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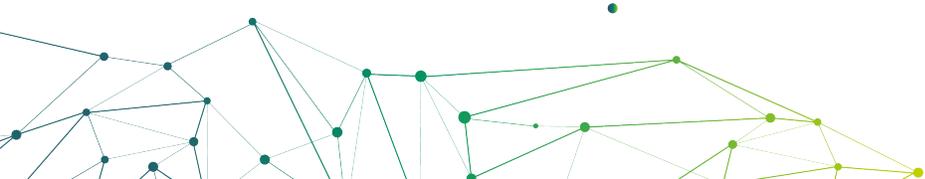
10 Recommendations from the I4MS Working Group of Upskilling challenges in the manufacturing industry

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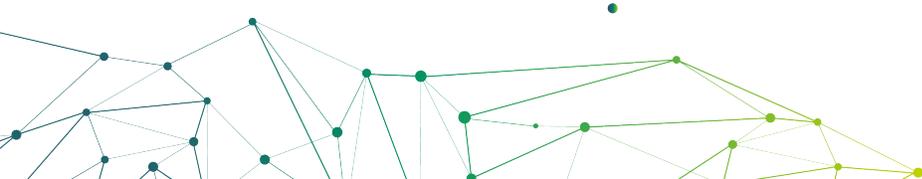
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1. Introduction

Since Europe is facing an unprecedented shortage of IT professionals, the EU's ambition must level up its digital transformation if it is to continue progressing towards the so-called digital decade. Around 20 million is the number of employed ICT specialists that the European Digital Decade strategy wants to reach in Europe by 2030.

What if workers could see the future of work? Would it make any difference in their career pathway? What about the impact of the pandemic on the workforce? Do companies already make a difference by considering workers as valuable assets instead of costs?

The good news is that the future of work is already happening. And yes! Students, workers-to-be, and current workers can already glimpse tomorrow's work market and orientate their career pathways depending on current developments.

Europe has established plans that are ready to fill the gaps and tackle possible crises such as a pandemic. Europe is ready to empower its workforce. Investments and strategy updates are ongoing to ensure workers' concrete and scalable futures. European actions are fundamental to shaping the future of work and ensuring synergies between industries and training centres. The I4MS initiative is just one of these such initiatives that has contributed to reshaping European SMEs by supporting them in their way to digital transformation.

The ten recommendations in this report are a summary of the powerful discussions held during the I4MS Digital skills working group sessions, between 2021 and 2022 and a [literature review](#). By gathering members of the European Commission, experts in the manufacturing sector, and researchers in the field of digital transformation, the I4MS initiative has contributed to enriching the development of essential questions pertaining to the future of education and work.

2. Europe's plans for the future of work

2.1. What does the future of work look like?

Almost €1.9 billion has already been invested by the European Commission (EC) in the future of work under Horizon 2020. According to the EC¹, the future of work, while changing fast, needs to be able to assess the social risks. Therefore, six aspects should be taken into consideration:

- Quality of jobs and employment
- Social protection and next-generation manufacturing
- The intersection of health and employment, and the platform economy
- Inclusive workplaces

¹ https://ec.europa.eu/info/research-and-innovation/research-area/industrial-research-and-innovation/future-work_en

- Reskilling and upskilling
- Human-machine collaboration

Considering these aspects, the European Commission within the industry 5.0 approach is pledging to focus on values that are for the benefit and convenience of each citizen: a human-centric approach. In industry 5.0², the worker is an asset to the company: "The worker is not to be considered as a 'cost', but rather as an 'investment' position for the company, allowing both the company and the worker to develop". Therefore, the employer must be willing to provide the workforce with both training and well-being. Although digital skills training is essential for the manufacturing sector, the vision of training must be enlarged to include more transversal concepts, such as soft skills. Ensuring workforce safety involves not only physical health but also mental health must be considered.

By adopting a human-centric approach, the benefits for the industry are long-term competitiveness and relevance if it can adapt to the many transformations. Another considerable challenge for the industry, according to the EC, is being able to remain competitive while ensuring environmental sustainability; this could be possible with a modern policy framework but also by adopting of the philosophy of doing better with less into the company, especially for the youngest member of the workforce³. Finally, flexibility is necessary for the industry to cope with political shifts, natural emergencies, family dynamics, and health issues.

2.2. Disruption and crisis: detecting challenges and trends

Borders restricting the free movement of people, goods and services, interrupted global supply chains affecting the availability of essential products, and the disruption of demand, restrictions imposed by the COVID-19 pandemic has caused 7 million jobs to be lost or not created in Europe in 2022. According to the McKinsey report (2020), around 24 million jobs, almost 50 percent of the number of jobs displaced through automation, are at risk of displacement due to both COVID-19 and automation. The pandemic has highlighted some of the gaps that were already detected, and accordingly the European Commission emphasized 6 future trends and challenges (2021):

1. **Accelerated automation** is a trend that has already impacted the number of jobs: "Compared with previous years, in 2020, creation of new jobs slowed down while job destruction accelerated".
2. Since the pandemic begun, the **skills gap** has been made more visible than before: "There is an urgent need for digital upskilling of workers, especially in older age groups".
3. 40% of working hours have been paid to employees working from home. Nevertheless, **teleworking as the new normal** seems to not have resolved some negative impacts such as

² https://ec.europa.eu/info/research-and-innovation/research-area/industrial-research-and-innovation/industry-50_en

³ https://ec.europa.eu/info/news/industry-50-towards-more-sustainable-resilient-and-human-centric-industry-2021-jan-07_en

workload and stress levels. Other issues included the software used to track workers' performance or presence: "This kind of monitoring can raise the question of how to strike the right balance between legitimate business interests and the digital privacy of employees."

4. **Platform work** enable organisations or individuals to access other organisations or individuals to solve specific problems or to provide services in exchange for payments, via an online platform or marketplace. The workers on such platforms often suffer from unclear employment status: "The employment status of platform workers is one of the hottest topics in public and policy debates on the platform economy in Europe and appears to be the most important challenge to address."
5. **Rethinking social protection** to adapt it to job reallocation situations: "While temporary and part-time workers are in principle covered in the same way as permanent fulltime employees in most Member States, as long as they satisfy minimum employment periods, workers in less secure forms of employment (such as casual employment, seasonal work or hybrid categories) face greater difficulties in accessing social protection".
6. The **pensions system** should be rethought since demographic changes are to come. European Commission proposes some solutions such as "increasing the statutory retirement age to reflect changes in life expectancy; equalising the pension age for men and women; limiting early retirement and integrating special pension schemes into the mainstream; increasing the employability and participation of older workers, including through life-long learning and active ageing; promoting active labour markets including for older groups; and encouraging private savings".

2.3. Action plans

Multiple European projects are looking at resolving these gaps, for instance the European industrial strategy and the European Pillar of Social Rights Action Plan put the future of work at the heart of their actions.

Targets by 2030



Figure 1 ICT European Targets by 2030

The European industrial strategy ([2020](#)) has been updated to integrate the lessons learnt from the pandemic by focusing on strengthening the resilience of the single market, supporting Europe's open strategic autonomy by addressing strategic dependencies, and accelerating the twin transitions to a green and digital economy: "The strategy includes an SME strategy that aims to reduce red tape and help Europe's SMEs to do business across the single market and beyond, access financing, and help lead the way on the digital and green transitions."

The Commission has set out concrete initiatives to deliver on the [European Pillar of Social Rights](#) to achieve a strong social Europe that is fair, inclusive and full of opportunity in the 21st century. 20 principles have elected to guide the future actions to be adopted⁴:

1. Education, training and life-long learning
2. Gender equality
3. Equal opportunities
4. Active support to employment
5. Secure and adaptable employment
6. Wages
7. Information about employment conditions and protection in case of dismissals
8. Social dialogue and involvement of workers
9. Work-life balance
10. Healthy, safe and well-adapted work environment and data protection
11. Childcare and support to children
12. Social protection
13. Unemployment benefits
14. Minimum income
15. Old age income and pensions
16. Health care
17. Inclusion of people with disabilities
18. Long-term care
19. Housing and assistance for the homeless
20. Access to essential services

⁴ https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/jobs-growth-and-investment/european-pillar-social-rights/european-pillar-social-rights-20-principles_en

3. I4MS initiatives: digitalization of the European manufacturing SMEs

3.1. What is I4MS?

I4MS, ICT Innovation for Manufacturing SMEs, is a European initiative supporting manufacturing SMEs and mid-caps in the widespread use of information and communication technologies (ICT) in their business operations. Under I4MS, SMEs can apply for technological and financial support to conduct experiments allowing them to test digital innovations in their business via open calls.



Figure 2 I4MS Basic Data

The European manufacturing sector includes approximately 2.1 million enterprises generating 31 million jobs and representing about 15% of the EU's GDP¹; within this sector 59% of all enterprises are small and medium-sized enterprises (SMEs). Given that together these companies generate about 45% of the total added manufacturing value, they are an important pillar of the European economy. For Europe to remain competitive internationally, its companies must be able to benefit from digital opportunities.

3.2. The Training Catalogue

The I4MS online training catalogue delivers support to European SMEs on their digitalization process by providing the most in-demand skills in the manufacturing sector, to overall help them remain competitive internationally through the development of the staff in the field.

I4MS

Trainings Catalogue

Find skills you need about in-demand digital skills and training materials about industry 4.0



Figure 3 I4MS training catalogue

Limited access to digital skills is one of the top three constraining factors for digitalization in manufacturing. This project aims to tackle this challenge by presenting a broad selection of trainings focused on upgrading the skills of workers in the industry. The main objective is to create a resource where the interested parties can find information about in-demand digital skills and training materials.

This upskilling consists of guiding SMEs in becoming aware of where and how digital technologies can improve product quality, process efficiency, and business profitability; mastering the deployment and operationalization of digital tools. Digital Innovation Hubs (DIHs) are taking over this role, as they incorporate technological and business competences and have the manpower and capacities required for doing so. Those courses can be applied in a series of vertical industries such as Automotive, Aerospace, Agriculture, Chemical, Computer – Software, Construction, Defense, Education, Research and Development or Energy.



Figure 4 Training catalogue visualization

(Link to the interactive version <https://public.flourish.studio/visualisation/8113683/>)

Each training published provides a summary of the technology in question, the training techniques applied, the channels, the technology absorption cycle phase it targets, target audience, the required instruction level, and an overview of the contents. Having this catalogue will help the European field to determine where and how to plan their skills and competence upgrades.

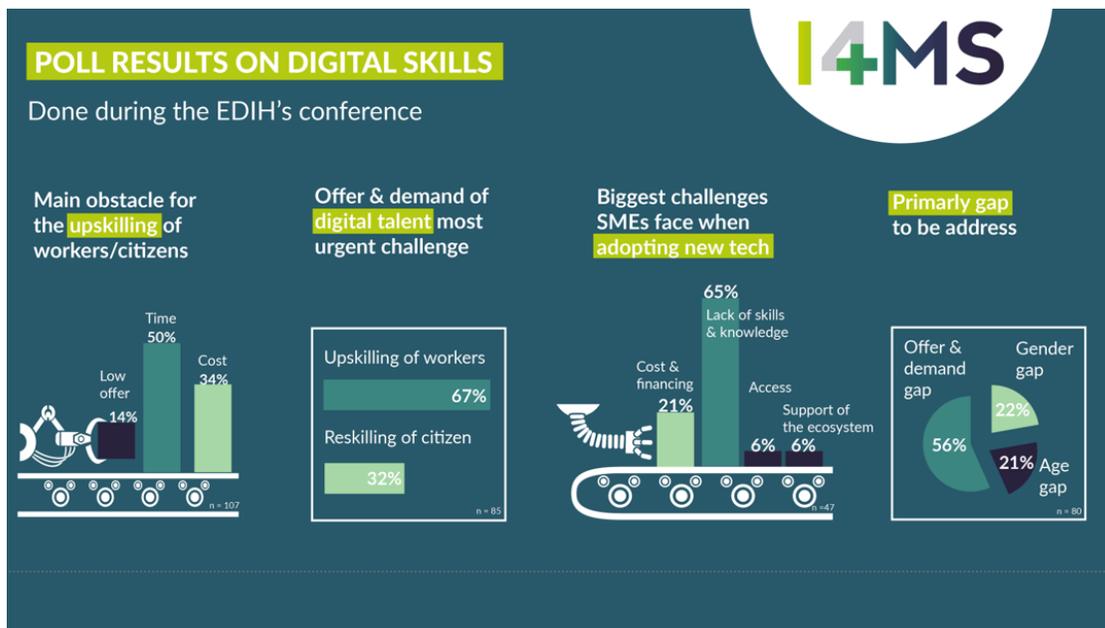


Figure 5 Poll results on digital skills during the EDIH conference

3.3. I4MS Working groups on Digital skills

The I4MS working group on digital skills brought together European experts and SMEs from the manufacturing industry to discuss the future of work.

- To **connect I4MS stakeholders & community** as well as other relevant and interested actors and initiatives from other related projects, etc.
- To **discuss common challenges** as well as on how to overcome the identified **gaps**, both general gaps, affecting the whole ecosystem (for example, upskilling mismatches and support to operational investments) as well as specific ones if possible
- Identify and support **best practices** that have either been discontinued or are only present in specific regions/sectors and should be extended
- To **share the I4MS value proposition** with relevant stakeholders
- To **set up joint strategies to leverage investments** for the benefit of European manufacturing industry
- To **tackle specific challenges** already identified at proposal phase for this phase 4, that specially need to be considered by the manufacturing industry, etc.
- To draw **policy recommendations** that could serve the European Commission as inspiration for the potential launch of new programmes.
- To **ensure the sustainability** of these Working Groups for the community.

Working group 1: The future of work: Digital transformation of employment in the manufacturing sector. The first session was dedicated to show ongoing and future digital skills activities within several projects funded by the European Commission and to explore the challenges to solve the skills gap. World manufacturing Foundation's (WMF) Lead, Scientific and Strategic

Projects, Mark L. Casidsid presented the skills for the future of the manufacturing sector and the recommendations of WMF last report (2020). Nero Su Bianco's Project Communication Manager, Sara Canella introduced to the audience the [Digital Industry Training Atlas](#) which aims is to provide visibility to the training programmes offered in Europe through an accessible, online catalogue. The skills development approach from the I4MS innovation action, AI Regio was explained by Mohammadmahdi Mohammadianghovaghloo and Sergio Gusmeroli from the Politecnico di Milano. The assessment tool from Change2Twin, another I4MS innovation action, was presented by Florence Martineau from Pôle Images & Réseaux.



Figure 6 Illustration of the working group session

The session was followed by a debate on the following upskilling challenges:

- #1 Access to digital skills
- #2 Participation in trainings
- #3 Up-to-date digital skills
- #4 Lack of long-life learning habits
- #5 Uncertainty for engaging in digitalization is cybersecurity.

Working group 2: Towards Industry 5.0: New skill and capabilities. The second session of the I4MS working group (WG) dedicated to skills was focused on the new skills and capabilities needed to adopt industry 5.0 values. Giovanni Crisona presented the Skillman Initiative that aims to reinforce human capital and provide people with the right skills. The Digital Skills and Jobs Platform was explained by European Commission policy officer Jakub Kajtman. Assistant professor Filippo Chiarello from the research group Business Engineering for Data Science of the University of Pisa presented the application developed to measure if and how much the European framework for Skills/Competences, Qualifications and Occupations (ESCO) is aligned with industry 4.0.

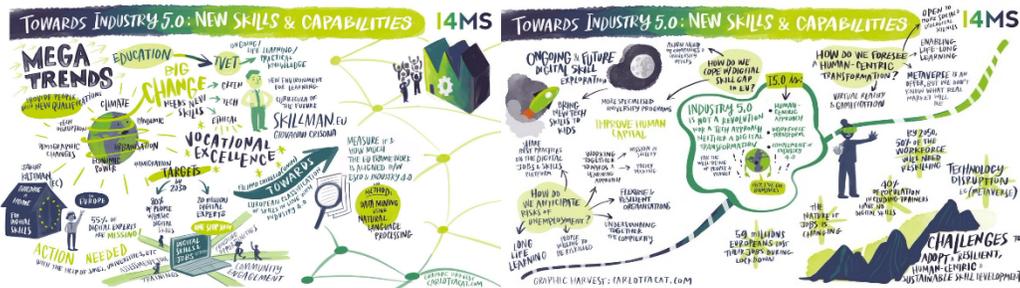


Figure 7 Illustration of the working group session

The second part of the session was dedicated to a debate on the following questions:

- #1 How do we cope with the digital skills gap?
- #2 How do we anticipate the risks of unemployment?
- #3 How do we foresee a human-centric job transformation?



Figure 8 Illustration of the working group session - mural

Working group 3: Upskilling and Reskilling in the manufacturing sector. The third session of the I4MS working group (WG) dedicated to skills was focused on upskilling and reskilling in the manufacturing sector for the adoption of new digital technologies. Silvia Fareri, from Erre Quadro, representing the I4MS Innovation Action (IA) KITT4SME presented a tool called Worker Profiler which is capable of assessing the skills gap of a single worker and define ad-hoc up-skilling and re-skilling training programmes. The trainings and education provided by I4MS innovation action Better Factory were presented by Paula Cervera and César Toscano, from Mobile World Capital Barcelona and INESC TEC, respectively. Tobias Hüsing, Senior Research Consultant in Empirica shared a three-scenario-vision for 2030 on the future of work by presenting the European Commission’s final report Skills for industry (2021). Finally, Inese Podgaiska, the Secretary General Association of Nordic Engineers Denmark, presented the skills and competencies for STEM professionals.

The second part of the session was dedicated to discussing about the following questions:

- #1 What reskilling/upskilling policies and initiatives are active in your countries?
- #2 Is upskilling or reskilling more important?
- #3 What are the risks of not matching the demand and supply?



Figure 9 Illustration of the working group session

4. The future of work in 10 recommendations

The working group sessions have been a fantastic opportunity to gather experts on digital skills and to debate on the future of work. A literature review white paper ([Upskilling challenges of SMEs and the digital skills gap in the manufacturing sector](#)), has been elaborated in order to collect all the relevant publications that have dealt with digital skills. To contribute to the development of the future of work, the discussions and ideas that were debated during those working group sessions have been transformed into ten recommendations (#10R):

1. Skills ontology

Need for the standardisation of everyone to be involved in the digital transformation

“One of the recommendations is to have sectorial skills ontologies to feed into ESCO. This is already working, but it is a good approach that should be further developed” - Tobias Hüsing, Senior Research Consultant in Empirica.

Ontology is considered a subcategory of taxonomy and can be defined as a formal specification. It is designed to delimit and group instances/concepts (facts, events, entities, elements, etc.) based on their common class (types, properties, interrelationships, etc.), thus formalising a full or a subset of a domain. European Skills/Competences, Qualifications and Occupations (ESCO) is in the EC skills dictionary, describing, identifying and classifying professional occupations and skills relevant to the EU labour market and education and training area. It is systematically showing the relations between those occupations and skills.

2. Light house project for skills

Show the impact to motivate your employees

“Re-skilling or up-skilling of shop floor operators is not only about acquiring the know-how, but to try to these operators to gain new insights on the potential application of the technologies”, Cesar Toscano from INESC TEC.

Skills training requires time, effort, investment, and can be especially delicate for SMEs to involve their few employees in a knowledge transfer process. Other barriers mentioned were that as employees age, there can be a lack of information, resistance to change, short-term focus, etc. Therefore, the impact of new knowledge acquisition must be seen by the workforce as a way to motivate themselves and take the path to new career development.

3. Workers as assets

Lifelong learning implemented in companies for all workers

“Lack of life-long learning habits is the most important challenge SMEs face for upskilling their staff”

A culture of lifelong learning must be adopted by SMEs that want their employees to have the knowledge, skills and competences adapted to the market and technology evolution.

The European Commission defined 8 key competences for lifelong learning ([2018](#)): 1. Literacy competence; 2. Multilingual competence; 3. Mathematical competence and competence in science; technology and engineering; 4. Digital competence; 5. Personal, social and learning to learn competence; 6. Citizenship competence; 7. Entrepreneurship competence; 8. Cultural awareness and expression competence.

4. Do it yourself

Self-assessment, implementation of systematic skills evaluation

“The [Digital Skills Accelerator](#) online self-assessment tool provides users with a tailored assessment of their own digital competence level, against the European DigComp framework.”

The European platform [Test your digital skills](#) is at the disposal of all people who wish to test their abilities. This kind of platform helps to create skills standardization, to orientate as to the training to follow to complete a certain education pathway, to discover a learning roadmap, etc.

5. Youth is the future

Taking a modern approach of future-proof vocational education and training (VET)

“We are missing the basics; we have an education system that is still designed for a society that is not anymore existing” - Giovanni Crisona

Data provided by The World Youth Report ([2020](#)), shows that unacceptably high numbers of young people are still experiencing poor education and employment outcomes: “There are presently 71 million young people unemployed, and many millions more are in precarious or informal work”. Nevertheless, in 2030, the number of young people is projected to have grown by 7 percent, to nearly 1.3 billion.

“With Youth 2030, I want the UN to become a leader in working with young people: in understanding their needs, in helping to put their ideas into action, in ensuring their views inform our processes.” These words are by United Nations (UN) Secretary-General António Guterres when presenting ‘Youth 2030: The United Nations Youth Strategy’. The Strategy is aimed at guiding the entire UN system to empower young people to realize their full potential and to stand up for their rights.

2022 has been defined as the [year of youth](#) by the European Commission, with the objective to renew positive perspectives for the young, to support young people at work, and to acquire a better understanding of the various opportunities available to them, as well as promoting said opportunities better to them, and to mainstream youth policy across all relevant Union policy fields.

6. Give your skills recognition

Adopt a micro-credentials system

“To strengthen lifelong learning, the Council is recommending member states to adopt a European approach to micro-credentials and in particular to apply a common EU definition, EU standards and key principles for the design and issuance of micro-credentials” (European Council, 2022)

Due to the future ICT specialists' shortage, the reorganisation of work, and technology disruption, the workforce has to deal with many changes while being flexible and ready to learn new knowledge. A range of platforms, formal and non-formal providers, are available to access innovative opportunities for upskilling and reskilling. Nevertheless, these alone does not allow the new knowledge to be recognised by the whole labour market. According to the Council of Europe, micro-credentials could help certify the outcomes of small, tailored learning experiences. Society and labour market needs would be better fulfilled, and skill gaps could be reduced, since this would allow the workforce to acquire knowledge more flexibly while not replacing traditional qualifications.

The [European Commission](#) will support the implementation of this recommendation by:

- Fostering dialogue on how to use and adapt existing EU tools and services to support the development of micro-credentials by all types of providers
- Supporting the sharing of information and promoting best practices
- Exploring how the Europass platform could support the technical implementation of the Recommendation
- Providing funding support through the Erasmus+ programme

7. Disruption is not the enemy

Be flexible

“Nature of work and skills are changing, and the key is to be flexible and be ready to learn new skills, follow life-long learning, soft skills and be open to new trends. The problem on the management side is the fear of technological changes” - Jakub Katjman

Looking at the future without fearing technology disruption can be difficult to accept since the last decades have been a rollercoaster ride of changes, integration, updates, etc. Furthermore, the pandemic and its restrictions have been quite a challenge for the European industries. With the Ukrainian war, more is about to come: energy shortages, rising prices of primary materials and with it the cost of living, etc.

For Assistant professor Filippo Chiarello, the keyword is complexity: “We (Europe, policymakers, industries, students,) have to find ways to break down the complexity in order to make fast decisions.” Chiarello argued that the digital skills gap means understanding where technology is going and where we can train, and upskill and reskill people to follow or anticipate the changes, as well as drive people. The objective is to translate this evidence into pedagogical actions.

8. Deal with the Green transition

Adopt green deal skills to be in synergy with the green transition of our society

“Encourage businesses and organisations to get involved in the Pact for Skills to help up- and re-skill workers” ([European Climate Pact](#))

To be aligned with the European Climate Pact, and to ensure opportunities for workers, it is vital for SMEs to be ready to reach the green skills objectives: promote and support green employment, address the skilling and reskilling of workers, and anticipate changes in workplaces of the future.

9. Don't be a robot

Soft skills

“Soft skills are essential for how we work together and influence the decisions we take every day and can be more important than hard skills in today’s workplaces” (European Commission)

According to the UNESCO, the Soft Skills (also known as Non-Cognitive Skills) are “patterns of thought, feelings and behaviours” (Borghans et al., 2008) that are socially determined and can be developed throughout the lifetime to produce value. Soft Skills can comprise personality traits, motivations and attitudes and are vitally important for the employability and adaptability of European citizens.

Employees can be ready to improve their soft skills and test them on the [SkillsMatch Platform](#). This online platform assesses and evaluates such skills and recommends different actions to the users in order to reduce the gap between their skills profile and the one needed for their professional opportunities.

10. Be a human

Ethical skills

Artificial intelligence can have an enormous impact on society, especially when dealing with the collection of data and the design of algorithms.

Therefore, ethical skills must be taught. The digital skills jobs platform offers a [free and complete course](#) to be able to talk confidently about the reasons to perform ethical analysis when working with AI, as well as how to identify the ethical and social implications of the technology across sectors.

In 2019, the High-Level Expert Group on AI presented [Ethics Guidelines for Trustworthy Artificial Intelligence](#) and provided a set of 7 key requirements that AI systems should meet in order to be deemed trustworthy.

5. Conclusions: The workers' horizon looks bright

There is no need to emphasize the considerable effort that the European Commission is putting into helping SMEs find their way into digital transformation.

Industry 4.0 has been an essential driver for implementing the most powerful technologies such as digital twins, cyber-physical systems, and cloud computing, which will help transform the manufacturing sector into a more productive and sustainable work environment. Still, the industry must overcome many challenges for companies to explore the possibilities of new processes and business models in depth. One of these concerns employment and skills development.

The human-centric approach is definitively the concept that will give many opportunities for the workforce to become assets for their companies. The industry 5.0 concept is poised to provide workers with the ability to be flexible, to learn new competencies, and most importantly, to feel they are in the right place with possibilities to evolve and reach other career goals.

Europe's plans for the future of work are on their way to empowering the manufacturing sector on a human level. During the last few years, I4MS's initiatives have worked hard to digitalize European manufacturing SMEs and give them the support to explore new opportunities to grow, not only by producing more but also by producing better products with a human-centric approach.

The future of work in 10 recommendations shows the need for workers to obtain an improved vision of the future. They have to be sure that their competencies correspond to the market needs (#R1) by accessing tools to help self-evaluate them (#R4). Lifelong learning training (#R3) must be implemented in companies with a human approach (#R9) and be sure to have in mind challenges involving certain types of technologies (#R10). Nevertheless, workers must understand this investment's impact (#R2), since there are still financial barriers and resistance to change. Flexibility (#R7) is not only to be considered for the workers that will have to learn new skills during their professional pathway, but companies should also carefully listen to megatrends to anticipate new technology disruption and respond to these new needs (#R8). In addition, recognition from companies and educational centres (#R6) is a way to motivate the new generations to embrace careers in the manufacturing sector. Young people (#R5) are not enough valued, and ensuring society understands their needs is the most upcoming challenge to overcome.