged in the process considering its strategic aspects and level of engagement required for candidates.

We have reached today more than 700 enrolled trainees and more than 490 graduates. Each of them realised around 300 hours of MOOCs plus 40 to 80 hours of project serving a concrete Business proof of concept including social learning events. This approach, easily scalable, will be extended to other emerging skills like Artificial Intelligence.

3. *Policies and initiatives for the New Industrial Age (Afternoon session)*

The afternoon session of the conference consisted of four presentations focussing on promising policies and initiatives for the New Industrial Age.

3.1. *SME future-proof challenge*, by Alexa Joyce, Microsoft (Belgium) and Mark Liedekerken, Open University (Netherlands)

Ms. Alexa Joyce and *Mr. Mark Liedekerken* addressed the topic of SME readiness for the future.

There is a clear need to build a **learning culture**, which implies:

- Introducing digital literacy and foundational skills;
- Equipping learners with industry-relevant, role-based skills to fuel the workforce and address the talent gap;
- Advancing curriculum to better attract/retain learners and reskill institutional staff.

Many SMEs are not yet future-proof, and they risk becoming extinct. SMEs struggle with the topics of cybersecurity, cybercrime, future business, governance and change management, IoT, robots, AI etc. They need assistance with these issues. The objective is to create an **SME helpdesk** where small companies would be supported with advice and funding to tackle the abovementioned challenges.

3.2. *METIS MicroElectronics Training, Industry and Skills: Europe's Newest and Largest Electronics Education Initiative*, by Emir Demircan, SEMI-Europe (Belgium)

Mr. Emir Demircan presented the METIS project.

METIS: Microelectronics Training, Industry and Skills, launched by SEMI and 19 partners from 14 countries, is a new initiative to fill the skills gap and boost workforce diversity by tightening collaboration between the microelectronics industry and education providers. The project will focus on the skills and related training needed to support emerging verticals such as AI, autonomous driving and Industry 4.0.

As a Sector Skills Alliance co-funded by the Erasmus+ Program, METIS is designed to overcome the skills shortage in the electronic components and systems value chain. Under METIS, SEMI and the partner organisations will establish a **Microelectronics Observatory** and **Skills Council** consisting of representatives from industry, academia, NGOs, think tanks and government. The consortium will develop a **New Skills Strategy for the microelectronics industry in Europe** with a focus on raising occupational profiles and skills critical to the future of the sector. The project will boost online education and work-based learning in microelectronics design and manufacturing. METIS will also promote workforce diversity in the sector and target increased participation of under-represented groups in microelectronics education and employment. METIS, a four-year project, will receive 4 million EUR in public funding to be invested in microelectronics workforce development in Europe.

Sector Skills Alliances work to improve skills intelligence and provide a clear strategy in a target sector through a double-barrelled approach of identifying existing or emerging sector-specific labour market needs and enhancing the responsiveness of education and training organisations to industry needs. Sector Skills Alliances are established to facilitate cross-border certification and therefore ease professional mobility and increase recognition of qualifications at European level within a sector.

The METIS consortium consists of SEMI, Infineon, Bosch, X-FAB, Graphenea, Summa, Arcelik, Silicon Saxony, imec, Technical University of Graz, Dresden Chip Academy, University of South-Eastern Norway, Technical University of Sofia, Budapest University of Technology and Economics, IAL-FVG, Fast Track into Information Technology, European Association of Career Guidance, European Association for Women in Science, Engineering and Technology, CIMEA and DECISION.

METIS aims to serve also as a 'testbed' for the Curriculum Guidelines 4.0.

3.3. A European reference framework for STEM Education, by Stephan Griebel, Texas Instruments Education Technology (Germany)

Mr. Stephan Griebel presented the proposal for a European reference framework for STEM education.

Since 2001, the very successful Common European Framework of Reference for Languages (CEFR-L) exists. This framework describes in three levels the degree of proficiency of a learner in a particular language. It is starting with A1 as lowest level and ends with C2 as top expert level. For STEM, however, such framework does not exist. Meaning across Europe there is no common understanding about the differences between basic, independent or proficient understanding for math or physics or computer science etc.

Benefits of such framework could be:

- Facilitating the mobility between school types and school systems, including the mobility between countries;
- Easier acknowledgement of qualifications, including qualifications acquired outside the K-12 school system;
- Stimulating lifelong learning.

The German Math and Science teacher organisation MNU, the International Center for STEM Education ICSE, the professional development network T³ Europe and Texas Instruments as industry partner formed an initiative to promote the adaptation of the CEFR-L concept for STEM: **CEFR-STEM**. The concept is not about concrete curricula, teaching methods or exams. Instead, the focus is about the acquired STEM competencies – ideally attained for lifetime - and their application in social contexts.

The initiative partners recommend forming a representative project team under the sponsorship and supervision of a European organisation with highest educational and political credibility. This project team should develop a first version of CEFR-STEM building on already existing ground work like OECD concepts of math and science literacy, EU frameworks such as DigCompEdu, DigCompOrg, LiFEComp, EntreComp or CoR opinion on Strengthening STEAM education in the EU and other.

3.4. Proposal: multinational EdTech ecosystem for innovating lifelong learning, by Märt Aro, DreamApply/Nordic EdTech Forum "N8" (Estonia)

Mr. Märt Aro presented a proposal for a multinational EdTech ecosystem for innovating lifelong learning.

We need to upskill approximately 200 million people in the next 15 years, focusing on supporting less privileged people. According to Eurostat, between 45–60% of all workers in Europe could see themselves replaced by

automation before 2030. It is estimated that 344 million jobs will need to be created by 2030 in order to address unemployment.

Implementing learning technologies to support people in finding the right learning opportunities and personalise it for them will make the offering significantly more accessible whilst also being economically more efficient, if done right. We anticipate that with an average cost of 100 EUR per person we can achieve the necessary impact, totalling 2B EUR, which is 1000x less costly than traditional education.

To have the solution available in time we need to address the market barriers in delivering such educational services. As a starting point to tackle the issues, we propose to urgently start **a pilot project to develop a model of a multinational EdTech ecosystem for innovating lifelong learning in Europe**.

The focus areas to achieve results include:

- consolidation of learning tools,
- ecosystem development, and
- dissemination of learning tools.

The pilot could start with establishing two learning innovation centres, one in Finland and one in Estonia. The centres would be responsible for:

- coordination of collecting and evaluating learning solutions;
- consultation, mentoring and support of ecosystem stakeholders (incl. learners, policy makers, employers and innovators);
- mapping and development of the learning innovation ecosystem; and
- partnering with stakeholders for dissemination of learning opportunities amongst European employers.

4.Curriculum Guidelines 4.0: How to maximise their impact?

The afternoon session continued with an Expert Panel Discussion moderated by *Prof. em. Roger De Keersmaecker*, RDK Consulting & Coaching (Belgium). The Expert Panel consisted of five experts, representing key stakeholder groups including academia, industry, supporting structures and students themselves. Each expert was asked to briefly reflect on one of the principles of the Curriculum Guidelines 4.0 which they consider as a top priority. The Expert speeches were then followed by a discussion between the experts and the audience.

4.1. *Expert statement by Nina De Winter*, European Students' Union (Belgium)

Principle 1.3: Viewing students as change agents and actively engaging them in curriculum development and implementation

Many educational programs are built on old-fashioned concepts of learning and teaching and much can be done to improve learning experiences and create higher education that is more responsive to contemporary society. Curriculum design can only be brought into practice effectively if both teachers and students are engaged and are aware of what is expected from them. It is where it often goes wrong. Personal example of studying in Ghent: curriculum looks great and innovative on paper, but teachers and students do not have the means and tools to effectively implement it. Students should be central in shaping their curricula in constant dialogue with teachers to enable innovative teaching methods, individual learning characteristics and personal learning. Only this will lead to education that answers to societal needs, innovative teaching methods, social inclusion and sustainable education. Teachers should be supported (with time, money and support systems) to fulfil their new role in de classroom.

4.2. *Expert statement by Gregor Cerinšek*, Institute for Innovation and Development of University of Ljubljana (Slovenia)

Principle 4.4 Incorporating non-technical disciplines into the curriculum in order to develop cross-cutting competencies and a mind-set beyond technical expertise

Understanding people (their values, motivational factors, behaviours, habits and practices) and furthermore, involving people as co-creators of products and services should become an indispensable part of the industrial development process from the very beginning. This requires a shift in understanding and changing the mind-set, it requires rethinking the conventional problem-solution paradigm, and – last but not least – it requires modifications of existing higher education curricula. Study programmes should be designed to take into account key principles of people-centred development; should enhance interdisciplinary collaboration between engineering and social sciences and humanities; and should furthermore enhance cross-sectoral collaboration between universities, companies and broader society so that students are able to apply and test acquired knowledge in practice.

A new kind of a mind-set means that people should not be perceived as passive consumers of the technology, but rather seeing technology as something still unfinished, incomplete and always reshaped by the people (users) who improvise and manipulate with it. **Crucial innovation lies in the ability to understand "what people will do with technology" and not "what technology will do to people"**. The key intended learning outcome should not be the skills to design and develop technologies that will impose a desired behavioural change, neither the skills to create the need for these solutions. The taught skillset and competences should focus on involving people in the very beginning of the product, service, or system

development process – opening-up the innovation opportunities through co-creation with the people and trying to understand how the existing behaviours could be the foundation for the societal and environmental change we aim to achieve. To develop meaningful, desirable, reliable, viable and sustainable products and services, we need a people-centred mind-set that goes beyond pure technical expertise.

4.3. Expert statement by Marcello Urgo, Politecnico di Milano (Italy)

The traditional learning scheme in engineering starts from basic theoretical principles to establish simple models easy to understand and use. Young engineers are supposed to learn how to build a theoretical model, validate and use it, with respect to a concrete but limited engineering problem. Then, engineers would have learned how to exploit these modelling building blocks to address real-size problems through their career.

Today, the distance between these building blocks and the size and complexity of real manufacturing problems is too large to be in charge of the self-learning attitude of young engineers. Data-driven knowledge and empirical models are becoming the only viable solution to this increase in dimension and complexity, but they are also driving the loss of the modelling and theoretical skills for our students.

Future education must follow a twofold approach, teaching theoretical approaches but, at the same time, exposing the students to real-life problems (**3.5 Creating learning environments that can offer experiences relevant to real- world working conditions**), to let them practice with the impossibility of controlling everything in detail, the need of building models mixing theoretical "roots" with data-driven leaves (**4.5 Teaching students how to acquire knowledge from the ever increasing 'ocean' of data**) and, in the end, train them to feel "comfortable" with complexity (**4.3 Offering a holistic view of a product and system life cycles**).

There is also a need for enriching the traditional learning approach for engineering with real-sized industrial cases designed in collaboration with industry, experiencing real manufacturing environments (internship, learning factories, and virtual learning factories).

4.4. Expert statement by Adelaide Almeida, EWF (Belgium)

Principle 1.5: Considering not only market/company needs (employability), but also societal needs (sustainability, ethics) and learner's needs/individual characteristics (i.e. respecting diversity of learners' contexts and capacities)

At EWF, we have the experience of developing harmonised guidelines for training and qualification of personnel regarding emergent manufacturing technologies at European and International levels. Being a private sectoral system, the content of our guidelines has always been aligned with the industry needs and requirements. From our expertise, the relevance and update of the technical side of the curriculum have always been a central part, and therefore our training guidelines established a minimum time devoted to the teaching and assessment of those technical contents.

Nevertheless, and gradually, the paradigm has changed because individuals have different interests/ambitions and must engage in life-long learning to fulfil rewarding careers, also because employers need to invest in up / reskilling their workforce to deal with skills shortages.

Currently, the focus is placed into a combined skills needs approach, meaning that in addition to the market needs (which continue to be the key driver for our harmonised technology-based curriculum aligned with the industry standards), we are committed to address the social needs and individual characteristics. Our guidelines are now being described in terms of learning outcomes, describing clearly what is the expected level of knowledge and skills of the learner after undertaken training. In addition, the curriculum design follows a modular methodology, which enables more flexibility and possibilities for learners to define their own learning path and to upskill themselves within the same Qualification System.

Having learners, training centres and companies speaking the "same language" and using a flexible system is an added value for the quality of the training courses and for the recognition of professionals at national and European levels. That is why the implementation of a learning outcomes and modular approaches into the EWF Qualification Systems in Welding and Additive Manufacturing fields has been one of our core priorities. We have been investing in engaging with all relevant stakeholders to guarantee a change of mind-sets of training providers professional organisations and policy makers.

A massive implementation is possible due to uniqueness of the EWF system, which is linked to its ability to leverage a single syllabus for each level of Qualifications, and a harmonised system for assessment and quality assurance system. It results in the same qualification being awarded by any of the estimated 650 Authorised Training bodies in 46 countries, where the system is currently in use, making this the only harmonised Qualification System in Manufacturing.

4.5. *Expert statement by Giovanni Crisona*, skillman.it/cscs.it (Italy)

Principle 4.2 Paying special attention to the questions of ethics, social inclusion, diversity and sustainability (e.g. incorporating the Sustainable Development Goals (SDGs) into the curricula)

There is a shift from the role of the education and from the role of the religions to the role of the VET in forming the consciences of those who learn. There is also a shift from the human capital theory to its alternative that Gavin Moodie, Leesa Wheelahan, and Eric Lavigne have defined as the human capabilities approach arguing that all qualifications have three roles: in education, in the labour market, and in society.

How can we ensure its massive implementation in practice? The process to identify the right skills ingredients and to define the curricula is not just a business process, and it is not a process that can be restricted to the sole environment of the education, but is instead a **societal project** that needs a large consensus and the interaction at all levels. This process embeds the need to make the learners more conscious and responsible for the future, as the results of the curricula design and implementation are the society of tomorrow.

The CoVEs solution is the most advanced model currently promoted by the EU to design the future of work. It risks to become mutilated if two of the most important ingredients are missing: (1) the embedding of the ethical aspects in the skills settings, and (2) the learners active involvement.

We need a general consensus and agreement and finally, thanks to this kind of settlement among the organisations involved in the CoVEs, it will be possible to combine human needs and growth through the continuous design of the VET pathways. We must be able to make possible:

- Re-engineering of the TVET for Change: rethinking with a bottom up process what is required of TVET to meet workforce and wider societal concerns; and
- Re-engineering of the TVET for society and not only for labour market: adopting a holistic approach to TVET, which includes an ethical dimension.

4.6. *Panel discussion*

Prof. em. Roger De Keersmaecker invited the experts to reflect on some of the statements and offered the audience to ask questions to the panel. The key points of discussion included the following:

- We should stop seeing learners just as users of education & training offers, and instead view them as humans with their own priorities, needs, behaviours and motivations.

- We need to be open to innovation in education methods, but we should not be obsessed with it.

- The curricula need to emphasise the importance of lifelong learning and boost the learners' motivation to advance competencies throughout their professional lives.

- Curricula development starts with the understanding of the future skills needs and finding the consensus around this understanding. There is a need to provoke and source a large debate able to stimulate a relevant interest about the skills anticipation in the manufacturing sector to assign to this activity not only a value for the future of the business, but also for the future of the society.

- We need to create the necessary social conditions, around the argument, to implement an equitable Technology Foresight exercise and to make possible the sector skills anticipation as a society exercise and not as a just business exercise.

- We need to bring the relevant information on future skills to a holistic table that brings together business representatives, academics, researchers and teachers, VET experts and social partners.

- The role of teachers needs to be emphasised, and teachers need to be provided with the right knowledge and tools to be able to implement future-proof curricula.

- The importance of informal learning should not be underestimated. Informal learning is often not recognised, while recognition is key for learner's motivation. Nevertheless, multiple initiatives are currently under development, aiming to enable the recognition of informal learning (e.g. open badges, recognition by peers etc.).

- Acquiring 'foundational skills' is important; however, additionally, learners/workers need to be equipped with an agile learning attitude (and with adequate learning methods & environment), allowing them to acquire additional skills whenever needed. Companies will have to support the 'continuous learning' (also to their own advantage) and governments will have to contribute (also to society's advantage).

5. *Wrapping up: concluding remarks*

Dr. Kristina Dervojeda thanked all the speakers, panellists and participants for their valuable contribution to the conference.

The conference and the release of the Curriculum Guidelines 4.0 may signify the end of the current initiative; however, they also imply the beginning of a complex and challenging process of making sure the guidelines are massively implemented by actors at all levels.

The Final Report of this initiative, once approved, will be published on the EU Publications. The conference participants were invited to explore the report and further disseminate the information about it via their own networks and communities.

Annex A: Conference programme

10:00 – 10:05	**Conference opening** by *Prof. Jan Willem Velthuijsen*, Chief Economist PwC Europe and *Kristina Dervojeda*, PwC (Netherlands)
10:05 – 10:20	**Keynote speech: Towards a Skills for Industry Strategy in Europe:** by *André Richier*, DG GROW of the European Commission (Belgium)
10:20 – 11:00	**Curriculum Guidelines 4.0: Future-proof Strategy, Collaboration Patterns, Learning Environment and Content,** *by Dr. Kristina Dervojeda and Naveen Srivatsav*, PwC (Netherlands)
11:00 – 11:15	**COFFEE BREAK**
11:15 – 13:00	**Models and approaches for the New Industrial Age (Morning session)** • **Scalable approaches to collaborate and learn manufacturing-related skills,** by *Bernd Rieth*, Festo Didactic (Germany) • **Education and training models for the "Automation First" era,** *by Margareta Chesaru*, UiPath (Romania) • **Rethinking (Higher) Education – why we need a radically different learning concept to educate the digital pioneers of tomorrow**, by *Manuel Dolderer*, CODE University of Applied Sciences (Germany) • **Teaching students about human well-being and system performance at work***, by Dr. Cecilia Berlin, Chalmers University of Technology* (Sweden) • **Data Analyst Full Digital Learning Program** by *Jean-Hugues Rodriguez*, Airbus (France)
13:00 – 14:00	**LUNCH BREAK**
14:00 - 15:30	**Policies and initiatives for the New Industrial Age (Afternoon session)** • **SME future-proof challenge**, by *Alexa Joyce*, Microsoft (Belgium) and *Mark Liedekerken*, Open University (Netherlands) • **METIS MicroElectronics Training, Industry and Skills: Europe's Newest and Largest Electronics Education Initiative,** by *Emir Demircan*, SEMI-Europe (Belgium) • **A European reference framework for STEM Education**, *by Stephan Griebel*, Texas Instruments Education Technology (Germany) • **Proposal: multinational EdTech ecosystem for innovating lifelong learning**, by *Märt Aro*, DreamApply/Nordic EdTech Forum "N8" (Estonia)
15:30 – 15:45	**COFFEE BREAK**
15:45 – 16:45	**PANEL DISCUSSION: Curriculum Guidelines 4.0: How to maximise their impact?** by *Gregor Cerinšek*, Institute for Innovation and Development of University of Ljubljana (Slovenia); *Nina De Winter*, European Students' Union (Belgium), *Giovanni Crisona*, skillman.it/cscs.it (Italy), *Adelaide Almeida*, EWF (Belgium); *Marcello Urgo*, Politecnico di Milano (Italy), moderated by *Prof. em. Roger De Keersmaecker*, RDK Consulting & Coaching (Belgium)
16:45 - 17:00	**Wrapping up: Concluding remarks** by *Kristina Dervojeda*, PwC (Netherlands)
17:00 – 18:00	**NETWORKING COCKTAIL RECEPTION**