G7 REPORT ON DRIVING FACTORS AND CHALLENGES OF AI ADOPTION AND DEVELOPMENT AMONG COMPANIES, ESPECIALLY MICRO AND SMALL ENTERPRISES

Authored by:

Raffaele Spallone – Ministry of Enterprises and Made in Italy

Matteo Bandiera – Competence Industry Manufacturing 4.0

The following report is the result of joint efforts among G7 countries and does not represent author's opinion.

INDEX

List of Figures and Tables

Figures

Tables

1. Introduction

1. 1 - Framing the report and identifying objectives

The future of our economies is strongly tied to our ability to promote with great determination an innovative environment. This objective entails facilitating our citizen and companies in the digital transformation, helping them realize concrete benefits out of this opportunity and attain the sustainability and resilience goals that are shaping and will shape the way we do business.

One of the core technologies that is driving transformation in industry and business is Artificial Intelligence (hereinafter AI). AI and other emerging technologies are going to play a pivotal role in the realization of such a change and the process of making these technologies available to citizens and companies is the first and most important step that our societies, led by the G7 countries, must make. Thanks to the expansion of computing systems' capacity and the development of complementary technologies, a new generation of AI systems has become increasingly prevalent across different functions of manufacturing firms.

Following the Ministerial Declaration of the G7 Industry, Technology and Digital Ministerial Meeting, the current report acknowledges the importance of these changes. This document will delve into the analysis of the driving factors and challenges of AI adoption and development among companies in manufacturing, especially MSMEs, providing policy recommendations for G7 governments to ensure safe, secure and trustworthy AI adoption.

Describing AI in a positive and normative way will provide insights into the integration of AI in production processes through technology adoption, technical collaboration, and voluntary knowledge exchanges. Furthermore, best practices are identified thanks to the collection and assessment of policy strategies and experiences for AI adoption among MSMEs across G7 countries.

Hence, this report builds on endeavors within the G7 Hiroshima AI Process, which focuses chiefly on advanced AI systems, including generative AI, and resulted in the *International Guiding Principles for Organizations Developing Advanced AI Systems* and the *International Code of Conduct for Organizations Developing Advanced AI Systems.* The aim of both of the aforementioned documents is to promote safe, secure, and trustworthy AI worldwide and to provide voluntary guidance for actions by organizations developing the most advanced AI systems. They further the development of common practices among G7 countries and effective strategies to support MSMEs through the creation of a common ground for AI development, deployment and use.

Compounding the work undertaken so far by the G7 countries, this report focuses primarily on the Manufacturing sector, given its relevance in the wider industrial scenario. Within this scope, it will center specifically on MSMEs, since companies of this size have been found to face the most difficulties when tasked with AI adoption.

The report is structured as follows: Chapter 2, titled *Data Facts and Trends,* introduces the main trends and statistics related to workforce dynamics and funding trends linked to AI deployment and development; it also analyses adoption rates, barriers to adoption and training in specific relation to MSMEs.

Building on this collection of empirics Chapter 3, *The potential Impact of AI on Production Processes*, contextualizes emerging technologies within the scope of Industry 4.0 and Industry 5.0 and delves into the potential impact of AI on production processes focusing on both the internal and external environment of MSMEs.

Chapter 4, *Limits Challenges and Risks,* complements such framework with an overview of the main issues relating to AI diffusion and accessibility, safety and trustworthiness of AI systems, and potential impacts on the workforce.

Chapter 5 is dedicated to present best practices among public policies designed by G7 countries in four major thematic areas, namely infrastructure, finance, regulation and education. Lastly, chapter 6 conclude this report by sharing recommendations resulting from questionnaires and dialogue with private stakeholders, facilitated thanks to the collaboration with TECH 7.

1.2 - Defining AI and its potential for industry

Framing Artificial intelligence

Without further ado, we intend, in this paragraph, to introduce the general definition of AI and highlight what are the aspects that such a technology has an impact on.

The introduction of the term Artificial Intelligence is owed to John McCarthy, an American academic who gave the following definition in 1956: *(Artificial Intelligence is)* “the science and engineering of making intelligent machines”.

Although it was framed in this precise manner only in 1956, the concept of intelligent machines was already present in a paper by Alan Touring titled “Computing Machinery and Intelligence”, dating back to 1950.

It is beyond the scope of this report to define more precisely the concept of Artificial intelligence. Hence, the disambiguation of terms is relegated in here. As previously stated, given the absence of a shared definition for Artificial Intelligence, it is reported here the quote that has been proposed by OECD: (Artificial Intelligence is) *“a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments”.*

It is worth highlighting three main concepts in this definition: first, in line with McCarthy’s definition, AI is a machine-based discipline, secondly it can connect inputs to outputs using mathematical modelling and lastly it has varying degrees of autonomy and adaptivity after deployment.

Of particular significance for the recent developments of AI is its subcomponent called Machine Learning. This technology analyses data using sophisticated mathematical models with the ability to learn the correlations between components in an

autonomous way. One of the most advanced mathematical models of this kind is the so called “neural network”, a construct that tries to emulate the brain structural functioning. The technology developed and constructed on neural networks constitutes the main building block of the subcomponent of AI called “Deep Learning”. This solution is currently at the forefront of AI development.

Artificial intelligence for industry

Focusing on the industrial potential of AI application, it is rather interesting to distinguish between vertical and horizontal AI within the comprehensive definition provided above. This further differentiation allows for a better understanding of the scope and use of AI solutions within the domain of manufacturing, and for a clearer vision of their future potential.

Vertical AI solutions are tailored by use case to address the specific challenges and opportunities within industries. By utilizing domain expertise and industry-specific data, these applications deliver exceptional results and potentially transform business practices. Designed to meet unique industry requirements, vertical AI solutions offer advanced functionalities and specialized capabilities, providing industry-specific insights, optimizing processes, and enhancing decision-making.

While vertical AI focuses on industry-specific challenges and applications, horizontal AI focuses on enhancing common cross-functional processes across industries. These versatile and widely applicable solutions serve as a foundation for various sectors, integrating into domains such as customer service, content generation, and information retrieval. Their adaptability allows businesses to quickly tailor these AI solutions to their specific needs.

Regardless of whether vertical or horizontal solutions are used, it is critical to understand how AI is integrated into production processes, and what are the components that constitute the key enablers for its application.

The afore described integration of AI into production can unlock significant potential for the industrial sector. AI has the ability to increase reliability and automation of production processes, all while enhancing overall productivity and output quality. In addition, AI application has a significant impact on the workforce and has the potential to shift their activities into tasks that result in a higher value added for the enterprise.

1.3 - The transforming potential of Artificial Intelligence

Industrial use of AI has the significant potential to have a transformative impact on society. This opportunity stems primarily from the fact that AI has introduced a new automation paradigm, enabling machines to learn from past experiences, adapt to situations and augmenting their real time decision-making. These unique abilities constitute the culmination of today’s technology and make AI the most powerful tool to catalyze and enhance the progress made so far in the digital transformation of our economies.

Nevertheless, AI comes with a great deal of prerequisites and challenges. Computational power, digital skills and competences, investment power and managerial skills, are only few of the main issues addressed in this report. Given these possible hurdles it is crucial that we recognize the pivotal role that AI is playing in the modern industry by redefining the industrial landscape. The innovative and transformative solutions offered by its application will allow companies to prosper in next future as long as they embrace and ride this revolution. It is thus imperative to raise awareness on AI, develop and promote practical guidance, and coordinate policy making among countries. These actions will ensure the presence of an enabling ecosystem for enterprises that wish to be AI ready.

Before moving on with our discussion, it is worth noting that we are currently in a period of exceedingly rapid technological change. Moreover, subsequent revolution waves are closely linked within a unique and continuous process of industrial upgrading. Remarkably, these features yield relevant consequences for AI adoption and development within MSMEs. On one hand, the incremental and cumulative way technological change happens should concentrate efforts towards digitalization before the adoption of AI and other emerging technologies. On the other hand, the consistent shrinking of intervals between revolution waves prospects a fast-changing landscape in AI adoption and calls for raising awareness towards opportunities for MSMEs.

1.4 - AI in the context of MSMEs

All companies are not born equal when it comes to embracing the AI revolution and organizing the necessary adjustments in business models and practices. Micro, small and medium-sized firms (hereinafter MSMEs) tend to exhibit more challenges in tackling barriers to entry the AI market. Hence, they need extra consideration when crafting AI policy to guarantee a fair transition to the AI age [1]. It is indeed crucial that we encourage fast, secure, safe, and trustworthy adoption of new technologies, so that regardless of dimensions, every company can grasp the benefits and remain competitive.

In those sectors in which AI was implemented on a massive scale, a radical transformation of business process has occurred: some components of tasks that relied primarily on human intervention, like data analysis, strategic planning and solutioning can often be enhanced by integrating AI. In this sense AI can function as a complimentary tool, offering initial insights and creative suggestions for human experts to validate and refine. With recent advancements in machine learning, AI offers the potential for a significant shift in business practices. In fact, prior to the emergence of machine learning, knowledge-intensive jobs and functions in business processes were only transferred to computer systems using explicit knowledge and developing classical AI systems necessitated significant codification efforts. Hand in hand with the increasing growth of AI, the amount of data available has also increased, broadening the range of applications for AI.

It is thus easy to see why AI has generated and will generate so much impact on economies, especially in industry, as anticipated above.

MSMEs are to be held at the core of the effort to disseminate AI technology. This intention must take into account the wider economic context of the last twenty years, when the ones that bore the blunt of recession were chiefly MSMEs. The biggest price they paid was in losing the necessary resources to invest in key advancements, accumulating an ever-growing technological lag over the years.

Therefore, AI represents the innovation they can leverage to reduce this gap and gain the competitiveness necessary to ensure natural continuation of their business. As we will later see, on the one hand, AI deployment entails changes in MSMEs' business models and practices, particularly considering the predicted advantages and prospects from AI adoption in terms of productivity, innovation, scale-up, and other factors. On the other hand, the business environment in which MSMEs operate has been witnessing major changes because of AI dissemination. This typically eases business circumstances and helps MSMEs to cope with current issues using innovative instruments [2].

Given the potential impact of AI on industry and the peculiar case presented by dissemination amongst MSMES, the next chapter will focus on highlighting major quantitative trends of adoption, as to offer a clearer picture of the current *status quo* and the upcoming challenges in the adoption of this technology.

2. Data, Facts & Trends

The rapid advancement of AI adoption, driven by the benefits associated with its application, have triggered a ripple effect that extends to the programming of investment in research and development, changes in labor market dynamics, and to the path to integration of AI in micro, small and medium-sized enterprises.

These trends are accompanied by challenges that relate specifically to the task of AI dissemination. To mention just a few, the significant disparities in AI adoption rates between large companies and MSMEs and the wide gap between the demand for AI-related skills and their supply.

To address these challenges, it is fundamental to accompany the natural diffusion of AI technology with an adequate policy framework to ensure a sustainable transition to a uniform, wide scale adoption. The prerequisite to construct well-engineered policies is dependent on a careful analysis of the trends currently characterizing the path of AI integration in the production process. Given the fast-paced changes that are associated with this technology, the latter exercise is therefore fundamental.

As AI technologies evolve, policymakers should focus on creating a supportive environment that promotes the absorption of innovation, reduces risk, and maximizes the benefits of AI adoption for all businesses, regardless of size. A strategic approach therefore becomes essential to address the potential of AI to drive economic growth and improve productivity.

To give a clear indication of the main challenges that need to be addressed by policy makers, this chapter aims at presenting the main trends surrounding the world of AI.

2.1 - Significant Trends

The scope of use of Artificial Intelligence in industry has grown wider with time. Its applicability to a broad range of business sectors and functions has greatly improved efficiency, innovation and product quality. The rapid growth of investment suggests strong confidence, among economic operators, in the ability of AI to reduce costs and increase productivity. This confidence, along with the potential of AI for industry, explains why governments are paying more and more attention to the issue, planning strategic interventions to support the integration of AI in their national industrial networks.

This section will attempt to quantify AI's impact and opportunities, focusing the analysis on three strategic indicators: the impact of AI use on the labor market, the potentials for investment in the technology, and trends related to AI adoption amongst MSMEs.

These specific trends have been selected due their significance in the context of AI adoption. The impact of AI dissemination on labor market dynamics is of particular importance given the potential of AI to perform a wide array of tasks that can increase automation. Monitoring the integration of this technology into the daily activities of the workforce is a fundamental step to ensure that its application is sustainable at the human level. Furthermore, the analysis of the job market can provide important indications on the human capital necessary to support wide scale AI adoption.

Investment in AI is also an important indicator to investigate. This factor can assist in providing an insight into the growth of the sector and provide a valuable base from which to assess the applications and enterprises that could benefit from the support of public investment. Lastly, this chapter will delve deeper into the main trends regarding MSMEs, a crucial subsector of enterprises in the race for AI adoption. These companies often face higher barriers to entry when attempting to integrate AI into their production processes and need to be accompanied in this endeavor by a well-engineered policy framework.

2.1.1 - Workforce

The following subsection will illustrate the impact of AI adoption on the workforce. This analysis will be focused on two main topics, the first related to the reception of AI technology amongst the workforce, and the second illustrating the trends related to AI in the labor market.

The potential of AI is evident from the results of questionnaires conducted with workers in the sector. Workers generally perceive AI as a complement to their skills, improving both performance and job satisfaction. Similarly, employers also highlight the positive impact of AI introduction, reporting that higher productivity and profitability are the main reasons for adoption.

As a result of this appreciation, the demand for a skilled AI workforce has increased in G7 countries and beyond, highlighting the need for upskilling and reskilling programs [3]. Still, when considering the demand of AI jobs, it is important to consider two detrimental factors for policy design: only a limited number of occupations require the specialized skill set needed to develop, adapt and modify AI systems and still, the supply of skilled AI workers remains insufficient to meet the demand, with many employers reporting difficulties in taking on AI roles. In this sense, it is fundamental to improve the ability of the workforce to interact with AI, also taking advantage of the AI-enabled user support functionalities provided by technology suppliers.

These unique observations highlight the importance of market analysis for AI positions as essential for the implementation of effective measures and policies, providing an overview of current and future needs of the workforce, enabling the implementation of targeted interventions that affect skills gaps and the promotion of effective training programs [4].

Impact of AI on the workforce

To serve the purpose of analyzing the impact of AI in the manufacturing sector, we chose to report some valuable data from OECD surveys. The most significant results are described below:

(i) *Workers side*: Manufacturing workers generally believe that AI integrates their skills rather than diminishing their value. The percentage of workers who agree with the statement "AI complements my skills" is about 20% higher than those who believe "AI has made some of my skills less valuable", as shown in Figure 1.

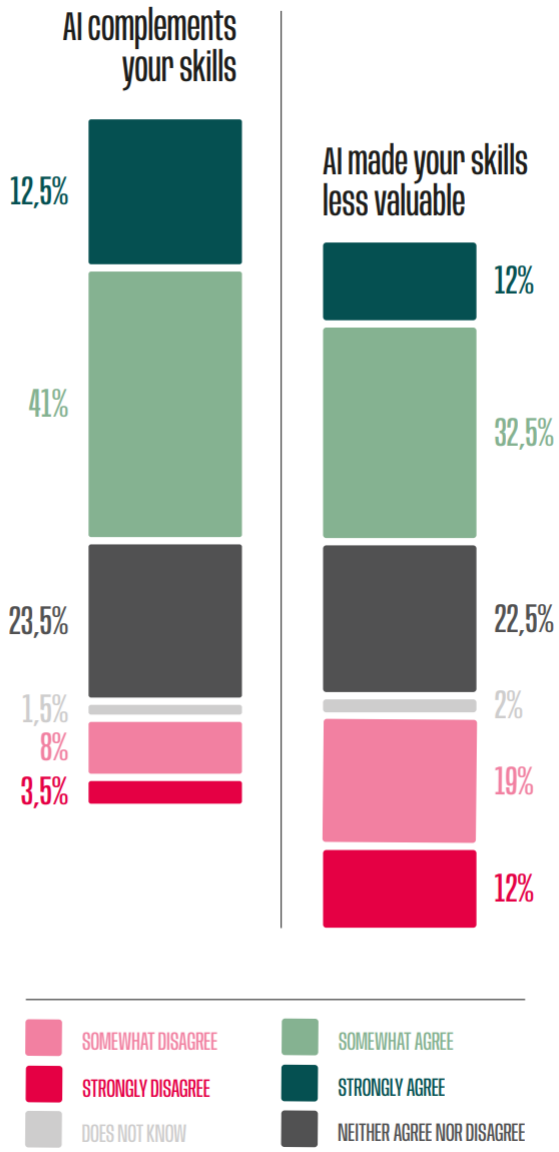

Figure 1: Perceived effect of AI adoption on workers' skills

SOURCE: authors' personal elaboration of Lane et al., 2023 (OECD). The impact of AI on the workplace: main findings from the OECD AI surveys.

Overall, workers have a positive view about the impact of adopting AI, particularly in performance. About 80% of workers reported performance improvements, while less than 10% reported a decline. In addition, workers indicated increased job satisfaction, improved physical health, improved well-being and mental health, and reported better treatment by their managers or supervisors [5].

(ii) *Employer side:* employers also express confidence in the ability of AI to improve performance and profitability. Key motivations for adopting AI include improving worker performance and reducing labor costs. Another significant reason is to address the skills shortage, which is particularly relevant for employers in the manufacturing sector, at least when compared to the financial sector. After the adoption of AI solutions, employers report positive effects on worker productivity and express greater satisfaction with managers' ability to measure employee performance within the company [6].

In addition to the positive reception of AI amongst workers and employers, data also highlights the importance of AI training in the company organization. In firms that have adopted AI it was noted how providing AI training is an efficient tool to enable workers to operate more productively and safely. Furthermore, this type of training is a valuable asset as upskilling or reskilling current employees is often preferred over the recruitment of new personnel.

Surveys in the manufacturing sector show the availability of such training and assess its impact on the working environment, job stability and wage expectations. In manufacturing, workers who have received AI training are more likely to report positive outcomes, including better performance, better physical and mental health, and greater job satisfaction. Results suggest that adequate training amplifies the benefits of AI on performance and working conditions [7].

Therefore, training activities are essential to maximize the benefits of AI for workers. However, despite the efforts made by governments in recent years, participation rates in education and training activities remain lower for low-skilled individuals than those with medium and high skills. Data from the European Union in 2021 show that only 5.28% of low-skilled workers, i.e., those with less than lower secondary education, participated in formal and non-formal education or training activities before the investigation, compared to 13.57% of highly skilled workers [8].

AI labor demand and supply

Job vacancies play an important role in understanding the dynamics of the job market, revealing the preferences of companies in relation to the skills required. To this end, the report analyses the trends in employment based on online job posting analysis. It is noted that they reflect a secondary or residual demand for skills rather than the total demand in the job market, as they only consider vacancies instead of the entirety of the job supply. Still, their analysis serves as a useful indicator to evaluate the extent to which companies prioritize AI-related knowledge over other skills.

There are distinct levels of skills often mentioned in online job postings related to "artificial intelligence": general and specific skills. General skills include competencies related to AI usage; competences that comprehend the tools necessary to apply AI. These can encompass programming languages, big data management, and data analytics and visualization. On the other hand, specific skills are required for building particular AI applications, methods, or tools. These typically involve specialized knowledge in making AI, such as machine learning and neural networks.

The main trend in the AI job market can be summarized as follows. While the percentage of jobs requiring AI skills is still relatively low, the demand for a skilled AI workforce has increased in OECD countries. Only a few occupations require the specialized skill set needed to develop, adapt and modify AI systems, as shown in Figure 2.

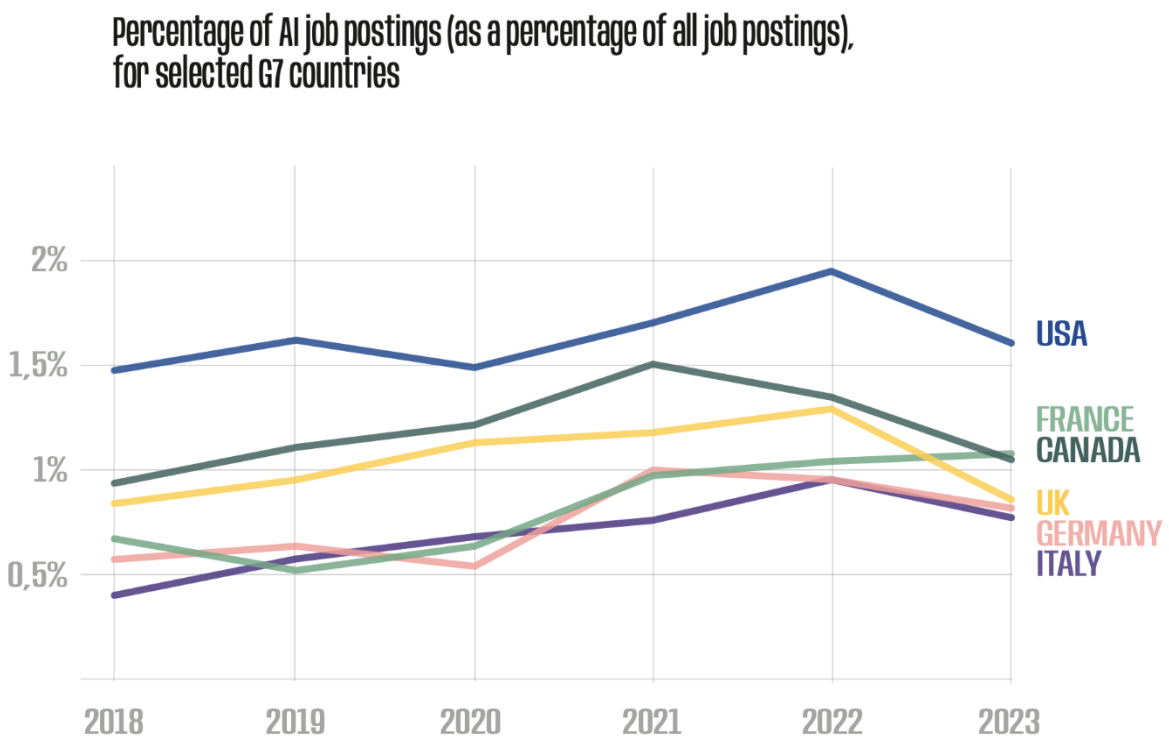

Figure 2: % of AI job postings, % of all job postings, for selected G7 countries

Data Source: *Lightcast, 2023. Authors' personal graphic elaboration of Artificial Intelligence Index Report 2024 from, Stanford University.*

Note: an AI job posting is defined as any job posting that requires at least one skill in AI, such as machine learning or natural language processing. The decrease observable in 2023 appears to be situational, and perhaps caused by an exogenous increase in operational job postings among big companies.

General skills are more broadly in demand across various roles and sectors. The most sought-after is a general knowledge of machine learning, which is required by 34% of AI vacancies. Most AI job postings are concentrated in professional services, ICT, and manufacturing sector. In contrast, industries such as hospitality, agriculture, and transport show less interest in AI-related profiles. While the development of artificial intelligence systems certainly requires specific, specialized knowledge, it is the general skills that are more frequently sought in the job market [9].

Studies have shown that AI skills are among the most valuable ones, earning a 21% premium compared to the average 4% premium paid for a more competent worker, ceteris paribus. This premium seems to be partly attributed to the complementary nature of AI skills with a wide range of non-AI-related skills, which increases their overall value. In addition, the persistent high demand for supply-side AI skills further explains this premium: as industries increasingly adopt AI, workers with these skills are in high demand, justifying higher wages [10]. However, employers recognize that while the importance of AI specialized skills has grown, there is an even greater emphasis on human skills: successful AI adoption requires not only AI skills, but also skills in creative and social intelligence, reasoning and critical thinking.

AI-specialized labor supply, despite a sharp increase, remains significantly lower than demand. Comparisons between 2022 and 2023 among various AI-related jobs

indicate that employers continue to face substantial recruitment challenges for these roles. Although fewer respondents reported difficulties in hiring AI data scientists, data engineers, and data visualization specialists than in previous years, between 45% and 65% of employers still report difficulties in finding AI-skilled workers for all positions [11].

The challenge of acquiring new skills in the age of digital transformation is particularly difficult for experienced workers, who are reluctant to upskill or reskill. Despite the difficulties in retraining these workers, it remains the preferred strategy to address the need to develop new skills. Re- and upskilling are the most popular choices among companies adopting AI, followed by outsourcing services and new hiring campaigns [12].

2.1.2 - Funding and Investment

Investments are a fundamental catalyst for the diffusion of a technology like AI. In this specific case, both private and public investments play a crucial role. Public funding can provide a comprehensively structured framework that aims at maximizing dissemination, and often has the ability to finance expensive projects and provide services at a lower cost. Private investment, on the other hand, is a fundamental actor for the development of ever more sophisticated technological solutions and for the creation of a service market centered around AI. Given that private investments are also motivated by financial gains in the market, the proportion of their investments is also a good indicator of the evolution possibilities of the wider AI sector.

Given the fruitfulness of analyzing the general trends surrounding funding, this paragraph will be focused on exploring the main trends characterizing public and private investment.

Public funding

The 2019 OECD Recommendation on AI advises governments to "consider long-term public investment, and encourage private investment, in research and development, including interdisciplinary efforts, to spur innovation in trustworthy AI". Monitoring government investment in R&D is crucial given the innovative nature of such practice.

Currently, there is no comprehensive method to monitor and compare R&D funding for AI in different countries. Therefore, proxy indicators such as R&D funding flows to major government AI agencies have been used to map the progression of government R&D efforts in AI. Figure 3 shows that the total volume of AI-related R&D funding has shown a steady upward trend, based on selected funding flows included in the OECD study. However, there are limitations: (i) data were not available for all funding flows during the period 2001-2019; (ii) many government agencies are excluded from count.

A significant portion of the funding streams was dedicated to financing AI projects concerning the application of AI in vertical solutions. Predominantly, this was the case for healthcare (e.g., Japan’s AMED, Canada’s CIHR, and USA’s NIH). Much of this increase in funding is concentrated in more recent years, with EU funding doubling in 2019 compared to the previous year [13].

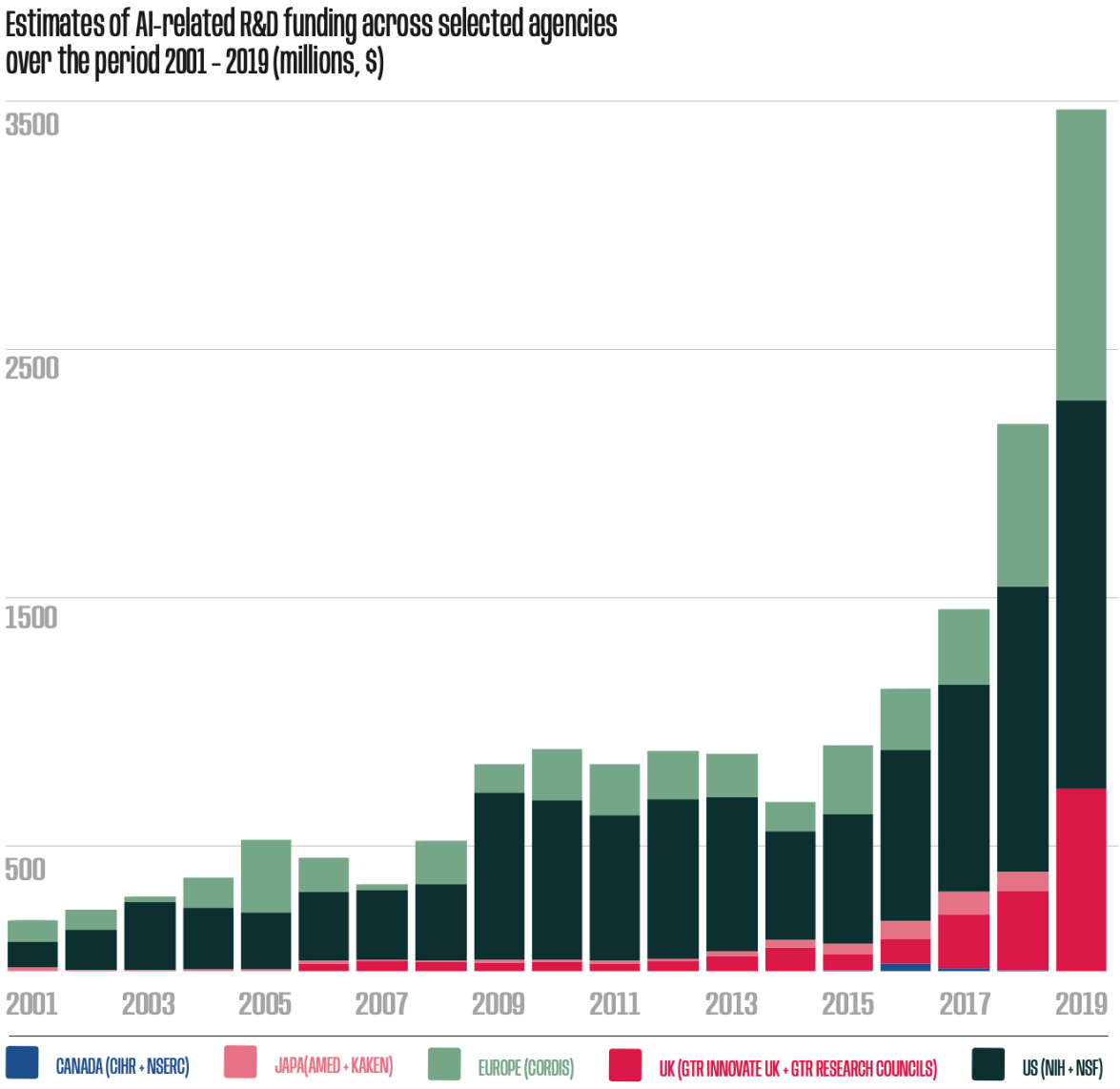

Figure 3: Estimates of AI-related funding across selected agencies (2001–2019, millions, USD)

Source: authors' personal elaboration of: "A new approach to measuring government investment in AI-related R&D", Cairns at. al, edited by OECD

Private funding

Growing investor confidence in AI is strongly supported by market research. Recent studies on the economic potential of AI suggest that AI solutions could increase global GDP by up to 14% by 2030[14]. Therefore, governments should welcome private investment in AI, as it does not only promote economic growth in the sector, but also increases the production of innovative solutions and stimulates research and development efforts.

The general upward trend in global non-public investment over the past decade underlines the confidence that private investors have in the potential for further progress in the sector. In 2023, the main areas of interest that attracted the most

investment were AI infrastructure, research and governance ($18.3 billion); natural language processing and customer support ($8.1 billion); and data management and processing ($5.5 billion). The importance of AI infrastructure, research and governance reflects significant investments in companies dedicated to AI application development [15].

Figure 4 illustrates the trend in global private AI investment from 2013 to 2023, including mergers and acquisitions (where one company's investment in AI involves merging with another company), minority stakes investments, private investments (funding of AI startups receiving over $1.5 million), and public offerings (bond issuance in the market and equities). Global corporate investment in AI has declined for the second year in a row. While private investment saw a slight reduction, the most notable decrease was in mergers and acquisitions, which fell by 31.2% from the previous year [16]. This decline reflects broader investment trends, with investors exercising caution due to the post-pandemic technology boom, rising interest rates, and inflationary pressures.

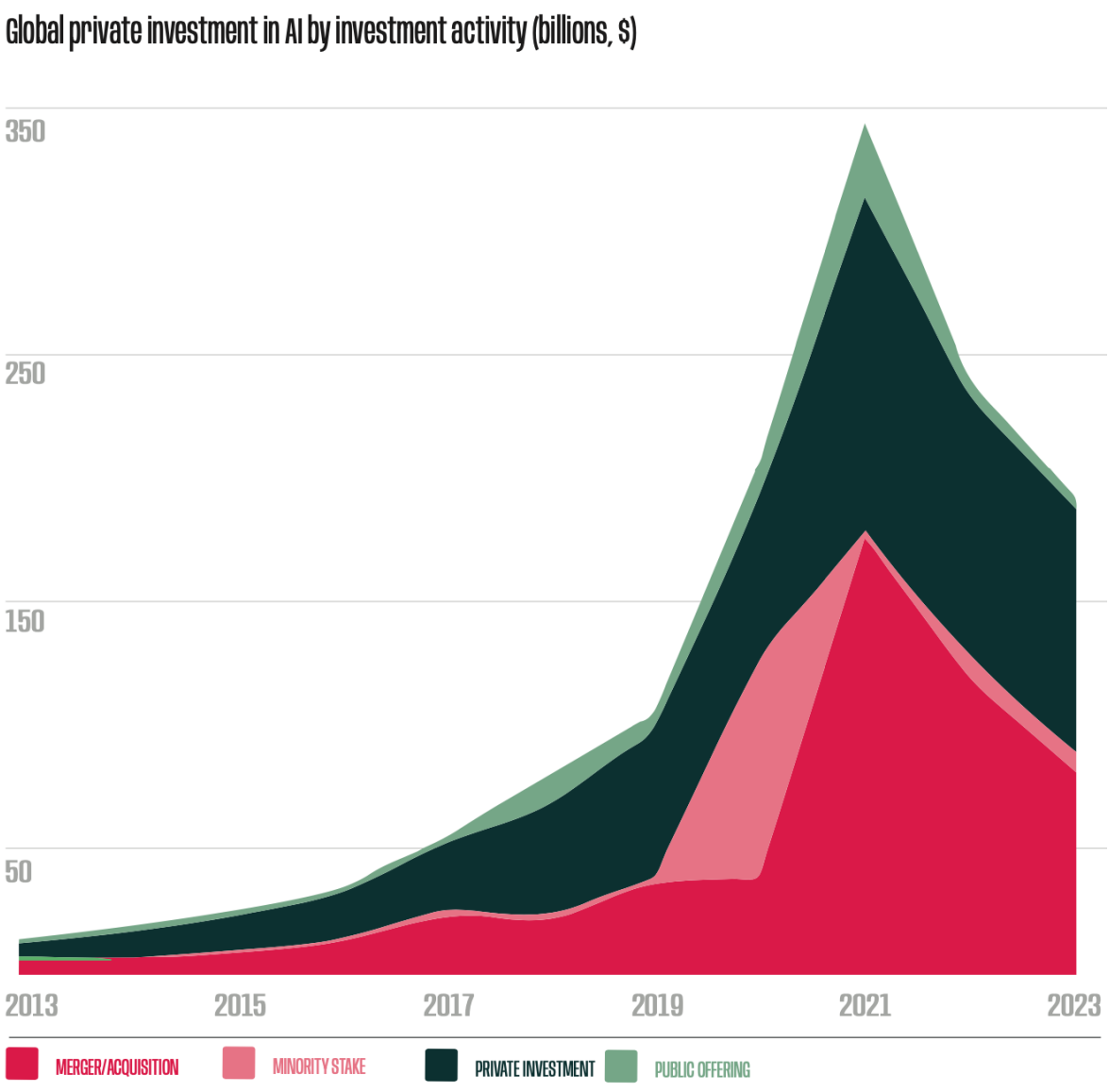

Figure 4: Global private investment in AI by investment activity (billions, USD)

Data Source: Quid 2023. Authors' personal graphic elaboration of the Artificial Intelligence Index Report 2024, Stanford University, CA

However, when differentiating by technology, investment in generative AI experienced a significant increase despite the overall decline in AI startup funding. In 2023, the sector attracted $25.2 billion in private investments, around nine times the amount invested in 2022 and about 30 times the amount from 2019. Venture capital firms are leading this trend, with investments in generative AI startups skyrocketing from $1.3 billion in 2022 to $17.8 billion in 2023: from 1% to 18.2% of total AI venture capital investments [17].

2.2 - Trends Specific to MSMEs

The examination of specific trends related to the adoption of artificial intelligence in MSMEs is essential to identify the unique challenges and characteristics of this field. Unlike large companies, MSMEs often face more obstacles in adopting advanced technologies. AI adoption rates in production processes are significantly lower in MSMEs than in large companies, mainly due to high costs and insufficient technical expertise, which negatively affects their growth potential. Understanding these dynamics enables the development of more effective policies to overcome the specific obstacles encountered by MSMEs.

This section focuses on specific trends that highlight the differences between small, medium and large companies. It will examine the disparity in AI adoption rates, the percentage of companies purchasing cloud computing services, and the proportion companies performing big data analytics. In addition, it will consider the main entrance barriers for AI-related products and differences in training patterns between large and small enterprises.

2.2.1 - Difference in adoption rates

For the sake of the following analysis, this paragraph will analyze the level of digitalization of SMEs instead of that of MSMEs. This change has been made to correctly interpret the data provided by OECD surveys on the matter. The digitization of small and medium-sized enterprises (SMEs) across all economic sectors is crucial to improving their productivity, promoting the inclusion of smaller businesses and achieving the environmental goals of the climate challenge. Many SMEs are already integrating data collected and analyzed through software into their decision-making processes, and are increasingly adopting digital technologies, including advanced generative AI, to reach new customers and improve productivity. In addition, many SMEs are beginning to use tools and data to assess their environmental performance.

To accurately measure AI adoption rates among SMEs, we utilized data from the OECD database, which is derived from surveys conducted by national statistical offices. These surveys typically provide conservative estimates; conversely, estimates from the private sector often indicate higher adoption rates. This is due to several factors: (i) private surveys do not always cover all industrial sectors, potentially leading to endogeneity. For example, surveys focusing exclusively on finance and manufacturing industry - sectors typically associated with increased use of AI - can produce upward-looking data. (ii) Private entities often struggle to reach micro and

small enterprises, which are generally less likely to use AI, thereby distorting outcomes for large enterprises. (iii) National business surveys are usually mandatory, ensuring wider participation, while private surveys are voluntary, potentially attracting responses predominantly from more technologically advanced employers, more likely to use AI. Therefore, we relied on OECD data [18] to mitigate potential biases and ensure more reliable estimates.

Table 1 below provides an overview of AI adoption rates by business size across G7 countries, while Figure 5 shows the OECD average. Both figures highlight that larger companies are the primary adopters of AI. This disparity in adoption impacts the ability of governments to address existing inequalities across industries, firms, and regions, potentially exacerbating these gaps as AI technology spreads.

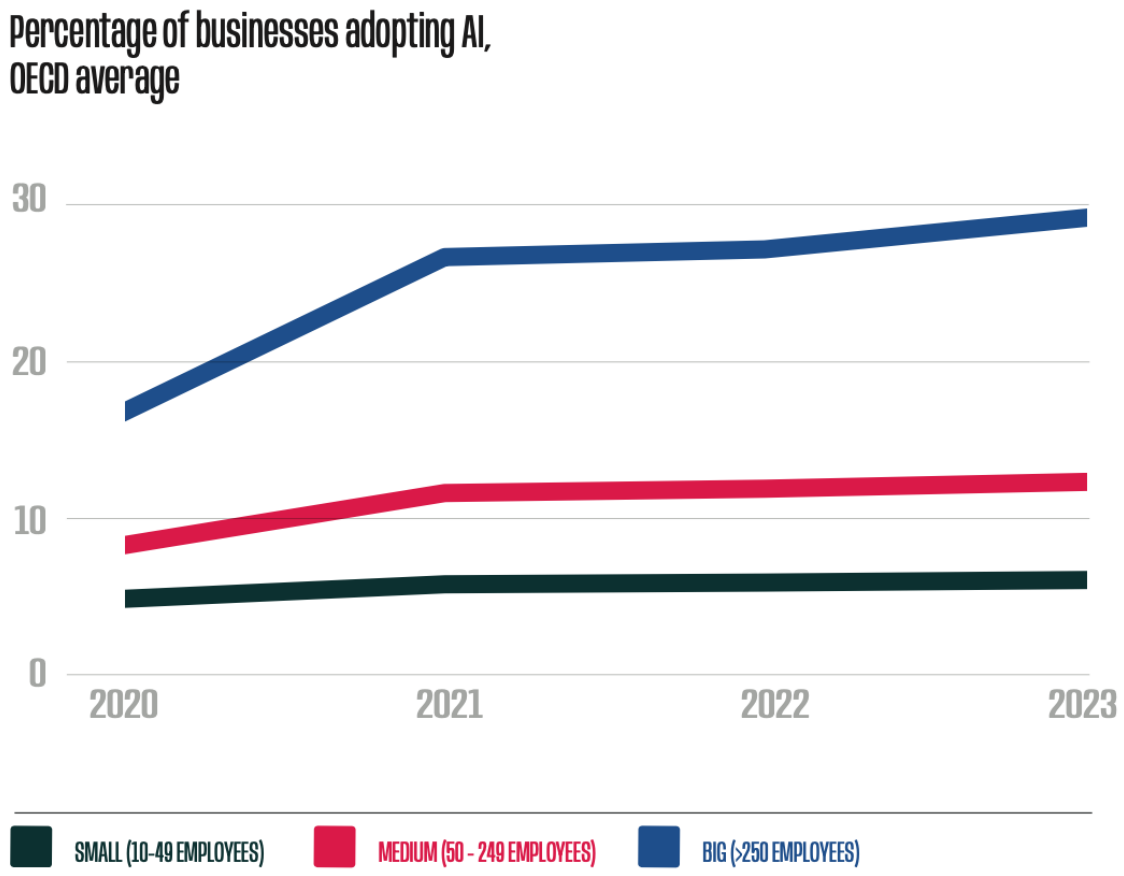

Figure 5: percentage of businesses adopting AI, OECD average

Source: authors' personal elaboration of OECD Data Explorer, 2024

Percentage of businesses using artificial intelligence, country-specific

G7 COUNTRIES	EMPLOYMENT SIZE CLASS			
	From 10 to 49	From 50 to 249	250 or more	10 or more
Canada**	3.5	11.4	26.5	4.7
France*	4.7	10.2	20.9	5.9
Germany*	9.7	16.2	35.4	11.6
Japan**	2.2	5.9	21.7	3.5
Italy*	4.4	7.3	24.1	5
United Kingdom***	3.7	4.9	11.5	4.1
United States****	3.5	5.1	7.5	3.7
Source: OECD, Eurostat	*Year 2023	**Year 2021	***Year 2020	****Year 2018

Table 1: Percentage of businesses using artificial intelligence, country-specific

Source: authors' personal elaboration of OECD Data Explorer, 2024

Note: it is crucial to acknowledge that multiple factors may contribute to the differing rates of AI adoption across various countries. One significant factor is the recency of data collection; countries with more recent data often display higher rates of AI adoption. This trend corresponds with the relatively recent emergence of AI applications in business contexts and the substantial reduction in associated costs over recent years. Additionally, it is important to consider that the data collected from surveys and aggregated by the OECD may not always reflect identical question formulations across different countries. In this report, we utilize OECD data to illustrate the tendency of lower AI adoption rates among MSMEs in G7 countries.

Several factors contribute to the increase in AI adoption rates in large companies compared to smaller ones. First, large companies can spread the high fixed costs associated with AI technologies over a larger volume of sales, thereby reducing average unit cost, or they can transform capital expenditures in operational expenditures by adopting AI as a service. In addition, large companies have the financial and administrative resources needed to manage the complex process of hiring AI specialists from abroad and offer competitive salaries and benefits, attracting top-class talent.

Adoption trends also need to take into consideration the rise of generative AI systems that have the ability to create original output and perform inference tasks. These systems include Large Language Models (LLMs) that can generate content and facilitate advanced applications based on Language Processing. Among MSMEs, that use AI for product and operations, generative AI is the most common type of AI application. According to a 2024 OECD survey, 18% of MSMEs implemented generative AI services, while only a minority use custom AI systems or digital tools with AI capabilities. In addition, most MSME owners have a positive view of the impact generative AI can have on their business operations [19].

2.2.2 - Businesses purchasing cloud computing services and performing big data analytics

The analysis of data usage, whether for third-party sales or internal business strategies, has become fundamental in contemporary business models. Big Data Analytics refers to the use of techniques, technologies, and software tools for analyzing the huge amount of data generated from electronic activities and from machine-to-machine communications, such as data derived from social media interactions and production processes. With the lower costs of data storage and processing, collecting and analyzing large datasets has become easier for enterprises. At the same time, cloud computing, defined by the OECD as computing services based on a set of computing resources that can be accessed flexibly, elastically, on-demand and with low management effort, allows clients to avoid substantial upfront investments in IT infrastructure and software, using instead for a pay-as-you-go approach.

The relationship between AI, cloud computing and Big Data Analytics is bivariate. Cloud platforms provide the infrastructure necessary to store the vast amounts of data required for training AI algorithms. In return, AI increases the ability to analyze and interpret data within cloud environments, making data processing more efficient. For example, in manufacturing, AI-driven analytics can be used to predict machinery malfunctions by analyzing historical data, thereby improving maintenance and reducing downtime.

The expansion of cloud computing, coupled with the development of user-friendly analytical tools, has particularly increased the accessibility of big data analytics for SMEs, which can experience lower costs while having access to cutting-edge technology and regular software updates. However, despite these advancements, large firms continue to dominate in the utilization of these technologies, as shown in Table 2 below. Several studies indicate that a significant reason for the lower usage of cloud computing by MSMEs, compared to medium and large companies, is the lack of awareness of its relative advantages. Concerns about the security and privacy of data stored on third-party servers also pose a critical barrier. Additional, more marginal factors include decision-makers' personal attributes, such as resistance to change, and inadequate support from cloud providers, which can obstacle the facilitation of cloud adoption [20].

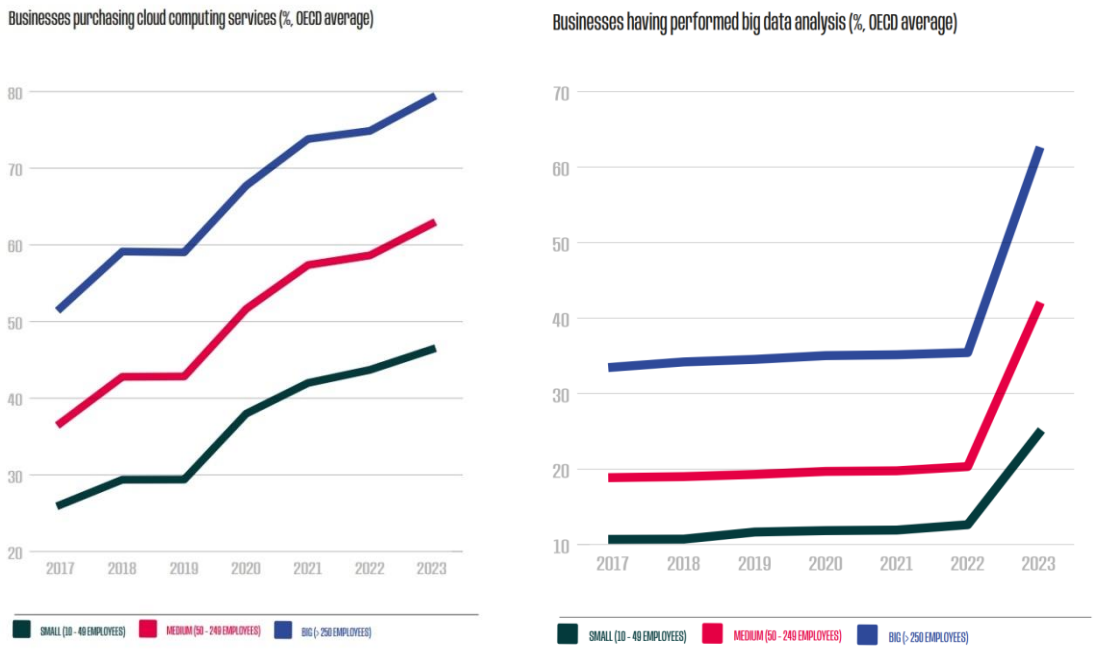

Figure 6: Businesses purchasing cloud computing services / performing big data analytics

Source: authors' personal elaboration of OECD Data Explorer, 2024

2.2.3 - Barriers to entry

Barriers to the adoption of AI explain why the use of artificial intelligence is not as widespread as it might reasonably be and they help identify the main reasons why large companies are the dominant users of AI, such as the impact of high fixed costs, as mentioned above. Below are the main entry barriers, based on OECD surveys.

The most frequently cited obstacle to the adoption of AI by employers is the cost of technology. The second most common barrier is the lack of necessary skills, with skepticism about technology in third place. Government regulation is the least frequently mentioned barrier. Among sectors we do not observe homogeneity of answers: employers in manufacturing are more likely to cite cost barriers and skepticism, while those in finance are more inclined to point to government regulation as an obstacle. This happens because costs tend to be higher in areas where AI is integrated with machineries.

Geographical differences, in terms of entrance barriers, are also evident. For example, in Canada, the cost barrier is perceived as more significant than in the UK (around 10 percentage points higher) while German employers are about 10% percentage points more likely to report a lack of skills as an obstacle than their French counterparts [21].

Furthermore, some surveys highlight another barrier to AI adoption: its supposed limited applicability to most businesses. This could be due to the current lack of AI applications that solve a wide range of business issues; however, the ongoing evolution of AI holds the potential to resolve this limitation. Another reason might be that employers underestimate AI's usefulness, possibly due to a lack of awareness or insufficient knowledge about available AI options [22].

Despite these barriers, 57% of SMEs surveyed perceive more opportunities than risks in using generative AI, in line with relatively low barriers to entry into skills and costs, which facilitate AI adoption by SMEs. [23] Generative AI costs have decreased rapidly over time. For example, from 2018 to 2022, the cost of training an image rating system decreased by 63.6%, and with AI entering the public domain, this cost reduction is expected to continue. Generative AI applications are becoming increasingly available at a low monthly cost or even free of charge, and it is logical to expect that these barriers will further decrease, leading to wider and more inclusive adoption in different sectors and regions [24].

2.2.4 - Training in MSMEs

As previously argued, training and digital skills' development amplifies the effects of AI adoption. Workers reported higher productivity and satisfaction, better physical and psychological health. Training is often provided by companies directly, or indirectly through external providers and online platforms.

According to available OECD data, around half of SMEs (54%) report that they have some type of skills program for the development of digital skills in the workplace. However, learning is often on-the-job or informal. Only 8% of SMEs provide internal training to develop digital skills and an even lower proportion (6%) get their employees to participate in external training. A lack of awareness about available training and skills gaps, as well as time-related and financial constraints explain their limited engagement in such training [25].

After having established some fixed points in our investigation, such as adoption trends, investment tendencies, upskilling and reskilling need and barriers to entry in AI market, we will focus, in our next chapter, on the industrial use of AI and on what are the most effective ways of implementing AI in manufacturing processes.

FOCUS. Approach to AI adoption in Italian enterprises

This box will investigate the results of a survey called "IATI – Intelligenza artificiale, cittadini, imprese, media" by the University of Cagliari, IPSOS and the University of Sapienza carried, in September 2024, on a sample of 200 Italian MSMEs. The topic investigated is the approach of MSMEs towards AI and the opportunities offered by the technology. The data indicate that amongst the 200 MSMEs interviewed only 19% have already implemented or are considering AI applications. In the remaining 81% of firms, 54% do not consider that AI has the potential for sustainable application within their business model. It is interesting to note that the percentage of enterprises that has utilized AI increases with their size. Amongst the 19% of interviewed firms that have declared to use AI in their operations the fields of a that have the most success are those related to industry and manufactory (27 respondents) and services (used by 20 respondents). Whilst these applications are the most favored by enterprises already familiar with AI, they are also considered the ones that are considered the least applicable by enterprises not utilizing AI, along with commerce applications.

Regarding the percentage of total revenue invested in technological innovation across various business sizes and sectors, the pie chart shows that 27% of companies invest 1% or less of their revenue in technological innovation, while 32% invest between 2-3%, 15% between 4-5%, 13% between 6-10%, and 3% invest more than 10%. The table further breaks down the data by company size and sector. Micro-companies (up to 9 employees) tend to invest more in technology, with 24% investing over 5%, while small and medium-sized companies (10-249 employees) mostly invest between 1-3%. The industry and manufacturing sector shows the highest investments, with 29% investing more than 5%, while sectors like construction lag behind, with 57% of companies investing 1% or less. Overall, the data highlights that smaller companies and specific industries like construction are more conservative in their technology investments, while larger companies and sectors like manufacturing are more committed to higher levels of technological innovation.

The survey also delves into what are the most significant barriers to AI adoption, based on three main issues: technological and operational challenges, business know how related challenges and investment capacity challenges. Regarding the first challenge, the main obstacles that MSMEs face when AI solutions are the following. The primary challenge, cited by 32% of micro-enterprises and 40% of small companies, is the limitation and inadequacy of their internal structures. Additionally, 22% across all business sizes report that a lack of system infrastructure in their regions hampers AI adoption. Other notable barriers include the difficulty in finding adequate technology providers (especially for small and medium companies), legal issues related to data privacy (with 14-19% of respondents affected), and concerns over the maturity and reliability of available AI technologies (13-15%). Furthermore, businesses report issues regarding data security, the absence of consolidated interoperability models, and regulatory uncertainty at the European level, though these are less commonly cited obstacles.

The second main challenge, related to business know how, impacts MSMEs as it follows. The most significant barrier to AI adoption is the limited ability of employees to adapt to technological advancements in the ICT sector, with 41-42% of micro and small companies and 32% of medium-sized companies citing this challenge. Additionally, 34-40% report that the limited use of current applications in their business class does not justify AI investments. Another major issue is the lack of digital and technological culture within management, particularly in medium-sized companies (29%). There is also some mistrust in new AI systems internally, though this is a less prominent concern, with only 12-17% of respondents highlighting it. Finally, the loss of know-how specific to the company is considered an obstacle by a smaller percentage, ranging from 6% to 13%. Overall, the data underscores the need for better employee adaptation, management culture, and trust in AI technologies for successful implementation.

The last significant challenge relates to the investment capacity of MSMEs into AI resources. The most significant challenge, affecting 41-44% of businesses across all sizes, is the investment required to develop human capital skills. Additionally, 28-30% of companies cite the cost of acquiring the necessary technical equipment as a major hurdle. The lack of adequate support from national and regional governments is also a concern for 25-36% of respondents, particularly for medium-sized enterprises. Lastly, 16-22% of companies report challenges in accessing favorable financing options from banks. This suggests that while skill development is the largest barrier, financial support and access to funding also play crucial roles in limiting AI adoption across businesses of all sizes[26].

3. The potential impact of AI on the production process

The use of AI in the industrial context, although not new, has evolved to be transformative and pervasive, and its diffusion has peaked in the last decade: it is with Industry 4.0 that AI came to be a massively adopted technology. Therefore, the first subsection of this chapter will focus on recalling the key characteristics of Industry 4.0 and Industry 5.0, as these constitute the fundamental framework to understand the current AI diffusion in industry. AI deployment implies changes in business models and business practices in light of expected gains from AI adoption in terms of productivity, innovation, scale-up, and more. Therefore, the second subsection will focus on presenting a clear panorama of the current trends of AI application, whether traditional or generative AI, across business functions. This analysis will highlight both the status quo and the opportunities for the future applications of AI in industry. Owing to the importance of manufacturing, the third subsection will be devoted to showcasing how a variety of AI use cases can be integrated through various aspects of the value chain. While AI becomes an increasingly adopted solution, as seen in the previous chapter, MSMEs show signs of weakness and scarce levels for AI assimilation, as previously highlighted.

3.1 - From 4.0 to 5.0

The Fourth Industrial Revolution is rooted in the progress of previous industrial revolutions and is characterized by a holistic approach to industrial and manufacturing processes with a high degree of digitalization, interconnection and automatic data exchange, automation and adaptability, virtualization, decentralization, optimization and customization of production, and human machine interaction. Industry 4.0 relies on the seamless implementation and integration of a wide range of traditional and advanced information, digital, and operational technologies, with the goal of realizing the fundamental design principles.

The most efficient way to fully grasp the essence of Industry 5.0 is by shaping its definition by comparison with Industry 4.0. While Industry 4.0 centers on the emergence of cyber-physical systems, integrating digital technologies into physical processes to optimize operations, Industry 5.0 offers a more holistic approach that ensures a framework combining competitiveness and sustainability. This new era emphasizes the role of industry as a pillar of transformation, focusing on the impact of alternative models of technology governance for sustainability and resilience. While Industry 4.0 still refers to the ultimate goal of cost minimization and profit maximization for shareholders, Industry 5.0 is centered upon empowering workers through the use of digital devices and promoting a human-centered approach to industrial efforts. It builds pathways towards environmentally, economically and socially sustainable uses of technology and expands corporate responsibility across entire production chains. A

regenerative Industry 5.0 approach can combine sustainability and resilience goals, lowering the economy's carbon and material footprints. Digital technology, when combined with green measures, can assist in fulfilling climate targets.

With this potential to have significant impact on pressing contemporary issues in mind, AI itself must be designed and executed with a far-sighted vision. Industry 5.0, at its core, promotes digitalization with purpose. The transition from Industry 4.0 to Industry 5.0 marks a shift from a purely economic focus to a broader perspective that includes environmental and social well-being [27]. As with industry 4.0, the main challenge in realizing the full potential of industry 5.0 is ensuring its widespread dissemination. MSMEs are still lagging behind in the digital transformation and are faced with substantial barriers to entry in accessing this technology and integrate it into their production processes. Hence the necessity of far-sighted policy making ensuring that no company is left behind when pursuing the goals of fostering innovation and strengthening our economies.

3.2 - AI adoption by business functions and tasks

The following paragraph will introduce some key trends focusing on adoption rates of AI and Generative AI across different business functions. This analysis will serve the purpose of describing the magnitude of permeation of these technologies into the industrial landscape.

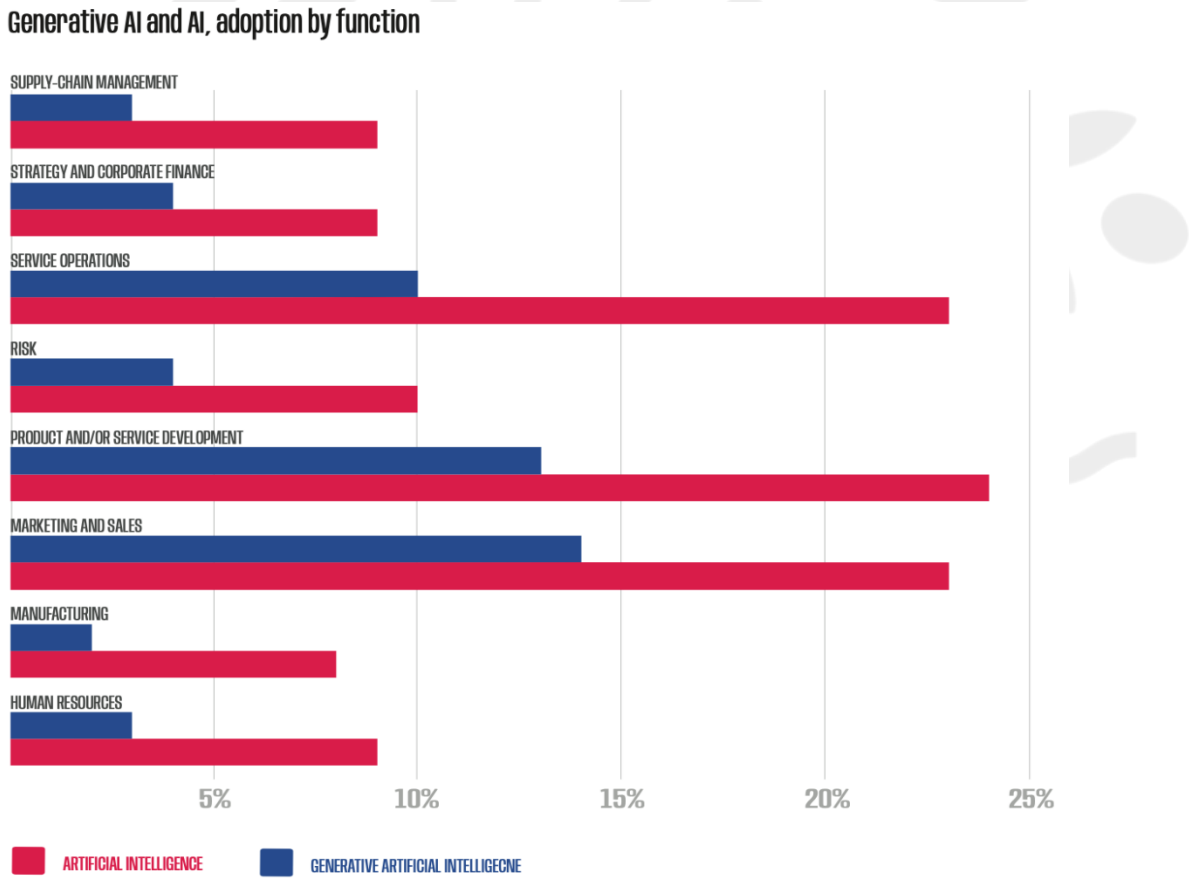

Figure 7: Generative AI and AI, adoption by function

Data source: McKinsey & Company Survey, 2023. Authors' personal graphic elaboration of the Artificial Intelligence Index Report 2024, Stanford University, CA McKinsey & Company Survey, 2023

The graph above clearly shows that traditional AI exhibits higher rates of adoption compared to Generative AI. This gap in permeation can be explained by the different levels of technological maturity between these two subsectors. Tools like Machine Learning and Deep learning have, to date, reached a higher level of applicability compared to generative AI solutions like LLMs. It is still expected that Generative AI will grow in terms of applicability potential, and possibly substitute some tools of traditional AI.

While no specific differentiation by firm size is provided, it is reasonable to expect that these patterns in traditional AI and generative AI adoption across business functions are not similar between large enterprises and MSMEs, with the latter lagging behind. This is due to larger enterprises having the necessary resources to promptly adopt and integrate Generative AI in their business practice. This pace is obviously much faster than the one achievable by MSMEs, given that they are subject to a much higher degree of barriers to entrance in that market.

Focusing on business functions, it is apparent that despite the lag between AI and Generative AI adoption, three sectors presented in the graph experience a higher level of permeation of these technologies. Those are Service operation, R&D and Marketing and Sales. This phenomenon can (also) be explained by the level of the technology appliable to these sectors and by the versatility of instruments such as LLMs and Deep learning techniques. It is interesting to note that manufacturing exhibits the lowest level of permeation of both traditional and Generative AI solutions. The following analysis will focus on the three business functions that stood out and deepen it by highlighting the functions that Generative AI can enhance in those very business functions.

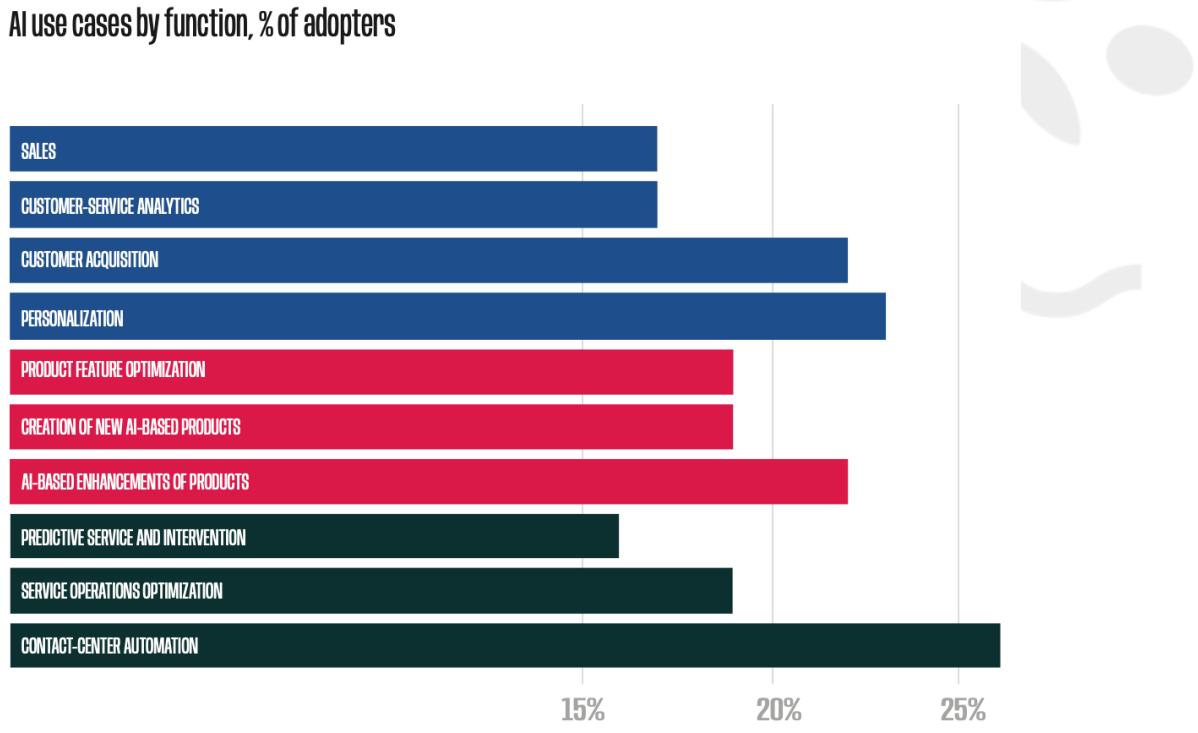

Figure 8: AI use cases by function, % of adopters

Data source: : McKinsey & Company Survey, 2023. Authors' personal graphic elaboration of the Artificial Intelligence Index Report 2024, Stanford University, CA Source: McKinsey & Company Survey, 2023

Contact center automation, AI based product enhancement and personalization in marketing and sales are the activities that showed higher adoption rates. The last two applications are of particular significance, as they highlight how AI dissemination is tied to other developments in the digital ecosystem. Both product enhancement and personalization are possible and benefit by the ever growing 'data economy'. The possibility of companies to harvest data has propelled the application of AI solutions dedicated to their processing and analysis.

This development tendency also resonates with the need of an ever-faster time to market and client customization of products, shifting business models towards a competition based on quality differentiation and market positioning.

The same type of analysis can also be made on the application functions of Generative AI. Because of its nature, and the popularity of LLMs, the functions that seem to be more impacted using this technology are crafting and summarization of texts, use of chatbots and identification of customer needs, as shown below.

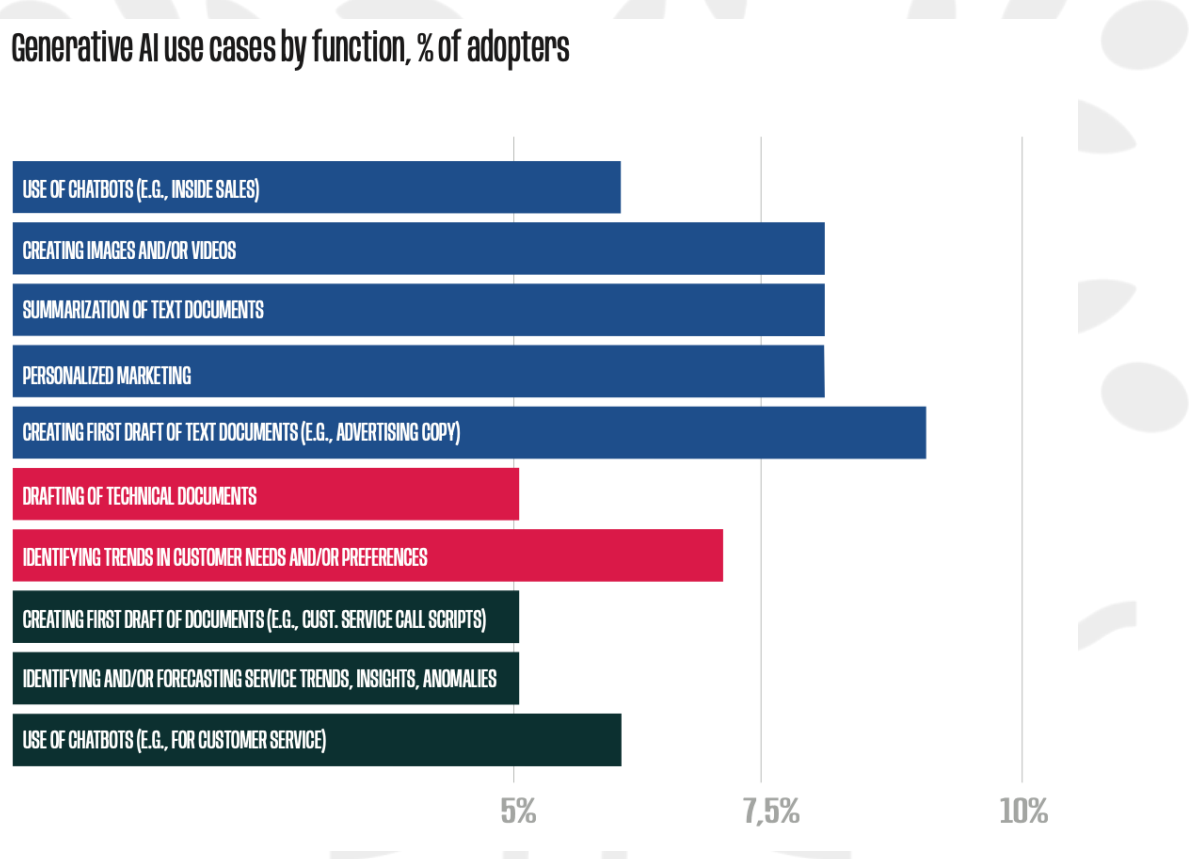

Figure 9: Generative AI use cases by function, % of adopters

Data source: McKinsey & Company Survey, 2023. Authors' personal graphic elaboration of the Artificial Intelligence Index Report 2024, Stanford University, CA

This graph also reflects the different levels of development of generative AI technology. By the degree of its dissemination, it is clear that LLMs represent the peak tool of

Generative AI. Still, it is interesting to note that amongst the most common use cases, there are some that depend on the inherently original ability of generative AI to produce original output and perform inference tasks. The first case is reflected in the diffusion of Generative AI application to create images and videos. The second case primarily applies to the use of this technology to do personalized marketing, identify trends in customer needs and preferences and forecasting service trends.

In these applications, the use of Generative AI surpasses the capabilities of traditional AI. In the specific cases of personalized marketing and preference trend identification, traditional AI is limited to clustering customers into homogeneous groups based on previously observed tendencies in purchasing. Generative AI goes beyond by extending its scope towards clustering based on profiles induced by sentiment analysis. This is because Generative AI exhibits higher potentialities when dealing with more complex tasks based on multi modal data inputs.

This afore mentioned example is just one of the possible applications of Generative AI. Still, it emerges that this technology can surpass traditional AI in scope of usage owing to its original inference abilities. Furthermore, it is expected that the latter will evolve beyond what is now their main field of application, which is primarily limited to text. With this expansion, and with the surpassing of traditional AI capabilities, it is expected that Generative AI usage will experience a growth in diffusion.

To sum up, exhibits show how traditional AI still dominates Gen AI in adoption rates. Furthermore, the business functions that are more susceptible to AI impacts are Marketing and Sales, R&D and service operations.

Having analyzed the main fields of application of AI and Generative AI respectively, the following subparagraph will focus on expanding the analysis to the most significant use cases in the field of manufacturing, which is the focus of this report.

3.3 - AI applications in Manufacturing

Benefits from AI application can range from gains in efficiency, costs reduction, improvements in quality standards to enhanced customer management. Those benefits are usually attained through automation of tasks in industrial context.

It is still important to note that Automation, understood in combination with AI, has a significance that extends beyond the simple replacement of human labor in repetitive tasks. AI, and especially generative AI, are technologies that can go beyond simple mechanic task emulation but can transform production processes by reshaping duties and work structure.

Overall, automation driven by AI systems can boost productivity and sustainability for manufacturing MSMEs. This goal can be achieved by shifting focus to higher value-added functions, cutting human and economic costs linked to accidents or injuries, and enhancing work conditions. Implementing these systems can help small businesses overcome administrative hurdles and improve responsiveness at lower costs by handling simple customer inquiries and facilitating customer interaction [28].

Given that MSMEs usually exhibit organizational issues, AI-driven automation aimed at optimizing operations and improving time management, could be highly beneficial.

In its most sophisticated and peculiar application, AI Automation can encompass the management and analysis of huge volumes of data coming from production at a scale that was not possible with traditional means. These additional capabilities extend the scope of data processing to serve a new and wider array of purposes: predicting events and outcomes, forecasting, and generating insights across business functions. AI systems can make statistical predictions by inferring diagnoses and analyses from previously obtained information, processing large datasets, and adjusting their algorithms accordingly. Unlike conventional predictive modeling, AI significantly reduces prediction costs and enhances data-driven decision-making in business, making a broader range of prediction methods more accessible.

MSMEs can utilize predictive analytics to navigate uncertainties, mitigate risks, and identify opportunities. AI-based prediction tools can automate business projections such as sales and budget forecasts and inventory management, allowing companies to make real-time business forecasts more efficiently.

The following subsections will focus on highlighting the main application of AI in the Manufacturing processes by analyzing three areas that characterize the latter: processes, products and customer relations. The scope of this analysis is to highlight the substantive impact that AI can have across a wide array of tasks that are fundamental to enterprises' functioning and success.

3.3.1 - Processes

Warehouse logistics optimization

AI can be used for the automation of warehousing through the integration of IoT systems and autonomous vehicles. This infrastructure then allows for the additional automation of in-company supply mechanisms, that can interact with a broader system centered on Enterprise Resource PlanningSoftware to optimize material procurement processes.

The AI transformation of warehousing can allow for a better integration and connection between factories and distribution platforms, improving the resilience and adaptability of supply chains [29].

Administrative processes

AI can alleviate administrative burdens through the automation of administrative tasks and processing of large volumes of data. The automation of document processing can ensure significant efficiency advantages in administrative procedures such as accounting, reporting, and payroll, with greater capacity to comply with tax duties.

Within general administration, such as HR, accounting, finance and internal communication, AI can help attract workers and differentiate them in terms of working conditions, wages, fringe benefits or responsibilities [30].

Predictive Maintenance

Predictive maintenance is amongst the most common use cases of AI in Manufacturing. It consists in using AI to infer the residual life of machines, so to avoid downtimes in production and schedule maintenance prior to failures and defects. By constantly monitoring machinery and system data, AI can detect anomalies and predict failures in advance, allowing companies to perform preventive maintenance interventions, reduce equipment downtime, and increase safety on the workplace.

Predictive maintenance can be tailored to the specific needs and characteristics of each piece of equipment or industrial plant. It enables the improvement of equipment efficiency and reliability, the reduction of maintenance costs and enhancement of the overall safety of productivity.

Predictive maintenance can be tailored to the specific needs and characteristics of each piece of equipment or industrial plant. It enables the improvement of equipment efficiency, reliability, it reduces maintenance costs and enhances the overall safety and productivity.

More specifically, predictive maintenance may involve repairing and analyzing vulnerabilities in IT systems and networks, ensuring more reliable detection of data breaches and cyber-attacks in terms of digital security risk management capacity [31].

Predictive analytics for decision-making

AI is used to analyze large quantities of data and extract trends to predict future behaviors, eventually suggesting solutions to defined problems.

For example, in assessing markets and competitiveness, AI is used to predict fluctuations of prices, demand and offer. Enhanced predictive capabilities enable greater market segmentation and price differentiation, allowing MSMEs to innovate and adapt their business processes.

By better predicting individual customer behavior and price sensitivity, MSMEs can anticipate shifts in demand and achieve market success through innovation

Additionally, AI generated insights can suggest products and services or anticipate nonperforming ones, provide sales and client forecasts to make informed decisions based on informed projections and scenarios, identify and understand general patterns and trends, and select areas for efficiency gains. They thus provide fundamental support in decision making across direction, strategy, planning and management functions [32].

Although this is certainly a compelling AI application, it requires the availability of a sophisticated data infrastructure and of internal or external data.

Efficiency improvements from supply chain to sales

The function of sourcing, procurement, and supply chain management is significantly enhanced through data analytics on contract management and strategic sourcing. This allows for the optimization of resource allocation by better anticipating shortages and managing purchases more effectively. Additionally, it improves risk management capabilities, particularly regarding supplier reliability.

The function operation management, encompassing stock management and maintenance, benefits from better planning capabilities through optimization. This includes lean management practices and an increased capacity for just-in-time production, which enhances responsiveness to end-use market variations. Additionally, these improvements lead to enhanced overall safety and increased cost efficiency, particularly in terms of energy consumption optimization [33].

3.3.2 - Product

Quality control

AI-based quality control (QC) is a strategy for organizing and evaluating quality data obtained by using AI algorithms. The objective is to improve the accuracy and efficiency of quality control operations by detecting flaws and abnormalities early on in the process. AI utilizes past data to train its algorithms, allowing it to detect outliers or defects in items before they are introduced into the market. This enables fast intervention and issue resolution, ensuring product dependability and raising customer satisfaction levels.

To summarize, AI-based QC represents a true revolution in the Industrial sector, ensuring maximum precision in identifying potential problems and optimizing production processes.

Personalization

AI use can also help enterprises to better tailor their products to their consumers. By integrating harvested data on consumers preferences into product development cycles, enterprises can enhance their products' customization degree of their products and have better insights on market preferences. This can significantly improve efficiency and resilience by reducing misallocations of efforts and resources.

Furthermore, personalization can become the key factor in enterprises' value proposition, shifting business models with to reap the benefits of the data economy developing around B2C products.

Time To Market

AI can speed up product development by automatically leveraging previous knowledge on the development process of a similar product. This may include the design project, the bill of materials and other technical specificalities. Based on this already available knowledge AI can generate a design proposal for new product thanks to techniques of image generation.

This can reduce the development costs for an entirely original design and allows for the introduction of new product into the market in less time. This reduction in time to market is a fundamental enabler for determining a competitive advantage in the market.

3.3.3 - Customers relations

Anticipate customer needs

AI offers significant opportunities for anticipating customer needs by enabling proactive engagement and delivering deep insights into customer satisfaction and preferences. By analyzing large datasets of customer behavior, AI can identify trends and patterns that revealing what customers want and need, before they even express it. This capability allows businesses to detect new product opportunities and tailor their offerings to better meet customer demand. Additionally,

AI can continuously monitor and assess customer feedback, helping companies understand and improve their services. Through these advanced analytics, businesses can stay ahead of market trends, enhance customer experiences, and drive innovation in product development.

Customer care

AI-integrated chatbots and voicebots can handle pre-programmed tasks in customer support systems. Chatbots deliver text-based responses, while voicebots simulate conversations with customers. These AI call center solutions can provide standard answers, address multiple requests simultaneously, eliminating customer wait times, suggest a template for the next response to customer enquiries. For complex requests, AI tools can analyze the conversation and redirect the call to the appropriate human agent, supplying them with necessary information from the initial interaction. The use of chatbots and voicebots allows to increase response speed and eliminate alienating tasks through the automation of basic and repetitive customer services, thus creating the potential for the assignment of other mansions to workers involved in such activities [34].

Many companies have implemented virtual assistants using Generative AI to interact with clients and offer technical assistance. These assistants can answer questions, solve problems, and give precise and specialized information, making the overall customer experience better. This may specifically advantage MSMEs which can implement standardized customer care services with a significant gain in terms of resources employed and costs sustained.

3.4 - AI adoption and MSMEs

MSMEs exhibit lower AI adoption rates compared to companies of a bigger scale. Given the previous analysis of business functions and their level of AI permeation, service operation, R&D and marketing exhibit the best potential for adoption by MSMEs. This circumstance is primarily due to the level of technological maturity of AI solutions appliable in these sectors. As a consequence, there is a greater possibility to leverage these use cases through SaaS integration. This opportunity allows for a reduction of the initial sunk cost required for AI application, facilitating enterprises that have a limited capacity for investment in innovation, a problem that has proved to be a one of the key barriers to AI adoption.

Spearheading AI adoption amongst MSMEs through these easier to integrate solutions can also facilitate enterprises in familiarizing with AI technology. Despite there being an objective lag in adoption between smaller and larger companies, addressing the permeation of AI amongst MSMES is a complicated task. The most significant challenge that is particular to enterprises of this dimension relates to the wide array of functions they perform. This results in the need for a more comprehensive portfolio of AI tools, tailored to improve the production process of a great number of enterprises with varying operational capacities. This challenge is necessarily a long term one, especially given the systemic nature of the barriers to entry that MSMEs are faced with. It then becomes necessary that this impediment is tackled with a well-engineered policy framework, one that has to take into account the whole ecosystem in which MSMEs operate. To ensure a successful transition to the age of AI no company should be left behind.

4. Limits challenges and risks

The AI boom, and especially its generative component, is projected to induce a 7% GDP raise in global GDP over a ten-year period, and the market for AI solutions is expected to grow to a USD 900 billion market valuation by 2026 [35]. This forecast constitutes both an opportunity and a challenge. The impact of AI is expected to generate profound changes in the working structure of the whole economy, and to raise overall productivity. Still the potentials of AI application in the economy can be fully realized only if the necessary infrastructure for its development is in place. This precondition is fundamental as it allows both for the scalability of the provision of AI services and for its capillary reach across enterprises and regions. Infrastructural development is also a catalyst for the development of more sophisticated AI technologies, as the latter are necessarily tied to the advancements in hardware capabilities.

For these reasons, ensuring that AI infrastructure is properly developed through the right policy framework is a fundamental factor to the growth of an ecosystem that allows both for the design and the adoption of AI solutions by enterprises.

This chapter will then focus on exploring what are the main enablers of AI development at a structural level, starting with the issue of Computational Capacity. This subsection will also delve deeper into the whole technology ecosystem that can boost computation, hence analyzing Data infrastructure and High-Performance Computing.

The second subsection will focus primarily on how to promote the conditions for the diffusion and accessibility of AI technology to ensure they reach the vastest amount possible of enterprises. Taking into account the centrality of the concept of ‘accessibility’ this subsection also explores the issues of connectivity, and how to improve its pervasiveness.

The third subsection will tackle a key argument surrounding the world of AI technology. Issues of safety and trustworthiness are in fact fundamental to allow for a sustainable diffusion of AI and need to be at the center of policymaking strategies.

The fourth subsection will instead focus on the assimilation of AI adoption by the workforce, and how to make this collimation sustainable.

As a general paradigm, the aim of this chapter is to highlights the potential limits challenges and risks that will need to be addressed to ensure that AI dissemination is sustainable and accessible for all.

4.1 - Computational capacity for AI development

A core element of AI development is computational capacity, an encompassing term that essentially refers to the hardware and software needed to develop digital solutions. Given the wide scope of this definition it is evident that developing computational capacity requires fostering a wide array of technologies including chips, GPUs, data centers and cloud solutions. All these elements are fundamental

keystones for the creation of a digital economy, but their interactions and capability will require a substantial scale up to accommodate the wide adoption of AI solutions by enterprises.

The necessity of a scale up in computational capacity derives primarily by the nature of AI technology. The latter, especially after the development of deep learning techniques, requires an infrastructure that relies on the integrated operation of different layers of software and hardware (stacks). In substance, AI solutions require a high level of computational capacity, that is essential to key development stages like training and inferencing of algorithms. This baseline necessity is also compounded by the trend that sees solutions related to generative AI growing in size and pervasiveness, pushing the demand of computational capacity higher. [36]

The growing trend of the development of generative AI solution is furthermore enhanced by the growing possibilities and opportunities offered by its application. The rise in the development of foundational models in the AI domain has shifted the traditional capabilities of the technology from single to multitask, allowing for the application of the same algorithm to the necessities of different industries and sectors.

Hence, the snowballing growth in demand and the evermore pressing pace of AI development reverberates on all the technologies that constitute computational capacity. More demand for these solutions will create the need for more powerful GPU units, and hence more sophisticated chip technology, whilst the volume of data handling required for algorithmic training will increase the need for data centers and cloud infrastructure. As a consequence, the need for high amount of data will require investments in 5G networks.

Evidently then, the forecasted widespread application of AI solutions requires significant investment in infrastructure and presupposes a high level of synergy between the main enabling technologies for their adoption.

Data infrastructure

Amongst the most significant technologies that require further development are those related to data. The latter have been a key driver of the digitalization of the economy in the past five years but have taken additional significance with the advent of AI. Large datasets are fundamental in the initial training of algorithms, but, more fundamentally, a constant influx of data enables the improvement of the model over time. This mechanism is the baseline enabler for the functioning of deep learning, one that is extending beyond the scope of LLMs as the application of AI technology expands to encompass more sectors and production processes.

In addition to the data needs of algorithmic training and maintenance, enterprises themselves have started to understand the importance of data to improve their performance. Owing to the advent of integration of more sophisticated IoT systems, data collection has expanded to the activities of firms in industry and manufacturing. This data is a key element in digitalizing enterprises and a necessary condition for the application of AI technology in production. This translates into an increased necessity for the availability of technology dedicated to data analytics functions, which in turn benefits from the application of AI solutions.

As more enterprises realize the importance of data and its application, and often start migrating their data onto cloud facilities, it becomes evident that the necessity for data management infrastructure is bound to increase.

The availability and accessibility of data centers then becomes a necessary condition to enable the growth of AI application in enterprises, primarily by allowing them to capitalize on harvested data. Moreover, the necessity for a well-engineered system of data centers has increased with the advent of more sophisticated cloud computing applications, on which enterprises rely to access the potentials of digitalization without incurring in high operational costs. Data center infrastructure has become a cornerstone for the provision of services ranging from 'Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). In the EU alone, up to 42.5% of enterprises used one of these cloud computing solutions in 2023 [37].

Essentially, data centers contribute significantly to the increase of computational capacity. Still, the already pressing demand for data center capacity has been enhanced by the advent of generative AI, which requires additional computational power to train and deploy models developed with vast amounts of data that will require additional storage with more advanced capabilities related primarily to aggregation and big data management.

In this sense, the design of measures to ensure that data management and storage infrastructure is available constitutes an essential building step. Achieving a sufficient capacity to accommodate modern AI solutions will require a high level of synergy between private and public actors. Private sector investments in data centers have been the driver in providing enterprises with this service and has developed the necessary strategy to provide coverage to different availability zones. Still, the public sector will have to complement their actions to ensure accessibility to smaller actors, like MSMEs, and to ensure that enterprises have access to infrastructure that is compliant to the ever-growing standards regulating data residency and usage.

High Performance Computing

Another fundamental infrastructure to improve computational capacity are High Performance Computers (HPCs), the last frontier in computer ability. HPCs take the form of either custom built structures or clusters of individual computers, and their main particularity lies in the capacity of running multiple tasks at once. This increase in capability allows so called 'supercomputers' to handle an amount of data vastly superior to standard solutions, hence allowing for a more sophisticated output.

For this reason, HPC technology is fundamental and can bring significant productivity gains to an increasing number of applications. These can range from matters of public interest, such as increasing the capability and precision of research results, but, more fundamentally, allow for the test and application of new functionalities and technology by enterprises. The capabilities of HPCs allow for the improvement of various tasks that are key in industrial production across all sectors. These can range from better capabilities in simulation exercises, increased precision and efficiency in product

design, better understanding of optimization strategies, more powerful forecasting and increased capacity for data analytics, in particular big data.

The potential of HPCs has significantly increased with the advent of AI technologies. Their application in the field is double pronged. Firstly, the increasing size of generative AI models requires a more powerful infrastructure than the one offered by traditional computing capabilities. As their tasks keep expanding, so does the amount of training necessary to finetune the model and, as a consequence, the amount of data fed into the algorithms. It becomes clear then that current development of LLMs and other deep learning technologies, related to the generative AI boom, is currently supported by HPC infrastructure, and that the emergence of any other model of the same kind will require access to this technology. This need is increasingly pressing as trends demonstrate that industry and private providers are showing growing interest and potential for the developing and training of AI models and are even starting to upscale the needs of public sector research. [38]

Secondly, HPCs offer the ideal tool for AI application. In this case, this infrastructure becomes the key enabler to sustain and infuse more capacity into an already existing AI models. This capability of HPCs is intrinsic in their characteristics, primarily owing to the ability of managing and processing larger amounts of data in a faster manner. Essentially, AI application to HPCs allows for results with a greater level of precision and tackling problems too big for traditional infrastructure, unlocking additional potential from the application of this technology.

With these capabilities, HPCs become an essential driver to increase computational capacity and unlock the most powerful benefits of AI integration. Naturally, demand for HPC capabilities is bound to increase substantially as they become necessary for the evolution of AI technology, and as their application capacity is set to deliver increasingly competitive AI powered solutions.

This demand is set to be absorbed both by the private and public sector. Private providers are already providing access to HPC technology through the provision of cloud solutions.

Still, it is fundamental that HPC infrastructure reaches a higher level of pervasiveness, especially given the expected rise in computational capacity demand. Currently, most supercomputers are concentrated in a handful of countries, predominantly China and the United States [39]. The availability of HPC infrastructure highlight the need of public investment in developing this technology, an action necessary both in terms of ensuring that future demand for computational capacity is met and also in terms of ensuring accessibility to the largest possible number of enterprises and research facilities.

In this light, countries are investing into the development of public HPC facilities, ranging from the United States, Korea, Japan, Chile and Colombia. In the European Union a multi county venture between Member States has given light to the European High Performance Computing Joint Undertaking (EuroHPC JU), a system to pool infrastructure and know how to create a network of easily accessible supercomputing and quantum technology [40]. Projects at this level of pervasiveness allow for better

access to the technology by a wider variety of actors, both in the research domain and in industry.

These kinds of initiatives have a decisive impact also given the high costs of HPC infrastructure. Both custom built computers and clusters require an array of resources that demand a high level of investment or are affected by critical bottlenecks in technology supply chains. Public sector coordination can then ensure the availability of all the necessary components of HPCs, ranging from state-of-the-art GPU units to integrated data centers, powered by significant amounts of costly energy. Public investment in HPC technology then allows for an initial cost investment in an expensive technology, maximizing the function between access and environmental and material cost of the technology.

4.2 - Diffusion and accessibility

Working on enhancing compute capacity to accommodate the rise of AI application is an important step to realize the potentials of this technology. Still, ensuring the presence of the infrastructure detailed above is simply the keystone for a wider set of conditions that will allow for a true dissemination of AI in production processes. Achieving a level of capillarity that benefits enterprises across sectors and economies will require a crucial contribution by the legislator in terms of policy orientation. The latter will be responsible for tracing a clear course and determining some issues that are key to AI technology, such as reliability, transparency, accountability and impact on the workforce.

Approaching these challenges will ensure that the rollout of AI follows a sustainable course and is achievable by all actors across the economy. To this end, some of the policy options that can be explored relate to characteristics that tie directly to the mechanism of AI 'production'. The latter concept refers primarily to the existence of two parallel modalities for generative AI development, one that is 'close source' and one that is 'open source'. The main difference between these two ways of developing AI relate primarily to the level of accessibility of their foundational models, including training datasets and parameters. Closed source AI models include some of the most popular AI products currently available for use, including Open AI's GPT 3.5 and GPT 4.0 and Google's Deepmind, whilst open-sourced AI models have traditionally been used to construct public libraries like Pytorch and Tensor Flow. Recently, though, open sourcing has become key in the development of AI by big firms, such as Meta's LLaMA2, and emerging firms in European markets, such as Mistral's AI 7B model.

In the past five years, the AI boom has been supported primarily through the application of AI solutions developed through closed source models, offering a tool that cannot be modified in its essence, but that can be adapted to accommodate 'plug-ins' dedicated to different functions. Further developments on the model by private actors is primarily conducted using APIs. Open-source AI, on the other hand, creates much more agile models, which can be modified at will by the recipient [41]. This possibility allows for the development of original application of the same core technology, with increased opportunities for small actors to tailor the model to their

necessities and implement original solutions with lower cost of access to powerful models. The open-source ecosystem also offers access to a collaborative community of stakeholders that can offer helpful feedback to smaller actors that are in the process of developing original technology, hence allowing for better access to qualified expertise.

The open-source paradigm also finds an application in the field of data availability, a key component of developing efficient AI models. Platforms such as Hugging Face, Kaggle.com, or open data repositories on GitHub offer a good base from which companies can access open and accessible datasets on which to elaborate their AI solutions and integrate them with data harvested from internal operations. This type of availability greatly facilitates enterprises in the adoption of AI technologies as data sets availability, especially those necessary for the training of complex AI models, can constitute a key bottleneck for enterprises.

Open sourcing, with the necessary regulatory supervision, can serve as a driver for the diffusion of AI by increasing the accessibility of both data and foundational models, and it is a landscape that policymakers must foster for its growth to match that of already comprehensively developed close source technology, which provides the dependability of a privately developed product. Ideally, a capillary network of accessibility for AI products will involve the parallel development of closed and open-source solutions, to provide enterprises with the amplest choice of instruments possible, from which they can pick the solution that works best for their organization.

Connectivity

Ensuring that AI adoption is supported by sufficient computing resources also translates into the improvement of connectivity. The latter is a fundamental aspect to ensure that communication networks offer the sufficient capacity and speed to accommodate the volume of data necessary for reaching the full potential of AI development and adoption. As mentioned before, working on network capacity and speed is a necessity tied to the current data demands of AI systems being developed, one that reverberates on the whole ecosystem related to AI, including on the efficiency of cloud solutions and data centers' operation. Furthermore, working on connectivity is also a precondition that will allow for the dissemination of the developing IoT technology ecosystem, with the latter being a fundamental component of the AI adoption revolution. The use of IoTs is of particular significance due to their high potential of integration in products and production processes, generating a data stream that becomes highly valuable for the scale up of product quality and production efficiency. Data harvested through IoTs reach their full usage potential when used in combination with AI technology, becoming a key component to drive innovation in industry and sustain the changes in factory management and automation.

Improving connectivity to meet the future demands of industry translates into the achievement of three main goals: capillary outreach of communication networks, capacity to accommodate current and predicted data flows, and the ability to do so with a sustained level of network speed. These objectives will need to be achieved through the improvement of terrestrial and non-terrestrial wireless networks [42]. The former refers primarily to the capabilities of 5G networks, a technology that can sustain

wireless connections beyond the digitalization needs of the consumer market and extend into the industrial sphere, thanks to its increased bandwidth and reduced latency.

Non-terrestrial wireless networks, on the other hand, have the potential to push connectivity technologies beyond the boundaries of terrestrial infrastructure, owing principally to the opportunities given by satellite technology. Reaping the benefits of the latter will allow to greatly improve and complement the capacity of traditional solutions, as well as to obtain new benefits, especially by providing access to 5G to remote locations that are difficult to reach with terrestrial infrastructure.

Achieving the circumstances required for connectivity standards to support widespread AI adoption in the economy will necessitate collaborative efforts from multiple stakeholders. The public sector has the option to invest in and coordinate research on both terrestrial and non-terrestrial infrastructure. In particular, the development of 6G wireless technology, the final frontier for enhancing connection, has been the focus of research programs in China, Finland, Germany, Japan, Korea, Singapore, the United Kingdom, and the United States, as well as the European Union [43]. Significant policy and scientific collaboration have also occurred among the public sector, space agencies, and corporate partners for the construction of satellite constellations aimed at enhancing connectivity. Emblematic in this sense are the recent initiatives of the European Space Agency for 5G and 6G connectivity.

In addition, achieving significant milestones, in the journey toward establishing a robust connectivity network, will necessitate extensive collaboration with the private telecom sector. This collaboration will require dedicated policy focus, particularly concerning spectrum management issues, and addressing the geographical disparities and territorial divide among regions within a single country. These efforts are crucial for ensuring equitable access to advanced telecommunications infrastructure and fostering comprehensive national connectivity strategies.

4.3 – Safe, secure and trustworthy AI

With the introduction of AI technologies into a wide array of sectors and production processes it is important to establish practices and guidelines for its safe and trustworthy design, development, deployment, and use. Achieving this is a difficult task, but one that policy makers and other stakeholders should contribute to.

To ensure that AI solutions are safe and trustworthy action should be focused on four main pillars. The first one relates to the issue of explainability of AI models. Whilst different levels of understanding of the causation between inputs and outputs exists between different models, it is still important to achieve a general level of explainability that ensures some insight into the logic that drives their functioning. This instance is fairly easy to achieve when dealing with AI solutions based on Machine Learning, an array of techniques that has particular relevance in the field of industry. Still, AI technology relying on Neural Networks, or Large Language Models, is much harder to explain, due to reasons that lie in the structure of the models themselves. Neural Networks in particular, because of the black boxed nature of their architecture, present particular challenges. With such a varied landscape, ensuring trustworthiness and

safety could be achieved through the usage of knowledge graphs, which shed light on the relationship between the network of real-world entities, such as objects, events, situations or concepts used by the model, as to provide a baseline knowledge on how AI models operate and create outputs.

Secondly, transparency is another key element that can enhance the level of safety and trustworthiness of AI systems. This issue is strictly linked to the one of explainability, as knowledge on the working of AI models obviously translates in increased transparency. The latter can better the understanding of AI systems, including their capabilities and limitations, improving the awareness of stakeholders interacting with it. To this end, it is also complementary to provide plain and easy-to-understand information on the sources and quality of data. In particular, it is important that high quality datasets are available to train AI models, i.e. data sets with low levels of inaccurate information (including labels in the case of supervised learning), low levels of bias, sufficiently high variety, and a sound and contextual use of synthetic data.

Thirdly, validity and robustness are other issues that, if addressed, can improve the safety and trustworthiness of AI systems. In addition, the trustworthiness of AI solutions can also be ameliorated with a raise in interpretability and transparency, taking into account the complexity of the model These factors allow for a better understanding of the models, hence ensuring a level of insight on the outcomes that can be expected from AI solutions. Knowledge graphs can increase insight into model's interpretability, also by having a greater understanding of AI related phenomena, such as hallucinations.

Lastly, an effective and well-structured system of guardrails can play a crucial role in ensuring that AI technologies are deployed safely and responsibly, without posing harm or unintended consequences to the public. These guardrails can be established through comprehensive governance solutions, which are designed to restrict or mitigate potentially harmful or unethical use cases that could be deemed a danger to society at large. By implementing stringent governance measures, ethical guidelines, and oversight mechanisms, these measures can safeguard against misuse, ensuring that AI serves the greater good while minimizing societal risks.

The previous four pillars are essential in ensuring that AI remains safe, secure, and trustworthy, particularly given the rapid growth of AI technologies, which has created the urgency for comprehensive action in this area. These foundational principles provide a robust framework to guide the responsible development, deployment, and governance of AI systems, helping to mitigate potential risks while maximizing the benefits.

4.4 - Impact of AI adoption on the workforce

AI is a transformative technology that implies the automatization of some tasks. This is a direct result of AI possessing the capabilities for carrying out complicated tasks at

a speed at to a capacity otherwise unachievable by humans. It is apparent then that the integration of such a technology in production processes across various sectors of the economy will imply changes in labor and labor organization. Still, the impact of AI on the workforce is, to this day, uncertain [44]. What can be predicted is that the outcome of widespread AI adoption can be tilted towards profitable changes in the way of working so to reduce and in some case prevent job displacement.

While it is true that AI can execute some tasks that are beyond human capabilities with a resulting increase in productivity, its application can still benefit from a well-curated complementarity with a properly skilled workforce. In fact, like any technology, AI requires and is enhanced by the guidance of workers who understand how to reap its benefits properly. Currently, the demand for jobs related to AI use is still limited and primarily related to skills regarding the operation of ML. Still, the supply of these jobs is lacking. This situation lies primarily in the nature of AI development. The latter requires the upskilling of the workforce for a variety of new competences that often presuppose a high level of education. The maintenance and development of AI systems alone requires familiarity with the general principles of the technology, as well as with AI tools and software. This specific knowledge has to be compounded by general data science skills related to data analysis, cloud computing and data visualization. Evidently, the skills necessary to foster the AI ecosystem of knowledge are varied and require a process of process of reskilling and upskilling of the workforce.

Embracing this change will hence require significant investment, both by the private sector, through in company training, and by the public sector, through measures aimed at increasing AI literacy. Still, it is important to note that the comprehensive reskilling to operate AI systems will only affect part of the workforce, with the vast majority needing to just develop the necessary familiarity with the general workings of machine learning. Still, there are complimentary actions that can be undertaken alongside reskilling and upskilling programs to ensure that the workforce is AI ready. These refer primarily to the conditions of accessibility for the development of AI solutions that are vertical and sector specific, namely AI for application, that requires the harnessing of some AI characteristics to achieve precise scopes. This will require that firms have access to the necessary infrastructure to develop the skills to produce these functional solutions and familiarize with the technology and tools to achieve this end. Such action will ensure the capillary diffusion of AI according to the different necessities of industry. Another catalyst for the development and familiarization with the skills necessary for AI use is the increasing democratization of AI solutions. The latter are available through APIs of easy application that allow for enterprises to adopt functional tools with a significant decrease of necessary costs. These products also significantly lower the level of skill necessary to interact with AI, allowing for a better dissemination of the technology.

Still, given the fast-paced evolution of AI capabilities, it is also complex to predict exactly the scope of reskilling and upskilling needed to properly accommodate these solutions into labor organization, and to which extent their capabilities will prove to substitute human functions on the workplace. This unpredictability constitutes an additional difficulty for the creation of wider policy programs that aim at reskilling the workforce on a larger scale and constitute a burden for SMEs an MSMEs approaching

the integration of AI for the first time.

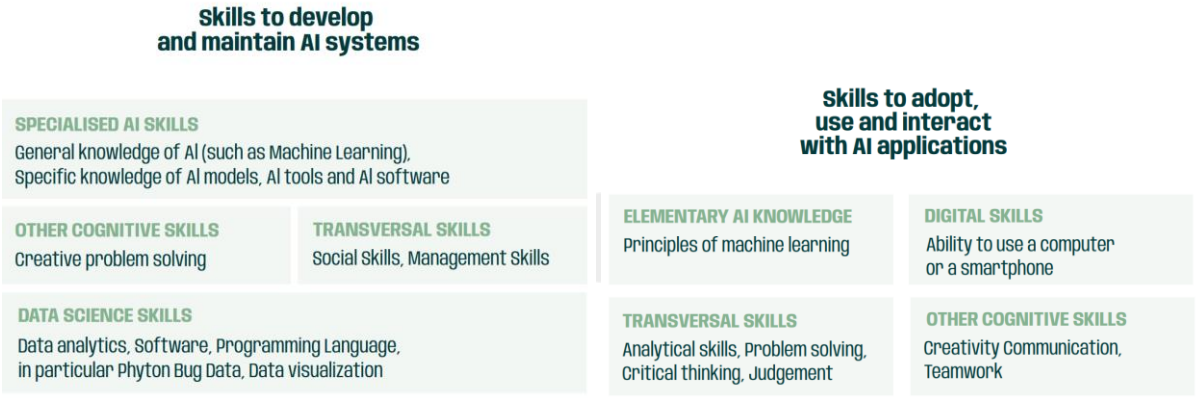

Figure 10: skills needed in the age of AI

Source: authors' personal elaboration of OECD (2023)

A greater spread of AI adoption can also be accompanied by a strict framework that governs the penetration of this new technology into the job market. This component may become critical given the possibility for job displacement associated with AI applications, as well as the potential negative ethical dimension of AI usage. Such a framework can be built at both the public and corporate levels. Initiatives of this kind are seen as necessary by more than 50% of workers, according to a survey conducted by the OECD [45]. 22% of employers have also invested in these kinds of initiatives, and more are willing to integrate policies to govern AI in their company's operations.

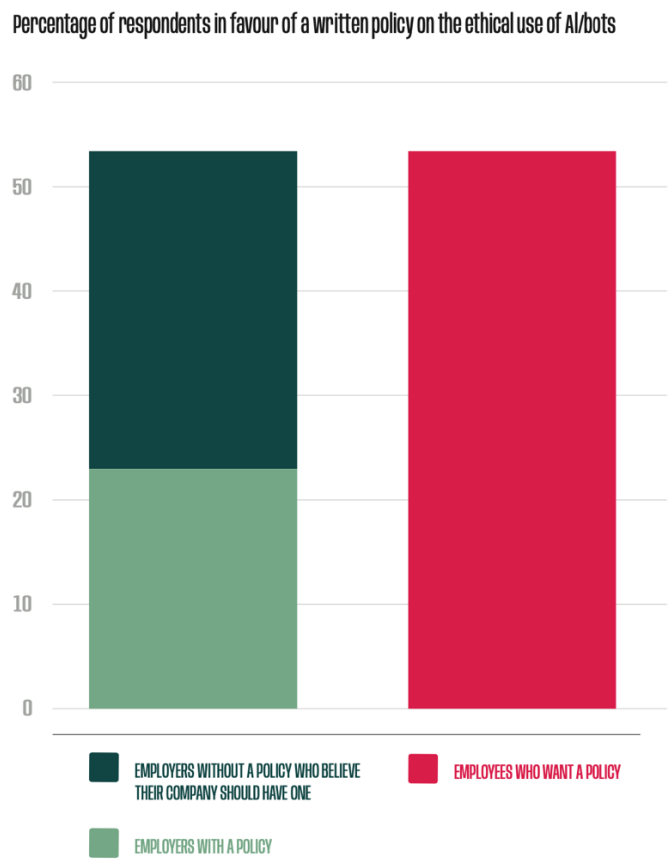

Figure 11: Workers' perceived value of written policies on the ethical use of AI

Source: authors' personal elaboration of OECD (2023)

5. Public Policies

AI, being a pervasive technology, with a strong potential in industrial context, has grown to be a subject of policy making in recent years.

Among decision makers, there has been established a commonality of intentions when trying to make policies on such a complex technology: it requires a multi-perspective approach.

In this chapter we have encapsulated some essential examples of policy making proposed by G7 countries that are, for the reader's ease, grouped into four major thematic areas, namely: Infrastructural, Financial, Regulatory and Educational.

5.1 - Policies for a shared infrastructure

Starting from the infrastructural side, G7 countries recognize the importance of developing shared infrastructure for AI purpose, as well as the importance of facilitating MSMEs in AI adoption through local, national and international garrisons. It is in this perspective that they have developed initiatives aiming to reduce barriers to entry in the AI market by providing computational power and competences that are both scarce and expensive for MSMEs, and by paving a common ground by localizing centers and cluster for AI innovation on their national territory, so that their strategy can be the most capillary possible.

Territorial structures do not only serve the purpose of offering computational power that MSMEs wouldn't normally have, but they do strongly reaffirm the need of a commonality of intentions and capillarity when thinking of AI effort, aiming to achieve the expected gain in productivity that massive adoption of AI has and to favor a stronger innovation ecosystem. The examples of initiatives that align with such intentions is unnumerable, and we intend to relegate our exposition to the cases of Canada and Germany, that seem to be the more representative ones.

PROBLEM:	*As infrastructure proved to be a crucial barrier to entry in AI market, the lack of proper infrastructure to implement and adopt Artificial Intelligence in MSMEs has been raised as a matter of policy making.*
POLICY:	• ***Canada*** *led to the establishment of several* ***National Artificial Intelligence Institutes*** *(NAIIs) with the aim of facilitating AI adoption, especially for MSMEs. It has also led to the establishment of the so-called* ***Global Innovation Clusters*** *aimed to accelerate promotion of collaboration between academia, industry and research institute in Canada and abroad. In 2021, they announced the* ***Pan-Canadian Artificial Intelligence Strategy*** *(PCAIS), consisting, in its second phase of a 40 million CAD investment in computing capacity dedicated to AI research. Along this, they have established the* ***Canadian AI Sovereign Compute Strategy***

	to develop infrastructure for governments, academia and industry able to respond both at near term and long-term demand. • ***Germany*** *led to the establishment of the* ***KI Servicezentren,*** *computing centers aimed at increasing computational capacity at disposal of both science and industry users throughout national territory. Moreover, it is aimed at conducting cutting-edge research in the field of AI with the intention of transferring, with a low threshold and agile approach, such techniques into practice effectively. The Federal Ministry for Economic Affairs and Climate Action developed the* ***Mittelstand-Digital Innovation Hubs*** *to support SMEs, start-ups and the skilled crafts through expert knowledge sharing, demonstrations, networking and practical application of digital skills, recently with more focus on AI readiness. Lastly, the* ***National Initiative for Artificial Intelligence and Data Economy*** *(MISSION KI), a joint project launched in May 2023 between the National Academy of Science and Engineering and the Federal Ministry for Digital and Transport, addressing the challenges of artificial intelligence on a broad sense, expanding databases for AI innovations, and promoting and facilitating trustworthy and marketable AI applications.*
OBJECTIVE*:*	*Since costs of infrastructure are unbearable by MSMEs, Governments acted as facilitators by sustaining the costs for infrastructural development and, de facto, creating facilities where MSMEs do not suffer this high barrier to entry.*

5.2 - Policies concerning financial leverages

The second aspect that has been taken into consideration is the financial side of AI adoption and to facilitate that, most countries have proposed incentive schemes and funding for AI purpose.

As previously stated, one of the main barriers to AI adoption is represented by the high costs it requires. AI, being a sophisticated application of computer science merged with mathematics, and moreover, being computationally expensive, requires high capital costs, in terms of infrastructure, and high operational costs in terms of energy consumption among others.

Moreover, if we consider training, in terms of upskilling, reskilling and talent acquisition, then we easily see that costs grow even higher.

It is in this sense that G7 countries have the duty to facilitate proper funding and promote incentive schemes and strategies to make AI adoption a viable way even for small businesses.

There have been multiple efforts, from a national side, to give proper funding for such initiatives and to facilitate matchmaking between offer and demand, here, for the sake of conciseness, we propose two of the most representative cases in the group of 7.

PROBLEM:	*Insufficient funding has proved to be one of the detrimental factors for AI adoption and development by MSMEs.*
***POLICY**:*	• *In June 2023, **France** launched the national program **IA Booster**. This program, operated by Bpifrance and funded under the France 2030 investment plan, supports MSMEs and mid-cap companies in their journey towards the adoption of AI for increased productivity, competitiveness, and greater capabilities for innovation. Its aim is providing financial aid in 4 areas: acculturation, awareness, provision of self-training in opportunities finding and challenges associated with data and AI use; assessment of data and AI capabilities and mapping of use cases for deployment; selection of the best solutions to accomplish use cases; support for testing of such solutions in a real-world environment. **Pack AI** is a regional program, similar in its aim to IA Booster, that has been running since 2019 to support MSMEs in AI adoption to ensure competitiveness of the industrial context. The program is led by a private consortium called Hub France IA and since it started, it has provided support for more than a 100 MSMEs to pilot their first AI projects - that usually have a span of 3 months.* • *In April 2023 the **United Kingdom** launched a new program, called "**BridgeAI**", with a platform of 100m pounds, coming partly from the Innovate UK & the Technologies Mission Fund (TMF), aiming to unlock the untapped potential of AI and drive greater productivity and efficiency across key sectors. It focuses on industries that traditionally have low a level of adoption of these technologies such as agriculture and food processing, construction, transport, logistics and warehousing industry. Responsible adoption of AI in UK will be facilitated by bridging the gap between innovation and implementation, so that there is a continuum between these two spheres that were used to live "parallel worlds".* • *Since 2017, the **National Research Council of Canada** Industrial Research Assistance Program (NRC IRAP) provided $705.8 million in contributions to AI-relatedfirmsIn addition, Budget 2024 will invest $100M in the NRC IRAP AI Assist Program to help small and medium-sized businesses scale up and increase productivity by building and developing new AI solutions.*

OBJECTIVE:	*By allocating national resources into AI fundings for MSMEs, France and the UK were able to compensate the size-bias that financial allocation suffers, explicitly aiming to facilitate MSMEs towards AI investments.*

5.3 - Governance

The third aspect that has been taken into consideration when think of policies was the governance aspect, a strong leverage to safeguard from misuse and potential impacts on societies.

It is only when AI techniques have advanced that regulation came into the picture, mainly due to the concerns that have been raised to policy makers.

Governance measures are one of the only counter actions that countries impose and enforce when dealing with issues that arise naturally from AI. With an ever-faster pace, many countries have started to propose regulations on AI to establish safe and secure practices to be followed when making AI and applying AI.

As we previously mentioned, AI practices, although being worldwide spread, are concentrated in Europe, North America and Asia. In such areas regulation came into reality earlier and here we report United States European Union, and United Kingdom cases.

PROBLEM:	*Artificial Intelligence has been so fast in development, that Governments have struggled to keep up with governance. Together with its pace, AI poses lots of questions related to misuses and potential harmful impacts on society.*
POLICY:	• *The **US**, in October 2023, under Biden's Presidency, enacted the **Executive Order** on the "**Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence**", to promote a fair, open, and competitive ecosystem and marketplace for AI and related technologies, with a particular focus on MSMEs, so that small developers and entrepreneurs can continue to drive innovation. The Executive Order contains guidelines and programmatic actions, amongst others:* ○ *The establishment of Small Business AI Innovation and Commercialization Institutes that will provide support, technical assistance, and other resources to small businesses seeking to innovate, commercialize, scale, or otherwise advance the development of AI.* ○ *The allocation of new funding and examination of existing grant programs related to the adoption of AI among small businesses.* ○ *The launch of a pilot program implementing the National AI Research Resource.*

- *Meanwhile the **European Union**, already dedicated in the preliminary drafting of the AI Act when the Executive Order became public, enacted in March 2024 a final version of such regulatory measure. It is thought to be applicable to all sectors, impacted by Artificial Intelligence, starting from August 1ˢ 2024, with the sole exemption of military, and it applies to all applications of AI in ECM. Being a product regulation, it is revolved on AI vendors and the entities that make a professional use out of these products. It regulates the application of AI based on the potential impacts and risks it can generate on citizens and it has 4 distinct levels of restriction base on 4 profiles of increasing risk:*
  - ***Unacceptable risk**: Forbids all those applications used by Public and Private Entities that provide social scoring or that make use of implicit subliminal techniques.*
  - ***High risk**: Regulates the application of AI in sensible sectors such as Transportation, Education and Labor amongst others and it applies to credit scoring, HR, law enforcement and critical infrastructures. It requires companies to conduct a "Conformity Assessment" prior to product release in the market and to satisfy rigid requisites.*
  - ***Specific transparency risk**: It applies to systems like chatbots, which must clearly inform users that they are interacting with a machine. In addition, certain AI-generated content must be labelled as such so that citizens are aware when interacting with AI.*
  - ***Minimal risk**: It applies to commonly used applications such as spam filters and AI-enabled video games. They face no obligation under the AI Act, but companies can voluntarily adopt additional codes of conduct.*

- ***The United Kingdom** is supporting SME implementation of its cross-sectoral AI governance principles through the development of the Department for Science, Innovation and Technology's (DSIT) AI Assurance Framework. The AI Assurance Framework aims to build a thriving AI assurance ecosystem, driving the development and adoption of tools for trustworthy AI, which measure, evaluate, and communicate whether an AI system is trustworthy and compliant with relevant regulations. DSIT has been developing resources to help startups and SMEs better understand how to navigate a complex global regulatory system, and support regulatory interoperability for SMEs operating across jurisdictions. To*

	support interoperable AI governance, and knock down barriers to AI adoption for SMEs, DSIT is developing: ○ ***AI Management Essentials*** *(AIME): AIME will distil key principles from existing AI-related standards and frameworks, including ISO/IEC 42001, the EU AI Act, and the USA's NIST Risk Management framework, providing a simple free baseline accessible for a broad range of organizations, including SMEs.* • ***Canada*** *also implemented the Artificial Intelligence and Data Act, which has the aim of guiding AI innovation in a positive direction to help ensure Canadians are protected from potential risks by ensuring the responsible adoption of AI by Canadian businesses.*
OBJECTIVE*:*	*Enable safe, secure, trustworthy adoption of AI, mitigating its misuses and risks by offering guard-rails and guidelines.*

5.4 – Acceleration of the Digital Capacities of Companies

Lastly, Artificial Intelligence has its roots in Computer Science and its applications are strongly tied to the ability of workers to build competence on top of existing digital skills.

Therefore, the last paragraph will be devoted to two examples of policy making aimed at facilitating the fostering of digital skills.

many countries have long tried to develop garrisons to facilitate such skill formation and to make digital environment more accessible for MSMEs. It is an effort that sees as actors not only Governments but also Academia and Industry.

We tried here to propose two examples, offered by Japan and Italy, that developed policies to foster digital skills and to facilitate the creation of such through training programs, upskilling and reskilling of workforce and through other educational initiatives.

PROBLEM:	*Digital skills widespread is still limited and it configurates as a necessary condition for AI adoption.*
POLICY*:*	***Italy:*** *The National Recovery and Resilience Plan (NRRP) has become a crucial opportunity to re-organize the Italian system of digital hubs technology transfer and fill out the gaps with respect to other European countries in terms of investments in technology transfer, cooperation between universities and enterprises and digitalization of enterprises. Notably, the investments 2.3*

	Strengthening and sectorial/territorial extension of technology transfer centers by industry segments *has the main objective to ensure the digital transition of SMEs.* *The measure has a budget allocation of 350.000 million of euro.* *The hubs financed are:* ➢ *the eight private and public partnerships, called* ***Competence Centers****, established in 2018 with the aim of facilitating digital transition and the shift to the 4.0 paradigm through a series of services provided to enterprise* ➢ *a network of 37 European digital innovation hubs (13 of them receive funding from the European Commission's Digital Europe Program) that have the general aim to ensure the digital transition of industry through the adoption of advanced digital technologies, and in particular, artificial intelligence, high-performance computing, and cybersecurity.* ➢ *two technical experimentation facility (TEF) -cofounded by the European Commission and the Member States -. TEFs are specialized large-scale reference sites open to all technology providers across Europe to test and experiment at scale state-of-the art AI solutions, including both soft-and hardware products and services, e.g. robots, in real-world environments.* ***Japan*** *in 2022 published the "****Digital Skills Standards (DSS)****", a comprehensive document aiming to outline the necessary skills for digital transformation. Japanese enterprises are trying to adopt such standards to develop a stronger new generation of workers, able to surf innovations such as Artificial Intelligence.* *Along this, they have established a web portal onto they provide digital education programs based on the DSS, fostering collaboration between companies and communities.* *In* ***Canada*** *CIFAR is enhancing programs to attract, retain and develop academic research talent, and maintain centres of research and academic training at Amii, Mila, and the Vector Institute. In addition, CIFAR is renewing its advanced research, training, and knowledge mobilization programs.*
OBJECTIVE*:*	*Increase the level of Digital Maturity of Enterprises to create a solid ecosystem for AI diffusion.*

6. Recommendations to Enable AI adoption and development among Micro, Small, and Medium-sized Enterprises (MSMEs).

After reviewing numerous examples of AI adoption policies implemented across G7 countries, we conclude this report by sharing recommendations resulting from questionnaires and dialogue with private stakeholders, facilitated thanks to the collaboration with TECH 7. These recommendations have a double perspective: on one side, addressing company leaders, offering practical, actionable measures tailored to help MSMEs to adopt AI successfully. On the other side, addressing policymakers, providing insights drawn from various stakeholders to promote adoption of safe, secure, and trustworthy AI. In line with the declaration approved in March, the recommendations aim to contribute to raise awareness on which strategies and policies can be effective to support MSMEs in the deployment and uptake of safe, secure and trustworthy AI. These recommendations align with the OECD AI Recommendation and its principles, which highlight that AI actors should respect the rule of law, human rights, and democratic values, including non-discrimination, fairness and privacy, and promote transparency, explainability, accountability, robustness, security, and safety.

Section 1: Sustaining AI adoption and development among MSMEs.

1. Developing AI Skills: The Essential Foundation for Successful Adoption

Skills are a critical enabler for the adoption of Artificial Intelligence (AI). The range of skills required in workers varies from basic to highly specialized, encompassing technical, cognitive and managerial competencies but also social skills. It is imperative that Micro, Small and Medium-sized Enterprises (MSMEs) prioritize the enhancement of these skills, improve AI literacy in its many functions, and actively promote AI knowledge among their workforce and their representatives.

2. A Change in Business Culture: Making MSMEs Active In The AI Revolution

Facilitating AI adoption within MSMEs necessitates a fundamental shift in the business culture surrounding technology. This can be achieved by fostering cross-level knowledge dissemination and promoting a culture of continuous learning. The inherently horizontal organizational structure of MSMEs presents a unique opportunity for bottom-up knowledge sharing. Additionally, the smaller scale of these enterprises makes the pooling of know-how more essential and encourages engagement with local communities and civil society. Innovative companies, MSMEs, and start-ups, with the operational expertise and resources to develop safe, secure, and trustworthy AI

solutions can help MSMEs stimulate adoption of new technologies, such as using open-source technologies.

3. AI Adoption in industry Needs a Clear Roadmap

Building upon the digital transition, a strategic approach to AI adoption is essential. The initial step involves enhancing the efficiency of existing industrial technology to prevent the potential of AI from being squandered on outdated systems. From this foundation, it is necessary to digitize operational data, thereby enabling the utilization of digital tools. The integration of these tools into production processes can lead to profound industrial transformations, exemplified by the evolution from Industry 4.0 to Industry 5.0.

4. Strategic Adoption: the Key to Improve Efficiency

In adopting AI, MSMEs should strategically identify the areas within their business' operations, planning, production and service structures where AI can be most effectively implemented. Given their limited resources, it is crucial to focus on fields that promise the highest return on investment. To achieve this result, it is fundamental that MSMEs obtain the necessary level of understanding of AI technology to make an informed choice.

5. Maximizing the Full Potential of AI, a choice amongst many tools

A critical step in AI adoption is determining when AI application is strategically advantageous and deciding between developing AI solutions in-house or acquiring them externally. Non-exhaustive considerations can include the following: Developing in-house AI solutions, while costly, can be one way to ensure strategic applications as it can provide significant competitive advantages and reduce operational costs over the long term. Conversely, purchasing AI solutions offers a more cost-effective and less risky alternative, making it suitable for MSMEs with limited resources. Additionally, MSMEs can benefit from the expanding ecosystem of "as-a-service" digital solutions or work with other MSMEs to develop their locally adapted AI solutions, often based on open source. However, reliance on externally sourced solutions may result in limited competitive differentiation and potential lock-in, which could impede long-term innovation. The option for MSMEs to build on top of foundational open source solutions enables a more competitive environment and helps manage these risks. No matter if the AI solution is proprietary or externally sourced, MSMEs would need access to AI algorithms, datasets that are AI-ready, and affordable access to AI compute to drive the successful adoption of AI applications.

Section 2: Policies to support MSMEs in the deployment and uptake of safe, secure, and trustworthy AI

1. Spearheading investments in AI solutions

Policymakers should prioritize investment in AI, with a particular view to engage the private sector, academia and other actors in the effort. These investments should be focused on the development of safe, secure, and trustworthy AI solutions. They should also foster competition and choice for AI models and applications, including by supporting a reliable and secure open-source ecosystem. Action by public actors should take in due consideration the needs of MSMEs by creating tailor made solutions to support the growth of AI technology amongst these actors. To this end, it is fundamental that investments in AI should be focused on creating an AI compute infrastructure that is accessible by small and big actors alike.

2. Empowering people with AI Skills

The increasingly pervasive diffusion of digital technologies is shaping a new labor market, influencing the demand for specialized skills necessary for the growth of our economies. When it comes to MSMEs, basic and specialized digital skills are needed to adopt safe, secure, and trustworthy AI. To help support MSMEs in uptake of AI tools that best match their needs, policymakers should promote AI literacy (i.e. understanding the fundamentals of AI, including its application, implications, risks and limitations), on-the-job continuing education, and private-public partnerships for reskilling and upskilling workers. Many workers already use AI tools regularly in their daily activities, this trend will most likely continue, enabling innovation and creativeness, so to promote competitiveness and growth of our economies. Targeting specific public policies for on-the-job continuing education will enable MSMEs to provide workers and workers representatives with the necessary AI skills. Public-private partnerships on workforce reskilling and upskilling can help MSMEs to realize the benefits of AI and promote access to business academies, innovation hubs, and private AI education programs.

3. Fostering an ecosystem that promotes innovation

To help MSMEs understand how to best apply AI solutions within their firms, policymakers should actively promote voluntary partnerships between the public and private sector, including MSMEs, as well as with academic institutions to promote research and development on AI tools and applications, and the formation of innovation clusters where appropriate. Policymakers should foster an ecosystem to help MSMEs gather the right know-how on how to best apply AI solutions in their firms, harnessing its innovative potential.

4. **Fostering cooperation: AI along the manufacturing value chain to strengthen industrial base**

The adoption of AI by MSMEs can be facilitated through transparency, learning, and cooperation within the global industrial supply chains they are part of. A competitive environment is key for innovation and for strengthening industrial base. Knowledge sharing, operational support, and joint initiatives for MSMEs can help promote the adoption of technological solutions with technical standards in certain vertical supply chains, taking into account the necessary guardrails e.g. provided by competition law or specific regulations. In addition, governments can foster AI deployment and uptake by promoting opportunities for a variety of players in the dissemination of AI technology.

5. **Promoting AI governance**

Policymakers should consider developing governance frameworks to promote safe, secure, and trustworthy AI. They should put in place programs that foster the transition of AI solutions from the research and development phase to the market. This may include fostering an appropriate scale up and testing environment, to ensure the readiness of newly developed AI technology. Policymakers should also take a risk-based approach and take the needs of MSMEs into consideration by creating appropriate governance solutions that consider questions such as the evaluation of risks, fairness, bias, privacy, and intellectual property rights.

6. **Developing and using AI Standards**

Policymakers should promote development of international technical standards for AI technologies that are interoperable. It is important to pursue a common understanding of key definitions and shared taxonomies, such as the concept of 'advanced AI systems' and foundational considerations to enable inclusive governance to promote deployment and uptake by MSMEs. Standards play a vital role in defining and clarifying key terms, practices, and taxonomies in actionable ways for businesses everywhere, helping support the goal that governance approaches should be interoperable. Policymakers should promote international standards to encourage global trade and cooperation.

Bibliography

[1] [2] [28] [29] [30] [31] [32] [33] [34]
OECD (2021), 'Artificial intelligence: Changing landscape for SMEs' in The Digital Transformation of SMEs, OECD Publishing, Paris. https://doi.org/10.1787/bdb9256a-en
[1] p. 194 [2] p. 201–203 [27] p. 201-203 [28] p. 206 [29] p. 206 [30] p. 206 [31] p. 206 [32] p. 206 [33] p. 201–203

[3] [9]
Borgonovi, F., et al. (2023), 'Emerging trends in AI skill demand across 14 OECD countries', OECD Artificial Intelligence Papers, No. 2, OECD Publishing, Paris, https://doi.org/10.1787/7c691b9a-en
[3] p. 20-21; [9] p. 25

[4]
OECD (2024), Methodological Note, Azuna data, OECD AI Policy Observatory Portal. Available at: https://oecd.ai/en/adzuna

[5] [6] [7] [12] [21]
Lane, M., M. Williams and S. Broecke (2023), 'The impact of AI on the workplace: Main findings from the OECD AI surveys of employers and workers', OECD Social, Employment and Migration Working Papers, No. 288, OECD Publishing, Paris, https://doi.org/10.1787/ea0a0fe1-en
[5] p.37 p. 42 [6] p. 34 p.35 [7] p. 67 p.72 [12] p.68 [21] p.95-96

[8]
OECD (2023), Indicator A7. To what extent do adults participate in education and training? Extract from: Education at a Glance 2023: OECD Indicators, OECD Publishing, Paris, https://doi.org/10.1787/e13bef63-en
[8] p. 1

[10]
Stephany, F. and Teutloff, O. (2023), Skills to 'race with the machines': The value of complementarity, CEPR VoxEU. Edited by Centre for Economic Policy Research. Available at: https://cepr.org/voxeu/columns/skills-race-machines-value-complementarity

[11]
Chui, M. et al. (2023), The state of AI in 2023: Generative AI's breakout year, McKinsey & Company. Edited by McKinsey & Company. Available at: https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year

[13]
Cairns, S. and Galindo-Rueda, F. (2021), A new approach to measuring government investment in AI-related R&D. Edited by OECD AI Policy Observatory Portal. Available at: https://oecd.ai/en/wonk/government-investment-ai-related-r-and-d

[14]
Rao, A. S. and Verweij, G. (2017), PwC's Global Artificial Intelligence Study: Sizing the Price. Edited by PwC. Available at: https://www.pwc.com/gx/en/issues/data-and-

analytics/publications/artificial-intelligence-study.html
[14] p. 6

[15] [16] [24]
Nestor Maslej, Loredana Fattorini, Raymond Perrault, Vanessa Parli, Anka Reuel, Erik Brynjolfsson, John Etchemendy, Katrina Ligett, Terah Lyons, James Manyika, Juan Carlos Niebles, Yoav Shoham, Russell Wald, and Jack Clark, 'The AI Index 2024 Annual Report', AI Index Steering Committee, Institute for Human-Centered AI, Stanford University, Stanford, CA, April 2024. [15] p. 254 [16] p.242 [24] p. 51 Available at: HAI_AI-Index-Report-2024.pdf (stanford.edu)

[17] [35] [42] [43]
OECD (2024), OECD Digital Economy Outlook 2024 (Volume 1): Embracing the Technology Frontier, OECD Publishing, Paris, https://doi.org/10.1787/a1689dc5-en
[17] p. 53 [34] p. 47 [41] p. 11-12 [42] p. 71 [

[18]
OECD (2024), 'ICT Access and Use by Businesses', OECD Telecommunications and Internet Statistics (database), https://doi.org/10.1787/9d2cb97b-en

[19] [23] [25]
OECD centre for entrepreneurship, SMEs, regions & cities (2024), SME digitalization in 2024 managing shocks and transitions, 2023 OECD D4SME Survey
[19] p. 9 [23] p. 9 [25] p. 7

[20]
A. Khayer, Md. S. Talukder, Y. Bao, Md. N. Hossain, Cloud computing adoption and its impact on SMEs' performance for cloud supported operations: A dual-stage analytical approach, Technology in Society, Volume 60, 2020, 101225, ISSN 0160-791X, https://doi.org/10.1016/j.techsoc.2019.101225.

[22]
Kathryn Bonney, Cory Breaux, Catherine Buffington, Emin Dinlersoz, Lucia Foster, Nathan Goldschlag, John Haltiwanger, Zachary Kroff, Keith Savage: 'Tracking Firm Use of AI in Real Time: A Snapshot from the Business Trends and Outlook Survey', Working Paper Number CES-24-16, United States Census Bureau, March 2024. Available at: https://www.census.gov/library/working-papers/2024/adrm/CES-WP-24-16.html
[22] p. 26

[26]

Marinelli, A., Cumunello, F. Lovari, A,. Ipsos. "IATI - Intelligenza artificiale, cittadini, imprese, media" research project sponsored by DGTEL – Ministry of Enterprises and Made in Italy

[27]
European Commission Directorate-General for Research and Innovation, Renda, A., Schwaag Serger, S., Tataj, D. (2021), 'Industry 5.0 a transformative vision for Europe: governing systemic transformations towards a sustainable industry', Publications Office of the European Union, Luxembourg, https://data.europa.eu/doi/10.2777/17322

[36] [38] [39] [40]
OECD (2023), "A blueprint for building national compute capacity for artificial intelligence", OECD Digital Economy Papers, No. 350, OECD Publishing, Paris, https://doi.org/10.1787/876367e3-en. [35] p. 21, p. 40-41 [37] p. 33 [38] p. 16 [39] pag.38

[37]
Eurostat, Cloud computing - statistics on the use by enterprises. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Cloud_computing_-_statistics_on_the_use_by_enterprises

[41]
European Parliament, 2021, Challenges and limits of an open-source approach to Artificial Intelligence. Available at: https://www.europarl.europa.eu/RegData/etudes/STUD/2021/662908/IPOL_STU(2021)662908_EN.pdf
[40] p. 7

[44] [45]
OECD (2023), OECD Employment Outlook 2023: Artificial Intelligence and the Labor Market, OECD Publishing, Paris, https://doi.org/10.1787/08785bbaen.
[43] p. 13-14 [44] p. 187

Acknowledgements:

The authors want to thank, for their contributions, Lea Cerin, Giacomo Focaccia and Luca Frigerio.