EDUCATIONAL PATHWAYS FOR THE AI TRANSITION IN SKILLS AND JOBS

Strategic Report

In collaboration with:

IBM

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January 2025

Strategic Report prepared by TEHA Group for IBM.

The contents of this Strategic Report refer exclusively to the analysis and research carried out by TEHA Group and represent its opinion, which may not coincide with the opinions and viewpoints of the individuals interviewed.

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INTRODUCTION

Artificial Intelligence (AI) is probably one of the most transformative paradigms of the decade and its rise has been characterized by both rapid and wide deployment. Much has been discussed about the potential effects of AI on organizations, for instance in terms of productivity growth (and other benefits for organizations) and job creation/displacement, as well as on society as a whole, such as with regard to the ethical implications of the technology. This study stems from the conviction that these impacts require an evolution in how people work and engage—that is to say in their tasks and jobs—as well as in the skills required to perform these activities, exacerbating already existing skills gaps, especially in tech. However, so far the **role of learning** in managing these changes for workers, citizens and organizations has not been adequately addressed by the literature.

For these reasons, within the development and deployment of AI, the mission of this study is to identify the appropriate **education and training pathways** to promote **inclusive access to education** and address the need to **upgrade skills in the midterm** within a 2030 horizon. The study therefore aims at advancing a skills-based economy as a benefit of improved alignment between education/training, skills, and employers.

More specifically, the goals of the study are:

- Analyze the **evolution of the workforce** up to 2030 in six focus countries (the US, UK, Japan, Germany, France and Italy), both in terms of **demographic trends** and **job dynamics**.

- Study the transformative **effects of AI** on a selection of **key tasks** performed by workers as included in international labor market literature and subsequently on skill sets.

- Assess the **skills to be updated** by analyzing current and perspective **shortcomings** and identifying the potential contribution of **complementary learning pathways**.

The preparation of the study was guided by a **high-profile Advisory Board** that involved **25 external experts**[1] in three meetings and one-to-one interviews to provide guidelines and original ideas for content production, check the progress of the content and coherence with the initial objectives and directions given, act as an expert board to challenge and validate the analysis, and facilitate contacts and relationships relevant to the project.

The experts involved in the Advisory Board meetings and one-to-one interviews:

[1] Experts were selected to ensure adequate representation of the focus countries.

- **Mondher Abdennadher** (Co-founder, Les Napoleons)
- **Daniel Andler** (Emeritus Professor, Université Paris-Sorbonne)
- **Guido Boella** (Vice-Rector and Vice-Chancellor for the promotion of relations with companies and business associations and for coordination with industrial innovation initiatives, Università di Torino; member, Italian government task force on AI)
- **Roberto Calandra** (Professor, Technische Universität Dresden, Faculty of Computer Science, Institute of Artificial Intelligence)
- **Kenji Doya** (Professor at Neural Computation Unit, Okinawa Institute of Science and Technology)
- **Roland Eils** (Bih Digital Health Center at Charité – Universitätsmedizin Berlin, Founding Director)
- **Arisa Ema** (Professor, University of Tokyo; Board Member, Japan Deep Learning Association)
- **Federico Frattini** (Dean, POLIMI Graduate School of Management)
- **Carl Benedikt Frey** (Professor of AI & Work, Oxford Internet Institute, Oxford University; Director, Future of Work, Oxford Martin School, Oxford University)
- **David Gann** (Pro-Vice-Chancellor for Development and External Affairs, Oxford University)
- **Manuela Geleng** (Director for Jobs and Skills, Directorate-General for Employment, Social Affairs & Education, European Commission)
- **Stefania Giannini** (Assistant Director-General for Education, UNESCO)
- **Takashi Ikegami** (Professor, Department of General Systems Sciences, University of Tokyo)
- **Antonio Krueger** (CEO and Scientific Director, DFKI)
- **Pierre-Carl Langlais** (Co-Founder, Pleais)
- **Agostino La Bella** (Professor in the Department of Engineering, Università di Roma Tor Vergata; member, Italian government task force on AI)
- **Justin Nogarede** (Senior Policy Officer, Friedrich-Ebert-Stiftung)
- **Cristina Pozzi** (Co-founder and CEO, Edulia)

- **Scott Pulsipher** (President, Western Governors University)
- **Stefano Scarpetta** (Director of the Employment, Labour and Social Affairs Directorate, OECD)
- **Matt Sigelman** (President, The Burning Glass Institute)
- **Fabian Stephany** (Departmental Research Lecturer in AI & Work, Oxford Internet Institute, Oxford University)
- **Hikaru Ohtani** (Expert, Japan Deep Learning Association – JDLA)
- **Gergana Vladova** (Head of Research Group Education for the Digital World, Weizenbaum Institute for the Networked Society).

From the standpoint of methodology, the key pillars of the study are:

- Analysis of the existing literature on AI and skills, with a detailed analysis of **>80** academic **papers** and international **reports**.
- Construction of the **reference database** linking tasks, jobs and skills for a total of **>23,000 datapoints**.
- Elaboration of an **ad hoc econometric model** to simulate the evolution in job markets, and one model for skill needs.
- Identification and analysis of **>30 case studies and strategies** at national and international level.

As mentioned above, the study is focused on six countries (**the US, the UK, Japan, Germany, France and Italy**) that account for **70%** of the OECD **GDP**, **53%** of the OECD **population**, **54%** of the OECD **labor force** and **61%** of the OECD **value added** of the **industrial** sector.[2] These are **advanced industrial economies** facing significant **demographic and labor market transformations** and, for this reason, offer pertinent case studies on the issue.

The structure of the study is based on the relation between tasks, jobs, skills and education. On the one hand, according to the International Labour Organization and International Classification of Occupations (ISCO), **tasks** are defined as activities and actions performed by one person, **jobs** are sets of tasks and duties, while a **skill** is the ability to carry out the **tasks** and duties of a given **job**. Linked to these are education and training, that is to say, the learning schemes to sustain the **development of skills**.

The present study is structured as follows.

[2] Source: The European House – Ambrosetti elaboration based on OECD and World Bank data, 2024.

The first part highlights the **scenario** of AI and its evolution through the analysis, evolution and adoption trends related to AI, as well as through identification of the overall benefits of AI in the workplace (Chapter 1).

The second part of the study addresses first the evolution in **tasks and jobs** induced by AI through quantification of the current and future distribution of job groups, analysis of the relation between tasks and job groups, and evaluation of the effects of AI on tasks and subsequently on job groups (Chapter 2). Subsequently, the second part focuses on the **skills** required for the evolution in tasks and jobs by analyzing the relation between the evolving tasks and jobs and skills, and by mapping the skills required by the evolution in tasks and jobs induced by AI (Chapter 3).

The third part is then dedicated to the **education and training schemes and pathways available** through the analysis of skills and educational gaps related to digitalization and AI, identification, analysis and in-depth study of currently-available learning schemes, mapping of the training offered in the different educational pathways, and estimation of the workforce to be trained for each educational level (Chapter 4).

Finally, the fourth part addresses the **learning model** required for the AI transition, by mapping the strategies implemented in the fields of jobs, skills, education and training in light of AI evolution, and by identifying policy proposals to favor the optimization of the skill ecosystem (Chapter 5).

The study has been realized by The European House – Ambrosetti in collaboration with IBM. The Working Group of IBM is composed of:

- Lydia Logan (Vice President of Global Education and Workforce Development, Corporate Social Responsibility)
- Claudia Cortes Romanelli (Director, WW Geos & Markets, IBM Corporate Social Responsibility)
- Roberto Villa (CSR Manager for Academia, IBM Europe)

The Working Group of TEHA Group is composed of:

- Lorenzo Tavazzi (Senior Partner, Head of Scenario and Intelligence)
- Francesco Galletti (Senior Consultant, Project Leader)
- Luca Celotto (Consultant, Project Coordinator)
- Chiara Bernabé (Analyst)
- Diego Medagli (Analyst)

EXECUTIVE SUMMARY

AI diffusion is accelerating at global level and skills shortage is emerging as a key issue for companies adopting it

AI diffusion is rapidly accelerating, with global private **investment growing by 134% in the last five years** and **42% of worldwide companies already adopting AI-based solutions**. The expansion of AI will have significant effects not only on the economy, but more importantly, on society. In fact, by 2030, it is estimated that approximately **729 million people worldwide will be utilizing AI tools**, a figure that is about 2.3 times higher than the current 314 million users. However, AI adoption is hindered by a **significant skill gap**, with one-third (33%) of companies globally identifying it as the biggest barrier. Considering the growing importance of AI and the lack of skills, **adapting and updating training** and educational schemes is crucial, as is **introducing targeted strategies** to bridge the gap, since education represents the key to deploying positive AI effects.

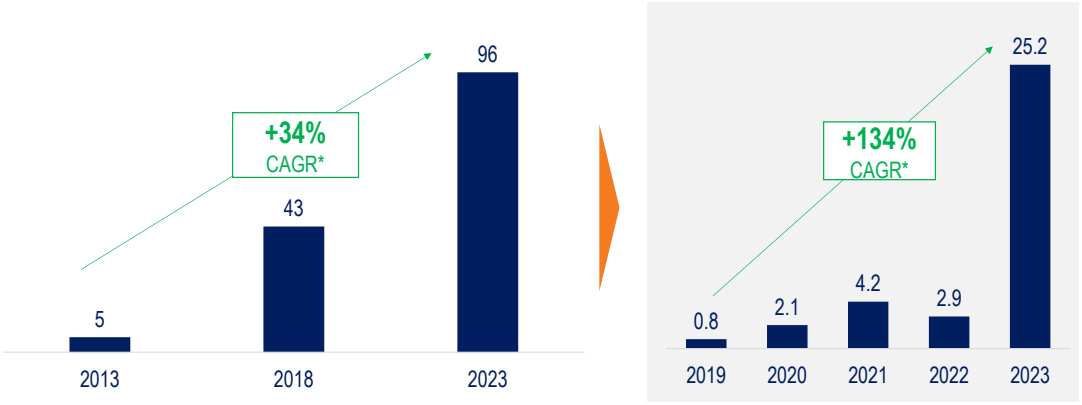

Figure I. Right: Global total corporate investment in Generative AI (billion $) 2019-2023. Left: Global total private investment in AI (billion $), 2013-2023. Source: The European House – Ambrosetti elaboration based on Stanford University Institute for Human-Centered Artificial Intelligence data, 2024. (*) CAGR Compound Annual Growth Rate.

AI adoption can increase productivity in mature economies, but skills mismatch needs to be addressed

The **demographic shifts** occurring in European countries and Japan, with significant declines in their working-age populations by 2030, and in the US and the UK with modest increases of their workforces, present pressing challenges for sustaining economic growth. **AI emerges as a pivotal solution, impacting on average 83% of tasks** across the six major job groups identified (Managers, Professionals, Technicians, Clerical support workers, Service and sales workers, and Plant and machine operators and Assemblers), and it is expected to **enhance productivity by up to 1.5 percentage points**

annually, helping maintain economic stability, particularly in countries facing labor shortages (Japan, France, Germany and Italy). However, the successful integration of AI requires a strategic focus on **reducing the growing skills mismatch**, which currently affects around **50% of workers** in the six economies considered (the US, the UK, Japan, France, Germany and Italy).

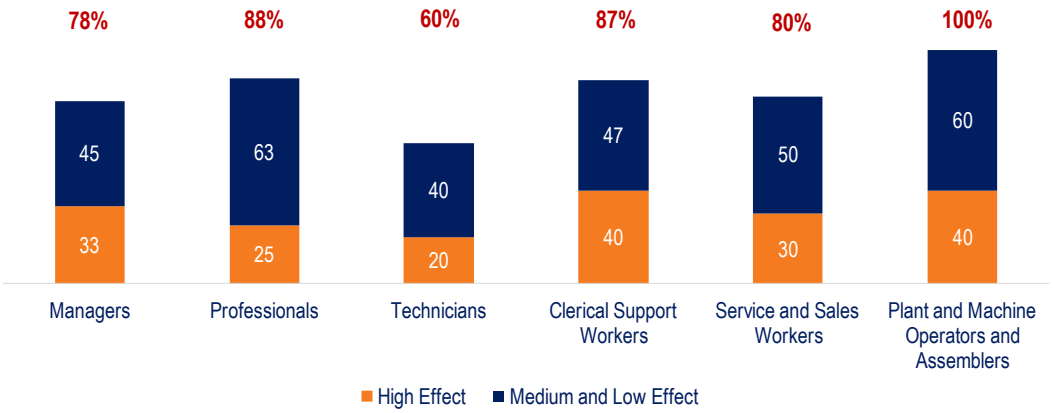

Figure II. Tasks potentially influenced by AI for each job group divided by magnitude of the effect (% of the job's total tasks). Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

Three out of four tasks are going to be augmented by AI, requiring investments in intellectual, technical and social skills

As **jobs** increasingly blend traditional and AI-enhanced tasks, job roles across industries will evolve with many of them **becoming hybrid**. While among the six job groups an average of **21% of routine tasks face automation**, the majority of them will be **augmented** (**79%**), allowing workers to shift toward more complex and creative responsibilities. This transition demands investment, especially in developing intellectual, technical and social skills, with particular emphasis on **digital proficiency and ethical considerations**. Developing these competencies is essential for leveraging AI's full potential while ensuring that economic growth remains inclusive and resilient amid demographic challenges.

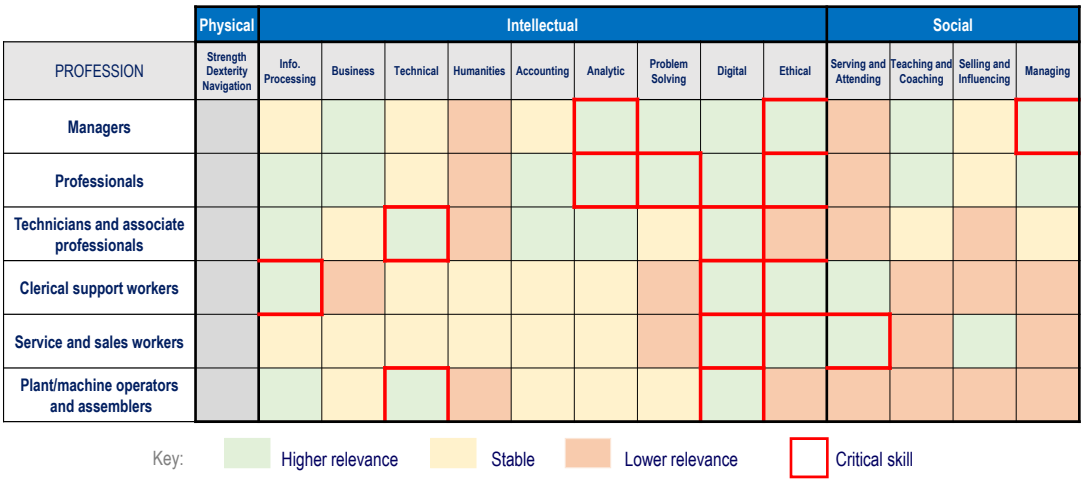

Figure III. Evolution of the relative significance of each skill as of 2030, compared to the current situation for each job group, 2024. Source: The European House – Ambrosetti, 2024.

With 450 million workers needing upskilling by 2030, non-traditional pathways, including online platforms, play a critical role in bridging the skills gap

The rapid integration of AI requires a **comprehensive approach to education and training**. Over **450 million workers in the six countries analyzed will need upskilling by 2030**, including more than 136 million outside traditional academic and corporate paths. While academic courses in AI have expanded, they neglect broader industry needs. In fact, **80% of them remain heavily STEM-focused**, where less than 5% of the tertiary educated people are graduates. **Significant disparities** also exist in training access, especially **between large enterprises and SMEs**, mainly due to high costs and resource limitations. Finally, **non-traditional pathways**, including online platforms, are expanding rapidly, reaching an increasing number of people with different backgrounds and goals, thus playing a **critical role** in bridging these gaps.

Course type	Target	US	Japan	Germany	UK	France	Italy
Academic courses	Students or professionals	104.9M people in 2030 (49.3% of the working-age population)	45.1M people in 2030 (63.0% of the working-age population)	18.1M people in 2030 (34.0% of the working-age population)	21.2M people in 2030 (49.3% of the working-age population)	18.4M people in 2030 (44.4% of the working-age population)	7.6M people in 2030 (21.5% of the working-age population)
Corporate training	Employees	52.4M people in 2030 (24.7% of the working-age population)	9.1M people in 2030 (12.8% of the working-age population)	16.6M people in 2030 (31.2% of the working-age population)	10.4M people in 2030 (24.2% of the working-age population)	3.8M people in 2030 (9.1% of the working-age population)	12.9M people in 2030 (36.4% of the working-age population)
Non-institutional and non-corporate courses	People without access to institutional or corporate training	55.2M people in 2030 (26.0% of the working-age population)	17.3M people in 2030 (24.2% of the working-age population)	18.6M people in 2030 (34.8% of the working-age population)	11.4M people in 2030 (26.5% of the working-age population)	19.3M people in 2030 (46.5% of the working-age population)	14.9M people in 2030 (42.1% of the working-age population)

Figure IV. Targeted population of every educational and training pathway by 2030. Source: The European House – Ambrosetti elaboration based on European Commission, OECD, IMF and various sources, 2024.

Policy proposals to prepare the workforce for an inclusive, AI driven future

Countries are implementing **strategies to enhance AI education and workforce skills**, targeting diverse groups with focused funding. The US emphasizes STEM investment, Japan focuses on ethical AI use in education, and European nations integrate AI into vocational and traditional learning. The strategic integration of AI into education and workforce development involves specific **policy proposals**: establish a **robust AI education framework** that introduces AI concepts across all levels of education, focusing on critical thinking, ethics and problem-solving, while enhancing teacher training and digital infrastructure; advance Vocational Education and Training (VET) and build multiple career pathways related to AI for advancing a skills-based economy and ensuring workers are equipped to effectively use AI tools; **support SMEs with incentives** and clear guidance for AI training, promoting peer learning and easily accessible opportunities to upskill their staff, as well as ensuring business leaders gain AI-related skills; **promote inclusive AI literacy** by creating opportunities for partnerships including with the private sector to increase citizens' access to free and low-cost AI fundamentals courses and by providing flexible government financed schemes such as Individual Learning Accounts to support AI training and life-long learning; create a **trusted credential ecosystem for AI education** guided by standardized national or international authorities, while encouraging collaboration between public and private stakeholders to align strategies and maximize impact. These measures aim to equip the workforce with **future-ready skills** and support enterprises in adapting to AI advancements.

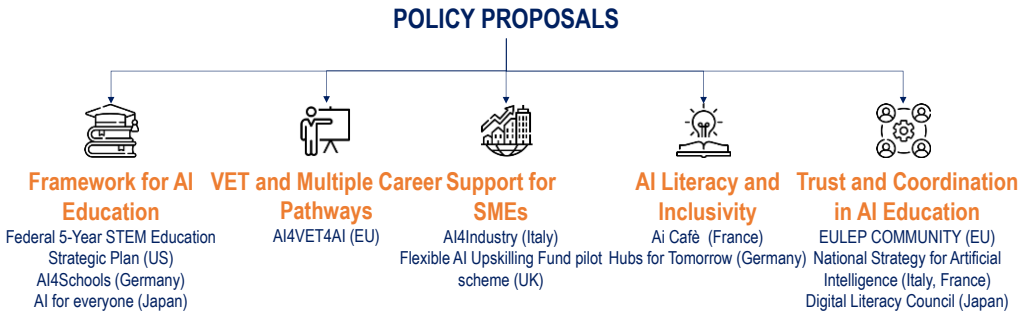

Figure V. The policy proposals and relative strategies that the six focus countries have already implemented. Source: The European House – Ambrosetti elaboration based on various sources, 2024.

CHAPTER 1

The Scenario of Artificial Intelligence and its evolution

The Key Messages of Chapter 1

- *Companies are increasingly investing in AI: **+134% CAGR** in investment related to generative AI in the last 5 years, with about **42%** of global companies that have already deployed AI-based solutions and an additional **40%** that are experimenting with them.*
- *Positive impacts from AI investment are already registered by companies, such as up to **10% higher ROI**, **50%** acceleration in software development and **40%** improvement in worker performance.*
- ***One-third** of companies reports the **lack of skills** as the **biggest barrier** to the successful adoption of AI.*
- *AI users who received training report higher positive impacts in **performance** (**88%** of AI users), **enjoyment** (**77%**), **mental health** (**68%**) and physical health (**69%**) compared to untrained users.*

1.1. Artificial Intelligence from a historical and geopolitical perspective

1. The term "Artificial Intelligence" was used for the first time in 1955 by a group of U.S. researchers led by John McCarthy, but the first publications concerning intelligent systems and machines date back to 1943 (W. Pitts, W. McCulloch) and 1950 (A. Turing). This group of researchers wrote the "**Dartmouth proposal**", considered by the scientific literature the "**year zero** of Artificial Intelligence". However, the development of AI, like that of any technology, has not been linear. On the contrary, it has experienced moments of acceleration accompanied by moments of hiatus.

2. The development process of AI can be easily represented by the **Hype Cycle model**, which describes the **lifecycle of a technology** and the alternation that occurs between initial overconfidence in its operation and the disillusionment that follows when experimentation and implementation of it do not produce the desired results. The **evolutionary path** of AI records a similar dynamic. In the 1960s, U.S. psychologist Rosenblatt created the Perceptron, an **artificial neutral network model** capable of learning from examples and recognizing shapes. However, the model was soon abandoned following criticism of ineffectiveness by two researchers in the field of AI (Misky and Pert). In the 1970s and 1980s, "expert systems"—systems capable of reproducing the mental processes of a human being in a given domain—became established. Again, after an initial period of optimism, strong skepticism prevailed, due to the continuous need for maintenance that such sophisticated systems required. It would be followed, with the same up-and-down trend, by Logic Programming in the 1980s, Fuzzy Logic in the 1990s, the Semantic web in the 2000s and in more recent years by Artificial Neutral Networks.

3. Nowadays "**Artificial Intelligence**", or AI, refers to a **technology** that enables computers and machines to simulate the intelligence and problem-solving ability of humans. As a field of **computer science**, AI includes (and is often mentioned together with) **machine learning** and **deep learning**. These disciplines involve the development of AI algorithms, modelled on the decision-making processes of the human brain, that can "learn" from available data and make increasingly accurate classifications or predictions over time.

4. Currently, AI can perform tasks that would, otherwise, require **human intervention**. The **presence of AI in our daily lives** is represented, for example, by digital assistants, GPS guidance, automated vehicles and a range of other generative AI tools. The success of these platforms led to the **mass affirmation and awareness of Generative Artificial Intelligence**, that type of AI capable of creating text, images, video and audio through algorithms.

5. However, as briefly stated in the previous paragraphs, AI is much more than that. For instance, it can be classified into **two main types**: **Weak AI** and **Strong AI**. Weak AI, also called **Narrow AI**, is trained and oriented to perform **specific tasks**. It is the basis of most of the AI applications used today. "Restricted" might be a more accurate term to describe

this type of AI, as it enables some popular applications, such as Chat GPT, IBM Watson Assistant and autonomous vehicles. On the other hand, **Strong AI** is composed of *Artificial General Intelligence* (AGI) and *Artificial Superintelligence* (ASI). AGI, or general AI, is a theoretical form of AI according to which a machine would have an **intelligence equal to human intelligence**, a self-aware consciousness with the ability to solve problems, learn and plan for the future. ASI, also known as **superintelligence**, would **exceed the intelligence and capabilities of the human brain**. ASI represents the type of AI, still far from being a reality, with the most sensitive **potential and risks**. In fact, as its name suggests, it is an AI capable of **surpassing human intelligence**, combining the capacity for analysis with awareness and autonomy. Within this framework, the present study focuses on Narrow AI, the **only type** of AI that currently exists.

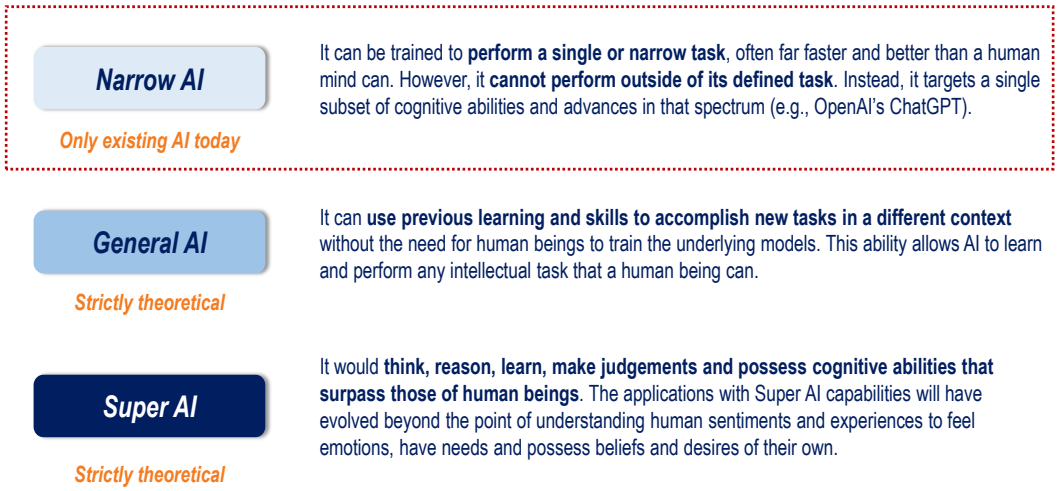

Figure 1.1. Classification of different types of AI. Source: The European House – Ambrosetti elaboration based on IBM data, 2024.

6. Another classification of AI is the one provided by Ca' Foscari University of Venice data scientist Francesco Corea, called the **AI Knowledge Map (AIKM)**. In the representation of this classification there are **two macro-groups** on the axes: **AI Paradigms** and **AI Problem Domains**. **AI Paradigms** (X-axis) are the approaches used by AI researchers to solve specific AI-related problems (includes up-to-date approaches). On the other hand, **AI Problem Domains** (Y-axis) are historically the type of problems that AI can solve. In a sense, it also indicates the **potential capabilities** of an **AI technology**.

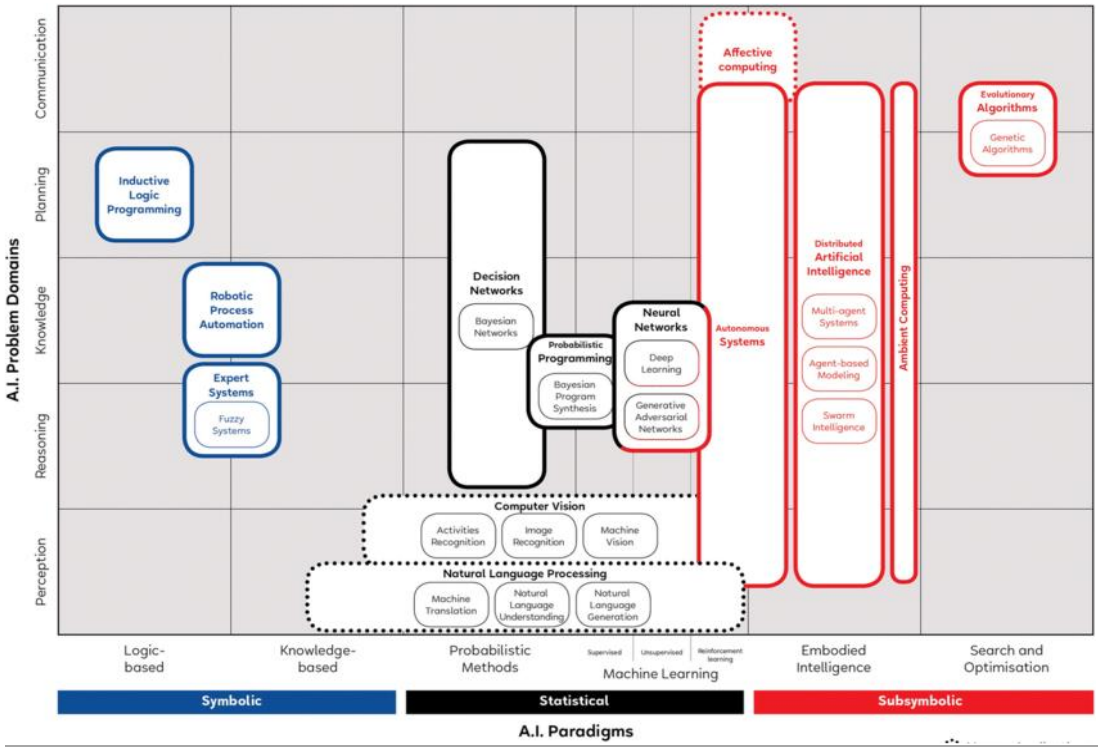

Figure 1.2. AI Knowledge Map. Source: The European House – Ambrosetti elaboration based on Corea F., *AI Knowledge Map: How to Classify AI Technologies* (2019), 2024.

7. Based on this structure, the following **six AI paradigms** have been identified:

   - **Logic-based** tools: tools used for knowledge representation and problem solving.
   - **Knowledge-based** tools: tools based on ontologies and huge databases of notions, information and rules.
   - **Probabilistic methods**: tools that allow agents to act in scenarios with incomplete information.
   - **Machine learning**: tools that enable computers to learn from data.
   - **Embodied intelligence**: engineering tools that assume that a body (or at least a partial set of functions such as movement, perception, interaction and visualization) is necessary for higher intelligence.
   - **Search and optimization**: tools that enable intelligent search with many possible solutions.

8. These **six paradigms** fall into **three different macro-approaches**: **Symbolic**, **Sub-symbolic** and **Statistical**. In short, the **Symbolic** approach states that human intelligence could be reduced to the manipulation of symbols, the **Sub-symbolic** approach is the one that does not involve specific representations of ex-ante knowledge,

while the **Statistical** approach relies on mathematical tools to solve specific sub-problems.

9. The **vertical axis**, on the other hand, indicates the **problems** for which AI was used, and the classification is fairly standard:

    - **Reasoning**: the ability to solve problems
    - **Knowledge**: the ability to represent and understand the world
    - **Planning**: the ability to set and achieve goals
    - **Communication**: the ability to understand language and communicate
    - **Perception**: the ability to transform raw sensory input (e.g., images, sounds, etc.) into usable information.

10. The patterns of the boxes divide the technologies into **two groups**, i.e., **narrow applications** and **general applications**. The two types of lines used in the graph (solid and dashed) explicitly indicate the distinction between technologies that can only solve a **specific task** (generally better than humans—**narrow applications**) and others that solve **more tasks now or in the future** and interact with the world (better than many humans—**general applications**).

11. In addition to the many transformational, organizational, business and educational challenges that Artificial Intelligence will bring about, in recent years, the development of AI has become a **strategic geopolitical issue** for all industrialized countries and emerging economies. The global race to invest in AI is set to shape the **future of society** and the world economy. In fact, AI is a **fundamental tool** not only for the defense of countries but is also capable of conditioning their normal political functions, since it radically changes the **creation and distribution of information**. The content generated by AI will have a strong influence on democratic processes in the future.

1.2. Evolution, adoption trends and benefits of AI in the workplace

12. The global economy is experiencing an **AI-driven revolution**, with predictions of exponential growth in the coming years. In fact, according to Statista's data, with increasing **investments in AI technologies** and the rise of **digital interaction**, the global **AI market**, worth around **$184.04 billion** in 2024, **35% higher** than the previous year, is expected to grow steadily over the next decade to reach **$826.73 billion** by 2030. In addition, AI **market revenues**, globally amounting to **$538.1 billion** in 2023, are projected to exceed **$2.6 trillion** by 2032 with a compound annual growth rate (CAGR) in the period 2024-2032 of **+19%**.

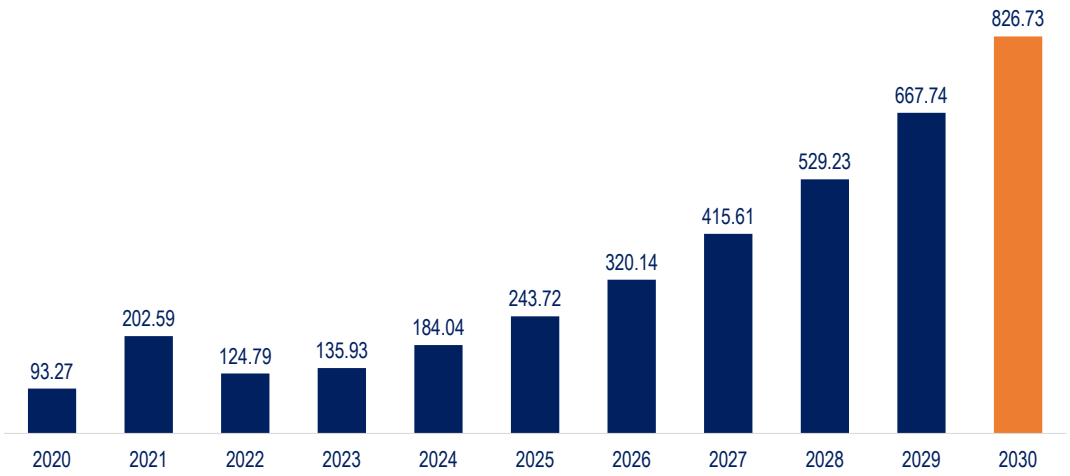

Figure 1.3. AI market size worldwide (billion $), 2020-2030. Source: The European House – Ambrosetti elaboration based on Statista data, 2023.

13. The interest of private companies in AI is seen in the **huge investments** being made. In fact, **companies** are currently investing increasingly in AI: **private investment in AI** has increased from $5.2 billion in 2013 to **$96 billion** in 2023, registering a CAGR over the decade 2013-2023 of **+34%**. Within AI investments, funding for **Generative AI** increased significantly. In fact, in 2023, the sector attracted **$25.2 billion**, almost **9 times** the investment in 2022 and about **30 times** that of 2019. Moreover, Generative AI accounted for **more than a quarter** of all private AI-related investments in 2023 with a **+134%** CAGR, from a value of $0.8 billion in 2019 to **$25.2 billion** in 2023.

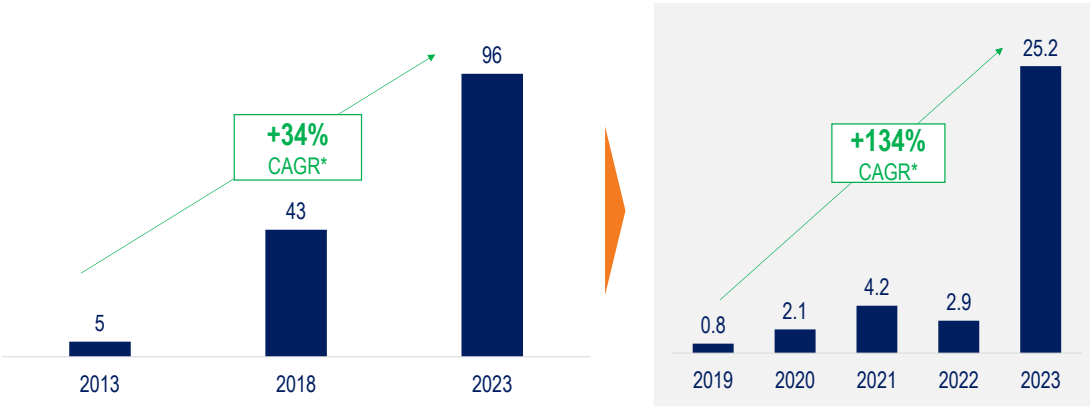

Figure 1.4. Right: Global total corporate investment in Generative AI (billion $) 2019-2023. Left: Global total private investment in AI (billion $), 2013-2023. Source: The European House – Ambrosetti elaboration based on Stanford University Institute for Human-Centered Artificial Intelligence data, 2024. (*) CAGR Compound Annual Growth Rate.

14. As the above data show, the use of AI is becoming increasingly widespread among organizations. However, the spread of AI represents a much broader phenomenon that will have profound impacts not only economically, but also, and above all, socially. In fact, it is projected that by 2030, around **729 million people** globally will use AI tools,

which is about **2.3 times higher** than current levels **of 314 million people**.

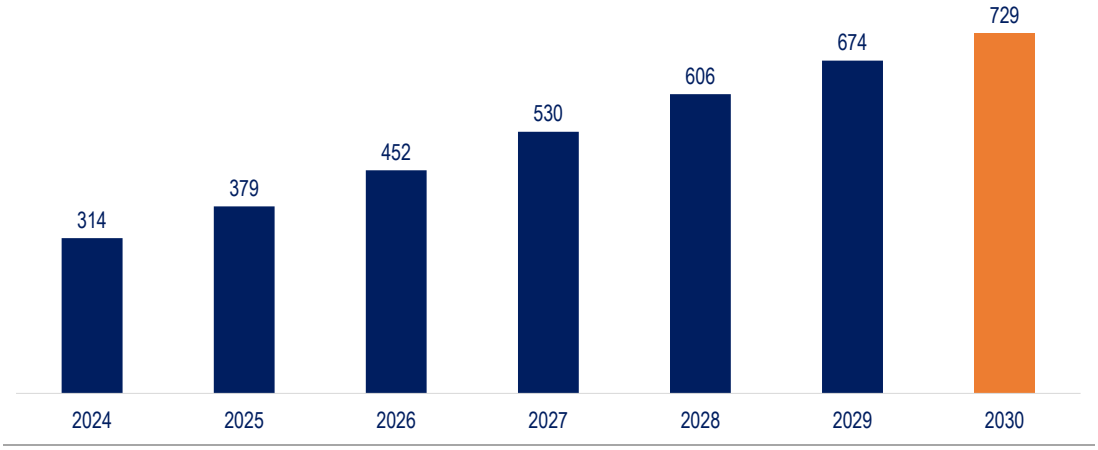

Figure 1.5. Number of AI tool users globally (million), 2024-2030e. Source: The European House – Ambrosetti elaboration based on Statista data, 2024.

15. AI adoption within organizations is driven by the significant **benefits** that are being recorded in different sectors. For instance, by automating repetitive and time-consuming tasks, **AI can increase efficiency** and productivity, allowing employees to focus on more strategic and high value-added activities. Another major benefit is **improved decision-making**. In fact, AI can analyze large volumes of data at unprecedented speed, enabling better business strategies. In addition, **AI enhances the customer experience** by enabling interaction and solutions that are customized to individual preferences and behavior. Overall, AI provides a **competitive advantage** by fostering innovation, improving operational efficiency and enabling more accurate decision-making. The **multidimensional benefits** of AI adoption are already evident for companies such as:

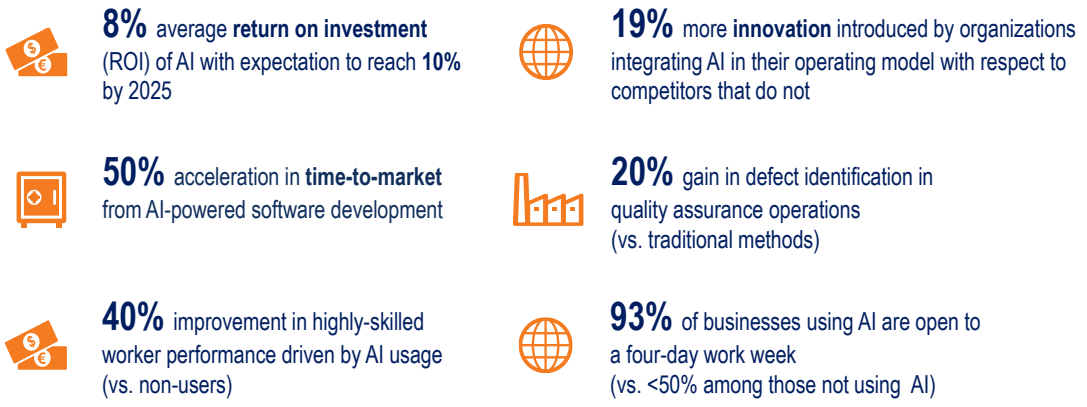

Figure 1.6. The benefits of AI adoption for companies. Source: The European House – Ambrosetti elaboration based on IBM Institute for Business Value and other data, 2024.

16. **AI deployment** will potentially lead to **augmentation or elevation effects** on employment.[3] On average, **87% of executives** expect job roles to be **augmented or elevated**, rather than replaced, by Generative AI. That figure is closer to three-quarters in marketing (73%) and customer service (76%) and **more than 90%** in procurement (95%), risk compliance (94%) and finance (94%). In this context, AI has a strong potential to radically **transform the employee experience**. For example, it can automate simple tasks, allowing people to focus on what they are passionate about or on more **strategic issues**, and create new roles and career paths.

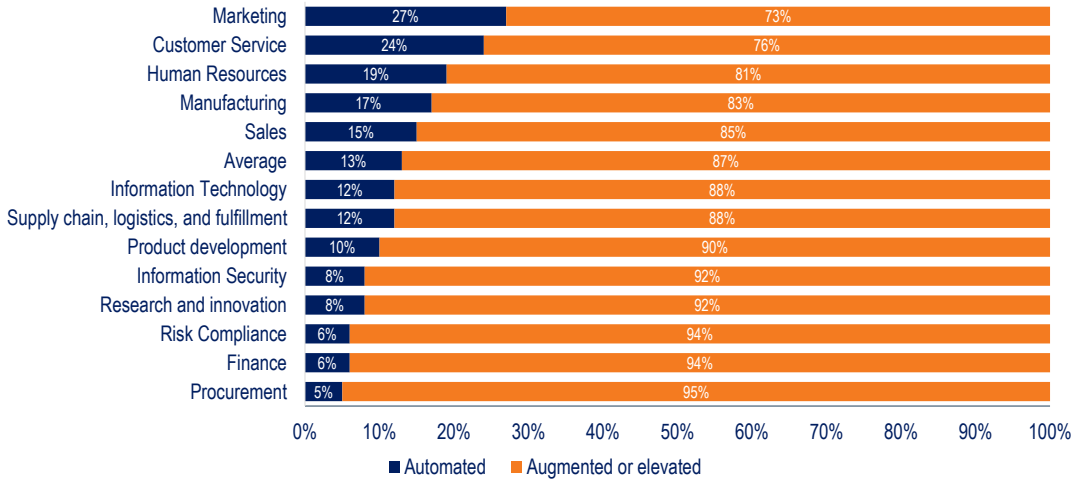

Figure 1.7. The effect of AI on employment according to executives, by function (percentage), 2023. Source: The European House – Ambrosetti elaboration on IBM Institute for Business Value data, 2024.

17. In this context, **education** represents the key to deploying **positive AI effects**.[4] However, **33%** of companies consider the **lack of skills** as the biggest barrier to the **full adoption of AI**. This is followed by: data complexity (25%), ethical concerns (23%), project complexity (22%), lack of tools (21%), high price (21%), lack of use cases (17%), lack of holistic strategy (17%), limited ability to govern AI (17%), locked-in to one vendor (13%) and no obstacles (11%).

[3] "Augmented work for an automated, AI-driven world – Boost performance with human-machine partnerships" conducted by IBM Institute for Business Value Data.

[4] OECD Working Paper "The impact of AI on the workplace: Main findings from the OECD AI surveys of employers and workers", No. 288.

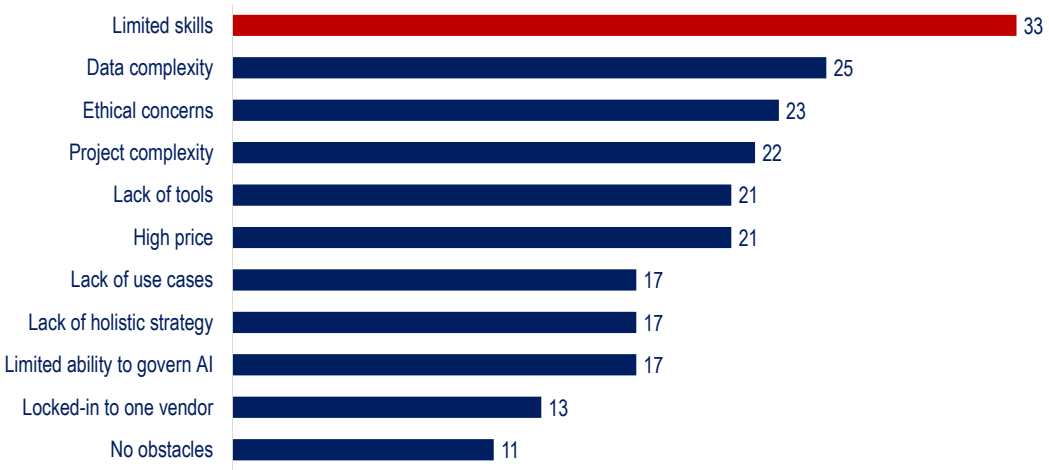

Figure 1.8. Barriers to successful AI adoption reported by companies (percentage of companies currently exploring or deploying AI), 2023. Source: The European House – Ambrosetti elaboration based on IBM data, 2024.

18. In fact, AI users who have received **training** are more likely to report **positive AI outcomes** compared to non-trained AI users. This is true in a variety of work-related areas, such as: **job performance** (88%), **enjoyment** (77%), **mental health** (68%), **physical health** (69%) and **fairness in management** (57%). In the future, therefore, there will be an issue not only of the **ability** to use the technology, but also **awareness** of how to manage it. However, as the survey data show, **training** is crucial for the **future management of AI**, as it provides a better understanding of **how a technology works** and the associated **opportunities** and **risks**.

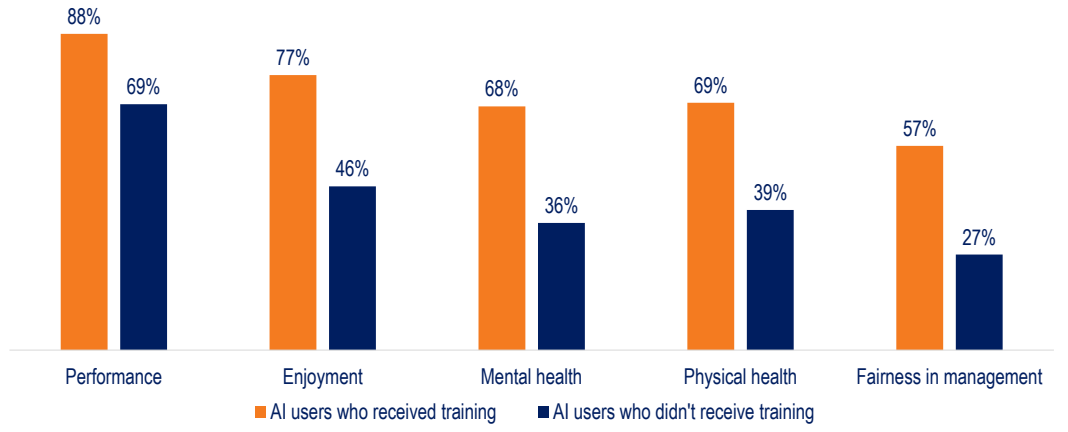

Figure 1.9. Percentage of AI users who think AI has positively changed some work-related aspects (percentage), 2022. Source: The European House – Ambrosetti elaboration based on OECD data, 2024.

CHAPTER 2

The evolution in tasks and jobs induced by AI

The Key Messages of Chapter 2

- *According to UN estimates, **European countries** and **Japan** will see a sharp **decrease** in their **working-age populations by 2030** (on average **-4.6%** with respect to 2023) with Japan experiencing the highest decrease, **losing almost 3.5 million** members of the working-age population (-4.7%) compared to 2023. The **US** and the **UK**, on the other hand, are predicted to see a slight **increase** in their populations (**+0.8%** US and **+0.9%** UK).*
- *AI can be a **tool to sustain economic output levels** for countries experiencing a decline in the working-age population and to **generate additional economic growth** for countries with a growing population.*
- *The **average age of the active population will rise** in all the six countries examined (**+3.2%** on average, from +2.1% in France to +4.5% in Japan), requiring **appropriate strategies** to address the different learning needs of workers.*
- ***Six job groups**, accounting for an average of **79% of the entire working-age population**, have been identified on the basis of the **most significant AI effects**: Managers, Professionals, Technicians, Clerical support workers, Service and sales workers, and Plant and machine operators and Assemblers.*
- *By 2030, according to the historical trends, in the six countries considered the categories of **Managers, Professionals and Technicians** are expected to **increase by an average of 10%**. Over the same period, also the job categories of **Clerical support, Service and sales, and Plant and machine operators** may be impacted, with variations up to 21%.*
- ***52 tasks** identified for the **six job groups** and **AI** can have a potential direct **effect on at least 43 tasks** (**83%** of total), with shares ranging from 60% for technicians to 100% for Plant and machine operators.*

2.1. Quantification of the current and future distribution of job groups

19. The combined effect of **socio-demographic changes** and **technological evolution**, such as that related to AI, is expected to contribute to a significant reshaping in the composition of the workforce and in the nature of jobs. This transformation will emphasize the importance of adaptability and learning. Consequently, understanding demographic trends becomes even more crucial to **anticipate and plan for the evolving demands of the labor market influenced by AI advancements**.

20. The demographic trends observed over the past years, together with the United Nations (UN) projections up to 2030, have highlighted varying outcomes influenced by the **aging of the population**, **the changes in the composition of the working-age** (15-64) **population** and the **dynamics in the labor force**. These trends reveal that countries with an aging population face distinct challenges, including a shrinking labor force and increased pressure on knowledge and skills updating. Conversely, nations with a younger demographic profile or stable working-age population composition tend to experience more robust labor force growth, supporting economic vitality. Understanding these **diverse demographic dynamics is essential for formulating appropriate workforce strategies** and policies tailored to each country's unique demographic landscape.

21. Among the six countries analyzed, **two opposite future scenarios emerge**, that of the European countries and Japan, which are expected to experience a significant decline in their working-age populations by the year 2030, and that of the UK and the US, for which the forecast is a modest increase in their age 15-64 populations over the same period.

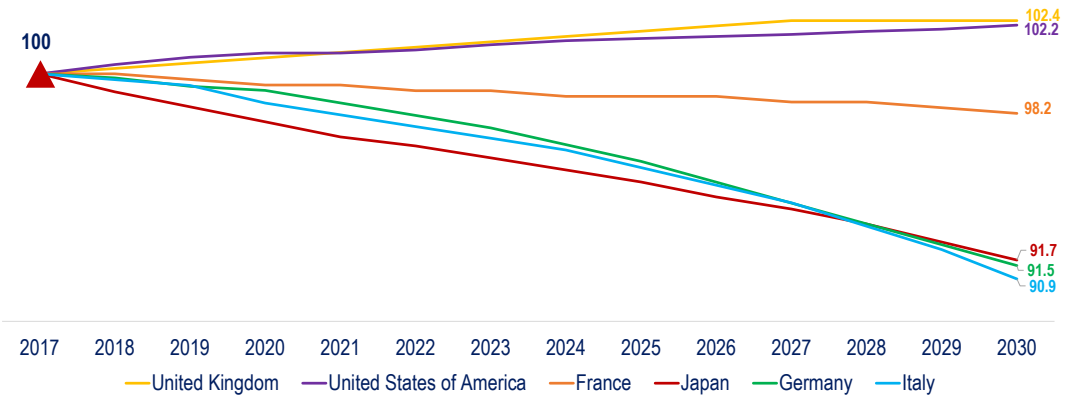

Figure 2.1. Working age population (15-64) trend in the six countries considered (2017=100) (millions of people), 2017-2030. Source: The European House – Ambrosetti elaboration based on UN and IMF data, 2024.

22. In particular, according to UN projections, **France, Italy, Germany and Japan** will witness an **average decrease of 4.6%** in their working-age population compared to 2023, with Japan experiencing the most substantial decline, with a loss of nearly 3.5 million individuals (-4.7%) within the working-age bracket. In contrast, the **United States and**

the United Kingdom will see a modest **increase in their working-age populations** of **+0.8%** and **+0.9%** compared to 2023, respectively.

23. Although both the United Kingdom and the United States are currently experiencing demographic growth, productivity growth in both countries has begun to slow. In fact, between 2002 and 2012, the GDP per person employed grew at a compound annual growth rate (CAGR) of +0.7% in the UK and +1.5% in the USA. On the contrary, in the 2013-2023 period, these countries registered a +0.5% and +1.2% CAGR, respectively. As a result, these countries will require **additional support and strategic interventions to sustain high levels of productivity** and prevent any potential deceleration in their GDP growth rates. Without such measures, the imbalance between population growth and productivity gains could pose significant economic challenges.

24. Overall, both the countries with a decreasing working-age population and those with an increasing one need to **enhance their productivity growth** to counterbalance demographic decline and maintain GDP growth. In particular, depending on their situation, the six countries examined require enhancement of their productivity annually from a low of +0.1% in the case of France, up to a high of +1.5% for the US, with +0.6% for Japan and +0.7% for Germany, Italy and the UK.

25. In this context, **Artificial Intelligence** can serve as a **pivotal tool due to its expected impact on productivity**. In fact, current estimates suggest that on average AI could contribute to productivity increases ranging from an additional 1 percentage point to 1.5 percentage points annually.

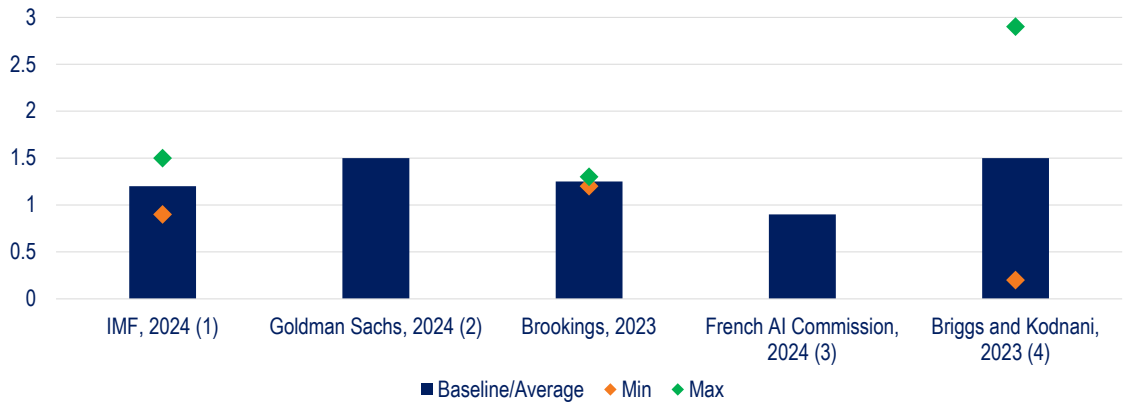

Figure 2.2. Estimated annual impact of AI on productivity growth in the focus countries (percentage points), 10-year horizon, 2017-2030. Notes: (1) In the UK. (2) In developed markets. (3) In France. (4) In the US. Source: The European House – Ambrosetti elaboration based on IMF, Brookings, Goldman Sachs, French AI Commission, Briggs and Kodnani, OECD and other data, 2024.

26. Among the age 15-64 population, the evolution over the years and the potential impact of AI have been analyzed specifically for the workforce subgroup, which entails all those **people who are actively engaged in the working environment**, either actually working

or actively looking for a job, excluding students, retired people and individuals who, for various reasons, are not available or are not actively seeking work. In the six countries highlighted, the evolution of this sample follows the working age population trend almost linearly.

27. The workforce itself can be divided into the **active labor force and unemployed individuals**. This distinction makes it possible to analyze the two groups separately according to the recorded trend up to 2023 and their growth trajectory by 2030 in accordance with the forecasts provided by the International Monetary Fund (IMF). The study outcomes demonstrate a critical perspective for all the six countries examined.

28. Although two of the six countries will experience an increase in the labor force in the coming years, all of them will experience an **overall aging of the labor force** by 2030, and up to +2.1 years in Japan, which already has the oldest population (47 years) among the countries.

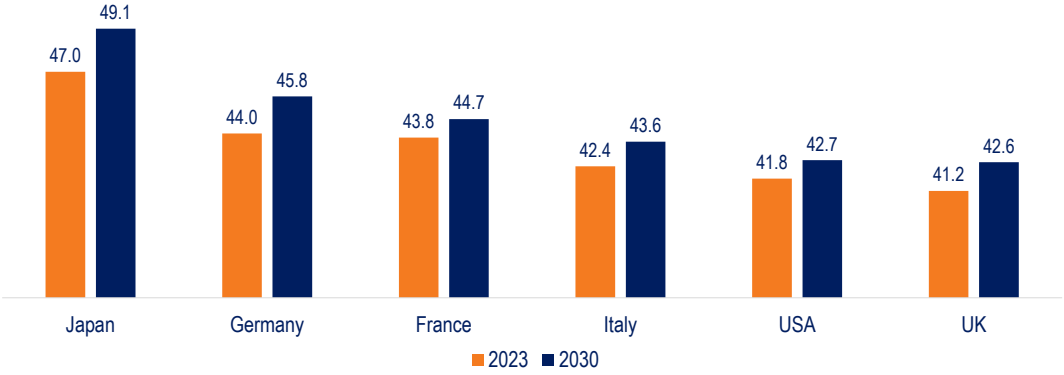

Figure 2.3. Average age of the workforce in the six countries examined (age), 2023, 2030. Source: elaboration The European House – Ambrosetti on various sources, 2024.

29. In addition to the demographic challenges associated with an aging labor force, both **Italy and the United States** face projected **increases in unemployment rates** by the year 2030. Specifically, Italy is expected to see an increase of 1 percentage point, while the United States anticipates a rise of 0.4 percentage points. Conversely, the remaining four countries are forecast to experience marginal decreases in their unemployment rates over the same period.

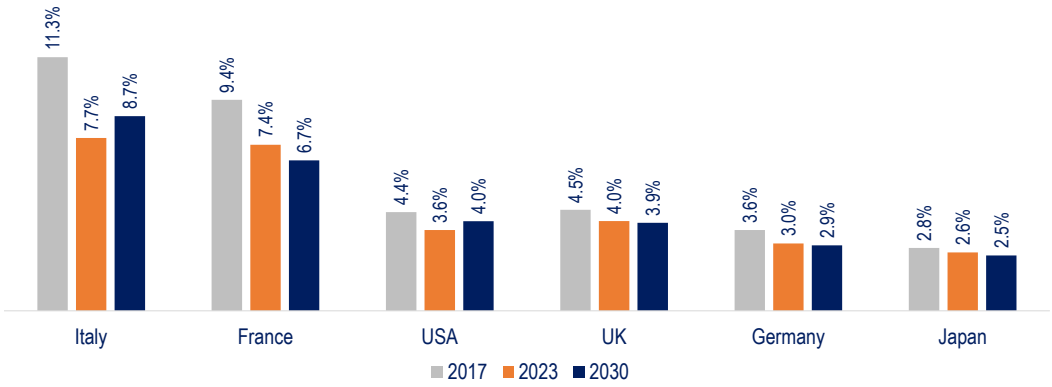

Figure 2.4. Unemployment rate in the six countries examined (% of total workforce), 2017, 2023, 2030. Source: The European House – Ambrosetti elaboration based on UN and IMF data, 2024.

30. Overall, the socio-demographic outlook for the six reference countries presents various levels of risk and concern due to several factors. The main issues include a shrinking working-age population, an aging workforce and rising unemployment. Given these internal challenges, existing literature suggests that **AI could serve as an effective tool to mitigate productivity losses and counteract the resulting slowdown in GDP growth**. To thoroughly understand the potential effect of AI on the labor market, it is essential to **identify which professions could be affected by the digital evolution**.

31. However, the **effect of AI** on the workforce is not uniformly distributed across all sectors and, in fact, **varies significantly depending on job categories and the specific tasks performed daily by each job group**. For instance, occupations involving routine and repetitive tasks are more susceptible to automation. In contrast, jobs requiring complex problem-solving, creative thinking, human interaction and interpersonal skills are more likely to be directly affected by AI technologies in terms of enhancement. Consequently, **understanding the varied effects of AI on different segments** of the workforce is crucial for **developing targeted strategies** that address the specific needs and challenges faced by various job groups.

32. Of the ten job groups identified by the International Labor Organization (ILO) classification, this analysis focus on six specific categories and their sub-categories, accounting for an average of **79% of the entire working-age population**, on which the **strongest AI effect** is expected. The selected job categories, along with their relevant sub-categories, are as follows:

    - **Managers** (chief executives, senior officials and legislators; administrative and commercial managers; production and specialized services managers; hospitality, retail and other services managers): they oversee and evaluate organizational activities, and develop and review policies and regulations.

    - **Professionals** (science and engineering professionals; health professionals; teaching professionals; business and administration professionals; information and communications technology professionals; legal, social and cultural

professionals): they advance knowledge, apply scientific or artistic theories, teach systematically, or combine these activities.

- **Technicians and associate professionals** (science and engineering associate professionals; health associate professionals; business and administration associate professionals; legal, social, cultural and related associate professionals; information and communications technicians): they perform technical tasks related to research, applying scientific or artistic concepts, operational methods and regulations.

- **Clerical support workers** (general and keyboard clerks; customer services clerks; numerical and material recording clerks; other clerical support workers): they manage information by recording, organizing, storing, computing and retrieving it, while also handling clerical duties related to money, travel and appointments.

- **Service and sales workers** (personal services workers; sales workers; personal care workers; protective services workers): they offer personal and protective services for travel, housekeeping, catering, personal care or security, and demonstrate or sell goods in shops, stalls and markets.

- **Plant and machine operators and assemblers** (stationary plant and machine operators; assemblers; drivers and mobile plant operators): they operate and monitor industrial and agricultural machinery, drive and operate vehicles and mobile equipment or assemble products.

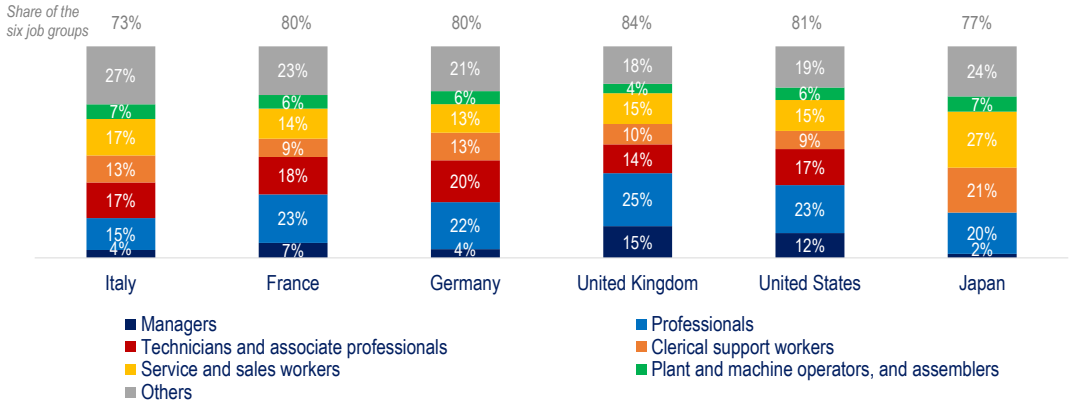

Figure 2.5. Share of total jobs in the six groups of jobs analyzed in Italy, France, Germany, the UK, the US and Japan (% of total), 2022 (last available data). Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

33. An analysis on the labor force composition in 2022 for each of these six countries was conducted, along with a study of the trends in the incidence of each labor category within the total labor force from 2017 to the present. These trends, combined with United Nations population growth estimates and with the IMF unemployment rate evolution

estimate, made it possible to **project the workforce composition up to 2030 and identify potential significant transformations within each country**.

34. Overall, according to the historical trends, in the six countries examined, the job categories of **managers and professionals will increase** by an **average of 10%** by 2030, while, in the same period, the job categories of **clerical support and service and sales** may be impacted with variations **up to 21%** by 2030.

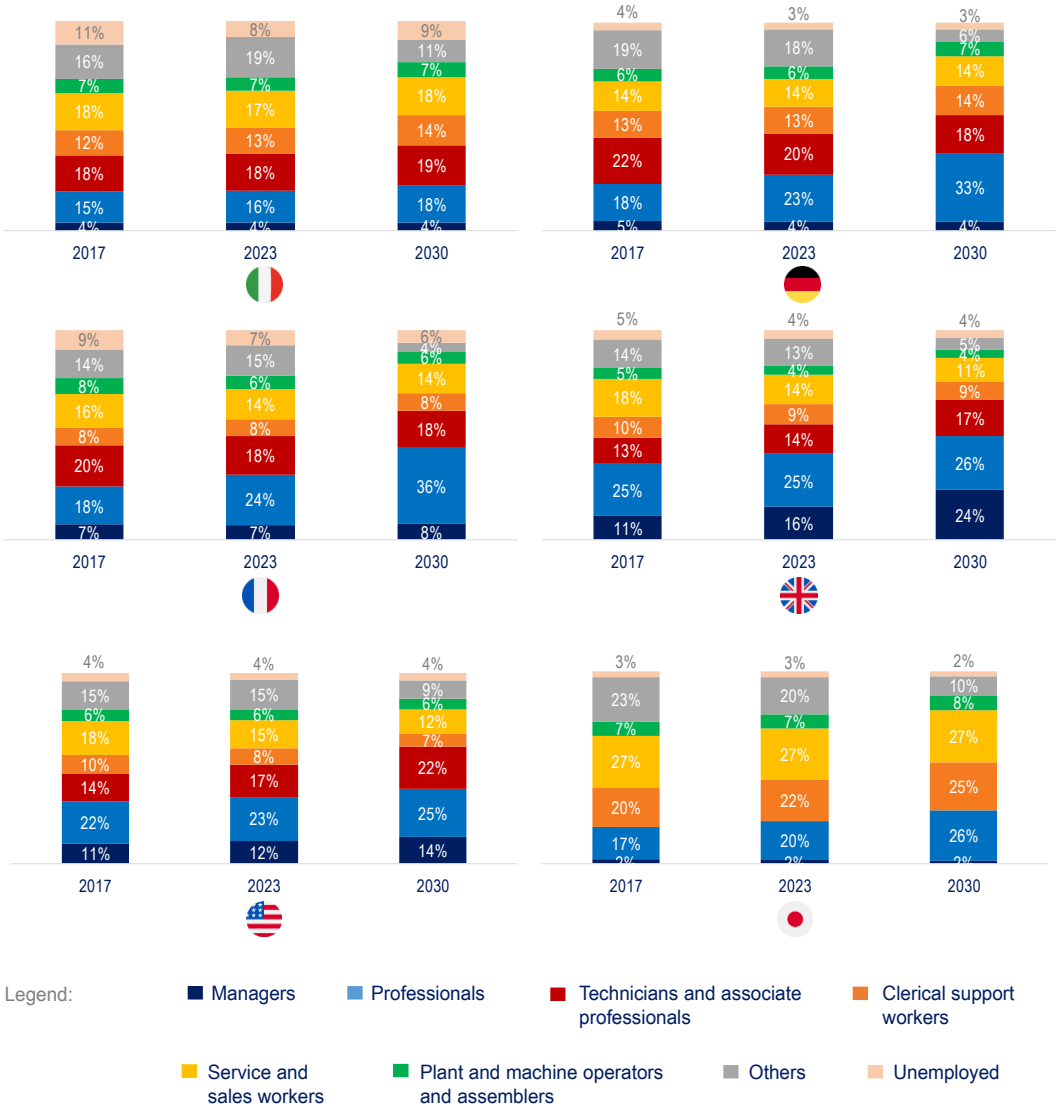

Figure 2.6. Workforce by job category in Italy, Germany, France, the UK, the US and Japan (% of total population), 2017-2023-2030. Source: elaboration The European House – Ambrosetti on ILO, IMF, Eurostat and UN data, 2024.

2.2. Analysis of the relation between tasks and job groups

35. After defining the evolution of job categories and workforce composition in the six focus countries, an analysis was conducted on the **tasks performed by each job group** to

identify the nature and extent of **potential AI effects by 2030**. Drawing on a literature review, international databases such as ILO, and expert input, **54 distinct tasks across the six job groups** were identified. The analysis was aimed at comprehending the transformative impact of AI on these tasks (e.g., high, medium, low or no effect depending on the magnitude and the severity of the effect and the areas of competence covered). Consequently, these effects will lead by 2030 either to **automation**, where machines predominantly perform human tasks, or **augmentation**, where humans and machines collaborate closely without complete task replacement.

36. For the job group of **Managers**, the ILO database has identified **nine distinct tasks**, some of which encompass multiple actions. Among these tasks, **AI is anticipated to impact on seven**, with **three expected to experience a significant effect**. Specifically, the task of "ensuring appropriate systems and procedures are developed and implemented to provide budgetary control" could be fully automated by AI, given its capability to analyze large volumes of financial data, automate accounting tasks, monitor corporate expenses and generate financial reports. Additionally, AI ability to analyze occupational health data and predict potential health and safety risks will significantly influence the task of "ensuring compliance with health and safety requirements". Lastly, the repetitive nature of "planning and directing daily operations" makes it suitable for optimization and streamlining through process automation and decision support by AI. Overall, **AI has the potential to affect 78% of typical managerial tasks**, with **one task being fully automatable** through digital evolution.

TASK	EFFECT	NATURE OF PREVALENT EFFECT
Formulating and advising on the policy, budgets, laws and regulations of enterprises, governments and other organizational units	◑	Augmented
Establishing goals and standards and formulating and evaluating programs and policies and procedures for their implementation	◑	Augmented
Ensuring appropriate systems and procedures are developed and implemented to provide budgetary control	●	Automated
Authorizing material, human and financial resources to implement policies and programs	○	-
Monitoring and evaluating performance of the organization or enterprise and of its staff	◑	Augmented
Selecting or approving the selection of staff	◔	Augmented
Ensuring compliance with health and safety requirements	●	Augmented
Planning and directing daily operations	●	Augmented
Representing and negotiating on behalf of the government, enterprise or organizational unit managed in meetings and other forums	○	-

Intensity of the transformative effect: ● High effect ◑ Medium effect ◔ Low effect ○ No effect

Figure 2.7. Tasks computed by Managers, AI effect on the specific task and nature of prevalent effect. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

37. **Professional** roles are characterized by **eight distinct tasks**. AI integration is expected to **impact seven** of these tasks, with **two** experiencing a **significant effect**. Specifically, AI can optimize supply chain management and customize customer experiences, supporting the task of "providing various business, legal and social duties". Additionally, the "preparation of scientific papers and research" is significantly impacted by AI's

abilities in reviewing, correcting, automating literature searches and synthesizing summaries. All these **tasks will be augmented**, requiring support from AI. In summary, AI has the potential to affect **88% of tasks associated with professional roles**, with one task being fully automatable through digital evolution.

TASK	EFFECT	NATURE OF PREVALENT EFFECT
Conducting analysis and research, and developing concepts, theories and operational methods	◑	Augmented
Advising on or applying existing knowledge related to physical sciences, mathematics, engineering and technology, life sciences, medical and health services, social sciences and the humanities	◑	Augmented
Teaching the theory and practice of one or more disciplines at different educational levels	◔	Augmented
Teaching and educating persons with learning difficulties or special needs	◔	Augmented
Providing various business, legal and social services	●	Augmented
Creating and performing works of art	◔	Augmented
Providing vocational guidance	○	-
Preparing scientific papers and reports	●	Augmented

Intensity of the transformative effect: ● High effect ◑ Medium effect ◔ Low effect ○ No effect

Figure 2.8. Tasks computed by Professionals, AI effect on the specific task and nature of prevalent effect. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

38. The tasks identified for **Technicians and associate professionals** total **five**. **Three** of these tasks, being **highly technical and mechanical**, are the **most susceptible** to the potential effect of AI integration. These tasks include "undertaking and conducting technical work related to research", "initiating and providing various technical services in trade, finance, administration and social work", and "offering technical support for the arts and entertainment". These three tasks may be augmented, as generative AI and AI-powered tools can conduct research, design simulations and automate certain mechanical or administrative duties. In summary, AI has the potential to affect 88% of tasks associated with technician and associate professional roles.

TASK	EFFECT	NATURE OF PREVALENT EFFECT
Undertaking and carrying out technical work connected with research and the application of concepts and operational methods	◑	Augmented
Initiating and carrying out various technical services related to trade, finance and administration, and to social work	◑	Augmented
Providing technical support for the arts and entertainment	●	Augmented
Participating in sporting activities	○	-
Executing some religious tasks.	○	-

Intensity of the transformative effect: ● High effect ◑ Medium effect ◔ Low effect ○ No effect

Figure 2.9. Tasks computed by Technicians and associate professionals, AI effect on the specific task and nature of prevalent effect. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

39. The **Clerical support workers** job category is the broadest, **encompassing various roles across different industries**, resulting in the highest number of registered tasks in the ILO database. Out of **15 tasks**, **87%** (13 tasks) are expected to be **impacted by AI integration**. Some of these tasks are largely mechanical and repetitive, making them prime candidates for **automation by AI**. For instance, tasks such as "entering data into computers" and "recording and computing numerical data" can be fully managed by AI algorithms, which can extract, categorize, analyze data, identify patterns and generate reports or visualizations. Additionally, AI can automate clerical tasks in "keeping records relating to stocks, production and transport" and in "filing documents" by categorizing files, assigning metadata tags and suggesting appropriate filing structures. **The remaining nine tasks will only be augmented by AI**, as they require information interpretation and social interactions.

TASK	EFFECT	NATURE OF PREVALENT EFFECT
Stenography, typing, and operating word processors and other office machines	●	Augmented
Entering data into computers	●	Automated
Carrying out secretarial duties	◑	Augmented
Recording and computing numerical data	●	Automated
Keeping records relating to stocks, production and transport	●	Automated
Keeping records relating to passenger and freight transport	◑	Augmented
Carrying out clerical duties in libraries	○	-
Filing documents	●	Automated
Carrying out duties in connection with mail services	◑	Augmented
Preparing and checking material for printing	◔	Augmented
Assisting persons who cannot read or write with correspondence	◔	Augmented
Performing money-handling operations	●	Augmented
Dealing with travel arrangements	◑	Augmented
Supplying information requested by clients and making appointments	◑	Augmented
Operating a telephone switchboard	○	-

Intensity of the transformative effect: ● High effect ◑ Medium effect ◔ Low effect ○ No effect

Figure 2.10. Tasks computed by Clerical support workers, AI effect on the specific task and nature of prevalent effect. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

40. **Twelve tasks** were identified for the category of **Service and sales workers**, with **eight expected to be influenced by AI**. For example, "providing personal and basic health care at homes or in institutions", as well as "hairdressing, beauty treatment and companionship", could be enhanced by AI's capabilities in remote monitoring, tracking vital signs, customizing services and simulating images. The most significant impact, however, is anticipated in tasks such as "selling goods in wholesale or retail establishments" and "demonstrating goods to potential customers", which are likely to **be fully automated**. This is due to process automation, service customization on various platforms and AI-powered inventory management systems that predict demand

fluctuations and identify consumer preference trends. Overall, **AI has the potential to affect 80% of typical tasks in this category**.

TASK	EFFECT	NATURE OF PREVALENT EFFECT
Organizing and providing services during travel	◑	Augmented
Housekeeping	○	-
Preparing and serving food and beverages	◑	Augmented
Caring for children	○	-
Providing personal and basic health care at homes or in institutions, as well as hairdressing, beauty treatment and companionship	●	Augmented
Providing security services and protecting individuals and property against fire and unlawful acts	◑	Augmented
Enforcing law and order (security services)	◔	Augmented
Selling goods in wholesale or retail establishments, as well as in stalls and on markets	●	Automated
Demonstrating goods to potential customers	●	Automated
Posing as models for advertising, artistic creation and display of goods	◑	Augmented

Intensity of the transformative effect: ● High effect ◑ Medium effect ◔ Low effect ○ No effect

Figure 2.11. Tasks computed by Service and sales workers, AI effect on the specific task and nature of prevalent effect. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

41. **Plant and machine operators and assemblers** is the job category expected to experience the **most pervasive AI impact** due to the technicality and repetitiveness of the **five tasks** defining this group. All tasks will be affected by AI evolution to some extent, but **only two will be fully automated**. Specifically, "driving, operating and monitoring mobile industrial and agricultural machinery and equipment" will be entirely digitalized by AI technologies and algorithms, optimizing fleet operations and traffic flows through data analysis from vehicle usage and traffic cameras. Additionally, "assembling products from component parts according to strict specifications and procedures" will be **automated through machine learning technologies**, which enhance efficiency and productivity by automating repetitive tasks. In conclusion, in Plant and machine operator and assembler roles, **AI has a potential effect on 100% of the typical tasks**.

TASK	EFFECT	NATURE OF PREVALENT EFFECT
Operating and monitoring mining or other industrial machinery and equipment for processing metal, minerals, glass, ceramics, wood, paper or chemicals	◑	Augmented
Operating and monitoring machinery and equipment used to produce articles made of metal, minerals, chemicals, rubber, plastics, wood, paper, textiles, fur or leather, and which process foodstuffs and related products	◑	Augmented
Driving and operating trains and motor vehicles	◑	Augmented
Driving, operating and monitoring mobile industrial and agricultural machinery and equipment	●	Automated
Assembling products from component parts according to strict specifications and procedures	●	Automated

Intensity of the transformative effect: ● High effect ◑ Medium effect ◔ Low effect ○ No effect

Figure 2.12. Tasks computed by Plant and machine operators and assemblers, AI effect on the specific task and nature of prevalent effect. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

42. Summing up, **52 tasks** for the **6 groups of jobs** have been identified and AI can have a potential direct effect on **at least 43 tasks** (**83%** of total), with shares going from **60%** for Technicians to **100%** for Plant and machine operators.

43. AI's transformative effect on various jobs can be summarized in four main categories. In **data research and analysis**, AI automates repetitive tasks by analyzing large amounts of data to identify trends and patterns, allowing experts to focus on complex work. Concerning **process and system optimization and automation**, AI enhances efficiency by optimizing stock levels, predicting demand and automating administrative and industrial operations. In **decision support** operations, AI aids businesses by analyzing data to provide critical information and interpret regulations. Lastly, related to **customization of services**, AI-driven recommendation engines personalize product and service offerings based on customer data, characteristics and purchasing history. Overall, AI significantly enhances efficiency and decision-making across industries.

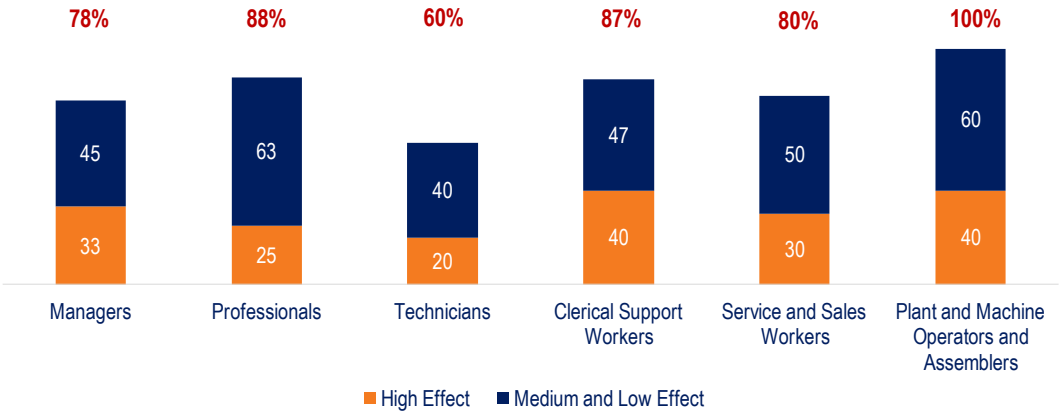

Figure 2.13. Tasks potentially influenced by AI for each job group divided by magnitude of the effect (% of the job's total tasks). Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

44. The analysis yields **results that are optimistic and counter to the prevailing public perception regarding AI's impact on employment**. Specifically, the findings indicate that, on average, across the six work groups analyzed, **more than 60%** of the tasks identified as potentially affected by AI will experience **augmentation rather than replacement**. This means that AI tools, platforms and techniques will primarily serve to **support and streamline work processes rather than displace human workers**. In practice, AI will enhance human capabilities by automating routine and repetitive aspects of tasks, allowing workers to focus on more complex and creative elements that require human judgment and expertise. For example, AI can handle data analysis and routine decision-making, freeing up time for employees to engage in strategic planning and problem-solving. **This symbiotic relationship between AI and human workers is expected to improve efficiency, productivity and job satisfaction**, demonstrating that AI's role in the workplace is more about collaboration and augmentation than about

replacement of human labor. The overall effect of this is that jobs will become increasingly **hybrid**, blending traditional tasks with others enabled by AI.

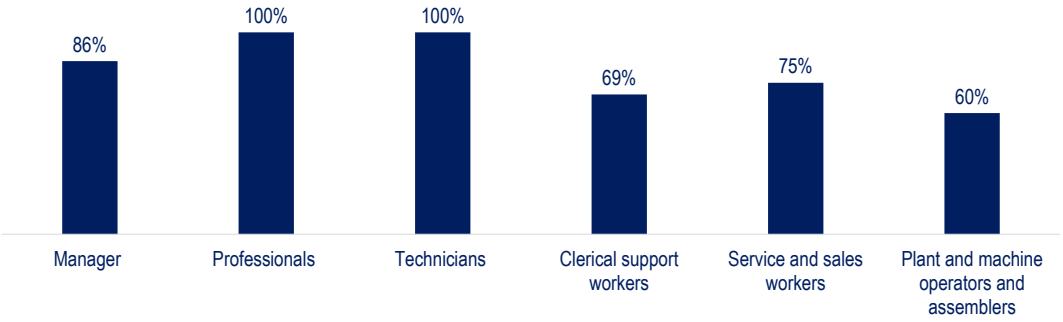

Figure 2.14. Tasks that will be augmented following the AI evolution (% of the job's total tasks affected by AI). Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

CHAPTER 3

Skills required for the evolution in tasks and jobs

The Key Messages of Chapter 3

- *The focus countries are experiencing a high and growing **skills mismatch** phenomena (on average **50%** in the six countries considered) which is expected to be exacerbated as a consequence of rapid AI deployment.*
- *In the six countries considered, reducing skills mismatch could lead to increased productivity (between +1.9% and +2.3% in productivity for each percentage point reduction in mismatch) and therefore **higher economic output**: US (**$414-501 billion**), Japan (**$88-106 billion**), UK (**$61-74 billion**), Germany (**$69-83 billion**), France (**$50-61 billion**) and Italy (**$38-46 billion**).*
- *Three **macro categories of skills** (physical, intellectual and social) and **sixteen subcategories** related to the **six job groups** have been identified on the basis of the international literature*
    - *Among these sixteen **Information processing**, **Digital, Ethical** and **Analytic** are the skills that will have a **higher relevance** in the deployment of AI.*
    - ***Digital** and **Ethical skills** will be critical for a variety of job groups.*

3.1. Analysis of the relation between the evolving tasks and jobs and skills

45. This part of the study considers the **skills** required by the **evolution in tasks and jobs induced by AI**. As a preliminary remark, it is useful to recall the link between these three different components. **Skills** are the competences and knowledge that an individual possesses and that are needed to perform certain activities or tasks. Skills can be technical (such as programming and data analysis) or transversal (such as communication and problem-solving). **Tasks** are the specific activities that must be performed within a job or project. These tasks require the application of **certain skills** to be successfully completed. **Jobs** are roles or positions within an organization that require the performance of various tasks. A job is a **set of tasks** which, taken together, define an individual's specific role within a company.

46. The **effect of AI on tasks** assessed in the previous section have been grouped according to the **prevailing areas** to which they belong and then compared with a **skills set classification** composed of **three skill areas** (Physical, Intellectual and Social skills), developed based on international literature and specifically on the EU Joint Research Centre framework (as suggested by the Advisory Board) and **sixteen subcategories**.

47. The **three categories** and **sixteen subcategories** of skills considered in the analysis are the following:

    – **Physical Skills** (physical manipulation and transformation of material things), including **Strength** (lifting people and heavy loads, exercising strength), **Dexterity** (precisely coordinated movements with hands or fingers) and **Navigation** (moving objects or oneself in unstructured or changing spaces).

    – **Intellectual Skills** (manipulation and transformation of information and the active resolution of problems), including **Information Processing** (receiving, encoding, storing, retrieving and utilizing data to make decisions or perform tasks), **Business** (managing, operating and growing a business and its key components), **Technical** (using specific tools, technologies or methodologies), the **Humanities** (interpreting, analyzing and enhancing diverse perspectives), **Accounting** (recording, analyzing and reporting financial transactions and data), **Analytic** (evaluating information, identifying patterns and drawing conclusions), **Problem Solving** (applying critical thinking and appropriate strategies), **Digital** (utilizing advanced and basic ICT tools) and **Ethical** (recognizing, evaluating and addressing moral issues). Specifically, this last component, **ethics**, was added within the cluster of Intellectual Skills because it was deemed important for assessing the effects of AI. In fact, the automation brought about by AI in society will make **ethical evaluations** increasingly important. An **ethical approach** is crucial to ensure that AI improves the quality of life for all by reducing inequalities and avoiding discrimination. Ethics in AI is not just a theoretical issue, but an **essential element** in ensuring that the development and use of AI technologies are aligned with human values and the common good.

– **Social Skills** (interaction and collaboration with other people and parts of the organization), which include **Serving and Attending** (assisting, supporting and meeting the needs of others), **Teaching, Training and Coaching** (imparting knowledge, developing skills and providing guidance and support), **Selling and Influencing** (persuading, negotiating and motivating others) and **Managing and Coordinating** (planning, organizing and overseeing tasks, resources and people).

Figure 3.1. The three categories and sixteen subcategories of skills considered in the analysis. Source: The European House – Ambrosetti elaboration based on Joint Research Centre data (2021), 2024.

48. In this section of the study, the types of **skills** to be developed were analyzed in detail for **each job role** (Manager, Professionals, Technicians and Associate Professionals, Clerical Support Workers, Service and Sales Workers, Plant and Machine Operators and Assemblers). Specifically, skills were identified to cope with AI-induced changes in each task.

49. The effects of AI on the job role of **Managers** have been regrouped in **three main clusters**. The first concerns **data analysis and data management**. In fact, AI through **data reprocessing** can identify and correct errors, handle missing values and remove duplicates in datasets, as well as unify data from different sources, transforming them into a consistent format for analysis. Or, through Machine Learning algorithms, it can identify **complex patterns and relationships** in the data that might not be evident through traditional methods. Finally, AI tools can generate **dynamic and interactive visualizations** that make data more understandable and useful for decision-making.

50. In order to be able to best manage the automation of AI-induced processes in the field of data analysis and data management, **managers** must be able to develop **certain skills** to support the work of AI. In particular, **Intellectual skills** (including Analytic, Technical, Information gathering and evaluation, Creativity and resolution, Business – Reading and writing, Digital – Advanced ICT) are crucial to **critically interpret** AI results. In addition to Intellectual skills, **Social skills** (Managing and Coordinating) must also be developed. In

fact, once some processes have been fully automated by AI, it is crucial for a manager to be able to **manage and coordinate** human resources and business processes.

51. Regarding **Monitoring and risk assessment,** Artificial Intelligence can significantly **improve the risk assessment process** in various sectors due to its ability to analyze large amounts of data, identify complex patterns and provide accurate predictions. In particular, AI can use historical data to predict future losses or incidents, helping companies to be better prepared, and can analyze real-time financial and market data to identify trends and potential investment risks. As with Data analysis and management, **Intellectual skills** (Analytic, Information processing and Information search and retrieval) for managers are crucial in the face of process automation resulting from AI. Furthermore, in addition to Intellectual skills, managers will also need to equip themselves with a set of **Ethical skills** such as recognizing, evaluating and addressing moral issues. This means that the automation effect induced by AI must necessarily be balanced by an **ethical component**, capable of providing a more "human-centric" assessment of business operations.

52. Finally, the third and last effect induced by AI is on **Process automation and optimization**, allowing for the automation of business processes by improving efficiency, reducing errors and enabling more intelligent and proactive management. Again, managers will need to be equipped with **Intellectual** (Analytic, Conceptualization, Learning and abstraction, Information processing, Information search and retrieval, Digital – Advanced ICT) and **Social skills** (Teaching/Training/ Coaching). In addition to these skills, the human experience and the quality of work are crucial to navigating the evolution of AI and process automation. These elements ensure that the automation of processes enhances, rather than replaces, the creativity, empathy, and nuanced decision-making that only humans can provide. Concerning the latter group of social skills, the automation of processes makes it indispensable for a manager to be able to create aggregation in a group of people and to be able to direct them in the different phases of work.

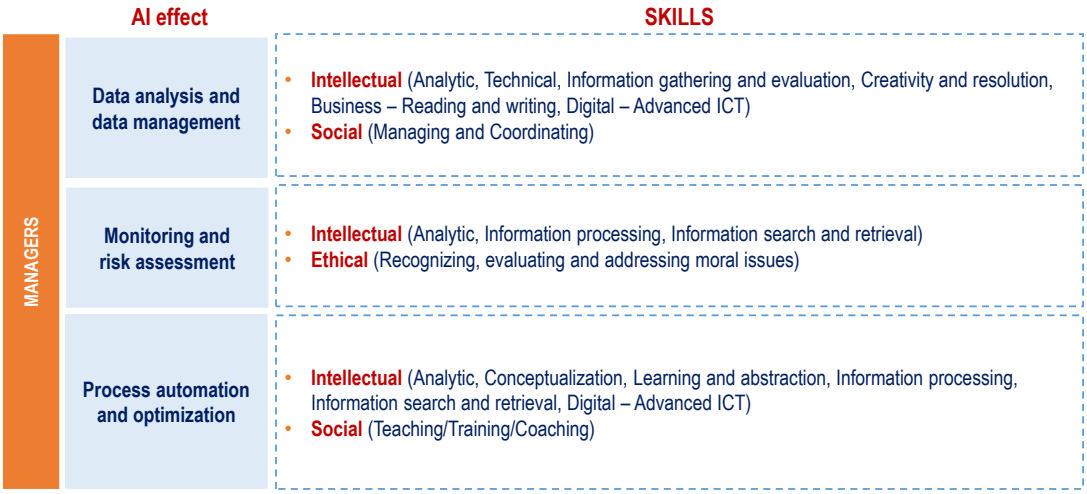

Figure 3.2. The skills that Managers need to develop to manage the effect of AI. Source: The European House – Ambrosetti elaboration based on Joint Research Centre data (2021), 2024.

53. Regarding the job role of **Professionals**, **three main effects** related to AI have been identified. The first concerns the area of **Research, review and correction, synthesis, summary and data management**. In this context, **Intellectual skills** in particular: (Analytic, Technical – reading and writing manuals, the Humanities – reading and writing books, Digital – Basic ICT) are crucial. In this context, Intellectual skills are key for understanding, evaluating and **critically reading** the results of AI work. In addition to the research and collection of data, research work includes, in fact, an extensive data processing phase in order to identify any anomalies or relationships in the material collected.

54. For the second aspect identified, Artificial Intelligence can significantly improve **Supply chain management** (SCM) through various advanced techniques and tools. In fact, through **predictive analytics**, AI can analyze historical sales data, market trends and customer behavior to predict future demand more accurately. Through **Intelligent scheduling** AI can optimize production planning according to expected demand, available resources and production constraints. In addition, with **Real-time visibility** AI can provide a complete, real-time view of the entire supply chain, improving transparency and the ability to make informed decisions. In this case, professionals will have to develop both **Intellectual** (Accounting, Analytic, Business and Planning, Ethics) and **Social skills** (Managing and Coordinating) so that all the different stages of the supply chain can be effectively governed and controlled by AI.

55. Finally, Artificial Intelligence can greatly improve **Customer support and customized services** through various technologies and solutions that make the service more efficient, personalized and proactive. Professionals have to develop three different types of skills: **Intellectual** (Problem solving – Creativity and resolution), **Social** (Serving/attending, Selling/influencing and Caring) and **Ethical** (Recognizing, evaluating and addressing moral issues). In fact, customer care, like any client-facing work with customers, necessarily requires a **human component** to make the service offered less

standardized and more in line with the customer needs and expectations. Furthermore, among the Social skills, that of **Managing and Coordinating** should be mentioned. This is because coordinating a team is crucial for the effective management of projects and activities within an organization. This skill requires a combination of communication, organizational and leadership skills. For Professionals, it is important to have a clear vision of the **group's goals** and to communicate this vision to team members, to **encourage and motivate** them, recognizing their successes, providing support in times of difficulty, and assigning tasks according to the skills and potential of each member. Furthermore, for Professionals, Managing and Coordinating also means **Team Building**, i.e., organizing activities that promote group cohesion and **Involvement**, i.e., making sure that all members feel involved and valued in the work performed.

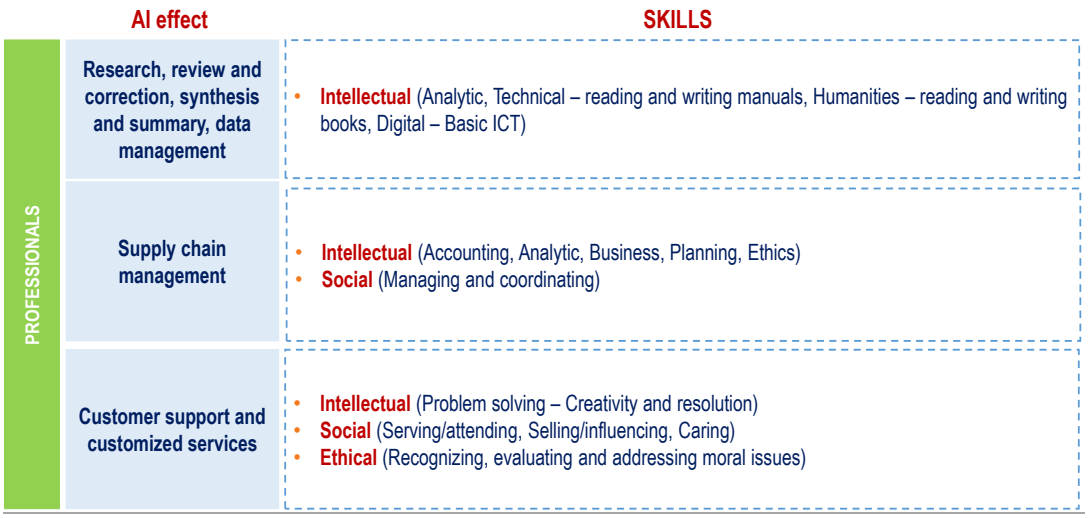

Figure 3.3. The skills that Professionals need to develop to manage the effect of AI. Source: The European House – Ambrosetti elaboration, 2024.

56. Regarding **Technicians and Associate Professionals**, a category very similar to the previous one, AI can have two potential effects: on **Data analysis and decision support** and **Process automation**. For the first point, Artificial Intelligence can support business decisions in various ways, exploiting the ability to process large amounts of data, identify patterns and provide accurate predictions. In this context, **Intellectual skills** (Information processing – Processing of codified information, Problem solving – Information gathering and evaluation, Problem solving – Planning and Implementation, Digital – Basic ICT), **Social skills** (Teaching/Training/Coaching) and **Ethical skills** (Recognizing, evaluating and addressing moral issues) are crucial to fully understand the action of AI. Intellectual skills, especially information processing—processing of codified information—is indispensable for understanding and interpreting the results of the work performed by AI. Here again, the **ethical component** is a central element for professionals who want, on the one hand, to speed up their tasks, but on the other hand to preserve the **human aspect** in professional relationships. This can be done by trying to be sincere and transparent in communications and day-to-day operations, acting in accordance with one's own values and those of the organization and, above all,

promoting a healthy **work environment** that values differences and guarantees equal opportunities for all.

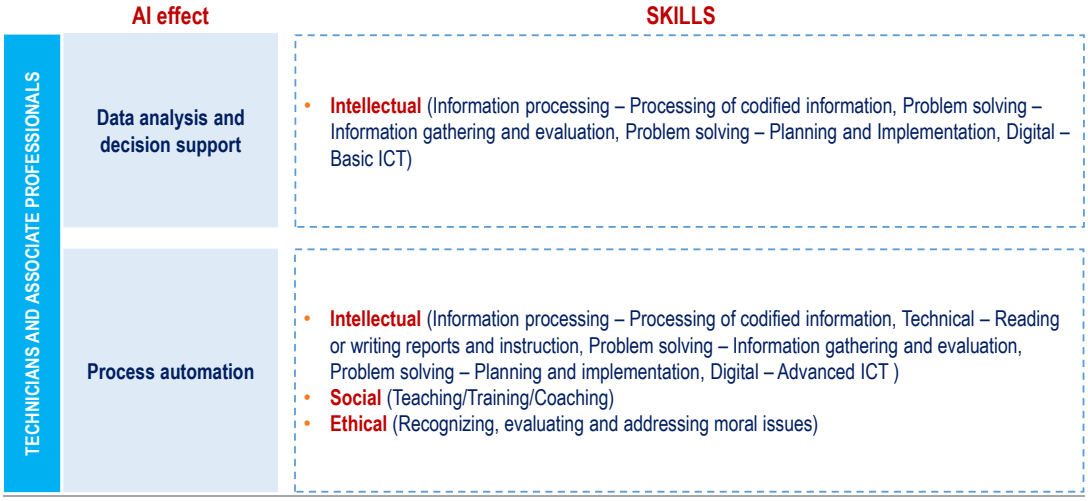

Figure 3.4. The skills that Technicians and Associate Professionals need to develop to manage the effect of AI. Source: The European House – Ambrosetti elaboration, 2024.

57. Within the framework of **Clerical Support Workers**, AI has potential effects in three main areas: **Process automation**, **Data analysis** and **Smart prediction.** Within this category of professionals, the skills to be developed are similar to those illustrated above. However, technical preparation within this professional category is fundamental. In fact, while often performing repetitive and automatic tasks, it is important to be able to consult technical documents, write reports and papers, as well as be familiar with digital and ICT technologies. Furthermore, it can be observed that **Social skills** in particular are crucial in this context. The excessive automation brought about by AI can lead to a natural detachment or alienation from a worker's job tasks. However, the **human experience** and the ability to **create relationships** in a working environment, or to understand the needs of a colleague, are activities that can only be fully realized through human relationships.

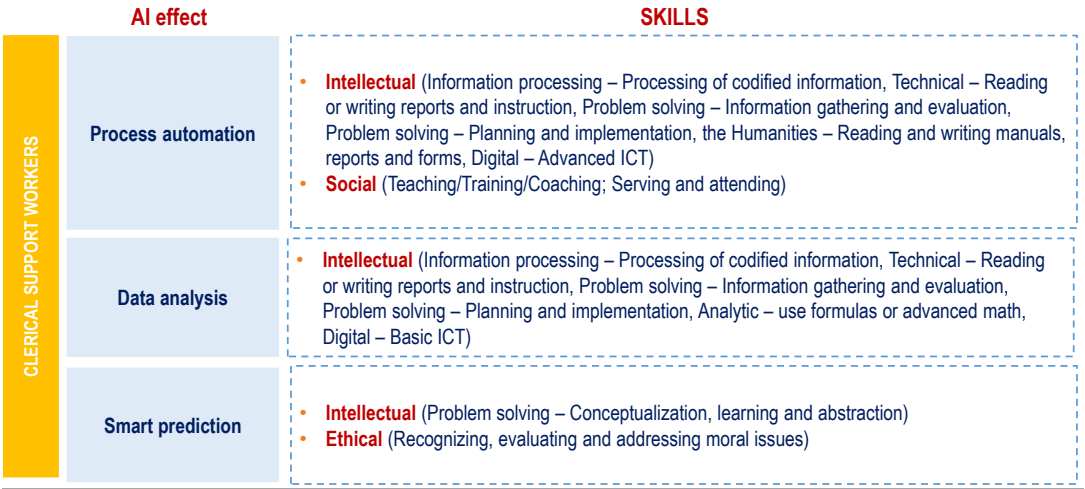

Figure 3.5. The skills that Clerical and Support Workers need to develop to manage the effect of AI. Source: The European House – Ambrosetti elaboration, 2024.

58. Regarding the **Service and Sales Workers** job group, analyses revealed that AI can have a potential impact on three areas: **Data analysis and research**, **Customization of services** and **Process automation and system optimization.** Intellectual skills are also crucial here, but perhaps even more important are Social skills. Within this profession, in fact, direct **contact with the public and/or customers** is constant and fundamental. AI can certainly promote enhanced personalization of services and faster understanding of needs, but the contribution that the **human aspect** with the customer, and more generally with the public, can make is crucial for this profession. In fact, the ability to listen to and understand people's different needs or to be able to correctly address a person's needs remain specifically human actions, which no AI device will ever be able to replace. Therefore, the set of social and ethical skills represent an **added value** for the worker in this category.

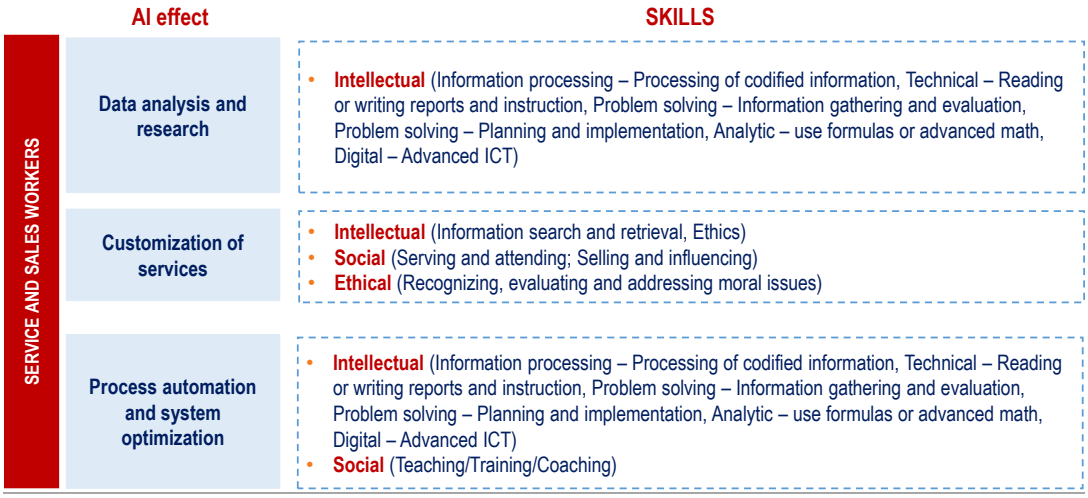

Figure 3.6. The skills that Service and Sales Workers need to develop to manage the effect of AI. Source: The European House – Ambrosetti elaboration, 2024.

59. Finally, for **Plant and Machine Operators and Assemblers**, a category operating mainly in the manufacturing sector, AI has potential effects in two areas: **Data analysis and machine learning** and **Process monitoring and automation and system optimization**. The skills to be developed are: **Intellectual** (Information processing – Processing of codified information, Technical – Reading or writing reports and instruction, Problem solving – Information gathering and evaluation, Problem solving – Planning and implementation, Analytic – use formulas or advanced math, Digital – Advanced ICT), **Social** (Coordinating) and **Ethical** (Recognizing, evaluating and addressing moral issues). Among Intellectual skills, in addition to **Technical – Reading or writing reports and instruction**, that are indispensable for all those working in technical-industrial contexts, the sub-category of **Problem solving** certainly represents an important element for this professional category. In fact, the automation of industrial or manufacturing processes resulting from AI, can lead to sudden breakdowns or inefficiencies that can seriously compromise the outcome of the production process. In this context, workers must be able to **understand the problem** that has occurred and remedy it as quickly as possible so as not to compromise the entire production process.

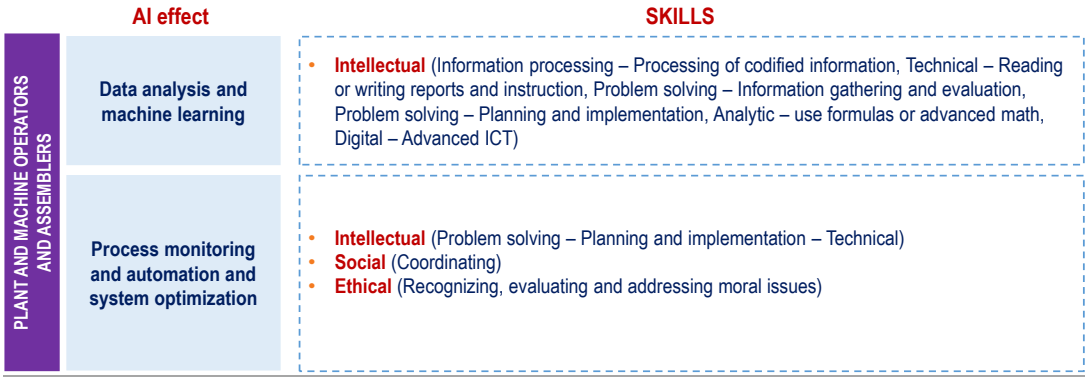

Figure 3.7. The skills that Plant and Machine Operators and Assemblers need to develop to manage the effect of AI. Source: The European House – Ambrosetti elaboration, 2024.

60. A group of skills will become **more significant** following the introduction of AI and, among these, some will be **critical**.

    – In particular, for the job role of **Manager** the sub-categories included in the Intellectual Skills group, especially the sub-categories related to **Analytic** and **Ethical skills**, will be critical. **Analytical skills** enable managers to interpret and analyze complex data, allowing them to make decisions based on facts and factual information rather than on intuition or personal opinion. This reduces the risk of errors and increases the likelihood of successful decisions. Furthermore, a manager with good analytical skills can quickly **identify problems or inefficiencies** within the organization, as well as identify new opportunities for growth or improvement. This is crucial for keeping the company competitive and responsive to market changes. In addition, **Ethical skills** are crucial for a manager because they influence not only his or her personal reputation, but also the organizational environment and long-term

sustainability of the company. Finally, **Managing skills** will be essential for a manager because they determine the ability to effectively lead a team, achieve business objectives and ensure the long-term success of the organization by enabling managers to plan and organize business activities efficiently. A good manager knows how to define clear objectives, allocate resources optimally and create strategic plans that take into account business priorities.

- For the **Professionals** job category, the Intellectual Skills group will be critical, in particular the subcategories related to **Analytic**, **Problem solving** and **Ethical skills**. **Analytical skills** will be crucial for a professional in almost any field, as they enhance the ability to understand, interpret and use the information provided by AI to solve problems, make decisions and achieve goals, while **Problem solving** is essential to handle the difficulties and uncertainties that arise in daily work and that AI is unable to deal with. A professional with solid problem-solving skills can quickly identify problems, analyze root causes and develop practical solutions to keep work running smoothly. Finally, considering the depersonalization of human relationships induced by AI, **Ethical skills** will be essential to build and maintain trust between colleagues, customers, superiors and other stakeholders. A professional who acts with integrity, honesty and transparency is perceived as trustworthy, which is crucial for establishing long-lasting and productive relationships.

- Regarding the **Technicians and Associated Professionals** job group, the subcategories of **Technical**, **Digital** and **Ethical skills** will be crucial. In fact, as a result of the introduction of AI, employees with strong **technical skills** will be able to perform their tasks more efficiently, reducing the time required to complete tasks and improving the quality of work. This leads to an increase in individual productivity and, consequently, to greater efficiency at company level. They also enable innovation and improvement of processes, products or services. Specifically, **Digital skills** have become essential for any modern worker, as the world of work will be increasingly digitally and technologically integrated.

- For **Clerical Support Workers**, in the future, **Information processing** skills will also be fundamental, and especially following the introduction of AI, the ability to collect, **analyze and use information** effectively to make decisions, solve problems and achieve goals will be important. Here, too, knowledge of digital technologies will be crucial to understanding, evaluating and assisting the work done by AI.

- Regarding **Service and Sales Workers**, the sub-categories **Digital** from the Intellectual group and **Serving and attending** from the Social group will be crucial. In particular, **Serving and attending** skills will be important in providing high-quality customer service. Knowing how to welcome, listen and respond to customer needs helps improve their experience and satisfaction. Excellent service can lead to increased customer loyalty and positive reviews, positively influencing the company's reputation. Service and support skills make it possible, especially

considering the effects of AI, to **personalize the interaction with customers or users**. Understanding and responding to individual needs helps to create a more satisfying and focused experience, improving the effectiveness of the service provided.

– For **Plant and machine operators and assemblers**, the **Technical** and **Digital** subcategories of the Intellectual group will be crucial. Technical skills, as an effect of AI, will enable operators to manage and control machines and plants efficiently. This includes understanding how to set up and calibrate machines, how to perform daily operations and how to monitor machine operation to ensure that everything runs smoothly. In addition, plant and machine operators must be able to perform preventive and corrective maintenance. Technical skills regarding this will be essential to diagnose and solve machine problems, reduce downtime and extend equipment life.

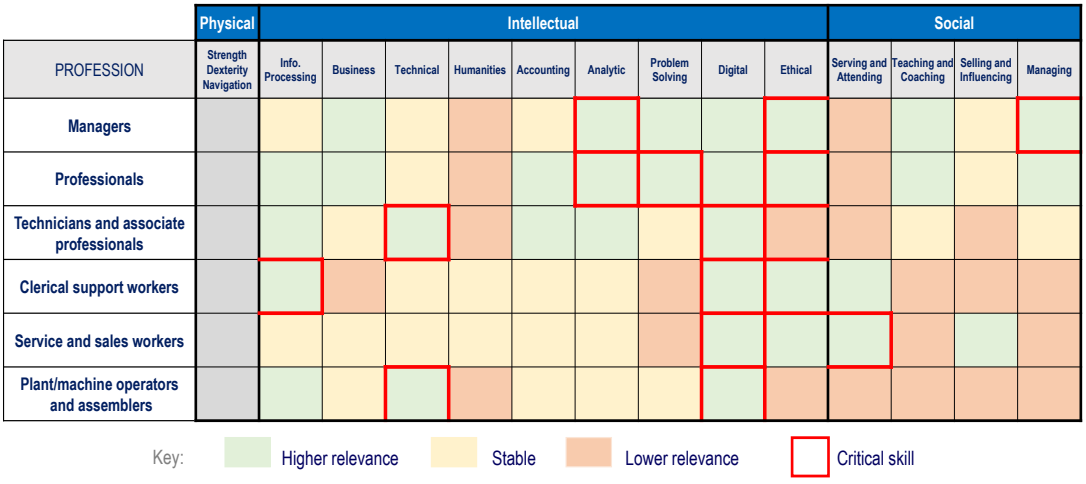

Figure 3.8. Evolution of the relative significance of each skill as of 2030 compared to the current situation for each job group, 2024. Source: The European House – Ambrosetti, 2024.

3.2. Mapping of skills required by the evolution in tasks and jobs induced by AI

61. This section will analyze some **labor market indicators** in the six countries considered, such as the labor force participation rate and the unemployment rate, which show positive trends. In addition to this, the educational and qualification mismatch rate (for both over- and under-qualification) and the educational level for each occupational category were analyzed. This with the aim of highlighting the **significant imbalances** that characterize the current labor markets in the six countries.

62. In the introduction to this section of the study, it should be noted that the focus countries are experiencing **positive trends** in their labor markets with rising employment rates. However, the **skills mismatch** phenomenon is still high and growing. Educational mismatch occurs when people educated in a particular field work in another. A part of the mismatch results from graduates in a field having to downgrade to find work in another field, generating economic losses. By creating new job roles and skill

requirements, **technology advancements** can exacerbate the structural **mismatch** between the **skills** individuals possess and those **arising** in the global job market, especially in the high-tech sector.

63. As mentioned above, the six countries considered have registered **an increasing labor force participation rate** over the past six years. Countries with labor market participation[5] rates **above the OECD average** of **82%** are **Japan**, **Germany** and the **UK**. In particular, Japan has the **highest labor market participation rate** of the six countries considered: **86%** in 2022, an increase of 2 percentage points compared to 2017. It is followed by **Germany** and the **United Kingdom** with rates of **84%** and **82%**, respectively, where it has remained largely unchanged over the past six years. Among the six countries considered, those with a **lower participation rate** than the OECD average are **France** (**81%**), the **United States** (**78%**) and **Italy** (**73%**). However, the following countries report an **increased participation rate** in 2022 compared to 2017, France by **2 percentage points**, the United States and Italy by **1 percentage point.**

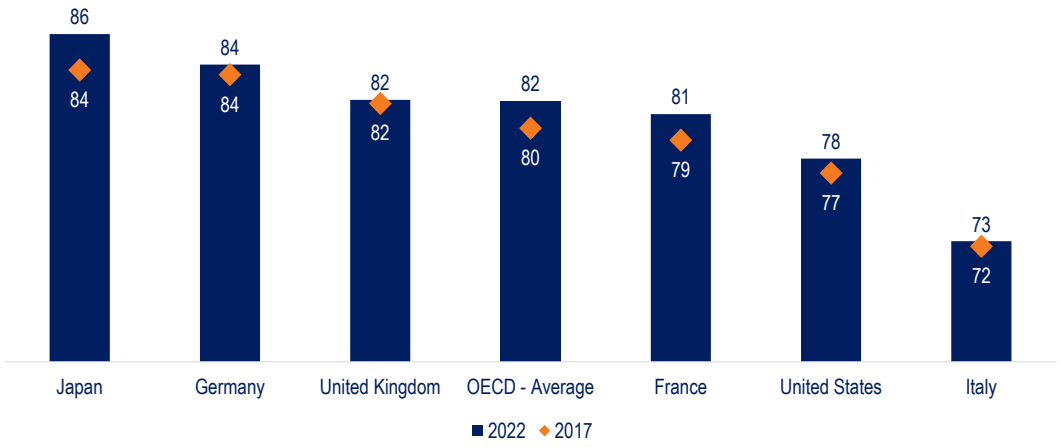

Figure 3.9. Labor force participation rate in the six countries considered and the average of the OECD members (percentage), 2017-2022. Source: The European House – Ambrosetti elaboration based on OECD data, 2024.

64. Together with an **increasing labor market participation rate**, the six countries are characterized by an overall **decrease in the unemployment rate**[6] that reached an average score **below 10%** in 2023. In particular, in 2023, the countries with an unemployment rate above the **OECD average** of **4.8%** were **Italy** (**7.7%**) and **France**

[5] Labor force participation rate is the ratio between the total labor force divided by the total working-age population. The working age population refers to people aged 15 to 64. This indicator is measured as a percentage of each age group.

[6] The unemployed are people of working age who are without work, are available for work, and have taken specific steps to find work.

(**7.1%**). However, these two countries recorded a **decreasing unemployment rate** compared to 2017, by **3.5 p.p. in Italy** and **2.3 p.p. in France**. Among the six countries considered with a lower unemployment rate than the OECD average are: the **United Kingdom** (**4.4%**), the **United States** (**3.6%**), **Germany** (**3.0%**) and **Japan** (**2.8%**). All of these countries, with the exception of the United Kingdom, also record a **decreasing unemployment** rate compared to 2017. In particular, the United States and Germany record a decrease in the unemployment rate by 0.8 p.p., while Japan by 0.2.

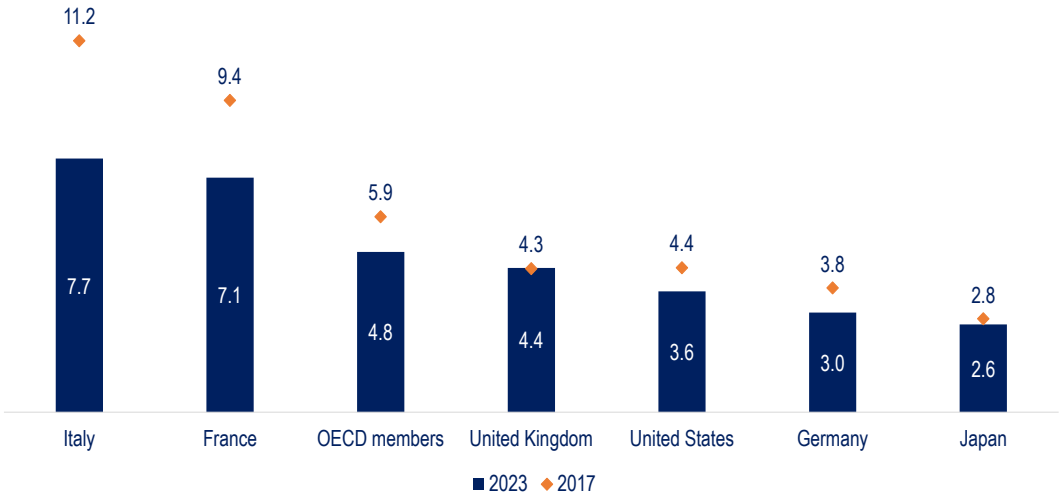

Figure 3.10. Unemployment rate in the six countries considered and the average of OECD members (percentage), 2017-2023. Source: The European House – Ambrosetti elaboration based on OECD data, 2024.

65. However, despite the positive labor market trends highlighted above, each country—to varying degrees—manifests issues related to both **overqualification** and **underqualification mismatch**. On-the-job skills mismatch (overqualification or underqualification) refers to a **discrepancy** between the qualification level of a jobholder and the requirements for that particular job. In particular, **overqualification** measures the number of medium- and high-skilled workers occupying a job for which they are overqualified, as a percentage of total employment while **underqualification** measures the number of low- and medium-skilled workers doing a job for which they are under-skilled, as a percentage of total employment.

66. The **educational mismatch rate** in the given countries is **higher than the OECD average** (**31.7%**) and growing over time, except in the UK. Specifically, the country with the highest educational mismatch rate, in 2022, was the **United Kingdom** (**60%**), followed by **Germany** (**54%**), **France** (**48%**), the **United States** (**45%**) and **Italy** (**43%**). Moreover, in all the countries considered, with the sole exception of the United Kingdom, where there was a decrease of 2 percentage points between 2018 and 2022, the **educational mismatch rate increased** by 6 p.p. in Germany, from 48% in 2018 to 54% in 2022, and by 1 p.p. in the United States, whose educational mismatch rate rose from 44% to 45% and in Italy from 42% to 43%.

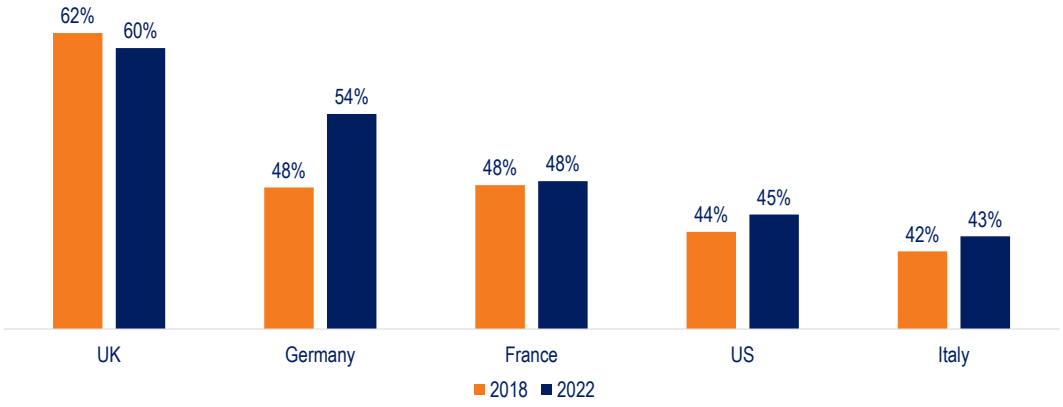

Figure 3.11. Educational mismatch in terms of education, by country (% of total employees), 2018-2022. Source: The European House – Ambrosetti elaboration based on ILO and OECD data, 2024. Note: Data for Japan are not available.

67. Overall, the average **qualification mismatch** in OECD countries is **34.4%**, among the six countries considered in this study, those with a higher qualification mismatch than the OECD average are: the **UK** (**40.5%**), **Germany** (**39.9%**) and **Italy** (**38.5%**), while among those recording a lower average are **France** (**33.5%**) and the **United States** (**33.0%**). In particular, the countries with a higher percentage of **overqualification mismatch** than the **OECD average** of **16.5%** are: **Italy** (**20.2%**) and **Germany** (**18.8%**). Lower than the OECD average are: United States (15.8%), the United Kingdom (14.5%) and France (12.5%). With regard to **underqualification mismatch**, the **OECD average** is **17.8%**. The countries with a higher average than the OECD average are: the UK (26.0%), Germany (21.0%), France (20.7%) and Italy (18.2%). By contrast, the country with a lower average than the OECD average is the United States (17.2%).

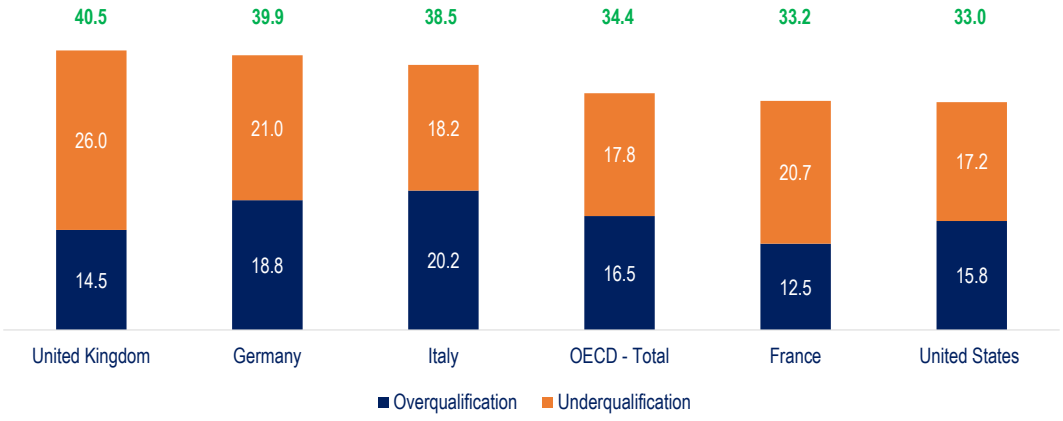

Figure 3.12. Qualification mismatch by country (percentage of total), 2022. Source: The European House – Ambrosetti elaboration based on ILO and OECD data, 2024. Note: Data for Japan are not available.

68. Reducing the **skills mismatch** can have a significant and positive impact on **productivity** and **Gross Domestic Product**. In fact, when worker skills are well-aligned with the demands of the job, they are able to perform their tasks more efficiently and

effectively. This leads to higher individual productivity and, consequently, to an increase in the **overall productivity of the organization**. Moreover, well-qualified employees are often better able to contribute to **innovation and continuous improvement**. When skills are adequate, employees can propose **innovative solutions**, optimize processes and improve the quality of work, thus contributing to higher productivity. Higher labor productivity translates directly into **increased production of goods and services.** This means a workforce that works more efficiently and productively contributes to an increase in **total output**, which can lead to an increase in **national GDP**. It should also be considered that a well-aligned labor market encourages **investment**, as companies are more likely to invest in areas where they can find workers with the right skills, facilitating **economic growth** and the expansion of the industrial sector, which in turn contributes to an increase in GDP. There is also a **wage aspect** to consider. With a more productive workforce, workers earn more and their purchasing power increases. This leads to an increase in **consumption**, further stimulating economic growth and contributing to the increase in GDP.

69. Reducing skills mismatch could lead to **increased productivity** and therefore **higher economic output**. In fact, a decrease of **1 percentage point** in skills mismatch could lead to an increase between **+1.9%** and **+2.3%** in **labor productivity**[7] corresponding to an **increase of GDP** equal to: **$414-501 billion** in the United States, **$88-106 billion** in Japan, **$69-83 billion** in Germany, **$61-74 billion** in the United Kingdom, **$50-61 billion** in France and **$38-46 billion** in Italy.

Figure 3.13. Increase in national GDP coming from a percentage point decrease in the skill mismatch by country (percentage of total), 2019. Source: The European House – Ambrosetti elaboration based on European Commission data, 2024.

70. Moreover, **educational levels** vary across the different occupations. On average, the six professional categories considered have the following qualifications: **Medium education** (**45%**), **High education** (**40%**) and **Low education** (**15%**).[8] Among the job groups with a

[7] Source: Vandeplas A. and Thum-Thysen A., *Skills Mismatch and Productivity in the EU*, European Commission Discussion Paper 100, 2019.

[8] Low Education (ISCED 0-2) 0 = Early childhood; 1 = Primary; 2 = Lower Secondary; Medium Education (ISCED 3-4) 3 = Upper Secondary; 4 = Post-secondary non-Tertiary; High Education (ISCED 5-8) 5 = Short-cycle tertiary; 6 = Bachelors degree or equivalent tertiary; 7 = Masters degree or equivalent tertiary; 8 = Doctoral degree or equivalent tertiary.

higher percentage of High Education employees than the **average of 40%** are **Professionals** (**83%**), **Managers** (**55%**) and **Technicians and Associate Professionals** (**46%**) while **Medium education**, whose average is 45%, is more widespread among **Service and Sales Workers** (**61%**), **Plant and Machine Operators and Assemblers** (**60%**), **Clerical Support Workers** (**58%**) and **Technicians and Associate Professionals** (**47%**). Finally, **Low education** whose average is 15%, is more widespread among the professional categories of the Plant and Machine Operators and Assemblers (**31%**) and Service and Sales Workers (**20%**).

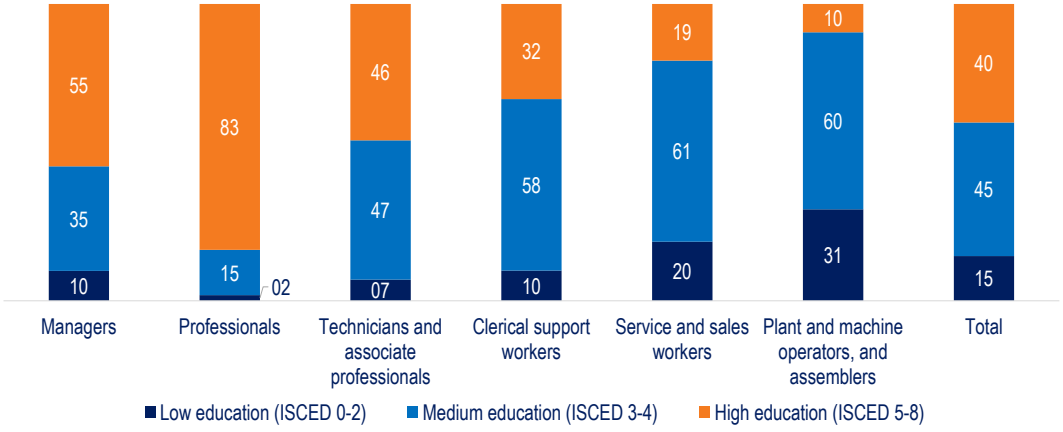

Figure 3.14. Educational level by occupation in the focus countries (percentage on total), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO and data, 2024. Note: data not available for Japan.

71. In addition, educational level varies in the different countries. With regard to the first occupational group considered, that of Managers, the countries with a higher-than-average share of **55%** of workers in this occupational category with high education are the United States (68.8%), France (67.1%), the United Kingdom (57.0) and Germany (54.6%).

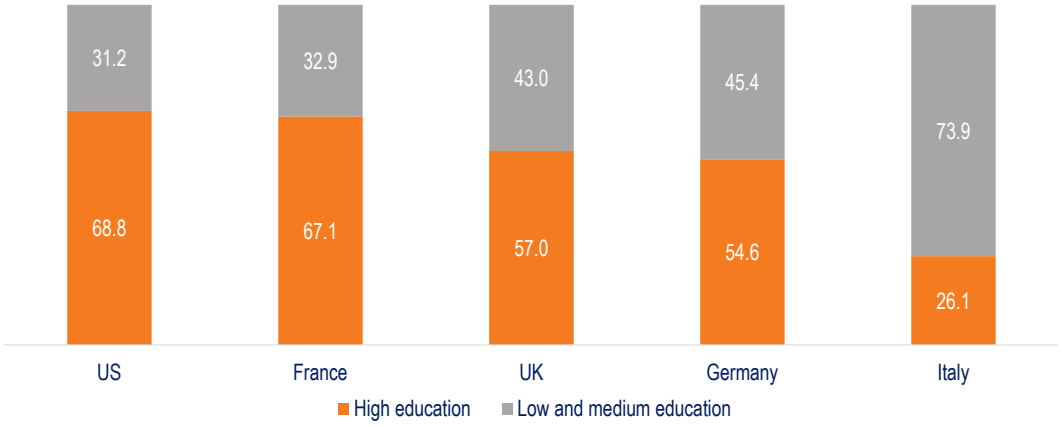

Figure 3.15. Educational level of Managers in the focus countries (share with high education – ISCED 5-8*), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO data, 2024. Note: Data not available for Japan. (*) 5 = Short-cycle tertiary; 6 =

Bachelor's degree or equivalent tertiary; 7 = Master's degree or equivalent tertiary; 8 = Doctoral degree or equivalent tertiary.

72. With regard to the job group of **Professionals**, the countries with a **higher education** than the average of **83%** are France (89.1%) and the United States (87.9%), while the countries with a lower than average value are: the UK (81.2 %), Italy (78.8 %) and Germany (77.3 %).

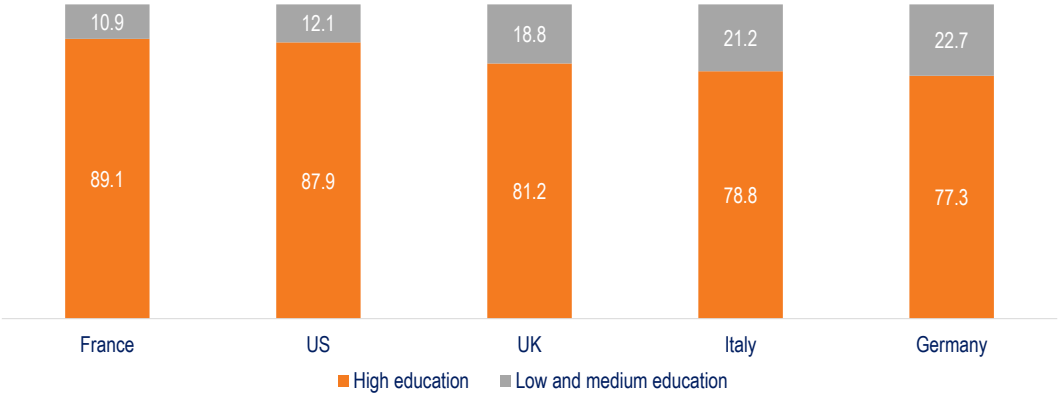

Figure 3.16. Educational level of Professionals in the focus countries (share with high education – ISCED 5-8*), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO data, 2024. Note: Data not available for Japan. (*) 5 = Short-cycle tertiary; 6 = Bachelors degree or equivalent tertiary; 7 = Masters degree or equivalent tertiary; 8 = Doctoral degree or equivalent tertiary.

73. For the **Technicians** job group, those with **high education** and with a higher-than-average percentage of **46%** are France with 57.3%, the United States with 56.3% and the United Kingdom with 48.7%, while the percentage of Technicians with **medium and low education** is highest in Germany (67.8%).

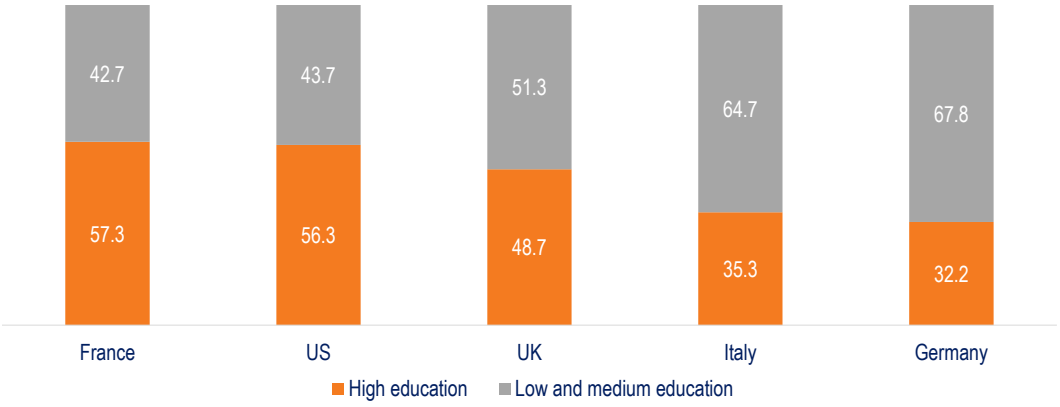

Figure 3.17. Educational level of Technicians in the focus countries (share with high education – ISCED 5-8*), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO data, 2024. Note: Data not available for Japan. (*) 5 = Short-cycle tertiary; 6 = Bachelors degree or equivalent tertiary; 7 = Masters degree or equivalent tertiary; 8 = Doctoral degree or equivalent tertiary.

74. Regarding **Clerical Support Workers**, those with high education are distributed among the six countries as follows: France (43.3%), the United States (42.2%), the United Kingdom (33.2%) and Italy (23.4%).

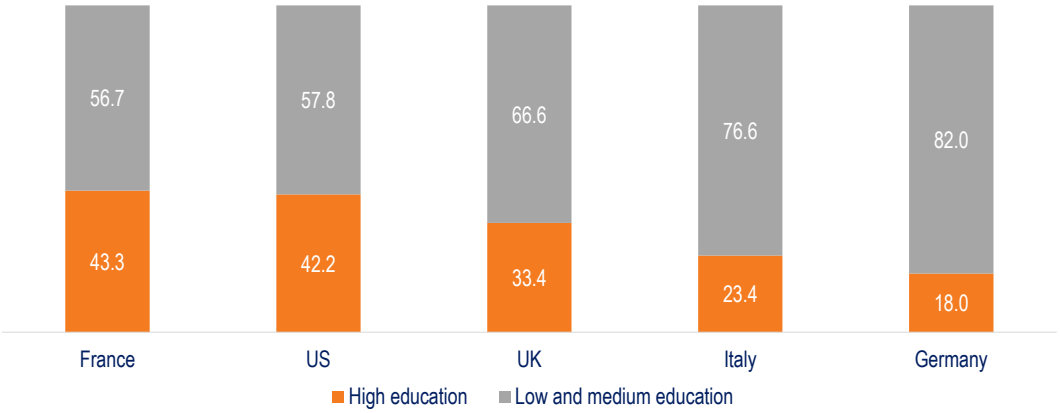

Figure 3.18. Educational level of Clerical Support Workers in the focus countries (share with high education – ISCED 5-8*), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO data, 2024. Note: Data not available for Japan. (*) 5 = Short-cycle tertiary; 6 = Bachelors degree or equivalent tertiary; 7 = Masters degree or equivalent tertiary; 8 = Doctoral degree or equivalent tertiary.

75. For **Service and Sales Workers**, all the countries considered have a share of over 60% of workers with low and medium education. This ranges from a low of 67.5% in the United States to 92.0% in Italy.

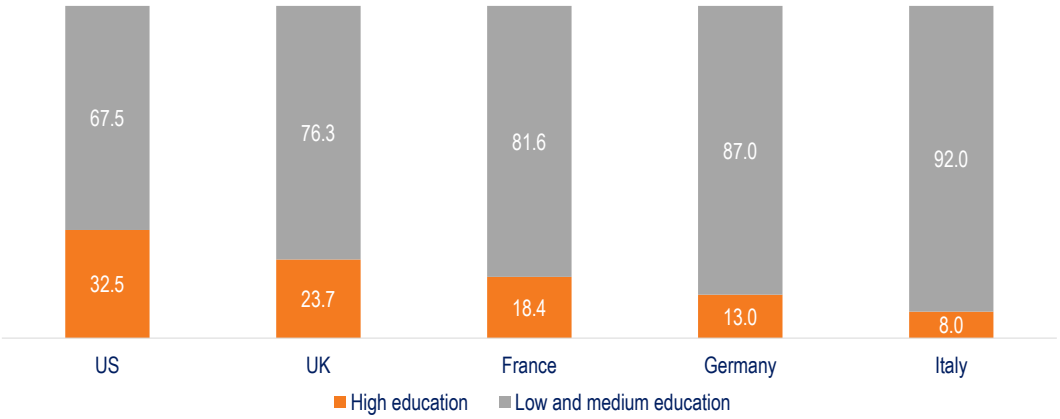

Figure 3.19. Educational level of Service and Sales Workers in the focus countries (share with high education – ISCED 5-8*), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

76. With reference to **Plant and Machine Operators**, within the countries considered, more than 70% of the employed have a **low and medium education**. Specifically, with 79.8% in the US and 97.3% in Italy.

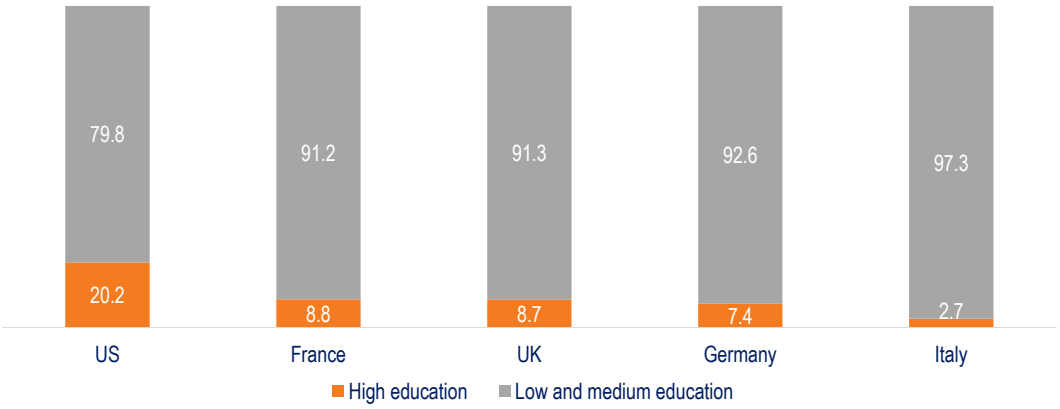

Figure 3.20. Educational level of Plant and Machine Operators in the focus countries (share with high education – ISCED 5-8*), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO data, 2024.

77. Some countries (e.g., Germany and Italy) register lower shares of high-skill workers compared to the average. In particular, Germany has a 13.7% lower share of highly-educated technicians than the country average and a 14.1% lower share of Clerical Support Workers. Italy has a 28.6% lower share of highly-educated managers than the country average, 11.2% lower for Service and Sales Workers and 10.7% lower for Technicians. France, instead, has a 12.4% higher share of Managers with high education than the country average, as well as 6.2% higher for the Professionals, Technicians and Clerical Support Workers (11.3%). The United Kingdom also has a higher share of Managers with high education than the country average of 2.3%, Technicians 2.7%, Clerical 1.4% and Service and Sales Workers 4.5%. Finally, the United States has a 14.1% higher share of highly-educated Managers than the country average, a 5% higher share of Professionals, a 10.4% higher share of Technicians, a 10.1% higher share of Clerical Support Workers, a 13.4% higher share of Service and Sales Workers and a 10.7% higher share of Plant and Machine Operators and Assemblers.

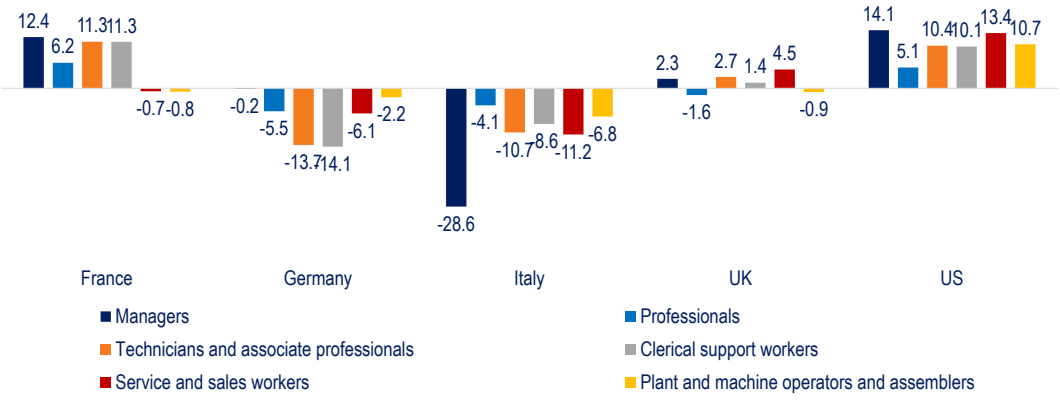

Figure 3.21. Difference in the share of workers with high education* compared to the focus country average (percentage points), 2023 or latest available data. Source: The European House – Ambrosetti elaboration based on ILO data, 2024. Note: data not available for Japan. (*) 5 = Short-cycle tertiary; 6 = Bachelors degree or equivalent tertiary; 7 = Masters degree or equivalent tertiary; 8 = Doctoral degree or equivalent tertiary.

CHAPTER 4

The education and training schemes and pathways available

The Key Messages of Chapter 4

- ***Five educational pathways*** *have been identified, with their own features, goals and scopes of action. Considering those in the active population that do not have access to* ***corporate or academic education****, a key role can be played by non-academic and non-corporate paths, such as* ***online courses like IBM SkillsBuild****.*
- *Overall,* ***>450 million workers will need some sort of training*** *by 2030, of which, on average,* ***more than 136 million*** *(one-third of the workforce in the focus countries) will be* ***outside traditional learning pathways*** *(academic education and corporate training) and will have to access other approaches.*
- *In the AI field,* ***academic courses are growing*** *in all the focus countries (+22% on average between 2017 and 2023), with increasing impact in the non-degree component (+36% on average between 2017 and 2023). At the same time, around* ***80%*** *of these courses are still* ***focused on traditional STEM*** *(Science, Technology, Engineering and Mathematics) disciplines.*
- ***SMEs and large enterprises*** *register* ***wide gaps*** *in terms of continuous vocational training (CVT) and ICT training provided to employees (the difference for ICT training is equal to around* ***50 percentage points*** *in European countries), mainly due to* ***high costs and limited time availability****.*

4.1. Analysis of skills and educational gaps related to digitalization and AI

78. As the integration of Artificial Intelligence continues to reshape various industries, the **demand for a workforce equipped with relevant skills and knowledge** is more critical than ever. The **education and training pathways** necessary to prepare individuals for the evolving landscape of tasks and jobs induced by AI must develop a comprehensive learning model to facilitate this transition. To develop this analysis, extensive data from sources such as the Organisation for Economic Co-operation and Development (OECD) and the International Monetary Fund (IMF) have been examined.

79. In addressing the educational needs brought about by the rise of AI (AI), it is essential to consider the **diverse educational pathways available, each offering distinct features and benefits**. These pathways can be broadly classified into **three** main categories: **academic education**, given that it is expected that all academic paths, even those not related to STEM or ICT specializations, will be enriched with a digital/AI course; **corporate training**, which involves all workers in enterprises which offer AI training and, finally, **non-institutional/non-corporate courses** addressing workers in enterprises which do not offer AI training, as well as the unemployed.

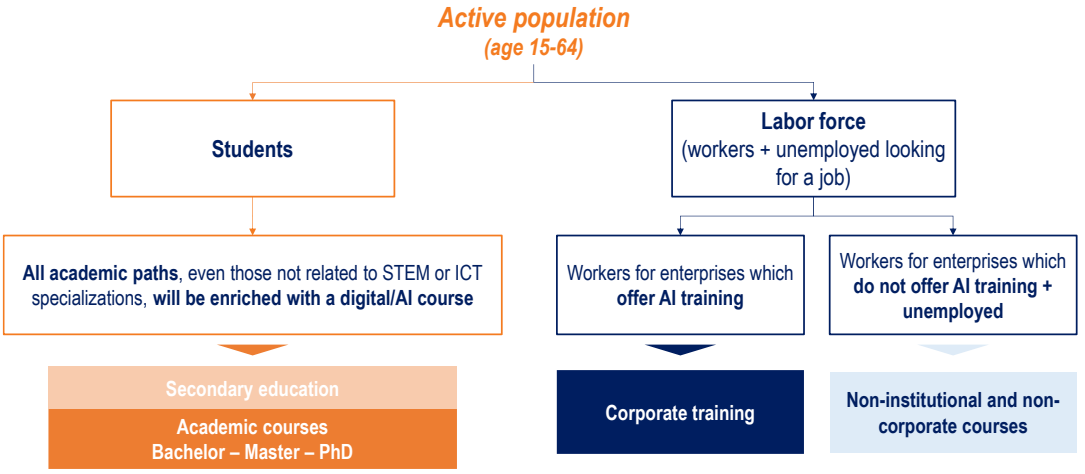

Figure 4.1. Available learning pathways and targeted population. Source: The European House – Ambrosetti elaboration, 2024.

80. **Academic education**, provided by universities and research centers, remains a cornerstone for intensive learning and specialization in AI. These institutions typically lead to **Bachelor, Master and PhD** degrees. They offer a **broad range of programs** focusing on **several different subjects**, providing students with comprehensive preparation to navigate various situations. Within this extensive curriculum, AI typically constitutes only a small portion, since its integration is constrained by administrative standards, resulting in **slower adaptation to emerging trends compared to other educational formats** (for instance, introducing a new course typically requires the removal of others, long validation processes, etc.). These programs are mainly **delivered on-site**, with some hybrid options, and require **significant time commitments**, often

exceeding three years for undergraduate and doctoral studies. While the cost of academic education can be high, many institutions provide scholarships and grants, particularly at the graduate level, to offset these expenses.

81. In contrast, **corporate training** offers a more **flexible and immediate approach to skill development**, tailored to meet the specific needs of businesses. In fact, this type of training usually has a **specific scope**, with each course dedicated to developing a particular skill needed to address a specific situation. Key types of training include onboarding, technical skills and soft skills development, which help integrate new hires and improve interpersonal abilities. Compliance training ensures adherence to legal standards, while leadership and management training prepares future leaders. Additionally, companies can offer health and safety education and professional development opportunities. Finally, **IT and continuous vocational training (CVT) programs** are increasingly important in today's digital landscape. The delivery of corporate training is **predominantly hybrid**, combining online learning modules with practical on-site activities. The **duration** of these courses is generally **shorter**, typically under six months, allowing employees to quickly acquire or update relevant skills. However, as will be highlighted in the paragraphs which follow, the **availability and extent of this kind of training can vary significantly between large enterprises and small- and medium-sized enterprises** (SMEs).

82. **Non-institutional and non-corporate courses**, offered by accredited training bodies and **online platform and programs**, such as IBM SkillsBuild, provide an **accessible and flexible alternative**. These courses are designed to cater to individuals who may not have access to traditional academic or corporate training paths (these may include employees of SMEs, freelancers, job seekers, etc.). They are characterized by a **modular and flexible structure**, focusing on practical, career-oriented skills that are immediately applicable in the workplace. These programs **can vary greatly both in subject content** in which every course focuses on a particular topic and knowledge, and **in length**, from short workshops to courses lasting several months, and are often delivered **entirely online**. This format allows for rapid updates to course content, ensuring that learners receive the most current knowledge and skills. Additionally, **the costs associated with these courses are generally more affordable than traditional academic programs**, making them an attractive option for a broad audience. Nevertheless, in certain countries like the United States, there remains a stigma and reluctance to fully accept online courses as high-quality education. Moreover, publicly funded programs often prohibit or limit the availability of online-only courses.

Course type	Course providers	AI integration in courses	Delivery method	Time commitment	Main targets	Scope	Adaptation speed	Costs
Bachelor	Universities	Limited by administrative standards	Mainly **on site**	**>3 years**	**Students or professionals**	Very wide	Slow adaptation	**High fees**, potentially covered by scholarships
Master	Universities	Limited by administrative standards	Mainly **on site**	**1-2 years**		Mainly wide		
PhD	Universities and research centers	Limited by administrative standards	Mainly **hybrid**	**>3 years**		Mainly wide		**Low fees** and **variable scholarships**
Non-institutional and non-corporate courses	Accredited training bodies and platforms	Modular and flexible	**Online/ on site**	**<6 months**	**People without access to institutional or corporate training**	Specific	Readily adaptable	Typically **more affordable**
Corporate training	Enterprises, trade associations	Modular and flexible	Mainly **hybrid**	**<6 months**	**Employees**	Specific	Readily adaptable	**Variable price** but typically covered by the company

Figure 4.2. Available education and training pathways and specific features. Source: The European House – Ambrosetti elaboration based on European Commission, OECD, IMF and various sources, 2024.

83. Together, these pathways provide a **comprehensive framework for equipping the workforce with the necessary skills to thrive in an AI-driven world**. Each pathway offers unique advantages, catering to different educational needs, time constraints and financial capabilities, thereby fostering an inclusive and adaptable learning ecosystem.

4.2. Estimation of the workforce to be trained for each educational pathway

84. The number of people who must receive instruction was estimated starting from the UN projections determining the total population of six countries up to 2030. It was assumed that this entire population requires education and training. Based on this assumption, and on the three primary training pathways defined above, the population has been classified as follows. Initially, the focus is on estimating the population segment expected to pursue an **academic path**. This involves projecting the annual number of university graduates and adding this to the existing stock of highly-educated individuals as of 2023. Next, the model identifies the group receiving **training from companies**, applying the projected percentage of companies offering training programs to the population not accounted for in the academic path. Finally, the remaining population, not included in either academic or corporate training, is assigned to receive education through **high-quality online courses** provided by various group including independent or non-profit organizations.

85. The magnitude of the effort required to train the workforce **by 2030** is substantial, with **over 450 million workers expected to need some form of training**. Notably, **more than 136 million of these individuals**—comprising approximately 30% of the workforce in the focus countries—will be **outside traditional academic and corporate training pathways**. This significant number highlights the **critical role of non-institutional and non-corporate educational input, such as online courses**, which are becoming increasingly vital in filling the educational gaps left by conventional systems.

86. The groups who will benefit from **academic courses at the Bachelor, Master and PhD levels** include **students and professionals**. The distribution of populations across the three educational pathways shows notable differences among the six countries. **Japan** stands out with the **highest** percentage of the working-age population enrolled in academic courses, at **63.0%**, indicating a strong focus on formal education. In contrast, **Italy** has the **lowest** proportion in this category, with only **21.5%**. The **United States** and the **United Kingdom** share similar figures, both at 49.3%, suggesting a **balanced approach** between formal education and other training forms. **France** follows closely with 44.4%, while **Germany** has 34.0%, highlighting a **moderate engagement** in academic pathways.

87. In addition to academic routes, **corporate training will play a crucial role**. **Germany** has the **highest** participation, with **31.2%** of the working-age population receiving training through their employers. This is notably higher than **France**, which has the **lowest** percentage at **9.1%**, reflecting a lesser emphasis on company-provided training. The **United States (24.7%)** and **the United Kingdom (24.2%)** show **moderate levels** of corporate training, while **Japan (12.8%)** has significantly **lower engagement** compared to the others.

88. Lastly, the population segment relying on **non-institutional and non-corporate** courses is highest in **France**, at **46.5%**, suggesting a **greater reliance** on alternative education sources. **Italy** follows with **42.1%**, indicating a significant portion which will be trained through these pathways. Once again, the **United States** (26.0%) and the **United Kingdom** (26.5%) show **similar and moderate levels**, while **Germany** has a slightly **higher rate at 34.8%**. **Japan**, at **24.2%**, has the smallest proportion of individuals depending on non-traditional education, reflecting the **country's preference for formal and corporate training pathways**.

Course type	Target	US	Japan	Germany	UK	France	Italy
Academic courses	Students or professionals	104.9M people in 2030 (49.3% of the working-age population)	45.1M people in 2030 (63.0% of the working-age population)	18.1M people in 2030 (34.0% of the working-age population)	21.2M people in 2030 (49.3% of the working-age population)	18.4M people in 2030 (44.4% of the working-age population)	7.6M people in 2030 (21.5% of the working-age population)
Corporate training	Employees	52.4M people in 2030 (24.7% of the working-age population)	9.1M people in 2030 (12.8% of the working-age population)	16.6M people in 2030 (31.2% of the working-age population)	10.4M people in 2030 (24.2% of the working-age population)	3.8M people in 2030 (9.1% of the working-age population)	12.9M people in 2030 (36.4% of the working-age population)
Non-institutional and non-corporate courses	People without access to institutional or corporate training	55.2M people in 2030 (26.0% of the working-age population)	17.3M people in 2030 (24.2% of the working-age population)	18.6M people in 2030 (34.8% of the working-age population)	11.4M people in 2030 (26.5% of the working-age population)	19.3M people in 2030 (46.5% of the working-age population)	14.9M people in 2030 (42.1% of the working-age population)

Figure 4.3. Targeted population of every educational and training pathway by 2030. Source: The European House – Ambrosetti elaboration based on European Commission, OECD, IMF and various sources, 2024.

4.3. Mapping of the training offered in the different educational pathways

89. **AI-related academic courses** have grown significantly across all the focus countries, with an average increase of 3.6 times between 2017 and 2023. This expansion includes both **degree and non-degree programs**. In particular, the former, which are the broadest part of the AI academic courses, include **Bachelor, Master and PhD** pathways and grew by 3.2 times between 2017 and 2023. On the other hand, non-degree programs, entailing **short and preparatory courses**, are still the minority, but grew by 6 times compared to 2017 (double the pace of traditional long courses). It should be stressed that only courses delivered in English are considered here, so actual data may definitely be higher.

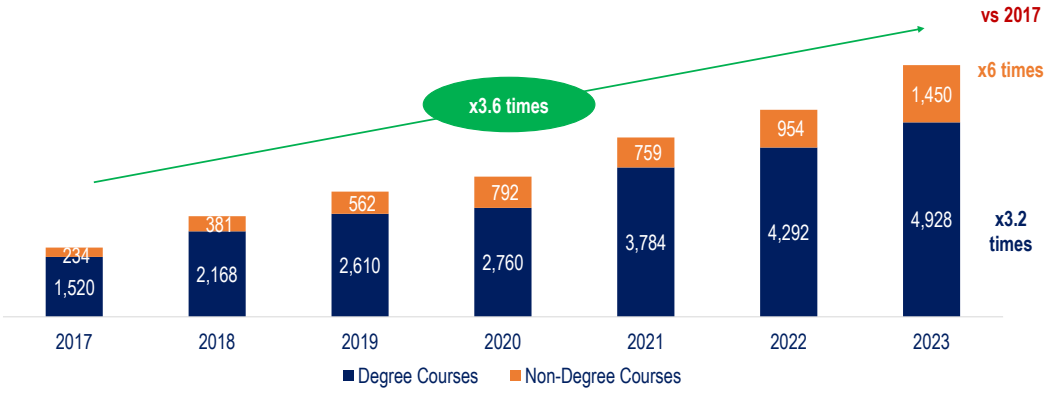

Figure 4.4. AI courses by educational level in OECD countries (number of courses and % variation), 2017-2023. Note: OECD data are extracted from Studyportals, a platform that centralizes information about study programs taught in English around the world. The database feeds from websites and is one of the broadest (over 207,000 programs in 120 countries). All courses belonging to the AI, machine learning, and/or data science sub-disciplines are considered as AI courses. Source: The European House – Ambrosetti elaboration based on OECD data, 2024.

90. Despite this growth, **approximately 80% of these courses remain concentrated within traditional STEM** (Science, Technology, Engineering and Mathematics) **and economics disciplines** (such as Business & Management). This focus reflects a broader trend where AI education is predominantly associated with fields that already possess a strong technical and analytical foundation. However, this narrow concentration presents a significant challenge, considering that the transformative potential of AI is not limited to STEM fields: **it spans a wide range of disciplines**, including the humanities, social sciences, the arts and health sciences. **Integrating AI-related content into these non-STEM academic pathways is crucial for developing a well-rounded, technologically-literate workforce**. **This integration** should not be superficial and **must be customized, segmented and adapted** to the specific educational and professional contexts of each discipline.

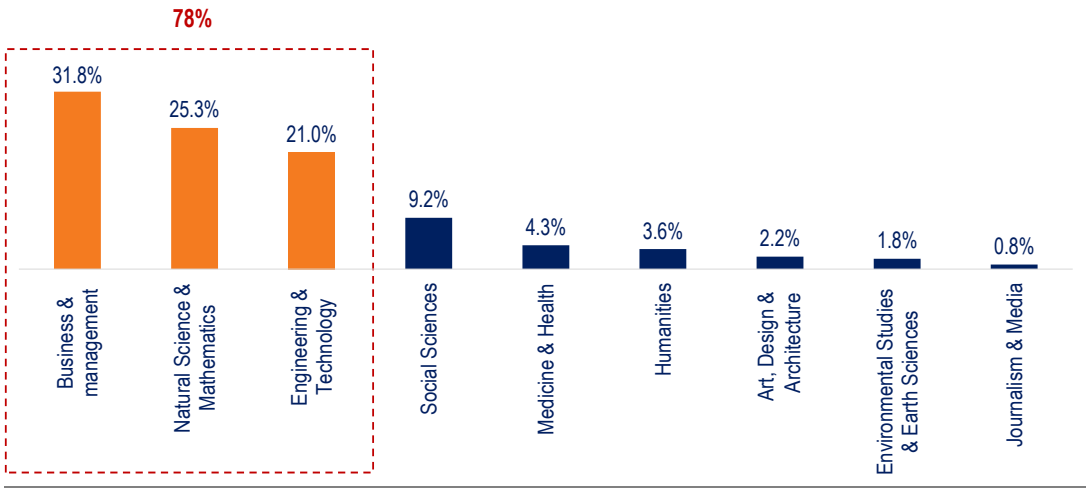

Figure 4.5. AI courses by discipline in the OECD area (% of total), 2023. Note: AI courses considered refer only to courses delivered in English. Source: The European House – Ambrosetti elaboration based on OECD data, 2024.

91. The integration of AI in **social sciences** fosters **interdisciplinary collaboration**, bringing together experts from computer science, statistics, psychology, economics and other fields. This collaboration can lead to more comprehensive research, combining technical expertise with a deep understanding of social issues. For example, AI applications in the **humanities** could include digital humanities projects, automated content analysis and **ethical considerations** of AI technologies. These ethical considerations particularly concern **biases in AI algorithms** and the potential for reinforcing existing social inequalities. **Social scientists play a crucial role** in critically examining these biases and advocating for ethical AI practices that promote fairness and inclusivity.

92. To achieve this integration, **educational institutions must design curricula that are not only inclusive of AI concepts but also tailored to the unique needs of each academic and professional field**. In a context where—in the focus countries—**less than 5% of tertiary education graduates are in ICT disciplines**, this involves developing courses that are accessible and relevant to non-technical students (i.e., those enrolled in non-ICT programs) to ensure that they acquire a foundational understanding of AI and its implications. Additionally, the adaptation process should consider the varying levels of existing knowledge, and the specific competencies required by different career paths. By doing so, **all academic paths, regardless of their traditional focus, can adequately prepare students for a future where AI plays an integral role in virtually every aspect of society**.

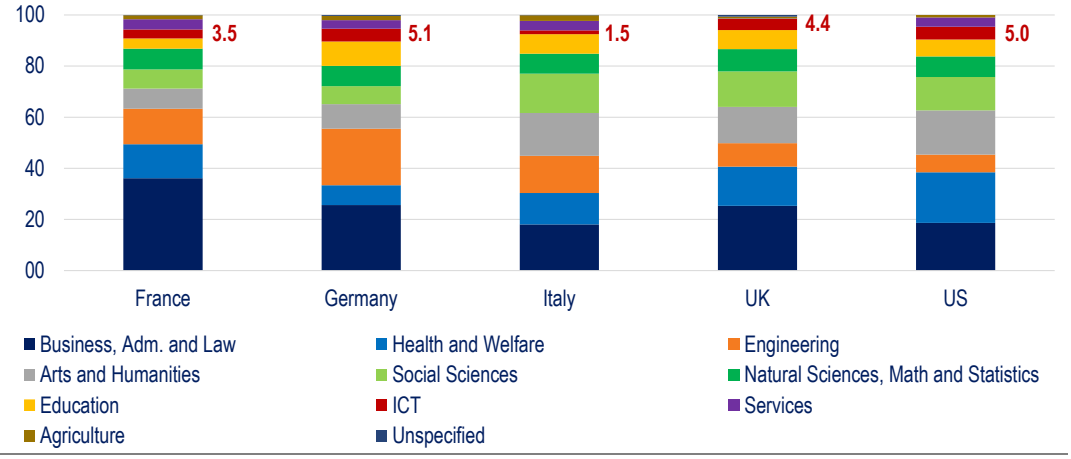

Figure 4.6. Percentage of graduates from tertiary education by program and by country (% of total), 2021. Note: Data for Japan are not available. Source: The European House – Ambrosetti elaboration based on OECD data, 2024.

93. Regarding training provided by **companies**, there is a **gap between small- and medium-sized enterprises (SMEs) and large companies in terms of continuous vocational training (CVT) and ICT training** (the difference for ICT training is equal to around 50 percentage points in European countries), **mainly due to high costs and limited time availability**.

94. In particular, concerning **CVT training**, in the UK, SMEs with 10 to 49 employees have a 13.3 percentage point lower rate of CVT provision compared to large firms, and a gap of 2.8 percentage points for those with 50 to 249 employees. This pattern is even more pronounced in Germany, where small enterprises lag behind by 20.6 percentage points, and medium-sized ones by 7.3 percentage points. Similarly, Spain and France display significant disparities, with SMEs trailing large firms by 27.2 and 27.4 percentage points, respectively, among the smallest firms, and slightly less among medium-sized ones. The situation is particularly stark in Italy, where small companies are 29.4 percentage points less likely to offer CVT compared to large companies, and medium-sized SMEs are 8.4 percentage points behind.

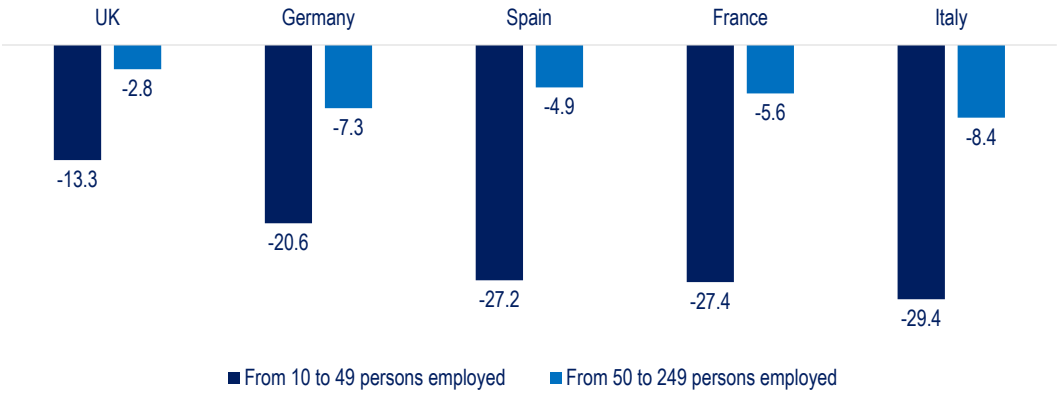

Figure 4.7. Difference between the share of small- and medium-sized enterprises providing continuous vocational training (CVT) and the share of large enterprises (percentage points), 2020.

Note: UK data refers to 2015. Data not available for other countries. Source: The European House – Ambrosetti elaboration based on Eurostat data, 2024.

95. Significant **disparities between large enterprises and SMEs** are evident across European countries also in **ICT training provision**. Large companies consistently offer more ICT training compared to their smaller counterparts. In Germany, 72.6% of large enterprises provide training, in contrast to only 25.8% of SMEs, with a slight decline from 2017. Both France and the UK also show a dominance of large companies in offering ICT education, although both countries have seen a reduction in training provision across all business sizes. The UK mirrors Germany's employee numbers but has double the SMEs, with only 22.2% offering ICT training, decreasing by 2.4 percentage points since 2017. **France reports the lowest commitment to training** across all company sizes, with the most significant decline from 2017. Conversely, **Italy demonstrates a notable increase in training involvement**, with a 13.2 percentage point rise among large companies and a 6.2 percentage point increase for SMEs, though the gap between small and large enterprises remains considerable (65.4% vs. 18.4%).

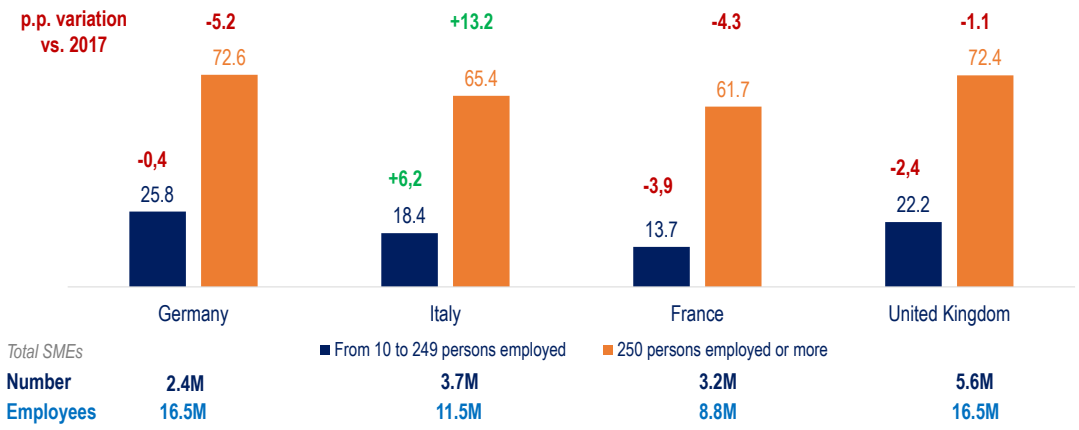

Figure 4.8. Enterprises that provided training to develop/upgrade ICT skills of their personnel by size class of enterprise (percentage of enterprises), 2017-2022. Note: Data not available for the 10-49 and 50-249 sub-categories. Data not available for the US and Japan. Source: The European House – Ambrosetti elaboration based on Eurostat, Statista and UK government data, 2024.

96. **These disparities are primarily driven by the limited resources and capacity constraints** faced by SMEs compared to their larger counterparts. Large firms typically have more substantial financial resources and dedicated training departments, enabling them to provide comprehensive AI training programs. This financial barrier is compounded by the fact that, by their very nature, SMEs find it more difficult to take advantage of economies of scale when investing, including in training-related activities. The **high costs of CVT courses** constitute one of the main reasons for not offering training programs to employees for only **21% of large companies**, but **up to 26% for SMEs**.

97. In addition, the operational dynamics of SMEs further exacerbate this gap. **High workloads and limited availability of staff** mean that SMEs often lack the time and flexibility to participate in or offer continuous vocational training (CVT) programs,

including those related to AI. Employees in smaller firms frequently juggle multiple roles and responsibilities, leaving **little room for additional training activities**. This situation contrasts sharply with larger firms, where more specialized roles and greater staffing levels allow for better distribution of workload, making it easier to accommodate training schedules. The **high workload and the lack of time available** for staff to participate in CVT training is, in fact, one of the main reasons for not providing this type of training for **28% of large companies and up to 30.2% of SMEs**.

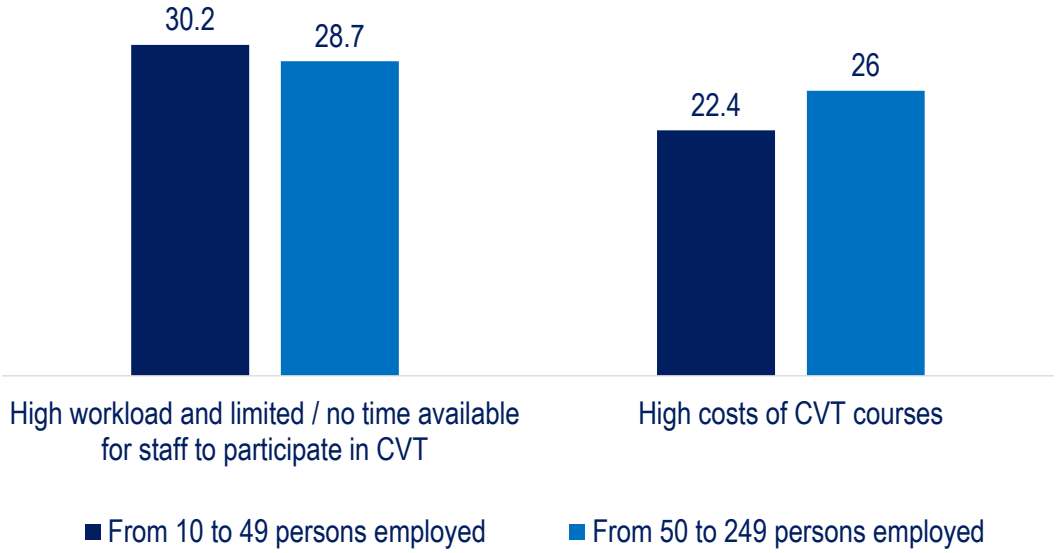

Figure 4.9. Main reasons for not providing CVT training at EU level (% of total of enterprises not providing CVT training). Source: The European House – Ambrosetti elaboration based on Eurostat data, 2024.

98. Finally, the **third training pathway** encompasses all those courses that are **not part of either academic courses or training provided by companies**, and which mainly consists of **online training**. The online platforms offering educational and training programs are quite different both in terms of course structure and topics covered. Some platforms offer academically designed courses, such as **MOOCs** (Massive Open Online Courses), designed to provide **high-quality education on a wide range of subjects**, often taught by instructors from renowned universities and institutions. MOOCs typically include video lectures, reading materials, assignments and interactive forums. They are characterized by their open-access nature and they can range from introductory to advanced levels and **often offer certification upon completion**, making them valuable for career advancement and lifelong learning. E-learning platforms and MOOCs are contributing to the "democratization" of education by making high-quality resources accessible regardless of geographical location. They offer **flexibility, allowing learners to study at their own pace and on their own schedule.**

99. To analyze online platforms and their training offerings in the field of AI, a **comprehensive mapping of the leading e-learning platforms** was conducted. These

platforms were ranked based on a detailed evaluation of their **course offerings**, the **breadth of topics covered** and the **user experience**. This approach made it possible to assess the quality and variety of available content, as well as the ease of access and usability for users. By systematically ranking these platforms, a clear framework was established to identify the most valuable and effective online training solutions available.

100. The customization and segmentation of AI training are crucial to addressing the specific needs of different training pathways. For instance, while traditional academic programs may require comprehensive, theory-based courses, non-institutional online platforms can offer more flexible, practical training suited to immediate workplace applications. This differentiation is particularly important for non-traditional learners, who may benefit from shorter, more targeted programs that can quickly upskill or reskill them for emerging job roles. There are also non-commercial and freely-accessible **programs like IBM SkillsBuild**, which - with more than 1,000 courses - offers a variety of pathways including high school, adult learners and educators, **exemplify the importance of high-quality tailored learning experiences that cater to diverse educational backgrounds and goals**. Among the key features of the IBM SkillsBuild program are the **engagement of trainers**, also through specific courses, the creation of **talent communities** and connection to **career opportunities**, as well as the integration of learning pathways with **project-based learning** (PBL), where learners gain skills by **solving real-world challenges**. All these courses are freely available in more than 20 languages. Moreover, the program allows people to acquire **credentials** in innovative technology areas of high interest to companies, such as AI, but also Cybersecurity, Cloud computing, and workplace skills like Design Thinking.

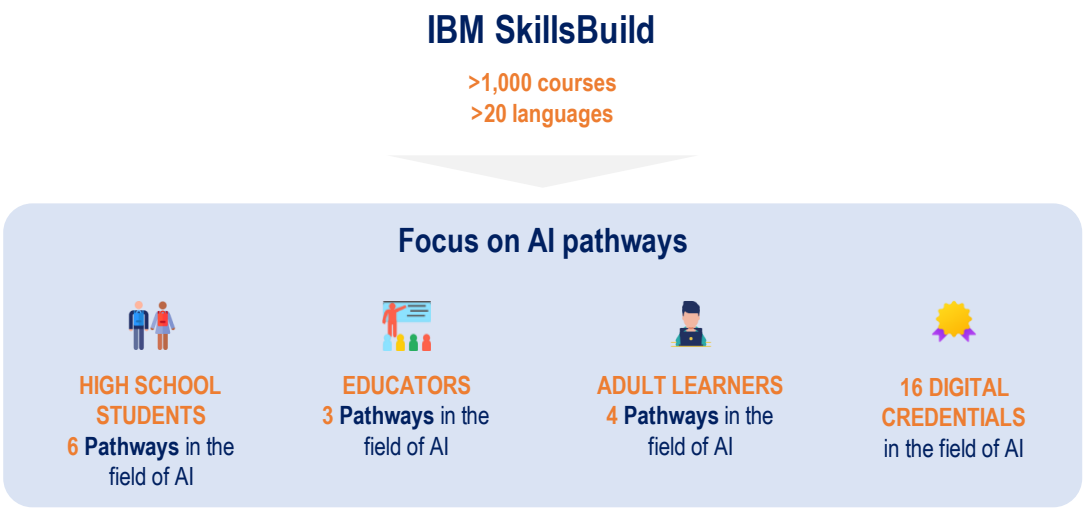

Figure 4.10. IBM SkillsBuild program structure. Note: Data on courses as of July 16, 2024. The analysis includes courses related to AI and Data. Source: The European House – Ambrosetti elaboration based on SkillsBuild data, 2024.

101. Regarding commercial platforms, despite the concentration in STEM, there is a recognized need to integrate AI training across a broader spectrum of academic

disciplines. **The integration of AI into non-STEM areas**, such as the humanities and social sciences, remains limited, representing only about **18-19% of the total courses offered by these platforms**. This gap highlights a critical area for expansion since the influence of AI extends beyond technical fields into various aspects of societal and economic activities. As the demand for digital competencies rises, it is essential that **AI education be customized and adapted to suit a wider array of academic and professional contexts**. Such integration would not only enhance the versatility of the workforce but also **ensure that AI technologies are developed and utilized in ethically sound and socially responsible ways**.

102. Overall, the data highlights the importance of adopting a comprehensive approach to AI education, one that **integrates both technical and non-technical skills**. Such an approach must be tailored to meet the **diverse needs of various learner groups**, from students and professionals to policymakers and the general public. By encompassing a wide range of skills, from coding and data analysis to ethical considerations and societal impacts, as well as AI's use of cases in specific industries and sectors, this inclusive educational strategy is crucial. It will not only **equip the workforce with the necessary technical skills** but also foster a broader understanding of AI's role in society. This holistic education will be essential in preparing individuals to effectively navigate, contribute to, and shape an **increasingly AI-driven world**, ensuring they can leverage AI technologies responsibly and innovatively across different sectors.

CHAPTER 5

The learning model required for the AI transition

The Key Messages of Chapter 5

- *The focus countries are promoting **several strategies and initiatives** to address the AI training challenges in the midterm, with different target categories and funding*
- ***Key policy proposals** have been identified to **promote inclusive access to education and address the need to upgrade skills in the midterm**: manage the deployment of AI in education by defining an adequate development framework; advance vocational education and training (VET) and build multiple career pathways; ensure adequate support to enterprises, especially SMEs; promote literacy on AI at national level and considering the differentiated needs; and facilitate a trusted and participatory framework in the field of AI education and training*

5.1. Mapping of the strategies implemented in the field of jobs, skills, education and training in light of the AI evolution

103. This section of the chapter provides an in-depth analysis of the **various strategies and initiatives implemented by the six focus countries to promote inclusive access to education and address the midterm need for skill upgrades in response to AI's rapid evolution**. In fact, the focus countries are actively pursuing several approaches to tackle the **challenges posed by AI in both the workforce and education** sectors. While each country has embarked on multiple initiatives, the analysis highlights significant differences in the strategies employed. These differences are evident in the diverse approaches taken, the range of stakeholders involved, the specific target groups addressed and the varying levels of financial resources allocated. This chapter maps out the **national strategies with greatest impact**, including some that were recommended by members of the Advisory Board, and offers a comprehensive overview of how these nations are navigating the complexities of AI-driven change.

104. Starting from the **United States**, this country is particularly committed to developing technical knowledge and strengthening the relative educational needs. It is estimated that the US invests $12 billion annually in STEM education. In addition, it has implemented a range of policies to strengthen AI education, including on an academic level, by focusing on STEM pathways. Particularly in the period between 2018 and 2023, a **STEM education strategic plan** was in force. The plan was to improve the education of STEM subjects in the US by first strengthening the foundations of already-established STEM subjects in schools and then increasing the pool of potential STEM students. Finally, to ensure the effectiveness of the program, the education system was brought into line to **fulfil workforce demands**. Key aspects of the plan were to promote hands-on learning and advanced computational literacy. Moreover, to ensure that adequate progress was being made toward the goal of having a well-prepared STEM workforce for the future, the **plan was federally coordinated** and evaluated by the federal government.

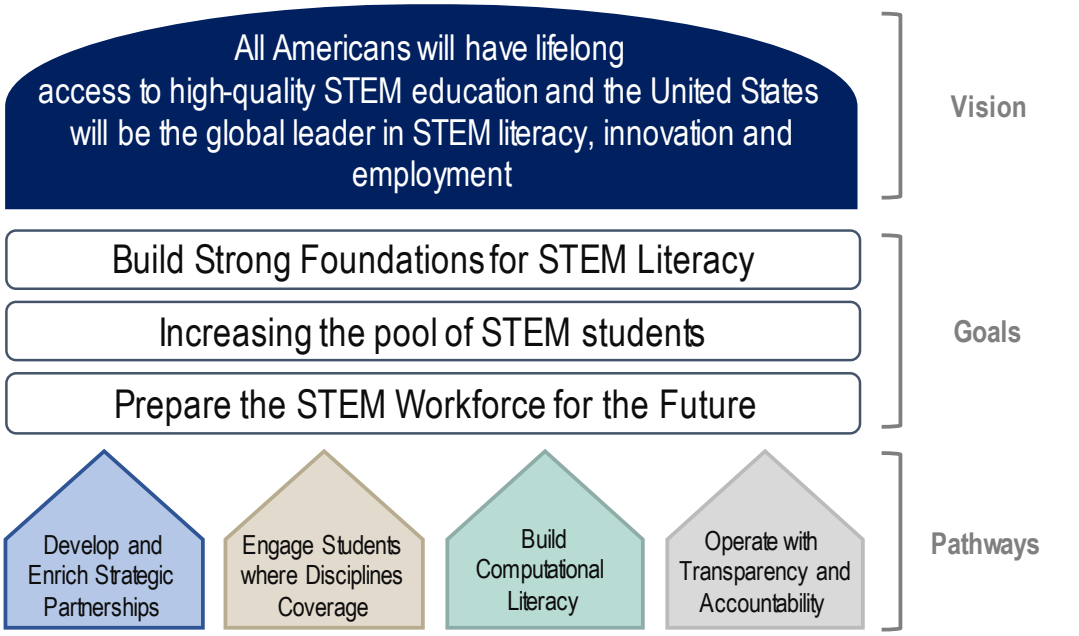

Figure 5.1. Vision, goals and pathways of the federal 5-Year STEM Education Strategic Plan implemented between 2018 and 2023 by the United States. Source: The European House – Ambrosetti elaboration based on OECD.ai data, 2024.

105. In 2018, **Japan** established the "**Council for Social Principles of Human-centric AI**" under the AI Strategy Expert Meeting for Strength and Promotion of the Innovation, for the purpose of examining the basic principles for implementing and sharing AI in a better way and reflecting it in AI strategy. In 2019, the government's Council for the Promotion of Comprehensive Innovation Strategy formulated the "**AI Strategy 2019**", and packaged a wide range of policies, including human resource development, research and the development, social implementation in each field, and venture support, into a national strategy to realize an "AI-ready society." Since then, the overall picture and process management of AI-related policy initiatives have been updated annually until "AI Strategy 2022," which has been the driving force for promoting and monitoring policy. In 2023, Japan further advanced its strategic approach in education by introducing **comprehensive guidelines for the use of AI in educational institutions**, including schools and universities. These guidelines are aimed at **enhancing the understanding of AI among both teachers and students**, ensuring that they are equipped with the knowledge to navigate and leverage this transformative technology responsibly. Additionally, the guidelines set **clear limitations on AI usage by students**, driven by concerns over potential copyright infringements and the broader ethical implications of AI in the educational context. This strategic evolution underscores Japan's commitment to not only advancing AI technology but also ensuring its responsible integration into society, particularly in the realm of education.

106. **Japan** also leverages **online training platforms** to expand AI education, with a notable example being the **Japan Deep Learning Association**'s adoption of Coursera's "**AI for Everyone**" course directed by Professor Matsuo. The Japan Deep Learning Association

(JDLA) is a non-profit organization founded in 2017 to promote the **adoption of AI and deep learning technologies in Japan**. It offers certification programs like E-DLX (Deep Learning for ENGINEER) and G-DLX (Deep Learning for GENERAL) to standardize skills, facilitates industry-academia collaboration and supports AI talent development. JDLA also organizes conferences and advocates for ethical AI practices, with the aim of enhancing Japan's competitiveness in AI-driven industries.

107. The course, which has already reached 600,000 students globally, provides a comprehensive introduction to AI, covering its applications, practical uses and the basics of machine learning and neural networks. By equipping learners with this foundational knowledge, the course is designed to safeguard future business opportunities by ensuring a broad understanding of AI's role in various industries. In addition to **technical content**, the course addresses **ethical concerns** and their potential **impacts on industry and business**, making it suitable for individuals from diverse backgrounds, including those in STEM fields, the humanities, or any professional sector. "AI for Everyone" is accessible free-of-charge, with an option to purchase a certificate upon completion. The course's primary objectives are to **promote AI literacy** on a global scale, foster **inclusivity in AI education**, encourage **innovation in AI applications** and **prepare** learners for the **evolving economic landscape** shaped by AI.

108. Moreover, in 2021 the Cabinet Office, Ministry of Education, Culture, Sports, Science and Technology (MEXT), and Ministry of Economy, Trade and Industry (METI) established the **Mathematics, Data Science and AI Smart Higher Education (MDASH) Programs Certification System** with the aim of achieving the goal "all humanities and science students of universities and colleges of technology should master introductory-level mathematics, data science and AI in their schools".

109. In addition to this, the Information-technology Promotion Agency (IPA), with the goal of nurturing talents and professionals for the digital age, has released "**i Competency Dictionary (iCD)**" as a structured dictionary composed of the "Task Dictionary" and the "Skill Dictionary". The iCD is the result of the IPA investigation about the ideal way of the skill standard in the IT human resource development. The iCD suggests Tasks, Skills, Rolls, and Jobs needed for not only the conventional business model such as system integrator but also the new age business models such as security, cloud, and data science. IPA has also established the **Common Career/Skill Framework** to serve as a reference model for the Information Technology Engineers Examination (ITEE) and three skill standards (ITSS, ETSS and UISS[9]), thus developing world-class IT human resources.

110. Finally, the Japanese government has deemed the traditional education system inadequate for teaching future generations about AI and, therefore, has decided to remedy this issue by introducing **education reform to update the curriculum and**

[9] Skill Standards for IT Professionals (ITSS), Embedded Technology Skill Standards (ETSS), Users' Information Systems Skill Standards (UISS).

address the AI skills shortage.[10] However, the Japanese government is having difficulty finding enough skilled people to teach in schools about the practical aspects of AI. The **growing need for skilled workers in AI** and other technology sectors calls for new educational approaches that focus on digital literacy and problem-solving abilities. For instance, the **Digital Literacy Council** is a public-private partnership conference founded in Japan in April 2021 by the Japanese government. The Council founded the **"Di-Lite" initiative**, whose goal is to develop a system to nurture professionals and promote **DX** (Digital Transformation) **implementation** through agile methods. This council defines "Di-Lite" as **fundamental digital literacy that all business professionals should possess** across three domains: IT/software, mathematics/data science and AI/deep learning.

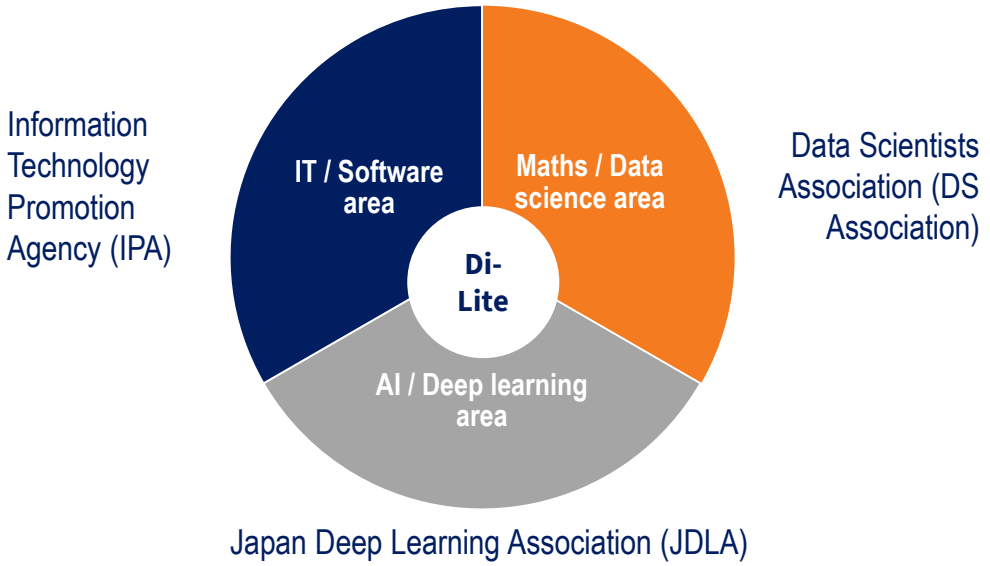

Figure 5.2. Di-Lite language literacy structure and the relative supporting associations. Source: The European House – Ambrosetti elaboration based on Japan Deep Learning Association data, 2024.

111. Moving to Europe, several different initiatives have been implemented at the European Union level to **spread inclusive access to education and training and support the digital transformation**, as well as promote transnational collaboration. For instance, the EU put into effect the **AI4VET4AI**, an initiative focused on **integrating Artificial Intelligence into vocational education and training (VET) systems**. The program aims to equip students and professionals in vocational fields with the skills needed to work with AI technologies, thereby enhancing their employability and supporting industries that are increasingly reliant on AI. Additionally, AI4VET4AI seeks to **leverage AI to improve the efficiency and effectiveness of vocational training itself**, making the educational process more adaptive and tailored to individual needs.

[10] OECD, *Internet literacy in Japan*, 2015. JDLA, *Study Group "AI governance and its Evaluation" Report on the Session #5(Phase Ⅱ)*, 2022.

112. Another project linked to the improvement of educational pathways and their adaptability to the modern working environment is the **EULEP** (European Learning and Employment Partnership). EULEP aims to **bridge the gap between education and the labor market across Europe**. It focuses on aligning educational programs with industry needs, promoting cross-border mobility for students and workers, and fostering innovation in teaching methods. By supporting lifelong learning and upskilling, EULEP ensures that **individuals are well-prepared to succeed in an evolving job market**, particularly in emerging sectors like technology and AI. The program typically involves collaboration between educational institutions, industry partners and AI experts to develop curriculum content, training modules and tools that incorporate AI. This initiative reflects the broader trend of **integrating AI across various sectors to ensure that the workforce is prepared for the demands of the future economy**.

113. On June 16, 2022, the EU Council adopted a **Recommendation on a European approach to micro-credentials for lifelong learning and employability** (2022/C 243/02). This initiative supports micro-credentials, which **certify short-term learning experiences and provide flexible education for essential skill development**, while highlighting the importance of establishing common quality and recognition standards. Micro-credentials can enhance education, training, lifelong learning and employability systems, playing a key role in advancing EU policy initiatives for digital and green transitions. They are expected to **support the Digital Education Action Plan 2021-2027** by offering flexible, accessible learning opportunities for digital skills, and contribute to the **goals of the "2030 Digital Compass" plan by fostering a digitally-skilled population and highly-skilled digital professionals in Europe by 2030**.

114. Furthermore, the EU Council Recommendation of 16 June 2022 on **Individual learning accounts** (2022/C 243/03) is a European Union initiative aimed at **promoting access to lifelong learning for all citizens**. The idea behind individual learning accounts is to facilitate the acquisition of **new skills and professional development** throughout life, responding to changes in the labour market, technological innovation and the needs of a changing society. The primary objective of the Recommendation is to make lifelong learning an **accessible reality for all EU citizens**, thus contributing to improving employability, productivity and social cohesion within the Union. Furthermore, this initiative aims at **reducing the skills gap**, support the dual transition (green and digital) and address demographic challenges. This initiative is a step towards building an economy and society based on **knowledge and lifelong learning**, promoting social inclusion and individual well-being.

115. **Two other recommendations** of the EU Council should also be mentioned: firstly, the EU Council Recommendation of 23 November 2023 on **Key Enabling Factors for Success in Digital Education and Training** (C/2024/1115) focuses on enhancing and adapting education systems for the digital age. The main objective of the Recommendation is to assist Member States in creating a **favorable environment for digital education**, ensuring that every individual can develop skills necessary for the future of society. This

initiative is in line with the EU Digital Strategy, which aims to make Europe a **global leader** in digital education and skills. The second EU Council Recommendation of 23 November 2023 (C/2024/1030) **on improving the provision of digital skills and competences in education and training** aims to promote the **improvement of the supply of digital skills** in education and training among the countries of the European Union. It also highlights the need to enhance basic and advanced digital skills among students and teachers by adapting curricula and supporting digital literacy. Furthermore, it emphasises the importance of ensuring safe use of digital technologies, addressing issues such as the use of AI and the digital divide between different social and geographical groups.

116. Focusing on country-level initiatives, the German **policy strategy** concerning **education reform** encompasses several possible solutions and initiatives with the goal of **improving formal training and education in AI, with an emphasis on the development of educators**. One of these policies was related to the launch of "**AI campus**", **a platform freely-accessible to students and professionals** that addresses the shortage of skilled workers and promotes a deeper understanding of AI. The platform includes basic and specialized courses, supports integration into academic and corporate settings, and emphasizes networking among users and experts.

117. Again related to including AI courses in traditional education pathways also at secondary education levels, the German Ministry of Education has supported a program named **AI4Schools**. It is a future-focused program that aims at **introducing AI and machine learning-related topics as well as practical skills in the usage of AI**. The course targets **high school students** between the ages of 15 and 19 and brings together different sectors of institutions such as schools, businesses, organizations and other advocates of digital education. AI4Schools aims to **go beyond simply educating students about AI** and is also designed to inform students of different aspects of **critical thinking, creativity, problem-solving and ethical considerations regarding AI**. AI4Schools is a two-day course for both students and teachers and is taught by AI experts.

118. Related to the working environment and the difficulties of providing training to employees, Germany's Federal Ministry of Labor and Social Affairs (BMAS) has launched the "**Hubs for Tomorrow**" program to **help small- and medium-sized enterprises (SMEs) adapt to AI and digitalization**. This initiative, deployed at the regional (Länder) level, aims to support companies and workers in navigating demographic, ecological and technological changes. The "Hubs for Tomorrow" program is **designed to transform the economy and workplace by introducing digital and AI-based technologies**. It emphasizes human-centered AI systems, ensuring that employees are actively involved in this transition, which promotes a more inclusive and future-ready workforce. Recognizing the importance of SMEs, the program encompasses **regional hubs** that provide targeted support for the digital evolution of the workplace. Since its **launch in 2021**, it has initiated **13 projects** with a substantial **annual budget of $20–$50 million**,

underscoring Germany's commitment to ensuring that SMEs thrive in the evolving AI landscape.

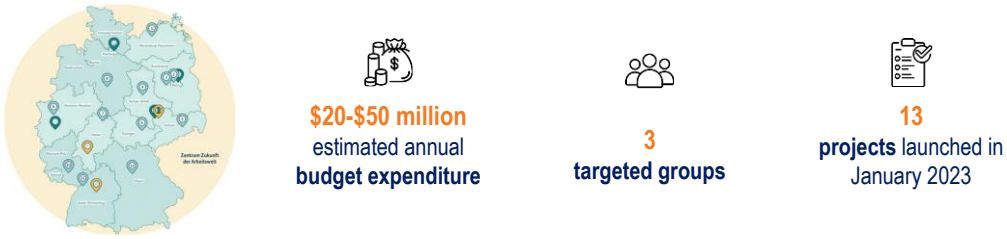

Figure 5.3. Hubs for Tomorrow project launched in Germany and main KPIs. Source: The European House – Ambrosetti elaboration based on Japan Deep Learning Association data, 2024.

119. Finally, Germany has launched the "**Civic Coding – Innovation Network AI for the Common Good**" initiative, in collaboration with community, science and business stakeholders, to promote the **social, sustainable and participatory development of AI**. To support the social application of AI, the federal government established **three platforms**—Civic Innovation Platform, Civic Data Lab and Eco AI Lab—**both online and physical**, to engage **individuals and stakeholders in AI projects and courses**. These platforms aim to foster knowledge sharing and encourage efforts to tackle pressing challenges such as climate change. Civic Coding expands on the Future Fund approach by promoting AI skills and driving social and sustainable AI innovation. With an **annual budget of €1-5 million, the initiative seeks to build a strong innovation network** that supports the common good-oriented development and long-term use of AI, including generative AI.

120. The **United Kingdom** has also recognized the importance of **Artificial Intelligence to increase resilience, productivity, growth and innovation** within the UK economy. As part of the previous government's industrial strategy £1 billion was invested as part of the "**Artificial Intelligence Sector Deal**" to support the private sector. Then in 2023, to encourage the transition towards a more AI-focused economy, the then government announced investments of more than £2.4 billion to fund a **National Artificial Intelligence Strategy**.

121. The Artificial Intelligence Sector Deal was an agreement between the UK government and the AI sector to boost the UK's global position as a leader in developing AI technologies. It was **part of the Industrial Strategy which consisted of five pillars**. First of all, raising R&D investment up to 2.4% of GDP by 2027. Secondly, investing £406 million in skills, including math, digital and technical education, helping to address the shortage of STEM skills. Third, investing £20 billion in the business environment encouraging innovation in high-potential businesses. The fourth pillar was focused on creating a new Transforming Cities Fund that will provide £1.7 billion for intra-city transport. The last pillar involves infrastructure and aims to support the National Productivity Investment by providing £31 billion in transport, housing or digital infrastructure.

122. Specifically in the field of skills, the UK has taken steps to increase the AI workforce through **conversion courses offered to STEM and non-STEM graduates**. The courses typically cover fundamental and advanced topics in AI and data science, equipping students with the necessary skills to pursue careers in these areas. The UK's Office for Students has supported **7,600 students** to enroll in AI and data science postgraduate conversion courses. A total of **37 postgraduate conversion courses in AI and data science** were delivered across **28 universities**. The UK government also allocated **£13.5 million in 1000 scholarships** assigned to women, black students and disabled students, among other groups considered to be underrepresented in higher education. This initiative is part of the broader government strategy to ensure the UK has a workforce capable of driving and supporting advancements in AI and data science, fields that are critical to the country's future economic growth and technological innovation.

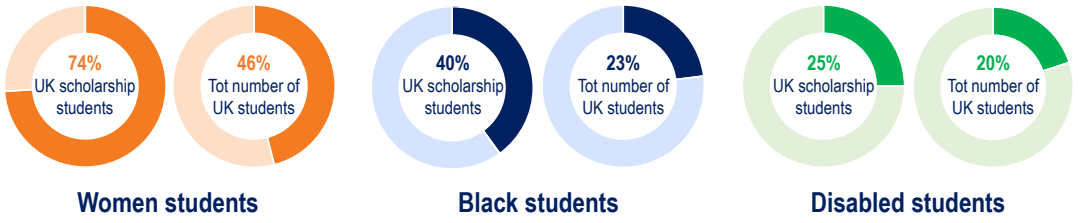

Figure 5.4. Scholarships assigned in academic year 2020-2021 to minority representatives in STEM education pathways who attended the AI and Data Science postgraduate conversation courses. Source: The European House – Ambrosetti elaboration based on Office for Students data, 2024.

123. More recently, the National AI Strategy of the previous government, has sought to **further build on the AI Sector Deal**. The 2021 Strategy was built on **three assumptions** about the coming decade. The first is that the key **driver of progress** in many different sectors like data computing and finance will arrive through AI, meaning that having a more developed AI industry would give a major advantage in these other industries. Secondly, AI will become much **more mainstream in the overall economy** and, thirdly, the government and regulatory bodies will have to **adapt quickly to the fast-changing demands** of AI. With these major investments, the then UK government hoped to fulfil the long-term needs of the AI ecosystem in the country to ensure the UK's leadership as a science and AI superpower; support the transition to an AI-enabled economy ideally capturing the benefits of innovation; and obtain national and international governance on AI technologies to protect the fundamental values of the nation.

124. Within the context of the Strategy, the previous UK government also committed to **support SMEs to implement AI training** for their own employees. More specifically, it invested **£6.4 million in the Flexible AI Upskilling Fund** to sustain SMEs to pay for AI-technology skills-based training (and not to purchase AI technology). This Fund pilot scheme covers up to **50%** of the cost of AI skills training. Around 2,000 SMEs were expected to be awarded these grants, if they meet certain eligibility criteria, with funding

available for the 2024-2025 financial year. This funding supports training that helps employees expand their technical skills and understanding of AI to develop, deploy or use AI in their jobs.

125. **France** is another European country that has developed its **own National Strategy for AI**. In 2021, this strategy was implemented as part of the broader "**France 2030" plan**, aimed at **fostering the growth of the AI ecosystem** at a national level through a public-private partnership. The strategy focuses on three key areas: improving the nation's AI-related skills; positioning France as a leader in embedded and trustworthy AI; and accelerating the integration of AI into the economy. The plan is structured around two main objectives: **doubling the number of AI specialists in France by 2030 and supporting the digital transformation of French SMEs**. Over the next five years, the national AI strategy intends allocating a total of **€2.22 billion to AI**, including €1.5 billion in public funding and €506 million in private co-funding.

126. The French strategy to **include AI in educational systems** focuses on creating an inclusive, ethical and forward-looking framework. It emphasizes the development of a clear, system-wide vision that prioritizes equitable access, ethical governance and the enhancement of learning outcomes. Key initiatives include **empowering teachers** through targeted training programs, **integrating AI literacy and competencies** into curricula and promoting research and innovation in AI applications for education. The strategy also stresses the importance of **human-centered AI deployment**, ensuring transparency, fairness and data privacy in educational tools. Coordination at both national and European levels is vital, aligning local initiatives with broader international guidelines. Overall, the approach seeks to **prepare educators and students for an AI-driven future** while safeguarding ethical standards and fostering innovation in educational practices. The French government emphasizes the importance of balancing technological advancements with ethical considerations and ensuring that AI contributes positively to educational equity and quality.

127. In addition, to sustain AI integration in the working environment, France can leverage the **Compte Personnel de Formation** (CPF) introduced in January 2015. This is a public financing system allowing **workers over the age of 16 to acquire additional skills or improve existing ones**. The Compte Personnel de Formation (CPF), or Personal Training Account, is a **French program that allows individuals to accumulate credits for vocational training throughout their working life**. It aims to give workers more control over their professional development by funding training that enhances their skills and employability. Every employed person in France, including employees and self-employed individuals, **earns credits on their CPF annually** and these credits can be **used to finance various accredited training programs**, ranging from skill development courses to certifications. The CPF is part of a broader effort by the French government to encourage lifelong learning and adapt the workforce to the evolving demands of the labor market. In the field of AI, there are five available courses: Live Mentor artificial intelligence training; the CPF artificial intelligence training École Cube that provides a mix of

theoretical instruction and practical AI applications; the Training IA CPF Clic-Compétences, offering flexible and customized artificial intelligence training with courses taught by experienced professionals in AI; the Wild Code School generative AI training; and the CPF Training IA Chatgpt M2iformation, available both in-person and online.

128. Finally, like many other countries, **France** is facing a major issue about AI evolution, which is **society's skepticism and lack of awareness** on the topic. In fact, in France, **AI is seen more as a threat to jobs** than a boost to create new jobs opportunities. This **fear of rapid change** is the reason why the French Digital Council decided to propose the concept of "**Café AI**". The aim is to reach the general public across France to have it **become familiar with AI and its impact**, and debate and demystify certain misconceptions about AI. This initiative has the potential to **involve millions of French citizens from various ages and backgrounds**. When aiming to transform mindsets, training becomes more (or only) effective if it is preceded by a **comprehensive understanding of the topic**.

129. Finally, the last country of interest in the study is **Italy**, which has implemented a range of initiatives and strategies to promote the potential of AI and integrate specialized training courses into academic, corporate and online educational platforms. The main policy tool provided is the national AI Strategy. **Italy's AI strategy for 2024-2026** aims to **position the country as a leader in the development and adoption of AI** by focusing on four key objectives: fostering the creation and implementation of AI solutions that enhance productivity and innovation across various sectors; promoting advanced scientific research to ensure Italy's competitiveness on the global stage; creating an environment conducive to AI growth through education, training and public administration modernization; and ensuring that AI development adheres to ethical, anthropocentric and sustainable principles in line with European standards. This strategy seeks to **leverage AI to not only boost Italy's economic performance but also improve social well-being and maintain the nation's distinct cultural identity.**

130. Within the education objectives, a significant role in the strategy is played by the **National Doctorate in AI**, with the goal of **boosting research and industrial and social innovation**. The National Doctorate in Artificial Intelligence is divided into **five** federated doctorates, **each for an area of specialization** in a strategic field of AI development and application, that bring together 61 universities and research institutions. The focus areas are: Health and Life Sciences, headed by the Bio-Medical Campus University of Rome; Agrifood and Environment, headed by the University of Naples Federico II; Public Administration, headed by the Sapienza University of Rome; Industry, headed by the Polytechnic University of Turin; and Society, which is headed by the University of Pisa. The strategy aims to **build a nationwide community of young AI researchers to drive innovation in Italy**. By encouraging PhD student mobility and interdisciplinary collaboration, it will strengthen the national AI research network and align with European initiatives such as the "**Towards a vibrant European network of AI excellence centres**" program.

131. To improve the national digital competences, the Italian Department of Digital Transformation also promoted the "**Repubblica Digitale**" initiative. This national strategic initiative aims to combat the cultural digital divide present in the Italian population, support maximum digital inclusion, and foster education on the technologies of the future. Fundamental to the achievement of this goal is the activity of the **National Coalition for Digital Competencies**, composed of the **public and private players** that adhere to the **Manifesto** for the Digital Republic, proposing concrete actions, capable of producing measurable and quantifiable results.

132. Also regarding the strengthening of educational programs, the Italian Ministry of Education has launched the "**Scuola Futura**" and "**Poli Formativi**" projects to **enhance AI skills within teaching**. The two programs are both delivering courses addressed to **teachers, trainers and school staff**. On one hand, Scuola Futura is an institutional platform providing around 40 courses dedicated to AI, targeting teachers from primary to secondary level. Poli Formativi, on the other hand, regards 52 poles dedicated to training at both national and local level, promoting courses for the digital transition and the dissemination of digital teaching and innovative tools.

133. Other Italian initiatives linked to the educational environment and launched at local level are "**Lucy**" and "**IA Costruire il futuro**". **Lucy is a STEM educational project** that was developed with the aim of creating an AI secondary school curriculum. The project proposes an **interdisciplinary approach** that integrates technical thinking with the humanities. **IA Costruire il futuro** is an **agreement among 55 educational institutions** in the Friuli-Venezia Giulia Region, through which they commit to increase **collaboration in the tasks of training staff and creating guidelines on the usage of AI for educational purposes**, with the goal of developing a common resource that is easily accessible and understandable for all participating schools.

134. Finally, Italy has also implemented several initiatives to tackle the problem of the lack of technical skills in the working environment. Particularly, the **AI4Industry Foundation** was presented on May 3, 2024, in Turin, to **perform transformative research in AI to support innovation, industrial transformation and economic growth**. The Foundation aims to attract young talented entrepreneurial scientists who will create major impact and evolution in the intersection of science, innovation and industrial transformation. In addition, in response to the employment needs and the demand for reinforcement of the skills of companies operating in large and strategically important supply chains, the **Piedmont Region** is promoting a new educational-organizational model: **the Supply Chain Academy**. The intent is to **complement and complete the more traditional training** authorized and financed by the region by directly involving enterprises in the regional training system.

135. In addition to the six focus countries of the study, many other nations are implementing strategies, tools and programs to spread awareness of the potential of AI in the workplace and the importance of training the current and future workforce, of any economic sector,

on digital issues from an early educational stage. Of these, one country particularly at the forefront is **Singapore**. Its **Guide to Job Redesign in the Age of AI** offers a comprehensive framework for businesses to navigate the transformative impact of AI on the workforce. It emphasizes the **need for organizations to understand how AI is reshaping industries** and to **proactively redesign jobs** to optimize productivity and job satisfaction. The guide outlines a systematic approach to identifying **tasks that can be automated or augmented by AI**, while redefining roles to leverage human strengths. It also highlights the critical **importance of upskilling and reskilling employees**, encouraging companies to invest in training that prepares workers for evolving roles. Through case studies and best practices, the guide demonstrates successful AI integration, **providing a blueprint for other businesses to follow**. Importantly, it advocates for a **human-centric approach, ensuring that AI enhances, rather than replaces, human work to foster a balanced and inclusive workplace**. This guide serves as a key resource for Singaporean businesses aiming to harness **AI's potential while ensuring their workforce remains adaptable and engaged in the face of technological change**.

136. In conclusion, various **international organizations** have also already mobilized to urge and encourage training in the integration of AI and its use in various fields of everyday life, **promoting collaboration between states**. One of these main organizations is **UNESCO**. Its strategy for AI in education emphasizes the development of a **comprehensive, ethical and inclusive approach to integrating AI into educational systems**. It advocates for policies that prioritize equitable access, ethical governance and interdisciplinary planning while **aligning AI applications with human-centered values**. Key initiatives include empowering teachers through targeted training, preparing students and citizens for an AI-driven future and promoting AI literacy. The strategy highlights the need for AI systems that promote equity and inclusivity, address biases and adapt to diverse socio-economic contexts. Additionally, it calls for **fostering global cooperation, supporting local AI innovations** and establishing **continuous monitoring and evaluation mechanisms** to guide effective AI integration in education. The overall vision is to leverage AI as a tool for social good while ensuring its responsible and equitable use in educational contexts worldwide.

5.2. Policy proposals to favor the optimization of the skills ecosystem

137. Considering the various strategies that the focus countries have implemented to **integrate AI into their training pathways**, including the application of AI into humanistic and technical subjects in high schools and academic careers, the adoption of corporate training programs and online platforms to educate about AI, the following **key policy proposals** emerge from this overview. These proposals are designed not only to build on successful initiatives but also to address existing gaps. They aim to ensure that those entering the labour market have the AI skills they need to succeed, that the workforce of any sector of the economy is equipped with **future-ready skills**, and to support enterprises—especially those facing difficulties in providing necessary training—to help develop the digital skills needed to navigate the AI evolution.

AI in Education.

138. AI creates new opportunities for individuals, workers, and students to continue upskilling, reskilling, and engaging in lifelong learning to gain the skills needed to work alongside these new tools. Policymakers should enable the deployment of AI in education by creating clear strategies, funding, and guidance to embed AI at all levels of the education system. To be resilient and benefit from developments in AI, individuals need a combination of technical but also human-centric skills such as critical thinking, creativity, problem-solving and ethics.

139. To effectively prepare the upcoming workforce for an AI-driven future, it is essential to define clear guidelines for introducing AI concepts and related practical skills in schools. In this context, it is critical that the deployment of AI in education is done in partnership with teachers and educators. Teachers should be actively involved in co-creating applications and **defining curricula** to ensure these skills are effectively integrated. Moreover, we also encourage policymakers to work with private sector partners to ensure educational institutions are equipped with adequate people management capacity, **digital training for teachers and trainers, and ICT readiness, including connectivity and hardware, to support these initiatives**. Collaboration with companies is also essential to have a clear understanding of the AI skills needed on the labour market.

Advancing VET and Building Multiple Career Pathways.

140. Promoting enrollment in vocational education and training (VET) programs and building career pathways related to AI is crucial for advancing a skills-based economy and ensuring workers are equipped to effectively use AI tools. Despite improvements in the last decade, vocational programs in some countries **remain underfunded and their availability is asymmetrical compared to higher education and STEM fields**. To address this, employers, governments, and education providers collectively need to challenge the assumption that the beginning of a career is always on a college or university campus. College degrees are one pathway among many to a rewarding career. Employers should ensure more pathways lead to high value careers and not merely entry-level jobs. Employers can do this by focusing on their employees' possible career pathways, not just the immediate job in question. Policymakers should: increase support for skills development, multiple career pathways, and skills-based hiring; focus on worker upskilling and reskilling; and expand government financing for short-term skilling programs. Furthermore, targeted communication and awareness campaigns, as well as collaboration with specific governmental agencies, are necessary to raise the profile of VET and varied career pathways in the AI context. In higher education, more investments in AI related experiential learning funding should be envisaged. With 78% of AI courses currently clustered in STEM programs, expanding AI education to diverse academic fields is essential. **Finally, aligning the length and pace of university degrees with the evolving socioeconomic landscape is key to ensuring their continued relevance and effectiveness**.

Supporting SME enterprises.

141. In order to maximize the benefits of AI in the workplace, it is essential to provide clear guidance on the evolution and opportunities that AI brings, while ensuring incentives opportunities for AI-related training activities. Incentives should be tied to programs and courses that adhere to specific standards to maintain quality and relevance. Additionally, promoting the assessment of digital and AI skills, both in terms of current capabilities and future needs, is crucial for defining effective skill development programs.

142. To support innovation and collaboration, it's important to **enable peer learning and easily accessible opportunities for SMEs** to upskill their staff, given the limitations in terms of time and resources. Among European countries, small- and medium-sized enterprises providing CVT training are, respectively, 21.4% and 5.8% less compared to large companies. A similar situation occurs in the development of ICT skills where only 20% of SMEs on average provide training in this area compared to 68% of large companies.

Promoting AI literacy.

143. To ensure that AI training is effective and accessible, policymakers should **create opportunities for partnerships including with the private sector** to increase citizens' access to free and low-cost AI fundamentals courses. AI literacy courses should be **tailored to the diverse social and professional needs** of the population in terms of content but also format, for example providing flexible and easily accessible courses in a variety of ways. These courses must facilitate comprehensive skill formation and certification, utilizing project-based and action-learning approaches in collaboration with companies.

144. Additionally, **flexible government financed schemes**, such as Individual Learning Accounts (ILAs), should be provided to support AI training and life-long learning, incentivizing access to accredited programs and implementing specific measures to address current and future digital gaps. Furthermore, given that on average AI users who received training have a more optimistic attitude towards AI, asserting that it positively changed some work-related aspects such as performance (88% of AI users who receive training vs. 69% who did not), enjoyment (77% vs. 46%), mental health (68% vs. 36%), physical health (69% vs. 39%) and fairness in management (57% vs. 27%), initiatives should be launched to raise public awareness about AI.

Enabling a trusted and participatory framework in the field of AI education and training.

145. In order to build a strong foundation for AI education, it is essential to develop a robust credential ecosystem for AI courses, guided by national or supra-national authorities, such as the micro-credentials supported by the EU Council, that are qualified to provide

guidelines and standards for course offerings and certifications. These authorities must foster consensus and trust across the sector. Crucially, a participatory and coordinated approach to AI education must involve not only trade associations but also the active collaboration of public-private partnerships and industry coalitions. Public-private partnerships are key in aligning educational content with industry needs, ensuring that AI training programs are both relevant and adaptive to technological advancements. By combining the resources, expertise, and influence of both sectors, public-private partnerships can help create scalable, impactful solutions that promote innovation, standardization, and widespread access to high-quality AI education, ultimately maximizing the societal and economic impact of these efforts.

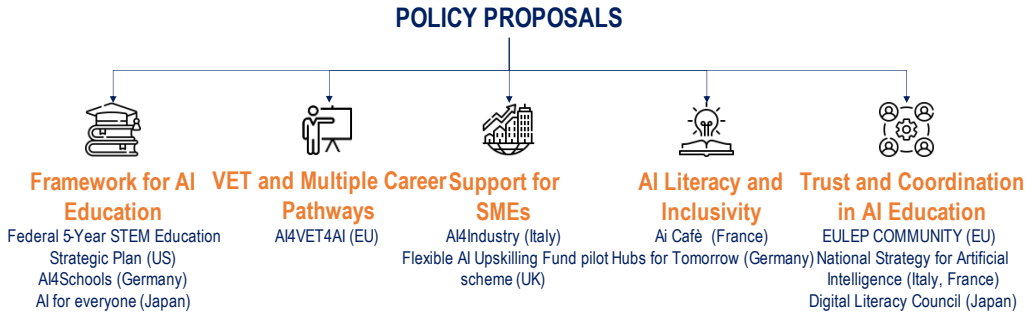

Figure 5.5 The policy proposals and relative strategies that the six focus countries have already implemented. Source: The European House – Ambrosetti elaboration based on various sources, 2024.

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